DESIGN FOR LEARNING - PRINCIPLES, PROCESSES, AND PRAXIS

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Design for Learning - Principles, Processes, and Praxis (McDonald and West)

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Dr. McDonald's research focuses around advancing design practice and design education. He studies design as an expression of certain types of relationships with others and with the world, how designers experience rich and authentic ways of being human, the contingent and changeable nature of design, and design as a human accomplishment (meaning how design is not a natural process but is created by designers and so is open to continually being recreated by designers).

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Introduction

Our purpose in this book is twofold. First, we introduce the basic skill set and knowledge base used by practicing instructional designers. We do this through chapters contributed by experts in the field who have either academic, research-based backgrounds, or practical, on-the-job experience (or both). Our goal is that students in introductory instructional design courses will be able to use this book as a guide for completing a basic instructional design project. We also hope the book is useful as a ready resource for more advanced students or others seeking to develop their instructional design knowledge and skills.

Our second purpose complements the first: to introduce instructional designers to some of the most current views on how the practices of design thinking contribute towards the development of effective and engaging learning environments. While some previous books have incorporated elements of design thinking (for example, processes like prototyping), to date no instructional design textbook focuses on design-oriented thinking as the dominant approach for creating innovative learning systems. Our aim is to provide resources to faculty and students for learning instructional design in a manner consistent with a design-oriented worldview. But because the classic approaches to instructional design are still important for many professionals, we also include chapters that introduce some of the traditional, systematic processes for designing instructional environments. We hope this blend of traditional and innovative views provides readers with a competitive advantage in their own work, providing them with a larger set of conceptual tools to draw on as they address the professional challenges they face.

This book is divided into two major sections. The first, ***Instructional Design Practice***, covers how instructional designers ***understand, explore, create, and evaluate*** situations requiring educational interventions and the products or systems used to support them. In this section, chapters address how we understand diverse learners and their needs; how to explore and frame the educational problems one is solving; how to analyze the context and tasks associated with the problems; how to iteratively generate decisions, prototypes, and solutions; and how to evaluate and understand the effectiveness of an instructional design.

The second part, ***Instructional Design Knowledge***, covers the sources of ***design knowledge***, a variety of ***instructional design processes***, approaches for designing ***instructional activities,*** and the ***relationships important for instructional design practice***. This section includes chapters addressing learning/instructional theory, design precedent, both systematic and agile design processes, and practical strategies for using technology wisely, managing projects, and creating instructional activities.

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One of the exciting things about the field of instructional design and learning technology is how quickly it evolves. As soon as new technologies are introduced we see instructional designers experimenting with how they might be put to use for learning purposes. The same is true regarding new scientific findings from psychology, sociology, communications, or other human sciences, with professionals in our field scrutinizing them to understand what relevance they might have for improving the learning or teaching process. We hope this book becomes a similar, cutting-edge resource that helps readers implement our growing understanding regarding how to design effective and engaging learning environments.

Good luck!

SECTION OVERVIEW

1: Instructional Design Practice

CHAPTER OVERVIEW

1: Understanding

1.1: Becoming A Learning Designer

Becoming a Learning Designer

Ellen D. Wagner

Editor's Note

Because of the close connection between these skills and the discipline of instructional design, many of the chapters in this book refer to the profession as instructional design, and professionals as instructional designers, even though many, like Dr. Wagner, prefer the term learning designer. The actual name of the discipline is continually evolving, as Dr. Wagner addresses in this chapter.

Learning design is the name of the professional practice that, in the views of many education, training, learning, and development professionals, is a next iteration in the evolution of the craft dedicated to creating, producing, evaluating, and improving resources and experiences that help people and organizations learn more and perform better.

A learning design is a creative pathway, with steps along the way, that guides someone from a point of introduction to a permanent change in knowing, doing, or being. By naming learning design as the focus of our collective activity, we make the declaration that our focus is on learning enablement, regardless of where, when, or with whom our design efforts will be taking place. Designs may revolve around the creation of a course, programming an application, or producing a webcast. Resources being designed as catalysts to induce learning may be as small as an element in a presentation or as big as an immersive environment.

Learning design consists of an amalgamation of several contemporary design traditions actively used within current teaching, learning, training, and development professions. As learning designers, we have profound opportunities to develop conditions, strategies, resources, tools, and platforms that will keep learners engaged and inspired. We can help people make new connections and meanings, spark new interests, and develop new abilities so that new learning will occur.

In order to understand what learning design is, it is helpful to understand its precedents and how they are related to each other. In this chapter, I will first describe several of the most notable precedents. From there, we will consider some of the current professional expectations for learning designers in the contemporary learning and development marketplace. I will then reflect upon some of the big variables shaping “Learning Designer Identity.”

Instructional Design

Perhaps the most familiar of learning design’s earlier traditions is *instructional design*. Instructional design (ID) is a foundational part of the profession dedicated to systematically improving the learning and performance outcomes of individuals completing a deliberate course of study. Originally, instructional design described a practice of creating lessons and courses. In this context, design is describing an activity or set of activities that result in a documented set of specifications for creating a lesson or a course. Follwing are the steps designers take when designing lessons or courses:

1. Assessing Content for the Course: What needs to be covered?
2. Assessing the Learners: Who is taking this course? What will they need to know and do? How will you know if they have accomplished those things?
3. Creating a Design Document: What needs to happen for this course to become real?
4. Asking What Needs to Be Developed: Who is going to produce it? How much will it cost?
5. Implementing the Design: What is needed for the lessons to be offered, for the students to respond, and for the course to be completed?
6. Evaluating the Design: Did the lessons work? How do you know? How could it be better?

At the end of this process, the designer would end up with a design document. This serves as a specification to guide the construction of a course. Design documents are a great way to review how you solved your design challenges—what worked and what didn’t work. They are important instruments for formative review and essential for summative review. A design document also forms the basis for a professional portfolio that will serve as evidence of your work over time. It is your record of how you communicated your plans for what needed to get done, both to yourself and to your stakeholders.

Over time, the term instructional design has also come to be used as an overarching term for any formal activity undertaken when designing and building learning resources or experiences, formal or informal. This causes some confusion when it comes to creating job titles for people working in the learning and development field in various capacities. Instructional design positions continue to represent a good percentage of today's jobs in the learning and development industry by virtue of the industry's emphasis upon the creation of digital courseware and digital virtual environments, especially after COVID-19 school and work closures in the spring of 2020. This is the case even for positions which may not actually be engaged in designing or developing formal learning programs, lessons, or courseware.

Additional Resources

For more information on the history of the instructional design approach, refer to the *Foundations of Learning and Instructional Design Technology* textbook available on EdTech Books, particularly the chapters on programmed instruction by Molenda and instructional design models by Dousay. Students might also appreciate perusing back issues of the *Journal of Applied Instructional Design*.

Instructional Systems Design

Given that so many learning experiences transcend instruction and must address bigger contextual consideration, sometimes the activities associated with this practice are described more broadly as Instructional Systems Design (ISD), where a significant nod is given to the impact of the broad conditions under which course, content, and experience conceptualization, as well as prototyping and production will be taking place. ISD is based on a process model for managing the establishment of a system within which instruction is a component. ISD calls for the following:

- Assess the needs and support requirements of target audiences and determine needs for the content presentation.
- Design for interventions or create solutions to improve outcomes, including baselines and methods for instructional measurement.
- Create development specifications: How will this solution be constructed?
- Create implementation plans: How will we get the new system to work? How will we engage learners?
- Determine formative and summative evaluation plans: How will we know if it is working? How will we make our revisions? How will we know if all our efforts have been worth it?

Depending upon the degree to which a program may feature multimedia or web technology systems as a part of their practice, one may still find practitioners of instructional technology—even though many using the moniker "IT" in 2020 are more actively engaged in the practices associated with information technology, the domain of enterprise computing, network management. In education and training, instructional technology is the place where one finds learning management systems, learning content management systems, knowledge management systems and, increasingly, platforms and programs that enable the tracking and analysis of resource use and user performance data.

User Experience Design

Another major set of influences upon the learning design profession have come from the world of User Experience Design. Since the mid-1990s, web browsers brought the World Wide Web to life and as web technologies and service platforms such as content and learning management systems became a more active component in systems developed for sharing, delivering, and distributing content, courses, and experiences. From this evolution, User Experience (UX) Design emerged as a field that has explored and influenced design considerations for how a website, online product, or digital product user would experience a product.

Coined in the mid-1990s by Donald Norman during the time when he was vice president of advanced technology at Apple Computer, UX describes the relationship between a product and a human. Back then, Norman argued that technology must evolve to put user needs first—the opposite of how things were done at the time. It was not until 2005 that UX gained mainstream relevance as 42 million iPods were sold that year and the mass market experienced great design at scale. Not long after, job descriptions and expectations shifted from putting information online to tailoring the online experience to the needs of end users. The field of User Experience Design had been born (Kilgore, 2016).

Additional Resources

For more information on UX design, see the chapter by Earnshaw, Tawfik, and Schmidt (2018), or their full open access book on the topic at https://edtechbooks.org/ux.

Design Thinking

The need for better user experience with technology hardware and software was undeniable in the 1990s and 2000s as tech systems, platforms, and tools evolved from being tools for the technologically proficient to being tools that were intuitive enough for “regular folks.” As the focus on considering user experiences shifted product design, a set of processes and design approaches known as “Design Thinking” grew popular.

The Interaction Design Foundation noted that Design Thinking emphasizes developing an understanding of the people for whom products or services are being designed (Dam & Siang, 2020). It helps develop a sense of empathy with the user. Design Thinking helps by continually questioning the problem, assumptions, and implications. Design Thinking is useful for tackling ill-defined or unknown problems, by reframing the problem in human-centric ways, developing many ideas in focus groups, and adopting a hands-on approach in prototyping and testing. Design Thinking also involves ongoing experimentation through sketching, prototyping, and testing new ideas.

All variants of Design Thinking embody similar principles which were first described by Nobel Prize laureate Herbert Simon in *The Sciences of the Artificial* (1969). The Hasso-Plattner Institute of Design at Stanford University, also known as the d.school, was at the forefront of applying and teaching Design Thinking.

The five-phased model developed by the d.school to explain Design Thinking included the following steps:

- empathize with users
- define users’ needs and problems, along with your insights about those needs and problems
- ideate by challenging assumptions and creating ideas for innovative solutions
- prototype to start creating solutions
- test solutions

These five phases are not necessarily sequential. They do not have to follow any specific order and can occur in parallel and be iteratively repeated. They are offered as an overarching conceptual framework.

Additional Resources

For more information on Design Thinking approaches, see the chapter by Svihla in this book, along with a similar chapter on agile design approaches by Cullen.

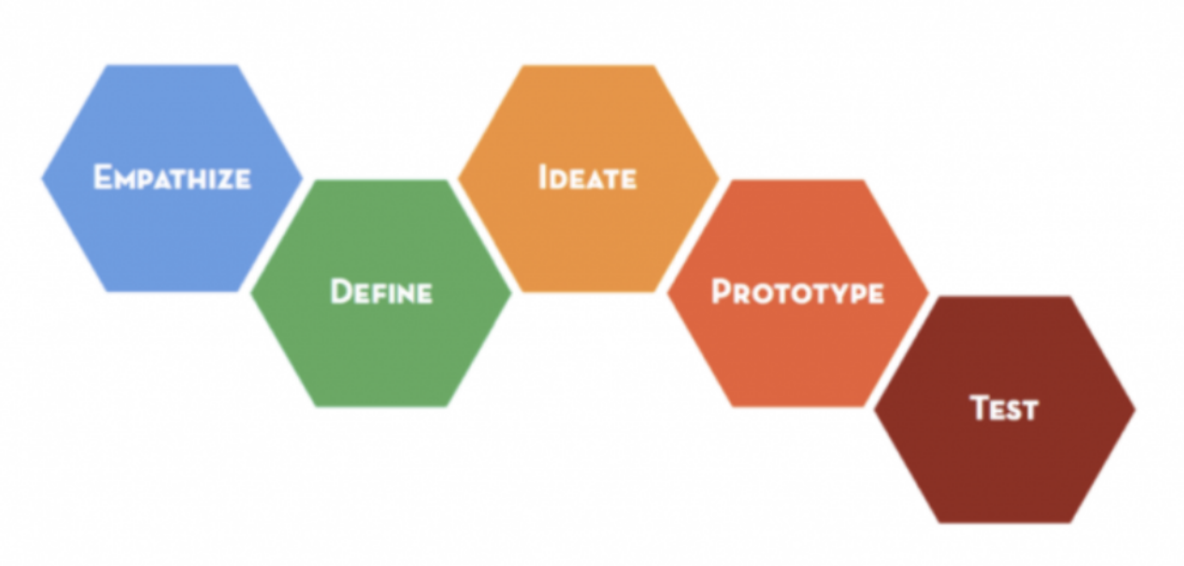

Figure 1.1.1.1: The IDEO Design Thinking Model

While Design Thinking does not address the requirement of designing for learning products, services, or experiences, per se, the recognition of the relationship between experiences that can engage and inspire, and conditions that must be present for learning were recognized in the early days of World Wide Web development.

Learning Experience Design: Unifying Design Traditions

While many informal discussions around learning experience began happening in the mid-2000s[1], Niels Floor and his colleagues in the Netherlands began actively exploring Learning Experience Design (LXD). They met in 2012 to unify the principles of UX Design with learning principles and instructional design principles, even if some of those ID principles might not necessarily be used to create direct instruction (N. Floor, personal communication, February 20, 2019). Where UX designers' responsibilities would include designing prototypes and wireframes, graphic and visual design, constructing user journeys or flows, collaborating with subject matter experts, and carrying out qualitative usability tests (Rosala & Krause, 2019), learning experience designers would bring a focus on rich multimedia experiences, learning outcomes, and performance improvement metrics.

Kilgore (2016) noted that LX designers develop experiential, multi-layered, complex, and contextual courses and lessons that do not necessarily end when a course closes. These experiences aim to provide learners with enhanced engagement, retention, affordance, and overall a more memorable learning experience. This requires advanced skills in planning, production, development, design, and a clearer understanding of modern learners and learning trends than what is required for more traditional instructional design undertakings. LXD appears to be less dependent upon both supporting the infrastructure of technological systems and upon formative and summative evaluation than more traditional ID and ISD practices have purported to be.

Learning Engineering

In recent years, learning engineering has emerged as a practice with the potential to serve as a strong complement to learning design. Learning engineering focuses on using data analytics, computer-human interaction, modeling, measurement, instrumentation, and continuous improvement to optimize learning and learning decision-making. It offers a renewed focus on formative evaluation and on experimentation in the learning workflow.

Learning engineering started to emerge as a new field of interest in the mid 2010s with the increased popularity of MOOCs, which served student populations in the hundreds of thousands in a single course. Suddenly, there were opportunities for conducting "big-data" research and analyses—the scope of which had only previously been available to commercial business analysis firms or to customers of online services. Furthermore, now "big data" were available to educational researchers, meaning that educational research was no longer confined to social science methods based on small sample sizes or random-controlled trial studies. Instead, machine learning, deep learning, data mining, and artificial intelligence could be applied to research on course-related behaviors, achievements, retention, persistence, and completion patterns. Initial contemporary interest in learning engineering began at institutions hosting MOOCs such as Harvard, MIT (EdX), and Stanford (Udacity, Coursera). Carnegie Mellon University had maintained an engineering-as-problem-solving tradition since the 1960s. Their Simon Institute openly licensed CMU's Open Learning Initiative products in 2019 for educators to bring continuous improvement to classroom instruction (Young, 2019). This was a nod to encouraging continuous improvement and classroom experimentation as an open education practice (OEP) associated with learning engineering and empirical education.

Learning engineering's first appearance can be traced back to 1966, and, as with Design Thinking, is attributed to Herbert Simon. At the time, Simon was a professor of Computer Science and Psychology in the Graduate School of Industrial Administration at what was then the Carnegie Institute of Technology. He was asked to give a speech (later published as an article) at the Presidents Institute at Princeton University. In this speech, "The Job of a College President," he took higher education to task for its approach to institutional management and operation: "Comparing colleges with other organizations, one sees that their most striking peculiarity is not their product, but the extent to which they are operated by amateurs. They are institutions run by amateurs to train professionals" (Simon, 1967). Among his suggested strategies for making colleges and universities more professional settings for teaching and learning, Simon believed there might be value in providing college presidents with a learning engineer—an expert professional in the design of learning environments.

As Simon envisioned this role, the learning engineer would be an institutional specialist with several responsibilities related to optimizing university productivity. Specifically, they would be responsible for working collaboratively with faculty to design learning experiences in particular disciplines. They would also be expected to work with administration to improve the design of the broader campus environment to facilitate student learning and faculty improvements. They would also be expected to introduce new disciplines such as cognitive psychology, along with learning machines and computer-assisted instruction (remember, this was 1966), to various disciplines on campus.

Simon and his colleagues instilled a tradition of linking research and measurement of results to the improvement of teaching and learning on his campus. Continuing in his tradition, a center was named for him at Carnegie Mellon to harness his vision for a cross-disciplinary learning engineering ecosystem.

With recent 2019 announcements from Carnegie Mellon University describing the Simon Institute's plans to open-source their huge collections of digital learning software, there has been much excitement that this will be a catalyst for encouraging interest in continuous formative improvement in direct instruction, learning, and performance support. There is hope that these efforts will have both direct impacts on learning engineering and indirect complementary impacts on learning design practices going forward.

Current Demand in Learning Design Still Calls for Instructional Designers

The term learning designer is still not being used broadly in the learning technology industry. For the most part, job postings continue to seek instructional designers. Dr. Jane Bozarth, Director of Research for the Learning Guild, reported that "In what was no surprise at all, I found the term Instructional Designer encompassed an ever-expanding, soup-to-nuts array of tasks. The title has become a catch-all for anything related to creating, launching, delivering, or even facilitating instruction in any capacity, and at any level of complexity" (Bozarth, 2019).

In a 2019 report from the eLearning Guild, Bozarth noted that in 2014 when applying for ID jobs, instructional designers were expected to be able to do the following:

- Conduct needs analyses
- Conduct task assessments
- Write learning objectives
- Know the ADDIE process
- Understand supplier management

- Use desktop publishing
- Create graphic designs
- Use authoring tools
- Create with PowerPoint
- Produce and manage live & recorded webinars
- Support the training database
- Work with subject matter experts
- Create instructor-led training

The eLearning Guild's 2019 review shows even more skills lumped into the ID job skill category (Bozarth, 2019). In addition to the list above, postings for jobs focused primarily on instructional design included a desire for expertise in

- Video production and editing
- Audio production and editing
- Web design/HTML5
- Game design/badges
- Dashboard creation
- Digital products
- Mobile app design
- Social and collaboration tools
- Assorted learning platforms
- Data analysis
- Content curation
- Augmented, virtual, and mixed realities

On top of this was the overlap between titles. Designer and developer were often used interchangeably. This is supported by eLearning Guild membership data. Many of those employed as instructional designers say their work actually entails doing "a little of everything," while those with more task-specific job titles (like multimedia developer) say they spend a lot of their time engaged in instructional design.

Some large technology company HR departments continue to vacillate on whether to classify instructional design positions along with technical communication positions (a fine job classification if you want to be a technical communicator, less so if your design and interactive technology skills are about to be relegated elsewhere). Some IDs are expressing interest in learning engineering job titles, thinking that it may bring a stronger recognition of technical skills back to a job that has been held hostage by job descriptions that, in their worst iterations, have become catch-all positions for "all tech duties as assigned."

Apart from the job stress of trying to wear a dozen hats, Bozarth has noted that the role confusion about what it is that IDs should do or ought to be doing makes it very difficult to pin down essential competencies (Hogle, 2019), educational and other background requirements, and correlating salary. "Calling yourself a learning experience wizard on Twitter probably isn't helping," Bozarth confides, "but calling yourself an instructional technologist, and being able to explain what that means, might" (2019).

Establishing a Learning Designer Identity

What we should remember from Bozarth's breakdown of instructional design job skill expectations is that the position descriptions advertised on job sites such as LinkedIn and Glass Door are generally defined by hiring managers. Hiring managers are always interested in getting the most out of their hiring dollars. While we must certainly pay attention to what the job postings say a company is looking for, the learning design profession also has a responsibility to articulate what *we* expect from our colleagues. Let us consider learning design with our own professional identity in mind. If we establish our own vision of what we expect from our fellow practitioners of learning design, this will help set expectations for what we want from one another in our work together. The following is a suggested list of expectations for collections of knowledge that we would expect qualified learning designers to obtain.

1. Understanding of Human Learning. We should expect each other to be familiar with the major schools of thought that explain the phenomenon of human learning. Whether we gain our understanding through the study of learning sciences, or through studies of human cognition, human behavior, or some combination thereof, we need to have an appreciation for the myriad

explanations for how people learn. Furthermore, we need to appreciate the degree to which learning is likely to manifest in the wide varieties of conditions, both formal and informal, that can elicit learning responses. We will need to know about the steps, stages, and processes that constitute the various phases of learning. We need to understand how learning outcomes may change under different conditions, and how conditions change in different populations, at different ages, under different kinds of support structures.
2. Understanding of Design. We should have a basic understanding about what design is. Because design is a creative process, there are many different ways that a design process may manifest. However, there are currently two major schools of thought related to how design processes are categorized.

Schools of Thought Models

One school of thought, called the *Rational Model*, tends to follow a sequence of stages or steps as a means of problem solving. The Rational Model proposes that

1. Designers attempt to optimize a design candidate to account for known constraints and objectives.
2. The design process is plan-driven.
3. The design process is understood in terms of a discrete sequence of stages.

Instructional design process models, such as the Dick and Carey model, the ADDIE model, and the ASSURE model, are all examples of rational process models. Much of instructional design and instructional systems design work over the years has been led by the development of rational process models.

The other common school of design thought is called the *Action-Centric Model*. The Action-Centric Model suggests that

1. Designers use creativity and emotion to generate design candidates.
2. The design process is improvised.
3. No universal sequence of stages is apparent – analysis, design, and implementation are contemporaneous and inextricably linked.

Both rational models and action-centric models see design as informed by research and knowledge. However, with the action-centric model of design, research and knowledge are brought into the design process through the judgment and common sense of designers—by designers "thinking on their feet"—more than through the predictable and controlled process stipulated by the rational model, which is presented as a more formal approach toward hypothesis testing ("Design," n.d.).

While action-centric models have not generally been part of the instructional design and ISD tradition, they have been more commonly found in settings where experience design, learner experience design and Design Thinking process models are used. With their focus on serving the needs of learners first, the newly emergent fields of open pedagogy (e.g., Jhangiani & Biswas-Diener, 2017) and open education practices (A. Gunder, personal communication, December 30, 2020) are likely to use action-centric design process models as a central part of their orientation.

This shift away from rational process models, especially at a time when learning engineering is likely to provide "data science cover" in post-COVID remote learning explorations, is likely to bring about interesting opportunities for dialogue.

With these key foundational pillars in place, learning designers will continue developing skills in analysis and evaluation, communications and media arts, creative learning design and production, and research and measurement.

Analysis and Evaluation

Much of our work will consist of figuring out how to organize information so that it can be easily understood. Sometimes we may need to determine if what we are dealing with is an information problem, or a performance problem. Sometimes we might need to determine if it is a problem for some but not all. Will people be best served with training? Might they be better served with performance support tools? Where and when will they need it?

Understanding techniques of needs assessment and content and task analysis will be essential. So will reviews of literature, knowing how to build a survey, and conducting market analysis. Formative and summative evaluation can help us determine whether or not the designs we provide will achieve the results we hope to achieve.

Communications and Media Arts

Effective communication is central to the role and function of learning design. We are often the people working with subject matters and learners, to help translate complex expertise into more easily understood, step-by-step procedural pathways. Creative arts, including writing, graphic arts, photography, videography, and web design are among the means of expression we have at our disposal for translating ideas and actions into words, images, recordings, and code strings.

Learning designers will find that the time spent developing good writing skills will serve them well. Regardless of the specific role, or the sector in which one is working, writers will always find their skills needed for a wide variety of tasks. These tasks may include, but not be limited by, writing scripts and screenplays; press releases and public relations documents; opinion/editorial articles and columns; research reports; executive briefing documents; grants; professional presentations; and professional articles. The more that one moves away from rational process models and depends on action-centric models that are produced in the moment, the more likely we are to depend upon project documentation to guide progress.

Media professionals will also discover the same value for time spent developing skills in digital photography and videography production and post-production skills. From still images to complex, multi-layered 3-D immersive environments, we can use visual representations to help extend understanding in profound ways.

Creative Learning Design and Production

Learning how to work as members of a team is an important part of being a learning designer. Production teams bring together groups of individuals who can bring a learning product from concept to product. For example, a relatively small learning product team producing web products may need a product manager, a graphic artist, a programmer, a writer, a web designer and an evaluator. These teams come together with a shared design document guiding the production of each stage of development.

Research and Measurement

One of the likely outcomes of the increasing number of enterprise technology systems (including web conferencing, LMS, SIS, ERP and other similar platforms) is that it is more likely that student/user data is collected within these systems. As a result, the expectations that these data are going to be used in future learning design scenarios is already on the rise. Learning designers may find it beneficial to increase competence in statistical and machine learning skills. Test item development and creation of measurement instruments will be a key skill.

Conclusion

The role of a learning designer has continued to evolve to make room for emergent technologies and frameworks. Always the goal has been to design the most effective learning using all theories, processes, or technologies at our disposal. In the modern version of the field, there are simply more of these theories, processes, and increasingly advanced technologies to assist us. Understanding how various design disciplines can inform our work as learning designers is both intimidating, but also exciting. This is a discipline where one never ceases to learn new skills and ideas. We can never be stagnant as a field and must increasingly improve our ability to learn from and collaborate with designers from a wide variety of backgrounds.

This book focuses on using design to create learning by focusing on key principles and various helpful processes, but most importantly, it focuses on the praxis or application of ideas in practice. Embracing the praxis inherent in action-centric design will help you develop a design identity that will bring you success in your work—no matter what your official job title or design context may be.

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[1] For example, after Adobe System had acquired Macromedia (the company that had previously owned products including Dreamweaver and Flash) in 2005, members of the former Macromedia Global Education team now at Adobe Worldwide Education continued to promote the "web user experience" in learning, and they referred to the work of creating interactive eLearning tools with their then market-leading products as "learner experience design." Wagner and her colleagues were offering presentations at the eLearning Guild Community Gathering conferences in 2005 and 2006, describing learning experience design features related to interaction and engagement.

1.2: Designing for Diverse Learners

Designing for Diverse Learners

Susie L. Gronseth, Esther Michela, & Lydia Oluchi Ugwu

Designing educational programs and curricula involves developing understandings of the learner and instructional environment characteristics that could impact learning success. While there may be some commonalities among learners, it is important for designers to recognize that there will likely be a great diversity of learning preferences, abilities, and experiences that learners will bring to a course or other learning experience. Rose (2015) remarked that the notion of an "average" learner is a misnomer, and learner diversity (rather than uniformity) is actually the norm. When learner variability is not addressed in a design, it is inevitable that many learners will experience obstacles to their learning, limiting the effectiveness of the learning experience for them and inducing additional costs in time and resources to make adjustments and accommodations (Brinck, 2005). Planning for learner variability from the outset is therefore a valuable step in the design process that can lead to more robust, accessible, and impactful designs. Being able to plan for diverse learners begins with developing empathetic understandings of the characteristics in which learners will vary. This chapter first describes ways that instructional designers can become familiar with the diverse needs of target learners and then offers recommendations for next steps in implementing inclusive design practices as part of curricular planning.

Recognizing Learner Needs

Learners vary along many different dimensions, with a learner's profile as "individual as DNA or fingerprints" (Rose & Strangman, 2007, p. 388). In general, people have different preferences and habits for how they approach learning that are worth noting in the design. Some learners may have specific disabilities that can impact how they absorb, process, and express information. Disabilities can affect sensory areas such as vision, hearing, speech, and motor control. They can also be characterized by neurodiversity in that there are distinct differences in an individual's neural networks involved with cognitive processes that impact how learners attend to, organize, and remember information. Learners may have varied needs in their social-emotional tendencies, which can drive how they work in groups, initiate and sustain engagement through the learning process, and create meaningful connections with content. It is also important for designers to recognize learner diversity in linguistic proficiency and cultural backgrounds that can play into how learners bridge their prior knowledge with new learning and the kinds of scaffolds and tools that could enable learning success.

Further, the use of technology as part of instruction and learning can pose challenges to ensuring equal access among learners. Digital educational materials and tools can introduce accessibility and usability issues. For example, some learners may use screen readers or closed captioning to review content; some learners may use voice-command, keyboard navigation, or gestural movements to interact with digital applications. When instructional designs do not support these varied means of access and interactivity, learners will experience barriers to being able to fully engage and benefit from the instruction.

Educational programs that require the use of specific technology equipment for access of computer-based instruction can be met with barriers to obtaining the equipment in parts of the world that have limited financial resources or under-developed infrastructures. For instance, the International Telecommunications Union (ITU, 2018) reports that just under half of households worldwide have a computer in the home. Similarly, web-based instruction is often dependent on learners having sufficient bandwidth through which to access the materials and activities, and this is not yet available in some areas. In the Americas, for example, about 70% of broadband subscriptions in 2017 reported access 10 Mbit/s or faster (ITU, 2018), which is generally sufficient speed for streaming video and making fast downloads. However, in least developed countries (LDCs, as designated by the United Nations according to their low socioeconomic development and Human Development Index ratings), access to high-speed Internet is not as prevalent. In 2017, 30% of broadband connections were at very slow speeds of less than 2 Mbit/s, which would make content streaming and course material downloads quite difficult. Designers can simulate slow internet in a variety of ways to understand how this impacts their learners.

Therefore, it is important in instructional design practice to recognize such elements and characteristics of the target learners and learning environments that relate to how learners will access, participate in, and show what they have learned through the instruction. Planning strategically to enable learners to navigate learning pathways that best meet their needs may involve greater investment of designer attention, time, and resources at the front-end. However, accessibility is necessary, and workaround solutions and accommodations are often costly and can have social implications that make them less than equal access for all learners.

Intentional effort in developing empathetic understandings of target learners during initial design phases can support more sustainable implementation of the educational program. This approach is characterized as universal design (UD), or designing for all people. UD “defines ways of thinking about and designing environments and products that work for the greatest number of people possible” (Null, 2014, p. 12). Robert Mace coined the UD term, noting that UD is “a process, rather than an achievement” (Story et al., 1998, p. 2). Applied to education, UD involves designing instruction that will be usable to the greatest extent possible by the target learners. The design should facilitate equitable use, offering equivalent means of access and engagement for learners with diverse abilities, and flexible use, providing options that accommodate varied learning preferences and abilities (Story et al., 1998). Thus, designing for diverse learners yields great benefits. Harris (2018) provides an example from nursing education, “Implementing UD concepts in nursing classrooms which support equity and inclusion of students with diverse learning needs is a practical and sustainable alternative to granting reasonable adjustments to students on a case-by-case basis” (p. 180).

Developing Empathy in Design

Designers of all types, and especially novice designers, can be somewhat self-centered. This is not to say that they are selfish, but they can be self-referential, reflecting their own needs, experiences, and preferences in their designs rather than those of the learners. For example, Molenbroaek and de Bruin (2006) related the story of a hearing aid designer who fit the shape of his designed hearing aid to the comfort of his own ears instead of those of older people who would actually wear them. This created great frustration for those who purchased the hearing aids when they found that they could not find a comfortable fit in their ears. (For more examples, search for “bad design style” or read *The Design of Everyday Things* by Don Norman.)

So, too, in designing for education, attempts at universally designed instruction can fail to meet the actual needs of the learners. While self-referential design can certainly be used as a starting point, designers should not stop there but continue to develop empathic understanding for the target learners who will be using their designed materials. Empathic understanding is not binary, that is, it is not simply present or absent; rather, it is a skill that can be developed and deepened over time through experience and effort. As Brinck (2005) related in the book *Cost-Justifying Usability*, the investment of time and attention will be well worth it.

There are many ways that instructional designers can build empathic understanding for target learners. Fila and Hess (2015) described five techniques often used by instructional designers. First, designers can directly observe learners, both within the target learning context and in related places beyond. By watching how learners interact with environments, tools, and problems, designers can see barriers and points of confusion, as well as learner-initiated workarounds and strategies. Another technique is for designers to directly interact with sample target learners. Face-to-face, phone, and email conversations can lead designers to ask pointed questions that can help them learn more about the learner’s experiences. Having a conversation with someone close to a target learner can also yield insights, such as discussing learning needs with parents of young target learners.

Designers may also project themselves into the viewpoint of a target learner in order to envision what his/her experience within the planned instruction might be like. To do so, designers can imagine how learners with various characteristics and abilities would experience the exercise, activity, or lesson and where they may encounter barriers, misalignments, or other frustrations. Finally, designers can simulate participation by piloting drafted designs and materials to gain understanding for how learners may experience interacting in the learning context.

Tools for Understanding Target Learners' Experiences

- Dyslexia
- Vision Disabilities
- Hearing Loss
- Slow Internet

For example, Dr. Temple Grandin uses a simulation technique when designing livestock facilities to build understandings for how to improve the designs for the users (Raver, 1997). Her ability to empathize with the reactions of livestock have made her an international expert on designing humane animal processing plants.

Explanatory Videos With Dr. Temple Grandin

Animal Behavior

Applying Empathy in Design

Empathic understandings of target learners can then be applied to design parameters, such as how content will be communicated to learners through the designed instructional experience, how learners will practice concepts and skills during a lesson, or how learning will be assessed formatively and summatively. As designers generate ideas for these parameters, they can integrate their empathic understandings of the target learners with expectations and requirements from stakeholders and the realistic constraints of available resources and the target learning environment. See Table 1 for a sample of learner characteristics, potential instructional barriers, and supports that can be built into a learning experience.

Table 1

Non-Exhaustive List of Potential Considerations, Barriers, and Supports

Considerations	Potential Instructional Barriers	Supports
Hearing difficulties	• Video • Podcasts • Screencasts • Lecture	• Captions (complete and synchronized) • Interpreters • Audio transcripts
Vision difficulties (such as low vision and color blindness)	• Presentation materials and demonstrations • Printed texts • Color use in presentations • Tasks requiring color differentiation	• Audio descriptions of visible motion on a video • Zoom functionality • Screen reader accessibility • Braille alternatives • Image alt-text • Designations other than color for conveying key information
Physical mobility difficulties	• Using a mouse • Physical requirements • Inaccessible spaces • Stairs and platforms	• Keyboard accessibility • Furniture rearrangement for increased mobility • Varied seating options
Information processing difficulties	• Assessment time limits • Extensive, complex tasks • Language comprehension • Technical jargon	• Remove time limits • Chunk information • Support strategy development (small goals, organize tasks, more deadlines for smaller sections) • Flexible schedules • Use simple language and/or provide vocabulary support
Language differences	• Spoken language • Written language • Collaborative activities • Writing tasks • Idiomatic language	• Translation tools • Vocabulary instruction • Captioning • Transcripts • Starter text for writing
Low Internet bandwidth	• Slow loading of large files (video, audio, images) • Poor connections for real-time interactions • Multimedia streaming limitations	• Provide alternatives to video • Reduce image file size • Have options for asynchronous participation • Mobile-friendly interface • Chunk content in smaller sections
Cultural differences	• Gender roles or relationships between genders • Power differences between students and instructors • Concepts of authority and respect • Behavior expectations	• Collaboration with knowledgeable stakeholders • Guided group collaboration structure and specified roles • Communicated expectations • Examples of expected contributions and activities • Connections between learner culture and new content
Digital literacy	• Tasks requiring technical skills • Navigation of online environments • Learning curve for digital tools	• Specific instruction or tool tutorials • Emotional support and encouragement • Time and scheduling guidance

	• Frustration or discouragement	• Just-in-time help desk support

Learner voice can be a valuable contributor to applying empathy in design. Checking in with learners and giving them a chance to respond to the design throughout the development process will likely result in meeting pertinent needs and avoiding miscommunications and misinterpretations. This can be done through formal and informal presentations of a drafted design to learners for feedback and further suggestions. Thus, instructional design is an iterative process of continual refinement through such feedback loops and checks for congruency and alignment across components of a module or educational program.

To illustrate how empathy can be applied in the instructional design process, two cases will be described. First, a case mentioned in Meeks, Jain, and Herzer (2016) related how medical students with color blindness experienced difficulty in histology courses when they were asked to identify microscopic structures, as the slides used to depict these structures were often stained using red or green colors that tended to obscure some key distinguishing features. The instructors addressed this barrier by converting the slides into grayscale, which enabled all students to view the structures. Thus, a recommended practice in designing instructional materials is to use shapes, labels, or other means to differentiate elements in illustrations, graphs, and other visuals, rather than color only. Doing so will facilitate a more universally designed experience for target learners.

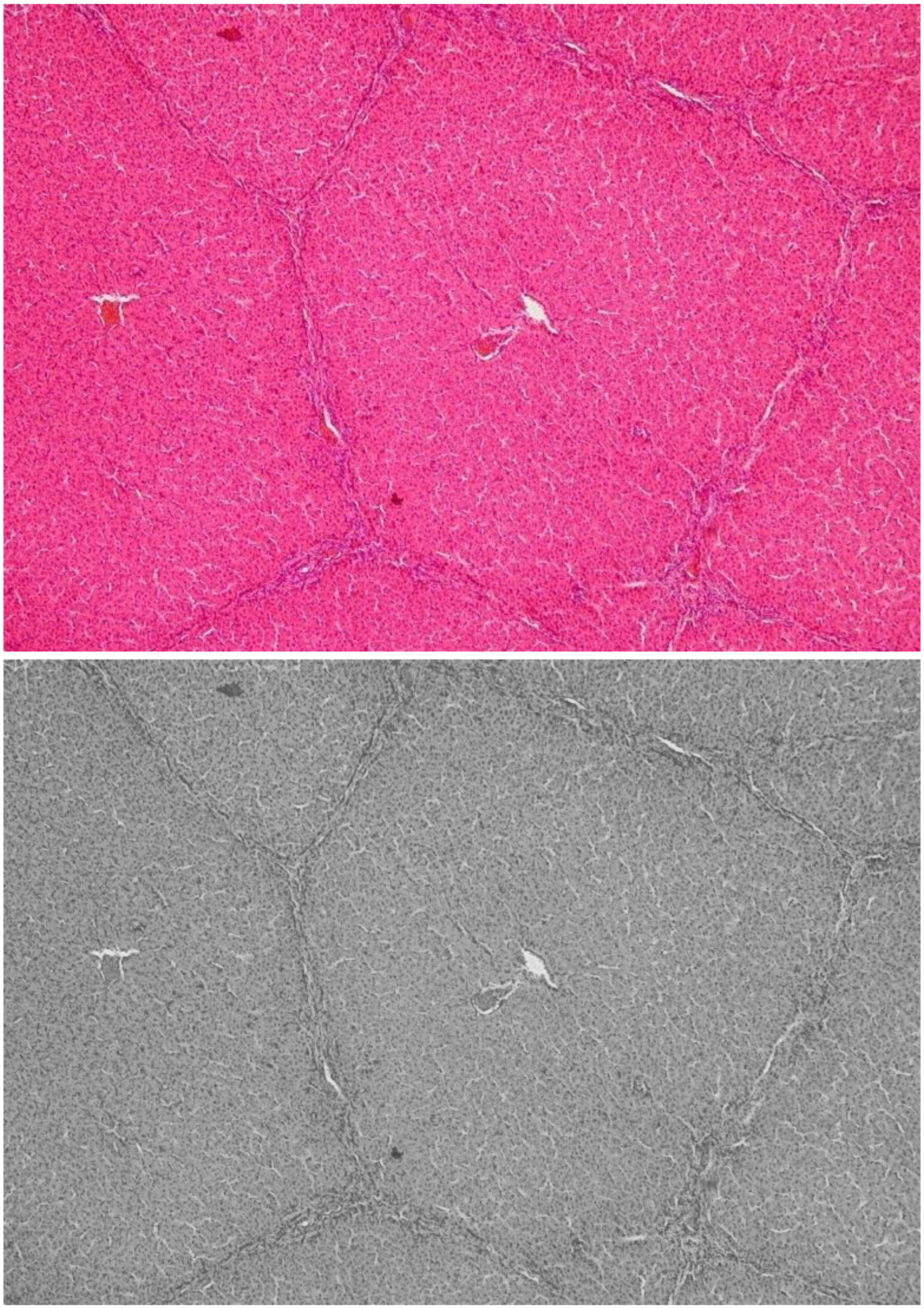

Figure 1.1.2.1: *Using Stain to Help Students with Color Blindness Identify Microscopic Structures*

A second illustrative case is from the Industrial Design program at the University of Illinois at Urbana-Champaign. Students in this program are coached to build empathy for users of their designed products and then use these empathetic understandings to refine their designs. One strategy that they use is to explore what it feels like to intentionally impair each of their senses and attempt to use their designs in representative home, school, and public spaces. This pushes them to develop insights regarding users who may have specific sensory impairments and how they may experience use of the design in varied environments. The design students also team up with non-design students who have both visible and invisible disabilities to review and pilot their drafted designs. Doing so allows them to build empathy through the interactions and dialogues with their team members, then they incorporate their user experience insights into future revisions (McDonogh, 2015).

Design Approaches to Address Learner Variability

Differentiated Instruction (DI)

Since learner variability is the norm rather than the exception, it is important that designers incorporate instructional approaches that will meet the needs of individual students and optimize their capacity to learn. One such approach is differentiated instruction (DI). Stradling and Saunders (1993) defined *differentiation* as "the process of matching learning targets, tasks, activities, resources and learning support to individual learners' needs, styles and rates of learning" (p. 129). This means incorporating flexibility in the modes of learning, types of provided resources, and assessments in order to respond to specific learner differences. Instructional designs can be differentiated in content, process, and product (Tomlinson, 2017). Each of these dimensions will be discussed in further detail.

Differentiation of content involves varying the concepts and skills students will learn. While engaging in instructional planning, designers may work alongside subject matter experts or instructors to identify learning goals and outcomes for a course. Within the goals and outcomes, there can be variance in the levels of knowledge, skills, and dispositions that learners could be expected to gain from the course. For example, the content can be differentiated into concrete and abstract concepts, and students could be provided with a range of options (additional links, supplementary material, multimedia) to access learning materials and to work at their own pace. A pre-assessment could be used to gauge prior content mastery among learners and identify areas of additional needed support. Pre-assessments may also be used to determine learner readiness levels, interests, and learning preferences (Tomlinson & Allan, 2000). Gaining insights into learner interests and learning preferences (including preferences regarding individual/group work, personality traits, and internal/external motivators) will enable appropriate matching of course design to these learner characteristics. A pre-assessment can be in written form (such as a survey or test), or it can take the form of one-to-one interviews, focus groups, or demonstrations.

Differentiation of process refers to the varied ways that students make sense of learning materials and take ownership of their own learning. For a designer, it means factoring in activities that are engaging and intellectually challenging and that lead students to practice and apply targeted concepts and skills. Some examples are problem solving, mind mapping, and reflective journaling. What learners create through such activities, that is, the products of their learning, can also be varied. Products should demonstrate knowledge and skills that learners have gained from a course, but they can be in various forms, such as written, physical demonstration, spoken performance, or a video compilation. Designers can develop performance expectations to guide learners to incorporate critical thinking and connections to real-world applications through their products.

Universal Design for Learning (UDL)

Universal Design for Learning (UDL) calls for a flexible approach to learning that supports all students. Similar to the tenets of Universal Design mentioned earlier, UDL aims to minimize barriers for learners as part of the design of curricula and learning environments so that they are accessible to as many people as possible. UDL involves building in flexibility into the curricula from the outset instead of retrofitting and adapting inaccessible curricula after the fact (Meyer et al., 2014).

It is worth noting that UDL differs from DI because it provides learners with multiple options to pursue self-directed learning whereas DI is often more instructor-directed.

Differences Between UDL and DI With Katie Novak

The UDL framework contains three key principles:

- Provide multiple means of engagement that stimulate interest and persistence in learning, thereby producing learners that are purposeful and motivated;
- Provide multiple means of representation so that content is delivered in varied formats, enabling learners to become resourceful and knowledgeable; and
- Provide multiple means of action and expression in which learners can show their developing knowledge in varied ways, supporting them to become strategic and goal-directed (CAST, 2018).

Each principle has guidelines and checkpoints that detail implementation strategies.

To access the UDL framework, visit http://udlguidelines.cast.org/.

Hall, Strangman and Meyer (2003) offer four steps for implementing UDL in the planning and delivery of curriculum: set goals, analyze status, apply UDL, and teach the UDL lesson. When setting goals, it is important to establish the context for the instruction. Designers may need to consider, for example, if target goals would need to align with state or organizational standards. Designers can also consider if the methods that students use to accomplish the learning goals can be separated from the goals themselves. For instance, a goal that requires students to “write a paragraph about how the circulatory system works” may be reframed to prompt learners to “describe a complete cycle in the circulatory system,” which would facilitate flexibility in the means that learners could achieve that goal.

Analyzing the status of instructional materials involves evaluating the methods, materials, and assessments that will be used, considering their accessibility and flexibility in the ways that students engage and demonstrate their learning and identifying potential barriers. UDL can then be applied to elements of the instruction wherein potential barriers and opportunities for flexibility have been identified. Ultimately, the intentional flexibility in the UDL approach to design is aimed to position learners to be more self-directed and self-regulated, as learners are provided options for their learning pathways that align with their individual needs.

So, how might that look in practice? To provide multiple means of engagement, students are provided with tools that enable them to take ownership of their learning. Challenge levels should match their readiness, and there should be built-in opportunities for mastery-oriented feedback. This could begin with a well-designed syllabus that clearly states learning goals and objectives, course expectations and structure, information on how to navigate the learning environment, methods of assessment, and options for participation. Learning environments should support varied navigation and control methods that are accessible to all learners. Designers may also consider incorporating checkpoints that can help learners chart their progress in a course and provide opportunities for feedback and self-reflection after completing a unit of study.

Providing multiple means of representation offers learners options to customize the display of information, make sense of language and symbols, and enhance their levels of comprehension. Course materials can be presented in a variety of formats to provide varied means for students to connect with the content. Materials may be customizable, enabling learners to adjust text size, color, contrast, etc. and access content in varied forms, such as video, interactive simulations, audio, and text-to-speech.

In providing multiple means of action and expression, designers can incorporate planned flexibility in learner response options, navigation, access to tools and assistive technologies, forms of communications, and demonstration of learning. One strategy to achieve this is to maintain uniformity in the design of the content, both across functionalities and through consistency of visual appearance. Another strategy is to offer multiple options for learners to demonstrate their mastery of the content, such as through text, mind maps, audio, and video.

Culturally Relevant Education

Culturally relevant education is built on the premise that culture is an essential component of students' learning, as instructional practices, curriculum, and modes of assessment that are couched in "mainstream ideology, language, norms, and examples often place culturally diverse students at a distinct educational disadvantage" (Howard, 2012, p. 550). Culturally relevant education is characterized by several frameworks, including culturally responsive pedagogy, culturally relevant teaching, and culturally congruent teaching. It is empowering to students intellectually, socially, politically and emotionally by using culturally relevant frameworks to convey knowledge, abilities, and attitudes (Ladson-Billings, 2009). Consequently, a culturally relevant education recognizes the culture, attributes, and knowledge that ethnically diverse students bring to their learning experiences and uses those resources to maximize their learning (Howard, 2012).

Culturally Relevant Pedagogy With Irvine, Gay, & Gutierrez

The question then becomes, how can instructional methods and materials be designed for cultural relevancy to learners, especially those on the fringes of dominant culture? An initial step for designers is to develop cultural sensitivity through becoming familiar with target learner interests, core values, traditions, modes of communication, and backgrounds. Knowledge about the learners can then be strategically integrated into plans for instructional methods and materials (Gay, 2002). To help learners see the relevance of instructional materials to themselves, instructional resources can be situated within the cultural and ethnic contexts of the target learners. Designers can incorporate materials and activities that reflect multiple voices and perspectives rooted in the personal experiences and cultures of the learners. Learner autonomy can be enhanced through the provision of varied options for expression. For example, learners can be provided an array of materials and activities to choose those that are relevant to their backgrounds of experience. Designers can also plan for ways that learners can share personal experiences as they are related to course topics, creating meaning-making opportunities.

Conclusion

Universally designing instruction involves recognition and intentional planning for components and features that often do create accessibility challenges for learners so that all learners can access and engage in learning experiences equitably. As learners vary in their characteristics, preferences, and experiences, so do the approaches through which designers can develop empathetic understandings and incorporate flexibility to meet diverse learner needs. This chapter offers an initial look into these strategies, and designers are encouraged to revisit these strategies in the instructional design process so that they can anticipate variability in their target learners and address this variability strategically.

Activity/Exercise Ideas

1. Explore built-in accessibility features. There are built-in accessibility features in many of today's tools that support varied vision, hearing, mobility, and learning needs. Explore the built-in accessibility features of one of the following:
    1. Mac OS: https://edtechbooks.org/-suAu
    2. Windows: https://edtechbooks.org/-dpZm
    3. iOS: https://edtechbooks.org/-HRy
    4. Android: https://edtechbooks.org/-xSo
    5. Chrome OS: https://edtechbooks.org/-haKY
    6. Other Google tools: https://edtechbooks.org/-rCsZ
2. Share in a discussion board post, blog, video post, Tweet, etc. about what you learned in your exploration of the built-in accessibility features. Did you find any that you would like to use in the future?
3. Experience accessibility of digital resources. Choose a website, app, or program, and access it in a different way than you usually do. For example, you can use some of the built-in accessibility tools from Activity #1, such as trying to do research through an online library website using a screen reader and voice-input (such as VoiceOver and Dictation on MacOS). You could also try navigating around a course site using keyboard-only (no mouse, touchscreen, or touchpad). Or, you could try using a web application on a mobile device that you usually access via laptop/desktop computer. Spend about a half hour accessing the digital resource in one or more different ways and then reflect on your experience. How accessible was the resource for the means that you accessed it? What did this experience prompt you to think about in regards to your own design of digital educational resources? Create and share a summary of your experience and related thoughts as an audio clip, discussion board posting, graphic (could include screenshots or sound clips), etc.
4. Observe universal design. Spend 30-60 minutes observing people using universally designed features in different contexts, such as the automatic door openers, ramps, buses, playgrounds, water fountains, food service centers, libraries, etc. What do you notice about who is using them and how? Collect pictures of examples and non-examples of universally designed features around campus. How might these impact people with different needs?
5. Using technology to implement UDL. Choose a guideline (see http://udlguidelines.cast.org/) associated with one of the UDL principles and find a technology tool that supports the implementation of the guideline. For example, you may find a tool that supports the guideline "recruiting interest" under the principle of engagement. How would the tool optimize individual choice and autonomy, optimize relevance, value and authenticity, and minimize threats and distractions?
6. Create accessible materials. Use the Accessibility Evaluation and Implementation Toolkit (AIET) to evaluate and improve accessibility in one of your own Word documents, PowerPoint presentations, Excel spreadsheets, a WordPress website, or a Canvas module. Use the links in the checklist to identify accessibility barriers and then resolve all errors.

Resources

- Accessibility Resource List from Designers for Learning based on "POUR" - Perceivable, Operable, Understandable, Robust recommendations related to website accessibility.
- Culturally Responsive Teaching & the Brain by Zaretta Hammond offers tools and recommendations for applying CRT into instruction.
- Dive Into UDL by Kendra Grant and Luis Pérez provides a UDL self-assessment and a variety of resources to explore UDL more deeply.
- Global Accessibility Awareness Day (GAAD) is an annual event in May that focuses on the design, development, and usability of technology for users around the world.
- Inclusive Learning Network of ISTE (International Society for Technology in Education) provides professional learning opportunities and resources on inclusive design and technology.
- National Center on Accessibility Education Materials (AEM) provides resources and technical assistance on producing learning materials that meet accessibility standards.
- Techniques for Empathy Interviews in Design Thinking is a resource with ideas for how to set up and conduct exploratory interviews with potential learners.

- The UDL Toolkit is a collection of UDL resources for teachers, coaches, and instructional leaders.
- UDL-IRN (The Universal Design for Learning Implementation and Research Network) provides resources and professional learning opportunities to connect with other educators and designers regarding implementation of UDL.
- UDL Progression Rubric by Katie Novak and Kristan Rodriguez provides specific examples of UDL practices across the three principles of providing multiple means of engagement, representation, and action and expression.

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1.3: Conducting Research For Design

Conducting Research for Design

Daniel R. Winder

Every field of expertise has elements that need to be investigated, and regardless of the discipline, how you discover evidence for learning is very similar. In this chapter I will present common issues I have encountered in the field of instructional design when planning a research study. This is followed by discussion of when and how to use certain research methodologies. Finally, I will discuss how to conduct research and report results.

When and How to Use Research Methodologies

Novice researchers will often limit themselves as only being a qualitative or quantitative researcher. In practice, the nature of the question will dictate the most appropriate research method that should be used. In addition, using mixed methods often yields stronger results. For example, survey teachers about what to cut or reduce in a curriculum, then follow up with focus groups to yield stories and experiences that explain the survey numbers.

When to Use Qualitative and Quantitative Methods

Qualitative methods generally seek to answer questions that center around experiences that involve understanding values, beliefs, perceptions, emotions, culture, growth, paradigm shifts, processes, taboos, morality, reasoning, and acquiring learning. In short, the more a question centers around “the human experience,” the more it lends itself to qualitative means which gather rich experiences, stories, and examples. An example of qualitative research could be using grounded theory to develop a new theory of language acquisition by analyzing data from journals, portfolios, and focus group interviews of persons learning a new language.

Quantitative methods generally seek to answer questions that center around how much of something has been acquired such as knowledge, behaviors, or attitudes. Experiments, correlations, causes, and descriptions are often the reasons why how much of something is being measured. An example of experimental research is when a pilot program is compared with an existing instructional program to measure the effect of different instructional treatments on how much students learn. An example of correlational research would be the effect of parental involvement on GPA. The hypothesis of such a study may be that higher parental involvement will correlate with higher GPA. An example of a causal research study is the effect of dogmatic political preferences on macro-moral reasoning abilities. Perhaps the assumption is that dogmatic political party views may inhibit one’s ability to morally think through all aspects of social issues. An example of descriptive research is when a researcher describes how many hours of homework 7th grade math teachers give per week.

General Steps to Qualitative Research

Identify Your Bias

The first step in qualitative research is to identify your biases via reflective means. Reflexivity activities help a person go through a meta-cognitive process of identifying their preconceived notions, judgements, and values that may influence the research project. This can be as simple as journaling your thoughts about a research topic. This video clip explains some qualitative research methods with a few examples. There is a great description of reflexivity about eight minutes into the clip.

Plan the Research

The second step begins by writing a problem statement and research question. Once these and variables of interest are identified, an important part of the research plan is to design interview or observation guides. This may involve designing interview or observation guides. Guides take various forms such as a checklist, a standardized open-ended interview guide, or an informal guide. A few tips in designing the guide are to a) have colleagues review questions or guide, b) pilot test your questions or guide, c) check for leading questions or leading interviewers or observation bias, and d) be open to scrutiny.

During this phase, plan reliability and validity measures are

1. Credibility (internal validity). Credibility of the research can be established via triangulation, prolonged contact, member checks of data or analysis, saturation, reflexivity, and peer review.
2. Transferability (external validity). The generalizability of the research can be enhanced by using thick descriptions and variation in participant selection.
3. Dependability (reliability) is established by extensive audit trails and using triangulation. Subjectivity audits are used during the data collection process to evaluate how a researcher's presence, questions, or biases may be impacting the research.
4. Confirmability is established with reflexivity and intra- or inter-coder reliability.

Gain Entry

The third step is to gain entry with the group or individuals the researcher is studying. This involves gaining trust, understanding the culture and environment, and helping the participants feel at ease. The amount of time and effort here depends on many factors such as the sensitivity of the topic and whether the researcher is taking a cultural native approach or acting in an apparent authority role. To further explore this concept of gaining entry, read this article.

Collect Data

The fourth step is to collect data. This can be done via observation, interviews, focus groups, open-ended surveys, and journals. During this phase, be prepared to adjust your thinking and be aware of your bias. Gather existing data and artifacts also. Because this is the step where the most mistakes are made, below are some additional practical tips and tools for qualitative data collection.

Observation

The most common ways to observe are live, virtual, recorded video or audio files, or a combination of the three. A rubric or observation guide can be designed to focus observation on certain concepts or phenomena. The benefit to live observations is the ability to view holistically all the nuances, expressions, non-verbal cues, and visual or auditory expressions that are not captured by other methods.

The benefit of recording video or audio files of observations is the ability to review them multiple times during transcription and analysis. One great tool for video observation is GOReact, where a pre-specified codebook can tag live or pre-recorded video files when coded phenomena occur.

Focus Groups

A focus group is one of the most common methods of qualitative research. Focus groups are group interviews with less than 10 persons. These persons are usually intentionally selected (e.g. students who meet certain demographic characteristics). Focus groups work well when participants feel non-threatened and permissive. They are effective because the interplay between participants can stimulate other's thoughts, beliefs, perceptions, etc.

Because of the ease of gathering these small groups, some researchers mistakenly use focus groups when other methods would be more appropriate. For example, novice researchers may gather a focus group and proceed to ask the group survey-like questions rather than gather rich descriptive experiences, stories, and thoughts. Another common mistake is that researchers default to focus groups for topics best answered by individual interviews; for example, asking an online cohort about their group cohesion in a focus group setting presents a situation where participants may give socially desirable responses (individual, confidential interviews may yield more truthful responses).

Common Mistakes in Focus Groups: Communication Errors

The most common mistake for focus groups (and individual interviews) are communication errors from the interviewer which hinders responses such as:

- Restating too often. In teaching situations and normal friendly discussion, restating is a great communication skill. However, in interviewing, it's not always a great method, especially with a novice researcher who can't tell when they are putting words in participants' mouths. For example, if you are interviewing a group to find out opinions on a particular LMS platform and they say, "It feels so isolating," a great follow-up to get more out that concept is to ask, "Can you tell me more about that?" or "Can you think of a story or experience that illustrates that isolated feeling?" In a focus group, it is best to seek clarification from the participants with additional questions, stories, experiences, or elaboration rather than assume you know what they mean.
- Leading the witness. Some interviewers inadvertently revert to their bias and ask leading questions.
- Overly emotional responses from the interviewer. Remember, you are an interviewer with a beating heart, but not a counselor or therapist. You don't have to validate or comment on everything or nervously giggle at comments when humor is not intended.
- Not qualified to discuss. Interviewing about content for which you are not qualified (e.g. impacts of mental illness, causes of anxiety, marriage counseling issues, or any other topics that most often involve a trained professional).

Common Mistakes in Focus Groups: Failure to Control for Groupthink

Groupthink is when one person in the group shares an opinion or thought and the group finds it hard to break away into any other vein or divergent thinking. Sometimes, there is an actual group consensus. Other times, it's groupthink. Discerning between the two takes experience. Some common indicators of groupthink are that a few people are not talking or give trite agreements ("what she said"). Discern if the persons not talking or tritely agreeing are just less articulate, or don't want to share their contrasting views. You may have to curb bold or strongly opinionated persons who may seek to bully or monopolize the group. For example, "Let's hear from someone who hasn't shared yet" or "Hold your thought for a minute while we hear from…".

To control for groupthink, first introduce the session with some ground rules for an open discussion (and repeat many of these introductory rules throughout):

- There are no right or wrong answers.
- In this group, it's okay to disagree and still be friends. If everyone is saying their experience was great, but for you it was horrible, you need to speak up so all perspectives can be heard.
- It's safe to be positive or negative, better or worse. Explain to participants that saying something positive does not make them a better teacher or student. Similarly, saying something negative does not make them a worse teacher or student.
- It's okay to remove the filter between the brain and tongue, just for 45-60 minutes in this focus group. "Don't worry if you are saying it right or wrong, just say what you experienced."
- Distance yourself as the researcher from the product. For example, "I didn't create this company or this training so however you feel about it won't affect me."

To control for groupthink during a focus group, use the following suggestions:

1. Have participants write out thoughts or stories before the interview begins. Refer back to these in the interview if groupthink emerges. Did anyone write something different?

2. Invite contrast throughout the interview by asking, “Did anyone have a different experience that I need to hear?” or “Have you or someone you know had a different experience?”
3. If the groupthink is very strong, use hypotheticals, such as “What type of person would have had a different experience?” or “Could someone have a different experience? Why or why not?” Follow up by asking, “Did any of you experience that at all?”
4. Employ indirect questioning. Indirect questioning seeks to control for socially desirable response sets. For example, if you were asking about a program designed to remove racial biases, there may be a strong socially desirable response set. To remove the social context, you could ask, “If you were to describe how well this program runs using an analogy of a car, what kind of car would it be? Why?” or “If this program were a TV show, what genre would it be? Why?” With indirect questioning, the goal is to remove persons from a contextual response set by asking about the program indirectly. This can control the parroting response set by making respondents think and respond in a new context about similar issues, impressions, or values, without having time to prepare a socially desirable response. The result is insights with some contextual limitations.
5. In conclusion, ask, “What do you want to make sure I heard from you?” (I often have participants to write this down). Or ask, “is there anything I should have asked but didn’t?”

Ethnography

Ethnography is a method of study that educational researchers adopted from anthropology. For example, a researcher may be a participant or observer in an online class and may conduct several interviews and focus groups. They may write about the setting, social implications, typical and best behavior, and seek a perspective from several groups (parents, teachers, students, administrators, etc.). The researcher could also report about the tensions between groups, or even explore power struggles within groups.

Analyze the Data

The fifth step is to analyze the data. After qualitative data is collected and cleaned (such as removing identifying names or using codes for participants instead of names), it is important to go back to your original questions and study plan. Although you can adapt and explore interesting concepts that emerge, it is also important to keep your focus on your original questions. Thoroughly explore the data and be open to new concepts, but do not be sidetracked by all of them. Word maps may help initially to see what phrases or concepts are prevalent.

In qualitative analysis, all artifacts are loaded into a software such as Delve (https://delvetool.com/), Quirkos (https://edtechbooks.org/-hVz), Dedoose (https://www.dedoose.com/), or MAXQDA (https://www.maxqda.com/) . The researcher then creates a codebook. A codebook is a list of concepts, behaviors, actions, thoughts, etc. that summarize themes in a group of qualitative data (such as responses to open-ended questions). My initial code book will also contain the original research questions. If you are working with a group of researchers you should make sure you all agree on the codebook and use it consistently when analyzing your data (often called “interrater reliability”—see this training for more information).

Common Mistakes in Analyzing Qualitative Data

- Failure to focus the codebook on the research questions.
- Failure to identify proximal relationships (e.g. math division, anxiety, and home support are all close together). For example, if less anxiety and parental involvement are often near each other in participant comments there may be a connection there.
- Myopic analysis—overly focusing on a powerful story that is not a generalizable trend.
- Failure to make your findings defensible by employing validity and reliability measures discussed in the second step (credibility, transferability, dependability, confirmability).

Report Findings

The final step is to report the findings. A good report involves the research question or problem statement; background, theory, and lit review; the study design; presentation of the data with rich descriptions; and an explanation of the data or findings. You can present findings in chronological order, or by theme, frequency, or rich narratives such as in a case study. To learn more, see this lecture: https://edtechbooks.org/-FNEs.

Common Mistake in Reporting Qualitative Data: Extrapolation Error

A common mistake is a tendency to want to extrapolate an ancillary finding into a generalizable trend. For example, a researcher may say, “I was talking to a student at lunch today and they mentioned… This is something I’ve heard many times.” When a researcher makes a generalizable error, they are often including a finding that was never asked for, planned to explore, or agreed upon. The anecdotes are often not related to the initial research purposes.

The danger of making such anecdotes into general findings is, in reality, it was only a few powerful stories from a few isolated interviews. These powerful stories should not be ignored, and can be explored further, but one should ask if the anecdotes alone are sufficient to represent a generalizable trend. For example, in one study, an educational administrator in Africa asked for a budget to buy a gun to scare the lions away from the school. Although this was an impressive story, it was not an administrative issue mentioned in any other program. However, all programs mentioned power or internet outages and lack of technological resources.

In summary, researchers who have planned, collected, analyzed, coded, and reported data from qualitative research understand that the benefits are rich descriptions and understanding concepts or phenomena in depth and context. However, a drawback is the significant time and resources spent in transcribing, reading, organizing, coding, analyzing, and reporting. In addition, the amount of information gathered is usually very focused and can be limited in scope. For this reason, many chose to use quantitative methods.

General Steps to Quantitative Methods

Quantitative research begins by developing an understanding of an instructional problem and possible theories to solve the problem. The key elements of this step involve knowing much of the background of a product or problem and identifying a client's needs.

Write a Problem Statement and Research Question

The result of a good review of literature is to be able to write a good problem statement. A well-written problem statement will bring up past research or needs that lead to an instructional design question, then lead naturally into defining the scope of the questions that will be answered in the study. Here is an example of a problem statement for teachers that are simultaneously learning a foreign language and teaching skills:

Research shows that when second language learners seek to achieve multiple learning objectives within a second language, the acquisition of those multiple learning objectives may be impeded due to increased cognitive load and learning anxiety.

The problem statement is general enough to be read by top administrators and specific enough to narrow down the project scope. The research question builds on the problem statement to define the specific questions of the study plan. Here is a sample research question from the previous example:

Does separating instruction of teaching skill training from language acquisition training affect student's: a) teaching skills, b) language acquisition, and c) foreign language learning anxiety when three pilot groups are compared with three control groups and baseline historical data?

Writing a Research Question

"I didn't have time to write you a short letter so I wrote you a long one instead." Mark Twain

This is applicable when writing a problem statement and research question(s). It is more difficult to be concise than verbose.

Another approach to writing a research question is to operationalize one's theories into a hypothesis. A hypothesis usually involves an if–then statement and defines the variables of interest. For example, if I use metacognitive strategies in my reading curriculum, then students will more efficiently learn to read at a 5th grade level. It is quite easy to turn a well-written hypothesis into a research question. For example, if I use metacognitive strategies in my reading curriculum, will students more efficiently learn to read at a 5th grade level? In this phase, there will be some operationalization of terms here such as efficiently, 5th grade level, and identifying some specific metacognitive strategies.

Develop a Study Plan

Once a research question is designed and variables are operationalized, it's time to develop a research plan. A good research plan builds on the problem to be solved and further operationalizes variables to be studied and controlled for.

The Study Plan Matrix

At this point, the client and instructional designer can create a study plan matrix as shown in Table 1 (based on the prior example of language acquisition):

Table 1

Sample Spreadsheet

Research Question(s): Does separating instruction of teaching skill training from language acquisition training affect learners'…	Method or Instrument	When will data be collected and by whom?	Analysis
…teaching skills?	Teaching assessment (existing internal instrument)	Teaching assessment administered at 6 practice teaching sessions, one per week, filled out by a trained rater receiving the teaching.	Independent samples *t*-test or Chi-Square to compare pilot and control groups. One sample *t*-test to compare pilot with baseline data. ANCOVA to control for Self-efficacy score. Interviewer will undergo reflective journaling to identify bias prior to interviews. Interviews, observation notes, and focus group data will be transcribed and analyzed via MAXQDA to identify main ideas and themes. Coded comments will be rated by two raters and inter-rater reliability statistics reported. Participants will check focus group findings. Cronbach's alpha on each scale will be reported for internal validity.
…language acquisition?	Opic (existing instrument)	Opic language assessment administered during the last week of the program by trained test proctors. ACTFL categories reported by testing company.	
…language learning anxiety?	Foreign Language Anxiety Scale (FLAS) with Self-Efficacy Scale, prior language self-report items, and focus groups.	Pilot & Control—FLAS Survey Monday of week 2. FLAS Survey Wednesday of week 3. Two 60-minute focus groups for pilot only—1) end of English instruction, 2) last week of language instruction (focus group will have the top 50% of language scores in one focus group, bottom 50% in another). Incoming and exit survey questions—existing internal survey.	

The study plan matrix operationalizes the study in a clear way. Instruments from the literature review are specifically identified. Analysis methods are clearly spelled out. In addition, the study plan will involve agreed-upon methods to control for extraneous variables and employ accepted reliability and validity measures to control for threats to validity. A good study plan can also control for scope-creep—when a research project is either ill-defined or a client attempts to pork barrel the project so as to make it much larger than it should be or was originally agreed upon. The study plan can be the basis for a business requirement document—a document that spells out timelines, cost, and deliverables for a client.

Data Collection

Sampling

Sampling is how one determines the selection of participants in a research study. Sampling methods result in a selection of a subset of a population. Random sampling methods (everyone in a population has an equal chance of being selected) aid in the ability to generalize one's sample to be representative of an entire population. For example, all fourth graders in the district are put into a random sample generator and 400 of them are randomly selected to be representative of all 4th graders in the district. Non-random sampling is when decisions such as researcher judgment or convenience determine one's sample. For example, selecting all fourth graders at the particular school at which one works. Differing methods have benefits and drawbacks but the ultimate goal in all sampling methods is to seek a representative sample of a population. For a simple explanation of types of sampling and their advantages and disadvantages see: https://edtechbooks.org/-hcm.

Experimental Research

The simplest type of experimental research is a single treatment and a single observation. Various designs seek to control for threats to validity (to learn more about how each design controls for threats to validity see https://edtechbooks.org/-Woh). The following chart shows various types of experimental designs.

Table 2

Experimental Designs (R = random selection, X = experimental treatment, O = observation)

1. One-shot case study	5. Posttest only, control group design
X O	R X O
2. One-group, pretest–posttest design	R O
O X O	
3. Time-series design	6. Solomon four-group design
O O O O X O O O O	R O X O
4. Pretest-posttest, control-group design	R O O
R O X O	R X O
R O O	R O

Survey Research

Surveys are a very common method of data collection and a great tool to use when the question you are seeking to answer can be easily responded to in categorical selections or written comments. For example, asking about the frequency of a known behavior, how well students like a method of instruction, how well they agree or disagree with statements about an instructional treatment, or conscious perceptions potential learners have about their learning environment or teacher. Essentially, questions about what or how much of something are great candidates for survey research. For example, how much do you agree or disagree with the following statement(s) about your instruction, or, how often did your teacher follow up on your homework? An open-ended item might be as simple as: "Explain your rating." Because surveys are so common, I will offer greater depth on this method of data collection.

General Survey Writing Tips

The following tips will help you design a better survey:

Pilot test. Test your survey out with 5-10 typical responders. Use a think-aloud protocol, where you ask people to say out loud what they are thinking when completing the survey. Conducting a pilot test will identify a majority of any usability or misinterpretation issues you will need to fix with your survey. In addition, asking 30 respondents to reply before sending it to all 1000 can give you a good idea of how your categories are performing. You may find a ceiling or floor effect for several items (all participants are selecting the highest or lowest category). This may be grounds for removing an item or revising it to be more discriminatory. However, it may also serve as a confirmatory item.

Review sample survey output files. If you respond to a few surveys and then review the output file, it can save you hours in data clean up later because you see how you can most effectively change the format for later analysis. For example, perhaps the output file has data from the same respondent on different rows. Or perhaps you notice where survey logic accidently skipped over a section that was not intended to be missed. Sometimes embedded data is not being properly gathered. Categorical responses could be in text format rather than numeric. In addition, you can test the import of your selected output file into your statistical software of choice. Part of that import may help to determine if the data is appropriate for your study plan. For example, linear regression may not be appropriate for nominal data. Nominal logistic regression may be a more appropriate analysis method (for a further discussion of regression, see: edtechbooks.org/-nWXt). Sometimes seeing the data can help inform whether your method of analysis is appropriate.

Do not gather what you do not need. Do not waste valuable survey response time in gathering already existing information. For example, many organizations, conferences, or workshops have participant information already gathered. If the organization has the appropriate data-sharing agreements in place, you can embed prior gathered demographic information and only verify its accuracy.

There are various types of items. Most survey software will offer multiple choice (a, b, c, d), Likert scales (1, 2, 3, 4, 5), semantic differential items (agree–disagree), ranking and ordering (place the highest on top), dichotomous (true–false), and open-ended items. For a discussion of when to use these differing items see https://edtechbooks.org/-yUXF. For an item writing workshop or lecture from the author, see: https://edtechbooks.org/-vgvS.

Establish criteria to measure and align your items to each criteria. For example, if you are using a survey for an implementation study, establish what teachers and students must do for a successful implementation. Then write items for each criteria identified. I use a spreadsheet for this. Here's a simple sample of criteria and items in an implementation survey design.

Table 3

Sample Survey Criteria

Definition of Effective Implementation of Canvas	Survey Question Type	Question Stem
Teachers ensure students have technical abilities to use Canvas.	Agree–disagree	1. I was adequately trained on how I should use Canvas.
Teachers introduce the course resources and refer students to them throughout the unit. Teachers are not having to provide direction for locating assigned activities.	Agree–disagree	2. After initial training, there was no need to ask a teacher for directions on how to use Canvas.
Students know and feel Canvas will help answer their questions.	Agree–disagree	3-5. I knew I could go to Canvas to find answers to my questions about: 3. class scheduling 4. class preparation 5. assignment due dates

Avoid leading items. For example, "How easy was it to use the app?" is a leading item because this assumes it was easy to use. A better way to word the item would be, "Rate your experience with the app" (then use categories like 1 = easy to use, 5 = difficult to use, etc.).

Avoid double-barreled items. Double barreled items ask about multiple elements. For example: Rate your experience regarding class preparation and knowledge of due dates. It is better to separate these into two distinct items.

Use a common stem to avoid repetition. When several items or options begin with the same words, use a single stem and put the items or options beneath it or in a survey matrix. Here's an example of a stem with a multiple choice item

What determines a person's eye color? Their parent's genetic…

a. centrioles

b. chromosomes

c. organelles

Use the right categories. There is a tendency to default to the categories your software provides, but the software may not always give you the right options. For example, the default may be a 1-5 scale but a 1-10 scale may be more appropriate based on participant responses. Or the software may give a numerical scale or a preset categorical scale, but a unique categorical scale should be developed for the audience or topic. For example, in one survey I created for teenagers, I took several days interviewing teens and testing categories to get the right "teen-speak" categories that they could effectively use to differentiate their level of belief in certain topics.

Timing. For volunteers, survey gathering should only be a few minutes. For employees that are required or strongly encouraged to take the survey, you can create a survey somewhat longer (7-10 minutes), while still respecting people's time. Test the time it takes to respond to your survey as part of your pilot. In addition, consider the time your survey will launch. When persons are busy and overloaded, they will not respond as well. For example, if you launch a survey at the same time HR requires a 60-minute online module, fewer people will respond.

The survey invitation. The survey invitation is just as important as the survey itself. Often, people will receive survey invitations in an email. Your email should include a brief description of the survey, the time it will take to respond, a deadline, who is asking for the information, how the information will be used, as well as any guarantees of confidentiality or anonymity. If there are any rewards for survey completion, how to collect the reward should be specified. The most obvious thing the invite should include is a working survey link with an option to cut and paste the link. During the data collection period, several follow-up invitations should be sent. Depending on the nature of the data collected and decisions to be made, it may be worth the effort to seek out non-responders via phone interviews, additional invites, or paper surveys to compare their responses with prior responders. Generally, your first responders are more positive than non-responders.

Sampling. Sampling methods should be employed to avoid oversampling or survey burnout. For example, if your population is 10,000 ready respondents, consider a random sample of 300-400 persons, especially if you are conducting several surveys throughout the year for this population. Survey sampling websites can help you determine the appropriate sample size. If a ready sample is not available, a researcher can pay persons to take the survey or use social media or snowball sampling methods to find their target audience (see prior section on sampling).

As efficient as surveys are, they are not the best method for questions that require complex explanations or for studying multiple overlapping concepts in developing fields. For example, a researcher may be seeking to design a user interface for an app or may be forming a theory where grounded theory methods would be more appropriate.

Statistical Analysis

There are four main types of quantitative analysis: descriptive, causal, experimental, and correlational (predictive). Descriptive analysis describes your data in a summary form. The mean score, a histogram, a standard deviation, frequencies, and skew are all examples of descriptive statistical data. Most often, descriptive data is used to determine the appropriate type of further analysis. For example, if your data is highly skewed, you would use a different correlation technique than simple correlation (r). This introduces the concept of a statistical decision tree. A statistical decision tree helps a researcher make the right decisions about using the appropriate methods for analysis. Click here to see an image of a statistical decision tree or here for a computerized model.

Analyzing Group Differences (Causality and Experimental Analysis)

T-tests are used to compare differences in two groups, most often the mean (average) difference of two groups. Essentially, all statistical tests are measuring whether differences are due to more than chance alone. The assumption behind comparing two differing tests are that some experimental treatment caused the differences; in instructional design, usually the designed curriculum or tool is assumed to be causal.

The most common *t*-test analysis is an independent samples *t*-test. This type of test compares two different samples on a common measure. For example, online and live student's final test scores in a course are compared. A paired samples *t*-test analysis is used when you have two measurements on the same person (or thing). For example, a pre- or posttest where student one's pretest score is compared with student one's posttest score. A third type of *t*-test is a one-sample *t*-test. This compares the mean of a single group with a known group. For example, comparing a current cohort's attitudes towards learning math with baseline historical data from prior years.

But how do you analyze differences in samples when there are three or more groups? You could perform several different *t*-tests, but this can become very complicated when there are several groups. Analysis of Variance (ANOVA) analyzes mean differences among several samples and yields similar statistics to *t*-tests to show differences are more than due to chance alone.

Analysis of Covariance is similar to ANOVA but seeks to remove the effects of known variables. ANCOVA can also be used when simultaneously analyzing categorical variables and continuous variables and how they affect a third variable. For example, suppose you are testing three different curricula, but you cannot assign students at random. To control for this lack of random sampling, you administer a pretest score. The pretest score is a very strong predictor of your posttest score. With ANCOVA, if the relationship between a pretest and posttest score can be statistically quantified, the effects of the pretest level can be controlled to examine the overall effect of the three curricula (essentially seeking to remove the impact of pre-existing knowledge).

Analyzing Relationships (Predictive Analysis)

Correlational research seeks to examine relationships between two variables, such as the relationship between the amount of books read and five paragraph essay scores. Often, the goal is to find predictive relationships (e.g. those who read 5 books a month are likely to have 3 times higher scores on 5 paragraph essay scores than those who read 1 book a month).

The simplest of relationships is a linear relationship, or a line. As one variable changes (increases or decreases) another variable changes in a consistent manner (increases or decreases). Pearson's *r* is used with simple continuous data (foreign language anxiety scores relationship with language acquisition scores). Spearman's rho is used with rank order data (rank in graduating class relationship with rank on the SAT). Phi coefficient is used with dichotomous categorical variables (Instagram account or not and retired or not).

Regression statistics measure the relationships between many variables. Linear, or simple regression produces a best fit line for prediction between two variables (e.g. score on one test and score on a second test). Multiple regression is when a dependent variable is predicted by many or multiple variables (amount of time studying, days in class, and pretest scores all predict final exam score). There are many specialized types of regression models used in predictive modeling and to exhaust them all would be a much larger paper, but linear and multiple regression are the most common types of regression models used in instructional design research. To learn more about correlational, predictive, descriptive, and experimental research analysis, enroll in a quantitative research methods course.

Common Mistakes in Quantitative Data Analysis

Following are the most common mistake in quantitative data analysis:

1. Inappropriate sampling. For example, too small of a sample, not using a random sample when the analysis method requires it, and over generalizing about all persons in a group when only a sub-population of the group was sampled (a.k.a. extrapolation error).
2. Inappropriate methods. For example, using Pearson's *r* for correlation with rank order data. Or, using a simple *t*-test when the data is highly skewed and a Wilcoxon method is more appropriate. A statistical decision tree can help you avoid this mistake.
3. Failure to report descriptive statistics. Novice researchers may jump right into their analysis or report of their findings without explaining why a method was chosen or not chosen. A simple qualifier in your analysis such as, "A histogram showed the data was not normal. Therefore assumptions of normality were not met and XYZ method was chosen for analysis," would suffice.
4. Failure to review and clean data. Your data must be in the right format for the statistical package you choose to use. Therefore, reviewing data, often in spreadsheet form, or reviewing the first few lines in your statistical package can help you see if the variables are all aligned with the data, if they are consistently coded, and if you are analyzing all or just some of your data.
5. Miscoding variables. Most statistical packages allow for some transformations or computing of variables. For example, strongly agree to strongly disagree could be recoded as 1 through 5. Or a total score can be computed with several or all of the variables. When recoding, be consistent. If 1 = strongly disagree on one variable, it should be consistent throughout the dataset. It's always good to double check when transforming data or recoding data.
6. Failure to account for missing data. Novice researchers often forget to decide how to account or code missing data. Others mistakenly treat missing data as a 0, and the results can be inaccurate.

Reporting Research to Stakeholders

In academic research, you report to a committee, usually with differing opinions, preferences, and specialties. In business, industry, and government, reporting is not very different. Learning what your stakeholders are interested in and how they prefer reports is important. For example, if they prefer visuals in the forms of graphs, charts, and process flowcharts, create those. If they prefer quantitative data (such as means, standard deviations, correlations, regression lines) over qualitative data (stories, experiences, and personas), then it may be worth reporting such data. However, most stakeholder groups are diverse enough it is often best to include several differing types of reporting, visuals, tables, flowcharts, diagrams, and rich experiences and stories.

Often, a persona of a typical person in a group or subgroup illustrates poignant areas of findings. For example, one client wanted research to identify who applies to teach for them. After analyzing data from 1500 applications, we created the following persona:

This is Sophia. Sophia is a Latin American Studies Major, with a Spanish Minor. She currently does not have a job but is looking. One of her friends suggested a job at [your organization]. She is bilingual and has just returned home from abroad in a Latin American country. She loves [the organization's] environment and mission and is always looking for opportunities to share what she has learned, especially with new language learners. Statistically, Sophia's persona is the most likely to apply to [your organization].

After the reports are presented and, data is shared and reminded, do not take it personally if the findings are not immediately acted upon or if every recommendation from the committee or research team is regarded. It often takes time for organizations to act upon new findings, and organizations are often juggling many initiatives. Often, researchers are not involved in strategic planning, so if your research findings are not immediately acted upon, there may be a strategic plan for acting on them at a later date or there may be other more pressing needs to address for the organization.

In one office I worked for, we had a phrase we used to describe a concept of waiting to share findings: "Don't share the wine, before the time." A common mistake of researchers is to share their findings before they have been fully gathered or analyzed. For example, the first 100 of 300 replies are analyzed and the most common finding is that students are enjoying the new LMS. However, there are still 200 responses left to code and analyze. Suppose the other findings differ but the findings have already been shared or reported as positive. And no matter how many times you say "this is preliminary data," all a stakeholder hears is a fact.

Conclusion

This chapter is an introduction to research that can be useful to inform design decisions. The tools of research in instructional design are similar as the tools of research in most other disciplines. Once the basic principles of research are mastered in one setting, it is easier to begin using them in others.

Even though there is a science filled with appropriate and inappropriate research decisions, there is also an art to research. With experience, a researcher sharpens their research skills and knowledge of when to use which method to a point where they see the art in the science, and the science in the art. As a researcher, I enjoy this process of aiding an organization or client in the art of discovery. Among my colleagues, I often joke about researchers being a special type of breed. We are curious by nature, so curious, that it leads us to almost crave discovery. And, in my opinion, that is why you will find the most curious minds are always engaged in research.

1.4: Determining Environmental and Contextual Needs

Determining Environmental and Contextual Needs

Jill Stefaniak

Because instructional design emphasizes facilitating learning and improving performance, instructional designers must begin by acquiring necessary information about their learners' educational journeys. Needs assessment can assist instructional designers to make recommendations and design appropriate solutions (both instructional and non-instructional solutions) that will assist their learners in translating what is taught to their successful implementation.

The purpose of a needs assessment is to identify the gap between the current state of performance and the desired state of performance (Altschuld & Kumar, 2010). This gap in performance is what then becomes the need. While needs assessment can be a powerful and informative tool, the instructional designer cannot get lost in analysis and delay their design work (Stefaniak, Baaki, Hoard, & Stapleton, 2018). They need to be able to work within the scope of their design space, rely on the resources they have available to them, and make decisions to the best of their knowledge.

This chapter will address how validating needs and contextual factors influencing learner performance can be accounted for in instructional design to ensure the transfer of learning in real-world contexts. It will also demonstrate how information gathered from needs assessment can be leveraged to identify and develop the necessary scaffolds to manage the learning experience.

Exploring the Intersection Between Needs Assessment, Needs Analysis, and Instructional Design

Richey, Klein, and Tracey (2011) defined instructional design as "the science and art of creating detailed specifications for the development, evaluation, and maintenance of situations which facilitate learning and performance" (p. 3). If we were to dissect this definition, I would point out that instructional designers are responsible for the following: (1) *creating detailed specifications*; (2) *conducting evaluations*; and (3) *maintaining of situations that facilitate learning and performance.*

The information that a needs assessment yields provides the details and specifications needed for an instructional designer to create an instructional product that is customized and accounts for the unique needs of the learning audience. It also provides benchmark data regarding the current level of performance (or situation) that the instructional designer and their team can evaluate and compare after instructional interventions have been designed and implemented. Instructional designers and the team members will also be better positioned to monitor the instructional delivery and transfer of knowledge to the job or desired application if they have been presented with sufficient data concerning these phases.

It is important to differentiate between needs assessment and needs analysis as they are not synonymous with one another but are often used interchangeably. **Needs assessment** is the process of gathering information to determine whether there is a gap between the current state and the desired state. This gap yields *the need*. **Needs analysis** is the process of further investigating the situation to understand why this gap exists in the first place. The data that is gathered during the needs assessment is analyzed to determine what is contributing to or causing the gap (Kaufman & Guerra-Lopez, 2013).

Needs assessment and needs analysis provide an opportunity for an instructional designer to develop instructional materials that can have a meaningful impact on their learning audience. In more cases than not, when instructional designers are brought onto a project, the solution (need) has already been decided:

- We *need* to design an online degree program
- We *need* to design a safety course for incoming employees
- We *need* to design a team training course for the hospital staff

If you look closely, you will see that each of the above-mentioned statements contained the word *need*. Whether it is your client or a supervisor, the need has already been decided. Another caveat is that there are a lot of times where the need has been decided with no needs assessment ever having been conducted (Peterson & Peterson, 2004). Oftentimes when this occurs, the instructional designer begins work on their tasks only to find that they have a lot of unanswered questions:

- Why are the learners experiencing this problem?
- How will they use the instruction after training takes place?
- How will we know if they are implementing what they have learned in their actual jobs?

- How do we know that the instruction we have designed is doing what it was meant to do?
- Has the organization tried this type of instructional method in the past?
- What is the rationale for proposing online instruction?
- Are we sure that instruction is going to solve the problem?
- Is there a subject matter expert that we can speak with to provide some more guidance on what the learners need?

All of these questions are very specific and unique to the learning audience of a project. Some of these questions may be related to the instructional environment while others may be looking ahead to how learners will be expected to transfer this knowledge to a real-world setting (i.e. the classroom, a job).

Regardless of what needs assessment model may be referenced, a typical assessment will consist of five-steps: problem identification, identification of data sources, data collection, data analysis, and recommendations. Table 1 provides an overview of each of these steps. While these steps are usually completed linearly, the individual who is conducting the needs assessment needs to continue to modify the problem and identify additional data sources as more information is uncovered during the assessment. With that in mind, the needs assessment process is very similar to the instructional design process in that both processes are recursive.

Table 1

Overview of needs assessment process

Needs Assessment Step	Description
Identification of Problem	This step is typically completed in consult with a client (or the individual(s)) requesting instructional design services. During this phase, the purpose of the needs assessment (the problem) is identified for the instructional designer to begin gathering data to address the gap in performance.
Identification of Data Sources	Once the problem to be explored has been identified, instructional designers must identify data sources that will help them better understand the situation. Instructional designers must gather data that will help them explore the situation from multiple angles. Examples of data sources include, but are not limited to, task analyses, direct observations, focus groups, interviews, document analysis, reviews of existing work products, and surveys.
Data Collection	This phase involves the instructional designer gathering data based on the data sources that were identified in the previous step.
Data Analysis	Once data collection is complete, the instructional designer begins to analyze all data to identify patterns and factors contributing to the problem identified at the beginning of the assessment. Depending on the findings from the data collection and analysis phases, the problem may be modified to be more consistent with the actual situation as depicted by the data.
Recommendations	Upon identifying patterns contributing to the problem, the instructional designer makes a list of recommendations to present to their client. These recommendations are typically prioritized according to the severity of need and level of urgency.

Figure 1 provides an overview of how needs assessment and needs analysis can help leverage instructional design practices to support the transfer of learning. Conducting a needs assessment provides the instructional designer with the opportunity to contextualize their project. It provides them with an opportunity to gain insight into things they should include in their designs, as well as things they should consider to avoid. Regardless of the situation, a needs assessment will help an instructional designer identify or verify the project needs. This is especially helpful when the needs have already been identified without the guidance of a needs assessment.

Needs analysis also aids the instructional designer by providing some context as to why these needs exist in the first place. If learners are facing recurring challenges completing a particular task, instructional designers should understand the causes so that they can account for these issues in their designs. By developing a better understanding of factors that contribute to or inhibit the transfer of learning, instructional designers will be able to develop a more realistic approach to the instructional solution. It will also provide them with the opportunity to determine if certain non-instructional interventions are needed to support the transfer of learning.

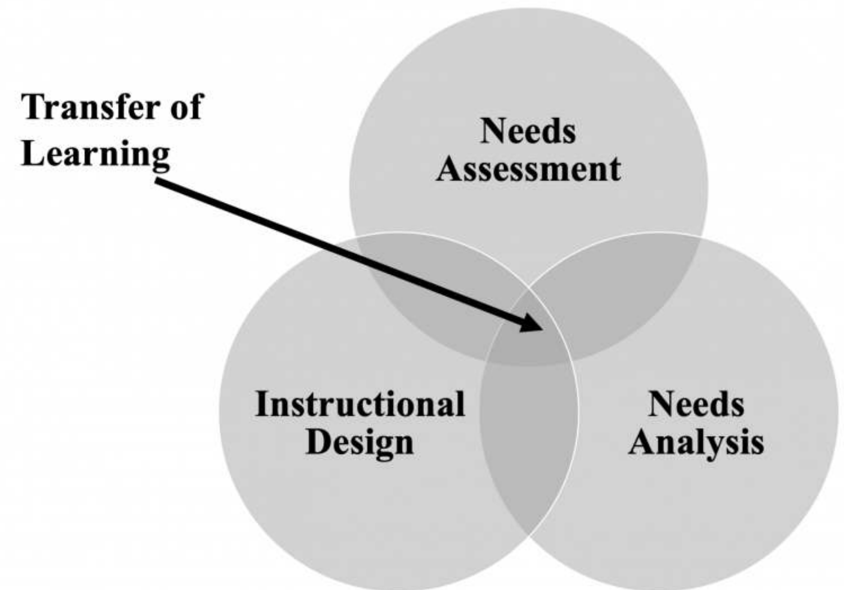

Figure 1.1.4.1: *The relationship between needs assessment, needs analysis, and instructional design*

The Role of Context in Needs Assessment

Needs assessment is recognized as being an important component of the instructional design process (Dick, Carey, & Carey, 2009, Morrison, Ross, Kalman, & Kemp, 2013; Smith & Ragan, 2005; Cennamo & Kalk, 2019); however, it often tends to be minimized to focus more on learner analysis. Contextual analysis is also a term that is used synonymously with needs assessment in a lot of instructional design literature. A seminal piece written by Tessmer and Richey (1997) suggested that contextual analysis should account for factors influencing performance in the orienting, instructional, and transfer contexts. Figure 2 provides an overview of the more common factors that influence each of these contexts. Tips for how to address these three contexts will be discussed further in this chapter. By addressing these factors in instructional design practices, designers put themselves in a better position to design experiences that were relevant to the learning audience.

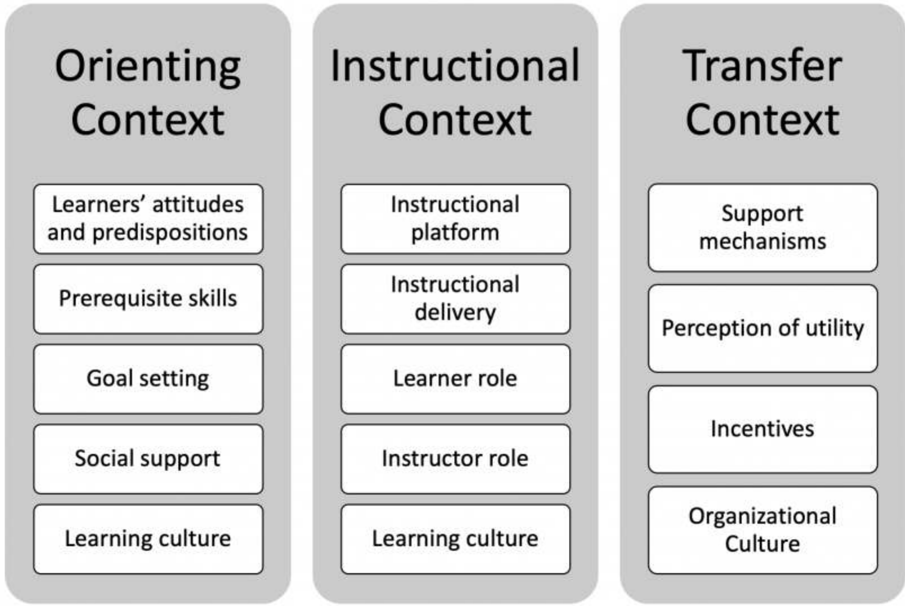

Figure 1.1.4.2: *Common contextual factors influencing instructional design adapted from Tessmer & Richey (1997)*

While contextual analysis aims at understanding the learner's work practice, needs assessment further delves into identifying, classifying, and validating the needs of users as they pertain to the context (environment). It is imperative that a designer fully understand the intricacies and nuances of the context (environment) so that they can design a prototype that addresses particular contextual factors that may support or inhibit the transfer of learning into the real-world environment (Smith & Ragan, 2005). These factors, both good and bad, ultimately influence the instructional designer's design.

While there are different types of analyses that an instructional designer may be required to employ during a project, it is important to recognize that while they are all different, they are not mutually exclusive. While each has different foci, all of these foci fall under the needs assessment umbrella.

Table 2

Overview of analyses an instructional designer may utilize to inform their design

Method of Analysis	Description	Resources and Studies for References
Needs Analysis	Analysis that occurs after a needs assessment has been conducted to understand the root causes contributing to a problem.	Brown (2002) Crompton, Olszewski, and Bielefeldt (2016) Dick and Carey (1977) Stefaniak et al. (2018) Stefaniak, Mi, and Afonso (2015)
Contextual Analysis	The process of analyzing factors that may contribute to or inhibit knowledge acquisition and transfer of learning.	Arias and Clark (2004) Morrison, Ross, and Baldwin (1992) Perkins (2009) Tessmer and Wedman (1995)
Environmental Analysis	The process of focusing on the impact that the learner may have on the environment outside of the organization such as customers, competitors, industry, and society.	Lowyck, Elen, and Clarebout (2004) Marker (2007) Rothwell (2005) Tessmer (1990)
Learner Analysis	The process of capturing an in-depth understanding of an instructional designer's learning audience. Demographic data, prerequisite skills, and attitudinal information are typically gathered to inform the instructional designer.	Baaki et al. (2017) Dudek and Heiser (2017) Öztok (2016) Stefaniak and Baaki (2013) van Rooij, S. W. (2012)
Task Analysis	The process of conducting direct observations of individuals performing job-related tasks and documenting in a step-by-step fashion. Task analyses are done to help instructional designers design instruction that is aligned with how the job will be performed in a real-world setting.	Jonassen, Tessmer, and Hannum (1998) Militello and Hutton (1998) Schraagen, Chipman, and Shalin (2000)

Table 2 provides an overview of the various types of analyses that may be used. Examples of instructional design studies that have explored these topics in more detail are also included for reference. A commonality among all of these analyses is that they typically involve collecting data from multiple sources to gain a better understanding of the situation. Out of all of the analyses listed in Table 2, needs assessment is most often the most time-consuming because it requires instructional designers to identify appropriate data sources, collect data, conduct data analysis, and consult with their client on recommendations for moving forward. Direct observations, document analysis, interviews, focus groups, and surveys are all examples of the types of data collection tools an instructional designer may utilize when conducting an analysis.

The use of the above-mentioned data sources has been used to inform the development of learner personas in instructional design (Anvari & Tran, 2013; Avgerinou & Andersson, 2007; Baaki, Maddrell, & Stauffer, 2017; van Rooij, 2012). With more emphasis being placed on user experience design practices, more attention is being placed on *who* our learners are as opposed to generalizing the learning audience. Learner analyses and contextual analyses are complementary in that both yield data that will inform the other. Environmental analyses add an additional layer by focusing on the impact that the learner may have on the environment outside of the organization such as customers, competitors, industry, and society (Rothwell, 2005).

The Reality of Instructional Design Work and Needs Assessment

While I would love to see every instructional designer be an advocate for needs assessment and push back when clients or supervisors present need statements with no assessment validating that the identified needs warrant instruction, the reality is that most instructional designers will have a hard time arguing the need to pause a project and conduct a thorough needs assessment (Hoard, Stefaniak, Baaki, & Draper, 2019; Stefaniak et al., 2018). Needs assessments *are* conducted; but often because the client has recognized the importance of needs assessment before approaching an instructional designer to work on a project. It is also important to note that a needs assessment is only as good as the data that is collected.

Table 3

Needs statements and further inquiries

Client Need Statements	**Instructional Designer Inquiries**
We *need* to design an online degree program.	How are courses currently being offered? What is the market for online instruction? What is the rationale for moving towards the development of an online degree?
We *need* a new learning management system.	How are training materials currently being stored? What features are used in the existing LMS? What features are needed? How are the instructors and students currently using the LMS?
We *need* to design a safety course for incoming employees.	What do incoming employees need to know about safety upon starting a new job? What incident(s) occurred that suggests there is an immediate need to create a safety course? What other training courses are incoming employees expected to complete?

What does this mean for the instructional designer? Recognizing that the absence of a thorough needs assessment is a common issue in our field, there are strategies that instructional designers can employ to gather additional data and information relevant to the project they have been assigned.

If a client has decided to conduct a needs assessment, it is important for the instructional designer to participate in framing the needs by asking appropriate questions. Table 3 provides an overview of examples of needs statements and questions an instructional designer can ask to gain further clarification of the situation. Like most projects, there are varying degrees of complexity an instructional designer can delve into when addressing needs assessment (Rossett, 1999). The amount of time and resources that an instructional designer can apply towards gathering additional data for a project will ultimately determine the scalability of the level of analysis that is completed (Stefaniak, 2018; Tessmer, 1990).

Just because a client or a supervisor may not allocate the time or funding needed to support a needs assessment, that does not mean that the instructional designer has to abandon the idea altogether. At the very least, there are key components that an instructional designer should address during an initial intake meeting with the client or kick-off meeting with the instructional design team. Table 4 provides examples of different steps instructional designers can take if they were to scale a needs assessment project.

Table 4

Scalability of instructional design needs assessments

Level of Scale	Tasks
Low (1–2 weeks)	• Review existing training materials. • Review documents explaining job processes. • Meet with a subject matter expert (in the organization) to provide guidance on content that should be emphasized in the instructional product. • Obtain an overview of the learning audience by the client.
Medium (1 month)	• Review existing training materials. • Conduct observations of employees performing job tasks. • Update existing task analyses. • Meet with individuals that represent multiple levels of authority within the organization related to the instructional project. • Obtain an overview of the learning audience by the client. •
High (several months)	• Review existing training materials. • Review strategic planning documents. • Meet with individuals that represent multiple levels of authority within the organization. • Conduct observations of employees performing job tasks. • Update existing task analyses. • Conduct interviews and/or focus groups to understand factors that are inhibiting the transfer of learning. • Triangulate information from multiple sources to understand patterns contributing to or inhibiting employee/learner performance on the job.

Table 5 provides an example of a form that instructional designers can use to gather the data they need to ensure their instructional design work is contextually relevant to the learners' needs. This form is not meant to be an exhaustive list of questions instructional designers should ask at the beginning of a project; rather, it is intended to help instructional designers spark conversation with their client about the contextual factors and needs of the project that should be addressed throughout the design. Depending on the information provided in the intake form, instructional designers will decide whether a detailed task analysis is required to understand specific tasks expected of the learning audience.

Table 5

An example of an instructional design intake form

INSTRUCTIONAL DESIGN PROJECT INTAKE FORM	
Date:	**Client:**
Instructional Designer:	**Project Name:**
PROJECT OVERVIEW	
1. What is the purpose of the project (instructional need)? 2. What is the scope of the project? 3. Learning platform (i.e., face-to-face, blended, online) 4. Overarching course goal 5. Learning objectives 6. What level of importance is the training? (i.e., severe, moderate, mild)	
LEARNING AUDIENCE	
1. Who is the intended learning audience? 2. What are the learners' experiences with the project topic? 3. What challenges do learners typically experience with this topic? 4. What are the learners' overall attitudes toward training? 5. What information will the instructional designer have access to regarding the learning audience? (i.e., job observations, meetings with learners, work products, interviews, etc.)	
INSTRUCTIONAL ENVIRONMENT	
1. How will the instruction be delivered? 2. How will learners access the material? 3. What is the length of the course? 4. What are the learners' roles during instruction? 5. What is the instructor's role during instruction? 6. What types of assessment need to be included in the instruction?	
TRANSFER (APPLICATION CONTEXT)	
1. How soon after the training will learners apply their newly acquired skills? 2. What are the anticipated challenges with applying these new skills in a real-world environment? 3. What resources are available to support learners during this transfer phase (i.e., job aids)? 4. Who is responsible for monitoring learners with transference?	
EVALUATION	
1. How and when will the instructional training be evaluated for effectiveness? 2. Who will be responsible for conducting an evaluation? 3. What methods of evaluation will be used to determine the efficiency and effectiveness of the instruction?	
OTHER COMMENTS	

Conclusion

To adhere to Richey et al.'s (2011) definition of instructional design encompassing the facilitation of learning, instructional designers must task themselves with gathering as much information as they can to understand the contexts that their learners will experience (i.e. the learning and transfer contexts). Not only is it necessary for the instructional designer to understand the instructional environment, but they must also have insight into how their learners will apply the knowledge obtained from instruction and apply it to a real-world setting. The purpose of this chapter is to provide instructional designers with an introduction to the potential that needs assessment offers instructional designers and provide some strategies and tools that can be applied to an instructional design project regardless of the context.

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1.5: Conducting A Learner Analysis

Conducting a Learner Analysis

José Fulgencio & Tutaleni I. Asino

As mentioned at the outset: designing a course that best fits the needs of learners requires both an understanding of who the learners are, as well as actual efforts to evaluate and understand their needs. The chapter reviewed both conceptual issues that concern learner analysis as well as practical approaches you can use to analyze actual learner needs.

Because of this, learner analysis is an important aspect of the instructional design process. It is important to remember that learners are not empty containers in which knowledge can simply be poured. They have experiences through which they understand the world and through which they will understand or evaluate the instruction. In this way, learning is a process that involves change in knowledge; it is not something that is done to learners but instead something that learners do themselves (Ambrose et al., 2010). Hence, "consideration of the learners' prior knowledge, abilities, points of view, and perceived needs are an important part of a learner analysis process" (Brown & Green, 2015, p.73).

Although various scholars may use different verbiage, broadly, a learner analysis can be understood as the process of identifying critical aspects of the learner, including demographics, prior knowledge, and social needs (Adams Becker et al., 2014), and "is characterized as an iterative process that informs vital instructional design decisions from front-end analysis to evaluation" (Saxena, 2011, p. 94) by customizing the instruction to the previous knowledge of each individual learner so that the learner controls their own learning and has a deeper understanding of the classroom material (Reigeluth & Carr-Chellman, 2009). For example, an instructor teaching a biology master's program can expect learners to have a solid foundational knowledge of biology. At an undergraduate level however, the instructor may expect students to have a somewhat limited understanding of biology. The instructor will also have to take into consideration the learner group characteristics such as first-generation students, international students, adult learners, and learners with accessibility needs (e.g. requiring note-taking accommodations and extra time on exams), all of which may influence teaching of content, distribution of content, and pace of content distribution in the classroom. Another characteristic is the learning preferences within the group of learners, such as whether they prefer and respond better to small group learning, hands-on experiences, or case studies.

Much has been written about learner analysis, in terms of definition and the process by which it can be accomplished. However, regardless of the definition advanced, what is important to discern is that through a learner analysis, the learner contributes to the instructional design of the course and miscommunications between the learner, instructor, and course goals are identified (Adams Becker, 2014; Dick et al., 2009; Jonassen et al., 1999; Fink, 2013). A learner analysis ensures that the learner benefits from a productive learning environment that can leave a lasting impact on their lifelong learning (Adams Becker et al., 2014; Dick et al., 2009; Jonassen et al., 1999; Fink, 2013).

The focus of this chapter is on how to conduct a learner analysis. This process often includes identifying learners' characteristics, their prior knowledge, and their demographics, all of which are key factors to consider when designing a learning environment (Adams Becker et al., 2014; Dick et al., 2009; Jonassen et al., 1999; Fink, 2013). Demographics include the environment in which the learner lives and works, ethnicity, accessibility to technology, and educational background. Other factors—such as motivation, personal learning style, and access to content—also play a role in how individuals learn (Adams Becker et al., 2014; Dick et al., 2009; Jonassen et al., 1999; Fink, 2013).

The chapter begins with explaining the components of a learner analysis, describing reasons for a learner analysis, and providing a learner analysis worksheet. The next section of the chapter explains an area that the authors believe is often not discussed when writing about learner analysis: the ethics of working with learners, developing personas, and experience mapping. The last section of the chapter includes a learner analysis design project to enable the reader to put into practice some of what is covered in the chapter.

Components of a Learner Analysis

When designing learning environments, there needs to be a birds-eye view of the entire process from who the learner is, the environment, background of the learner, and the goal of the learning environment. An educator cannot make assumptions about learners based on the educator’s experience. The following are key factors of the learner analysis to consider.

1. Learner Characteristics

Understanding the characteristics of learners can help shape the design of the course. For example, if your class is an executive-level course for Fortune 500 high-level officers, you may expect learners with professional experience, and who have different goals for learning and their careers, which is different from a class of undergraduate students who have little to no work experience.

In examining factors of learner characteristics, these are key questions to think about (Adams Becker et al., 2014; Dick et al., 2009; Jonassen et al., 1999; Fink, 2013):

- Who are the learners?
- What personal characteristics do these learners possess?
- What are the dimensions of the learner?
- What contributes to the reason for learning about the topic?
- What is the reason for enrolling in the course?
- What are the student’s learning styles?
- What is it about the topic that motivates the learner?

2. Prior Knowledge

Time is a finite resource for most people, so instructional time should not be wasted covering material that learners already know, but instead building on their prior knowledge. Students’ prior knowledge influences how they interpret and filter new information given in the classroom (Ambrose et al., 2010; Cordova et al., 2014; Dochy et al., 2002; Umanath & Marsh, 2014).

In examining factors of prior knowledge, there are key questions to think about:

- What do learners already know?
- How might this information contribute to the content and order of what you teach?

3. Demographics

Understanding who the learners are and their demographics can directly impact the instructional material. It is important, for example, not to include instructional material that may be culturally insensitive or that has no connection to students. This is particularly important when using media such as film that could be considered historic to one group and offensive to another. Culture is integral to learning and plays a central role in “determining the learning preferences, styles, approaches and experiences of learners” (Young 2014, p. 350). It is worth noting that culture can also relate to organisational cultures. For example, using learning materials or illustrations that promote collaboration amongst employees in an organization that does not have or prioritize such a practice, may run contrary to the typically established culture.

In examining factors of demographics, key questions to think about are:

- Where are the learners coming from in terms of their education level, ethnicity, demographic, hobbies, area of study, grade level?
- Why are these demographics important for the material you will be teaching?

4. Access to Technology

In education, it is important to make sure that all learners have access to the educational material. As technology becomes a necessity to participate in learning opportunities, it is also important to gauge whether or not students have access to technology. Material should be flexible, but you can imagine if you are assigning work through an app that is only available for Apple devices, how this can affect learners who own Android phones. Thus, make sure that throughout the course, educational material is universally accessible.

Sometimes issues of access can be tricky or surprising. For example, if there is only one computer, or limited internet bandwidth, but two parents and two children all need to access it for their job or homework, then there is not sufficient access. Similarly, the computer or internet access may be too old to play the instructional multimedia in a module. Thus, it is important to look beyond the statistics to truly understand the level of access.

In examining factors of access, key questions to think about are:

- How accessible is technology to every learner in my class?
- Are learning materials universally accessible for individuals with disabilities?
- If access is not universal, how can I adapt my course curriculum to include all learners?

Put Your Skills to Use: The Learner Analysis Worksheet

When conducting a learner analysis, a collection of learner information will help develop a positive learning environment. The Learner Analysis Worksheet below is one way to collect and record key factors and general information about the learners, using information available from student enrollment data. This worksheet can be adapted for designing instruction for various learning environments. Student information is often provided when a student enrolls, and academic advisors or student enrollment professionals may also be able to share this information with you. Another way to gather demographic information is to speak with the colleagues in your department. Who are the students who usually register for this course?

For example, a community college will have higher enrollment of non-traditional and first-generation students who are older than 25 and who are full-time workers compared to the conventional student body of 18 to 22-year-olds at a traditional institution who are part-time workers. The more information you can gather for the Learner Analysis Worksheet in Table 1, the more equipped you will be in designing the best learning environment for your learners.

Table 1

Learner Analysis Worksheet

Demographic Characteristics	Learner Details
Size of target audience	
Are there any subgroups that may participate?	
Age ranges	
Educational/grade level, or academic program year. How long have they been out of an educational setting?	
Gender breakdown	
Cultural backgrounds	
Primary language	
Employment status	
Socioeconomic status	
Traditional/non-traditional/first generation learners?	
Geographic location(s)	
Internet connectivity?	
Access to technology?	

Note. Adapted from https://en.wikiversity.org/wiki/Instructional_design/Learner_analysis/what_when_why

Ethics of Working With Learners

There is now an ever-increasing amount of information on students available on the internet broadly, and specifically through learning management systems and social media that institutions and designers can access. Data on learners includes but is not limited to: personal information, enrollment information, academic information, and other data collected by educational institutions. What was once kept private between the learner and institution on paper can no longer be assumed as safe. Records which are now held in digital format are vulnerable to hackers and are enticing to outside agencies that are seeking to monetize the data. How, then, do institutions assure ethical use of learners' data that may be needed or used for learner analysis? How much data is reasonable to share? If institutions are asking learners to be ethical in their academic assignments, shouldn't institutions do the same when it comes to working with learners? This section covers professional expectations regarding ethical conduct towards learners.

Professional Expectations

In the context of conducting a learner analysis, a professional is expected to be "committed to the needs and best interests of their clients who are basically their learners" (Wainaina et al., 2015, p. 68). There are various code of conducts from which one can draw guidance for ethical practice as most professional organizations have codes of conduct or ethics. An example is the Association of Educational and Communication Technology (AECT), which is available at (https://edtechbooks.org/-RXIX) and aims to aid all members of AECT both individually and collectively in maintaining a high level of professional conduct. However, it is critical to know that just because one adheres to a code of ethics, it does not mean there will never be conflict. What is unfortunately inherent in all human relationships is a level of conflict, even when one has good intentions. So the question then is what happens when conflicts or perceived ethical violation occurs especially when a designer is engaged in collecting data needed for learner analysis? There are various approaches, but here we suggest the following ethical framework developed by Mathur and Corley (2014) which suggests considerations and questions to ask:

- Fact-finding – Most conflicts are related to communication or lack thereof. Hence one of the first steps is to engage in fact-finding exercises. What are the facts? What is known and what is not known?
- Who is involved – who are the people that care about this case or incident? What has been (mis)communicated? Who are the individuals involved?
- What is the conflict? – Is the conflict about the frameworks being used? If so, what are those frameworks and what is conflicting? If the conflicts concern the values, morals, or policies, establish what those are and what needs to be adhered to.
- Potential consequences to actions — What are some of the possible consequences for any actions taken to solve the dilemma? How would the people involved like to be treated? What is the role of the designer in solving the conflict (whether or not the designer is involved in causing this conflict)?
- Reflection – Lastly, reflect on the actions taken. What are the repercussions, if any, to the actions taken from the difficulty?

Educators have a responsibility entrusted upon them when educating learners. The duties include but are not limited to, creating a safe environment and being professional not just in virtual space but also in digital space. When educators neglect their responsibility to be professional and ethical (an expectation that we often have for students), this can be detrimental to learners.

Developing Personas in Learner Analysis

It is often stated that if you want to know a person, you must walk in their shoes. This idiom captures the goal of a learner analysis by helping us figuratively walk in someone's shoes and come to understand them more deeply. One way to do this is through personas. Personas are fictional characters that embrace the needs and goals of a real user or group of learners (Faily & Flechais, 2011). Personas help generate an understanding of learners and what their key attributes are that learning designers need to know for their designs (Dam & Siang, 2019). Personas may be fictional characters, but they are built based on real learner analysis data and thus embrace the needs and goals of real learners.

Effective personas do five things (from the following website: https://edtechbooks.org/-bXV):

1. Represent the majority of learners
2. Focus on the major needs of the learner
3. Provide clear understanding of the learners' expectations
4. Provide an aid to uncovering universal features
5. Describe real individuals

To develop your own persona, the following chart in Table 2 can be helpful.

Table 2

Questions to Ask During Persona Development

Objective	Questions
Define the purpose/vision of the course	What is the purpose of the course? What are the goals of the course?
Describe the user	Personal What is the age of the learner? What is the gender of the learner? What is the highest level of education this learner has received? Professional How much work experience does your learner have? What is your learner's professional background? Why will the learner take the course? Technical What technological devices does the learner use on a regular basis? What software and/or applications does the learner use on a regular basis? Through what technological device does your user primarily access the web for information?
User motivation	What is the learner motivated by? What are the learner's needs?

Note. From the U.S. Government usability website (U.S. Department of Health & Human Services, 2020) "questions to ask during persona development" chart.

When developing your persona, remember to organize the information in an easy-to-read logical format, and make it as visual as possible to convey the greatest sense of the "humanness" of the learners. Key pieces of information to include are the persona group (i.e. learner), fictional name, personal demographics, goals and tasks for the course, physical/social/technical environment, and a casual picture representing their learning environment.

Following in Figures 1–4 are some examples that provide an illustration of worksheets and examples for creating personas.

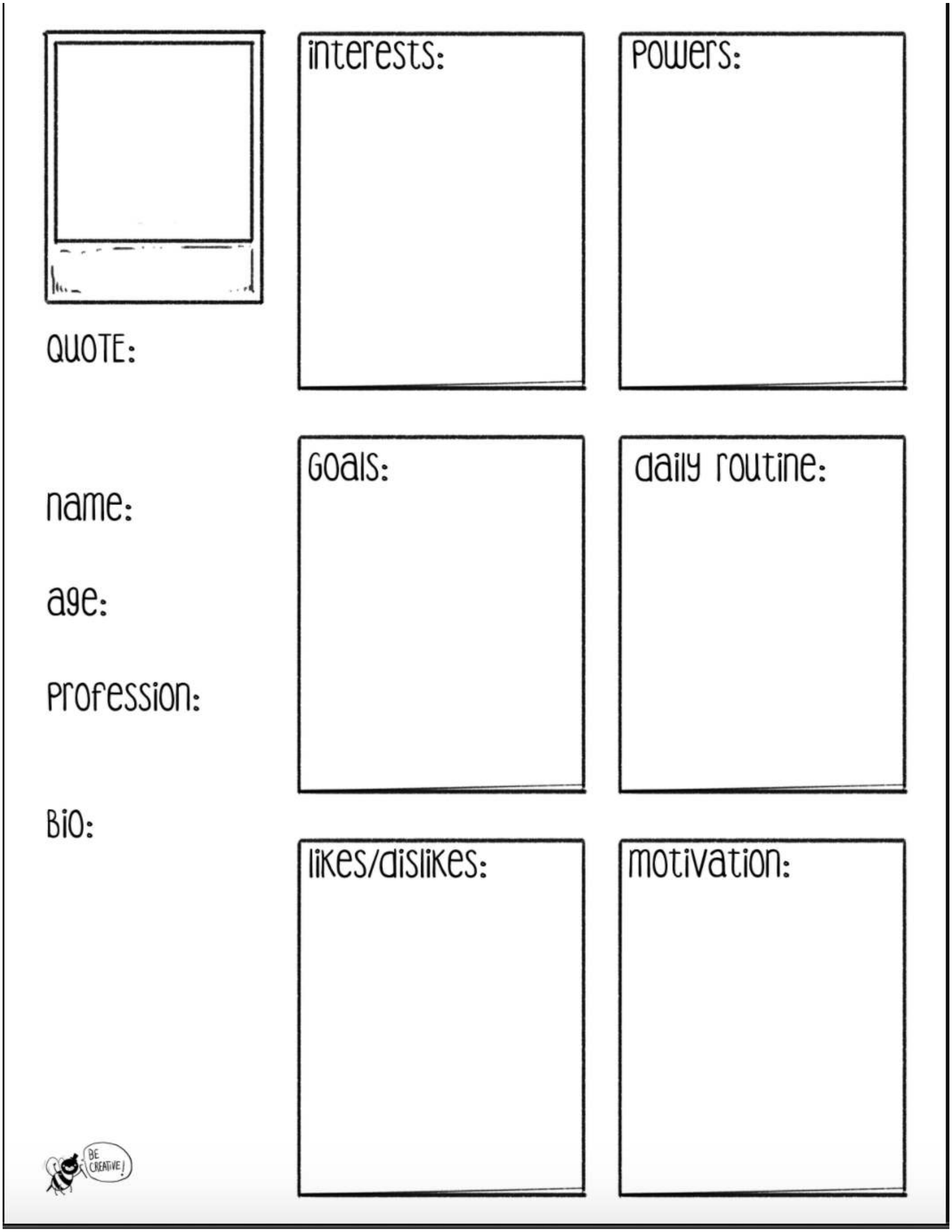

Figure 1.5.1: *Persona Worksheet 1*

Note. Persona worksheet from Open Design Kit https://edtechbooks.org/-oyBd

NAME

Use a realistic name. Don't use names of colleagues.

DESCRIPTOR

What type of persona is it. Describe the most prominent differentiator.

Just sketch your first impression!

EDUCATED GUESS

QUOTE

Capture the essence to one or two points that could come out of the persona's own mouth - so to speak.

WHO IS IT ?

Sketch the personal profile, age, location, job title, what kind of person is it? Think about one or more personas from segmentation.

ASPIRATIONAL

WHAT GOALS?

Wat is the supreme motivator? What are (latent) needs and desires?

WHAT ATTITUDE?

What is the point of view? What is the expectation, perception of the service, company or brand. What motivates the persona to go to the website, into the shop, or use the service.

ACTUAL

WHICH BEHAVIOUR?

What does she do? Tell stories about her behaviour while using a service, product or site. Channel usage for various needs (internet, visiting comparable sites, mobile, social media). What works well, what are the frustrations, what is stopping her from choosing a function, service or product?

Which Trends, mindstyles or other indicators are applicable for this persona?

How important are functional, emotional, expressive benefits.

Fast or slow decision maker? Why, how can you tell?

Decisions made on facts or emotion?

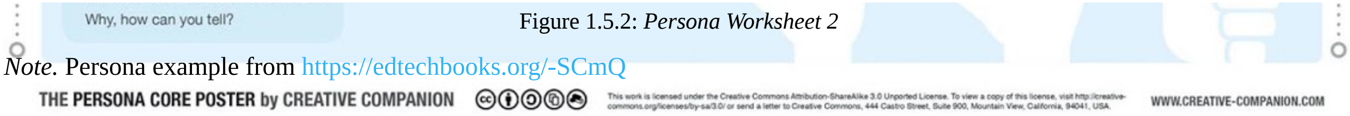

Figure 1.5.2: *Persona Worksheet 2*

Note. Persona example from https://edtechbooks.org/-SCmQ

Figure 1.5.3: *Persona Example 1*

Note. Persona example from https://edtechbooks.org/-GLf

Sam Nyugen

COLLEGE STUDENT

Personal Profile

- Age: 25
- Pronouns: she, her
- Lives less than 50 miles from campus

Quote

"I'm excited and super anxious about navigating the university and paying for my education."

Work History & Workload

- Works full time

Education

- AS degree - general studies
- Currently completing BS degree

Goals

- Personal experience with immigrant parents who arrived in 1992 drives her to succeed
- Wants to run for office after completing her degree in political science
- Willing to explore law school options to satisfy parental expectations

Personal Details

- Gets about 6 hours of sleep per night

Financial Information

- Cost is a major factor in her choice of school and program
- She has taken time out to work and save money to finish her degree

Family Background

- Parents are supportive of her getting a bachelor's degree but are not supportive of career aspirations
- First-generation college student

Attitudes & Beliefs

- Has a hard time navigating the resources available and some of the expectations, such as "office hours"

Social Support Structure

- Lives off campus with family
- Struggles to feel a sense of belonging in college

Figure 1.5.4: *Persona Example 2*

Note. Persona example from https://edtechbooks.org/-GLf

Personas are a helpful way for designers to create a more engaging, more productive, and more effective educational experience for learners. Follow the guidelines provided in Table 2 when creating personas and be flexible and open to new information, as the personas may not be the same from start to finish.

Understanding Learners Through Experience Mapping

The popular adage of "the customer is always right," is often used to emphasize the importance of providing excellent customer service (Samson et al., 2017). While educational institutions are different from traditional service industries, they can still benefit from paying attention to learners' experiences. An experience map is a strategic tool that captures the journey of customers from point A to point B and generalizes critical insights into learner interactions that occur across such experiences. The journey captured in experience mapping, which is adapted from Schauer (2013), is split into four characteristics that generalize the experience of a learner:

1. uncover the truth
2. chart the course
3. tell the story
4. use the map

The first step, uncover the truth, includes studying the learner's behavior and interactions across channels and touchpoints. Channels are the interactions a person has with a product or service. Touchpoints are the interactions of a person with an agent or artifact of an organization. In the first part of the experience mapping, a designer finds various data and insights relevant to the experiences in the mapping process, including actually talking to the learners. Previous learner surveys and evaluations of the course or program are a good data source to begin. In order for the map to be believable, it needs to tell an authentic story and provide strong insights.

The second step, chart the course, collects the takeaways from learners to create actionable results. After you have collected data, obtained key aspects of the learner's journey, and obtained quotes from learners, it is time for the third characteristic: tell the story visually in a way that creates empathy and understanding. The goal of this characteristic is for the experience map to stand on its own, inspire new ideas, and foster strategy decisions.

The last step is to show the map to stakeholders that have insights and interactions with learners. Telling the story to stakeholders provides insights into the learner's experiences. The experience must go beyond the physical location and create an experience of usability such as identity, familiarization, memorability, and satisfaction (Ghani et al., 2016). Failure to meet the learner's needs can result in loss of interest, bad reviews, and challenges to getting the learners to accomplish the task.

As with personas, there are a number of examples of what format an experience map might take. Most are considered copyrighted and proprietary to the organizations developing them and so cannot be included here, but you can find examples of experience maps at the following sites (each also provides some practical tips for developing your own experience maps):

- What is a Customer Experience Map? How to Create an Effective Customer Experience Map?
- The Ultimate Guide to Creating a Customer Experience Map

Conclusion

As we said at the outset: designing a course that best fits the needs of learners requires both an understanding of who the learners are, as well as actual efforts to evaluate and understand their needs. We reviewed both conceptual issues that concern learner analysis as well as practical approaches you can use to analyze actual learner needs.

At this point, the best the authors can offer is to wish you luck! Your learner analysis activities will lay a strong foundation for the rest of your project, and it is worth the time it will take to set your project off right.

Practice: Learner Analysis Design Project

This learner analysis design exercise provides an opportunity to apply knowledge gained from this chapter. Imagine, you have been hired by a company based in New York City to design a Security Awareness course that teaches newly hired and senior employees to identify and prevent security breaches. The course focuses on teaching the company's staff the different types of security awareness, email and phishing attacks, malware, ransomware, social media awareness, and password security.

For your project you must do the following:

1. Complete a full learner analysis worksheet.
2. Complete a learner-centered design process based on the description of the course.
3. Develop two learner personas for the course.

Upon completing the project, share and discuss with others how you completed the learner analysis worksheet, how you developed the user-centered design and what resources were used to create the personas.

This exercise is meant to help you consider learner analysis from a practical perspective. However, realize that every company has their own style of course design for their employees, and their own methods for conducting learner analysis. While the principles discussed in this chapter should remain the same, the ways they are applied within any instructional design organization may vary. Despite this variety of approaches, our goals remain the same: all instructional designers agree on the important need to understand and empathize with learners in order to create instruction that best meets their needs.

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CHAPTER OVERVIEW

2: Exploring

2.1: Problem Framing

Problem Framing

Vanessa Svihla

Is design a problem solving process? To answer "No" suggests that designers do not produce solutions to design problems. However, in order to produce such solutions, designers must first frame—and typically reframe—the problem. Understanding this can help newcomers recognize the need for a different approach, rather than jumping straight to solutions. What does it mean to frame a problem? In this chapter, detailed below, I define it as follows:

Problem framing: To take ownership of and iteratively define what the problem really is, decide what should be included and excluded, and decide how to proceed in solving it.

To understand what problem framing looks like in practice, this chapter introduces and illustrates key terms that help us speak consistently about design problems and how they differ from other problems. Vignettes highlight how designers direct their problem framing process. The chapter concludes with tools for framing problems and diagnostics for common pitfalls.

The Problem of the Problem: What Makes Design Problems Different from Other Problems?

Most of us have had abundant opportunities to solve problems, beginning in elementary school. But these problems were predominantly well-structured (Jonassen, 2000), meaning there was a single correct answer and the instructor knew what that answer was. Repeated experiences with such problems can lead us to privilege accuracy and efficiency over spending time dwelling with the problem. And surely getting to the right answer quickly is valuable in many situations. But design problems differ—there is not a single right answer or even a best way to come to a solution.

As a result, when tackling these ill-structured problems we must first frame them (Jonassen, 2000). Framing a problem involves defining the problem and bounding it, then deciding what to include and exclude and how to proceed (Dorst & Cross, 2001; Schön, 1983). This, in turn, relies on activities described in other chapters in this text, including the following: (a) gathering information about the task, learners, and context; (b) generating tentative ideas about the problem and solution; (c) making and revising decisions about the problem (often influenced by precedent); and (d) evaluating tentative ideas in light of design requirements and learner needs. Some therefore treat problem framing as a higher-level category that includes all of these activities. Others treat problem framing as an activity threaded through the design process. Regardless, problem framing is the process by which designers take ownership of a problem. This means that two designers, given identical design briefs, would not only produce different solutions, but would have solved different problems (see Figure 1.; cf., Dorst, 2003; Harfield, 2007).

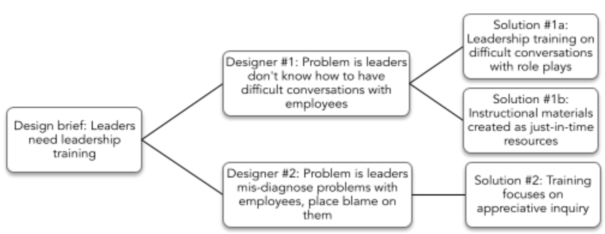

Figure 2.1.1: *An Example of How the Same Initial Problem may be Framed and Solved Differently*

To see how this might play out, try finding multiple problems in the scenarios below (Table 1). Can you frame the problem as an instructional design problem? Can you also frame the problem not as an instructional problem?

Once you have framed possible problems in the scenarios, consider the ill-structuredness, complexity, and domain specificity of each problem (Jonassen, 2000). Each problem you framed may differ in these dimensions (Figure 2):

- Structure refers to the degree to which a problem has a single solution and most-efficient solution path (well-structured) or many possible solutions and solution paths (ill-structured). Problems are sometimes presented to instructional designers as well-structured, but design problems are ill-structured by definition.
- Complexity refers to the number of variables involved and how interrelated they are. Most—but not all—design problems are complex. This characteristic can be tricky to assess simply because we use the term informally as a synonym for "difficult."

- Domain specificity refers to whether domain general strategies would suffice; Jonassen (2000) described domain specific problems in terms of both “abstract” and “situated,” knowledge, generally placing such knowledge in formal domains. Almost all ID problems are domain specific.

Table 1

Framing Both Instructional Design and Other Problems

Scenario 1	Management at a chemical plant identifies that the most expensive chemical is not typically used efficiently, unless it is used under specific conditions. They contract an instructional designer to create a job aid to ensure the chemical reactor is operated optimally. The reactor includes 15 stages, six chemicals, and gauges for setting pressure, temperature, and rate at each stage. Data suggest workers tend to apply settings from a similar reactor, resulting in waste.
Scenario 2	Beth is hired by a dietician to create instructional materials—printed handouts—for parents/guardians of children with special dietary needs based on a specific disability. The dietician provides published, effective dietary standards based on the specific disability and shares that some of the terms in the standards are hard for families to understand. The production budget is small and timeline tight. The organization provides a set of images they previously created and want used in the handouts.
Scenario 3	A university’s instructional technologies committee selects and implements a learning management system (LMS), heavily guided by their own expertise, along with issues related to copyright law, tight institutional budget concerns, and interfacing with systems for registration and grading. As a consequence, instructional designers are hired primarily based on their capacity to provide technical support for the cumbersome, difficult to use LMS. To ensure they can support the faculty, they create a highly structured course shell.
Scenario 4	A district purchases science kits and curricula for teachers in Phoenix, AZ. While the resources seem useful, the teachers realize there are issues. For instance, the curriculum teaches "Fall is when the leaves change colors," but the teachers know their students have never seen leaves change color. They meet during a cross-school professional development session to address these issues, guided by curriculum leads who graduated from an instructional design program.
Scenario 5	An instructional designer is tasked with migrating courses from a decommissioned LMS to a newly adopted one. None of the content or sequencing is to be changed. The two LMSs differ greatly in many ways (e.g., how objects are connected to courses, the order in which settings must be selected, and the number of features available).

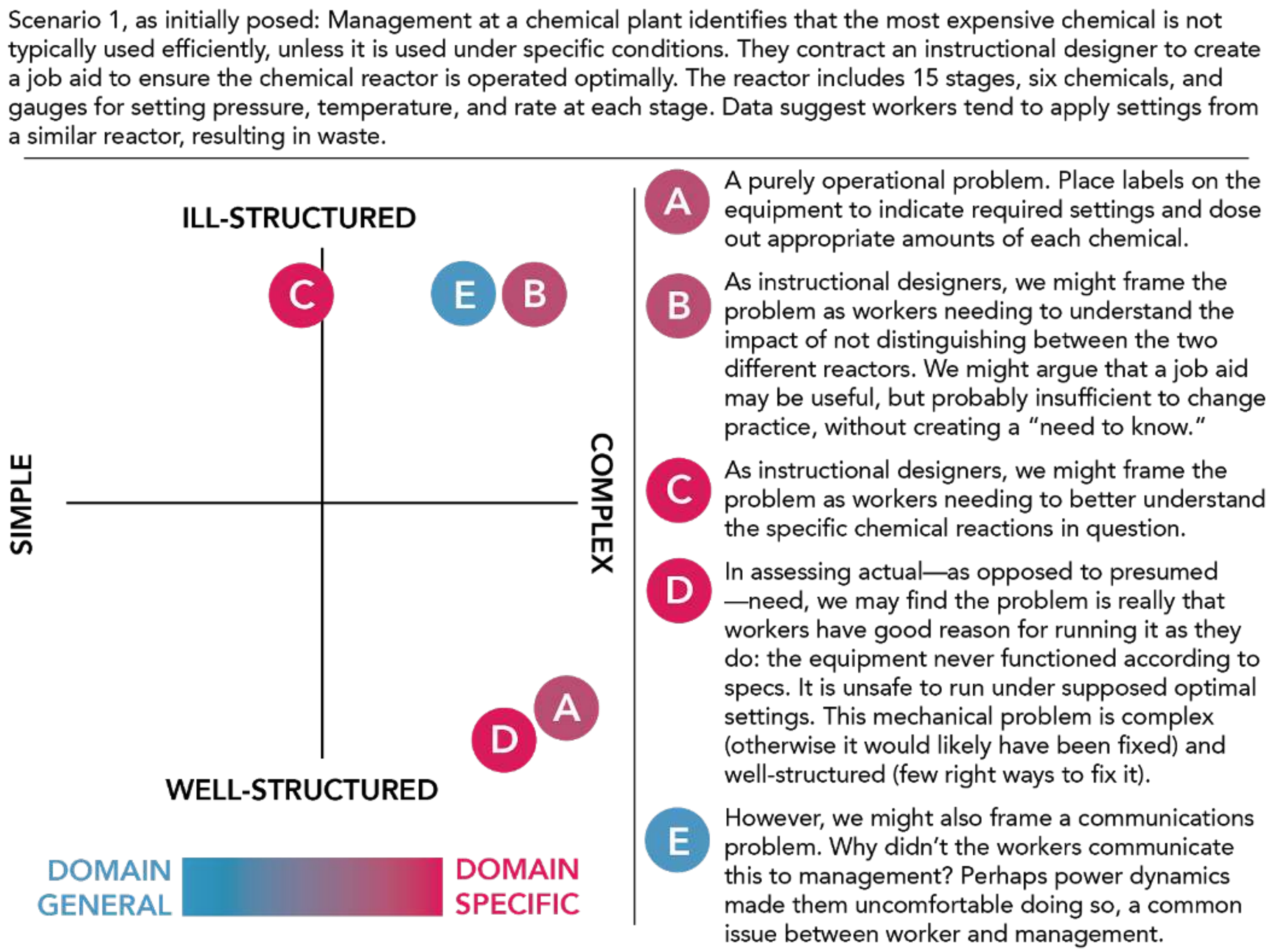

Figure 2.1.2: *Problem Structure, Complexity, and Domain Specificity Differentiate Between Problem Types*

Note. Design problems are always ill-structured, and usually complex and domain specific. The letters refer to the problems above related to scenario 1 in Table 1.

How Do Designers Frame Problems?

Problem framing can occur through both overt and covert activities. Some activities and deliverables make the problem visible, but other problem framing work happens through talk or individual thinking. Covert framing activities involve abductive reasoning—filling in gaps in knowledge (e.g., Kolko, 2010). This kind of thinking is heavily influenced by past precedent, and designers contend with the salience and limitations of their own experience.

From their first contact with the problem, designers consider whether the problem seems like one encountered previously and how the current problem seems to differ from past precedent.

How might you convey to a client why framing the problem is important?

Their framing of the problem is visible in the project objectives and learning goals they set. As they seek to understand and explore, researching the task, context, learners, and possibly other precedents, they reframe the problem and consider whether the client will accept their reframing, which is made visible in learning objectives and problem statements. Prototypes may likewise reveal their problem framing. Evaluation of a prototype's feasibility, desirability, and ability to meet identified learning needs may lead to further reframing.

Clients often undervalue and underestimate the time and effort needed to frame the problem. Clients may request a specific deliverable or solution, yet may not have a deep understanding of the actual needs. Making a value proposition can sometimes help.

This means communicating clearly about what problem framing is and why it can benefit the organization by preventing ineffective training.

What Does It Mean to Have Agency to Frame a Design Problem?

Experienced designers—regardless of discipline—know to direct their framing of the problem. They make consequential decisions that lead them to new understandings and reframings of the problem. This “framing agency” is a hallmark of design in which designers rely on information they gather and on their past precedent—as described in other chapters of this volume. What does framing agency look like in practice?

In the case below (Figure 3) a team faces some challenges in part because not all members understand that they need to frame the problem; this is visible in their expectations about their roles and in their talk. In the vignettes, words are highlighted to draw attention to ways the team members are talking that help us notice whether they are framing the problem or not. Designers often share framing agency with other designers, with envisioned stakeholders, and sometimes even with the materials in their designs. In ID, this happens when they reference the learning and transfer contexts, and the modes of learning (e.g., face-to-face, online, etc.) to justify decisions. Another indicator of framing agency is staying tentative, staying with the problem. Using verbs that show possible actions (e.g., could, might, etc.) and hedge words (e.g., maybe, kind of, etc.) invites both the designer and others to revise their thinking about the problem. In contrast, using verbs that show a lack of control (have to, need to, etc.) over the situation tends to shut down problem framing, unless the verb refers to a design requirement (like Yen’s use on “need to” in vignette 2).

Read through the vignettes in figure 3 and answer the following questions:

- Who treats the problem as not needing to be framed?
- How does the instructional designer encourage them to frame the problem?
- Who else shows framing agency?

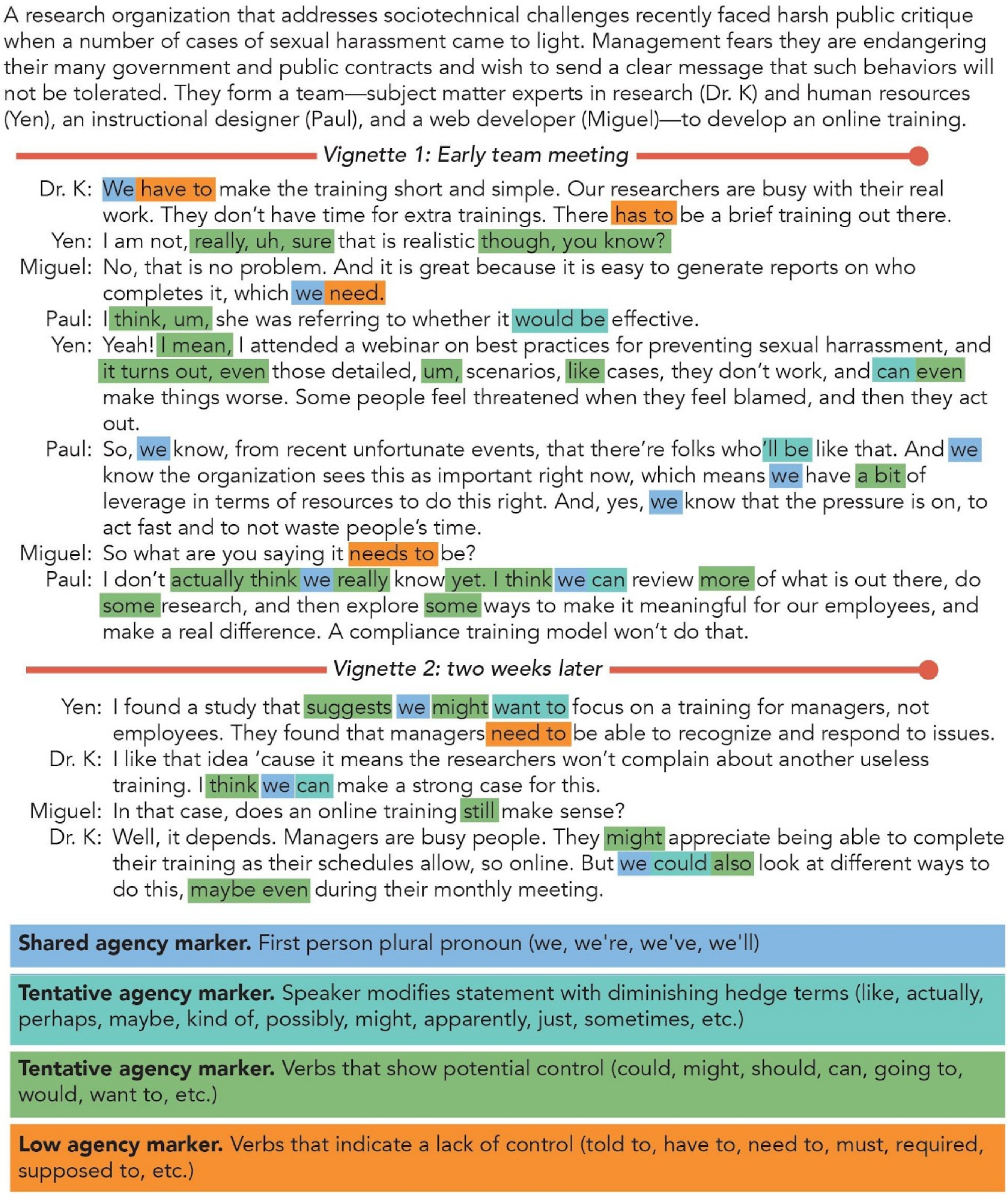

Figure 2.1.3: *Vignettes From a Design Team: Who Shows Framing Agency? Who Does Not?*

If you are on a team that is resisting framing the problem, how will you communicate with your team? Using the key in Figure 3, how can you use tentative language to invite them to frame the problem with you? How will you help them understand the importance of framing the problem?

Learning to notice how you talk with your team may help you diagnose whether or not you are framing the problem. When someone sounds tentative, consider it an invitation to engage in framing with them. Try to avoid no-control talk that shuts down problem framing.

What Tools Help Designers Frame Problems?

Mapping unknowns, assumptions, and conjectures can help clarify the work needed to frame problems. In addition to the tools that other chapters in this text have offered, I have found the following tools help make problem frames explicit yet open to revision:

- Problem statements
- Storyboarding
- KWL charting
- Design conjecture maps
- Root cause + sphere of influence analysis

It is important to remain tentative in using these tools. Just as we saw with design talk, staying open to revision is key. For this reason, I typically use pencil and paper or whiteboards for these kinds of activities. Rather than polishing and perfecting them, staying in draft mode can help you stay open.

Problem Statements

Problem statements are concise and provide clarity about the problem frame. Your problem statement should begin with one or two sentences describing a vision of what is possible if the problem is solved. Next, describe—in one to two sentences—what the specific issues are. This should include who, what, when, where and why. Finally, in one to two sentences, describe the primary symptoms of and evidence for the problem. You should not include a solution! Expect to write your problem statement multiple times to capture changes in your understanding of the problem.

Problem Statement Worksheet

Storyboarding

Vividly depict the problem—not the solution—as a sequence of events from a particular point of view. You may hand draw this, use photos, use a graphics program, or try out one of the many free storyboard/comic strip creation websites (see Additional readings and resources). When depicting the problem, consider other points of view, and represent these in another storyboard, with thought bubbles, or as a branching storyline. Avoid depicting the solution!

KWL Charting

KWL charting is adapted from tools commonly used in project-based learning classrooms and supports learners to identify what they do and do not know, as well as what they still need to know (Ogle, 1989). This tool is useful for designers as they manage the ambiguity of the design problem. Using it frequently as a means to track progress can help teams direct their own progress in bringing information into the problem.

Table 2

Example of KWL Charting

Date	What do we know about the design problem, learner needs, and other requirements or constraints?	What precedent do we want to (or not want to) bring into the problem?	What do we want to learn about the problem and how will we learn it?

Design Conjecture Maps

Design conjecture maps are based in tools like logic models and design-based research conjecture maps (Sandoval, 2014). They help designers coherently link the task to learning objectives and to their design ideas. First, place the learning objectives on the same page as the task analysis, then make links between them. Second, after generating tentative ideas, try connecting these to the task analysis and learning objectives using yarn or string. Third, as you begin to develop more solid designs, try connecting these back to the task analysis and learning objectives.

Design Conjecture Mapping

Root Cause Analysis

Root cause analysis techniques, like the five whys (Ohno, 1978; Serrat, 2017), can help designers identify underlying causes rather than treating symptoms. While some use this approach to craft a linear set of causes and effects, creating a network of whys is more effective for framing problems from multiple points of view. In this way, for each problem, you should ask "Why does this happen?" and "Why else does this happen?" This results in a network of possible root causes. Pairing this analysis with sphere of influence analysis—meaning, deliberately analyzing whether each cause is within your capacity to influence the problem through instructional design—provides an opportunity to consider the feasibility and impact for any particular cause. To do this, for each cause you should consider whether it is a problem you can influence and whether it is an instructional design problem (Figure 4). Which of these causes suggest an instructional design problem?

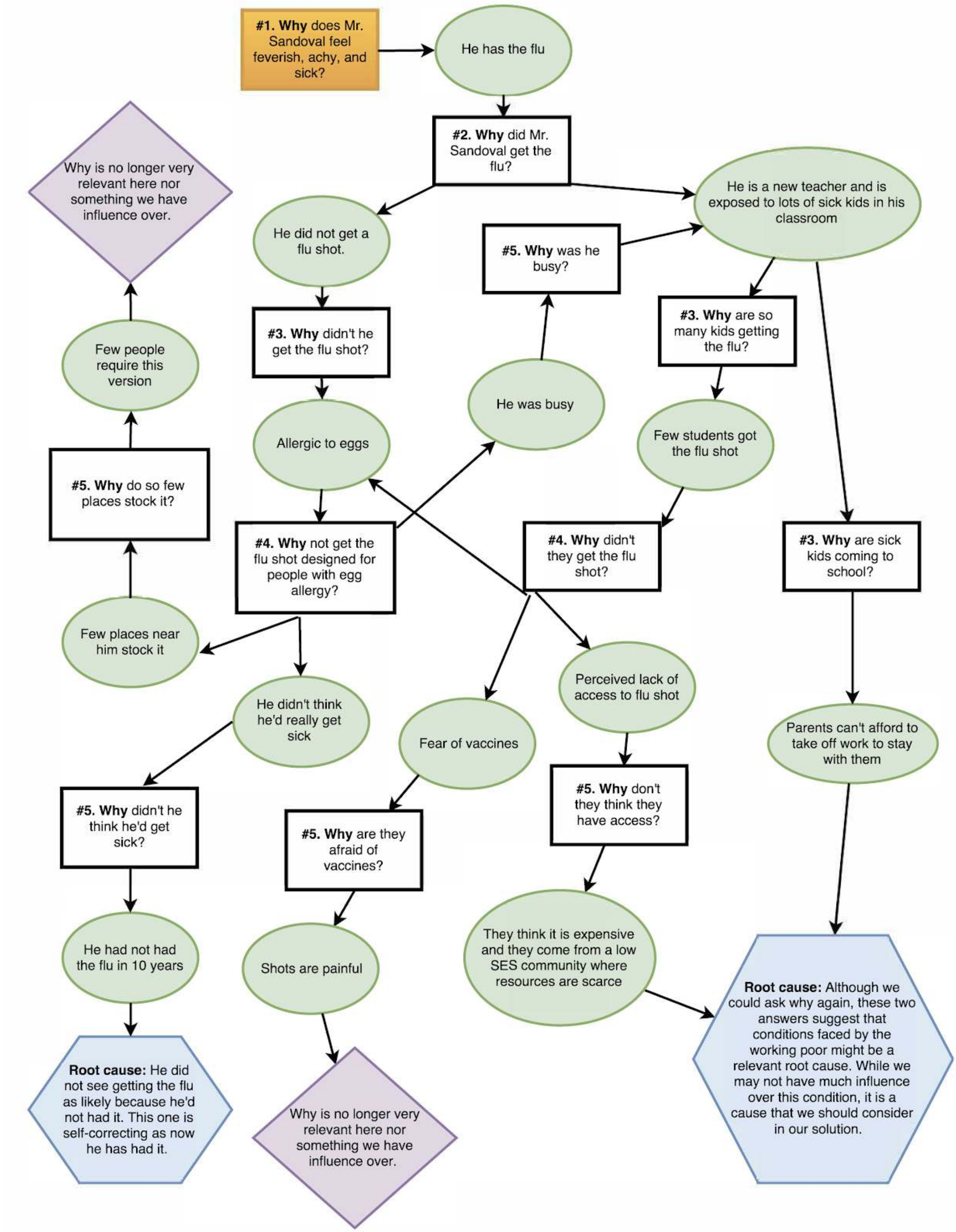

Figure 2.1.4: *Example of the Five Whys as a Network*

Do-It-Yourself

Now that we have learned about several tools, here are some specific ways you can apply these. First, you can try out the tools in the previous section using the scenarios above in Table 1. Second, if you are in a class that includes developing an instructional design, you can use these tools for your class. When teaching instructional design, I always require students to work for clients on real design projects because I have observed issues that come up without clients. Students spend as much or more time inventing fake clients as they would learning how to assess needs. Without a real client and context, it can be hard to learn to frame problems authentically, to really understand that even though you are designing something for others, by framing the problem, you are taking ownership of it. That is challenging to do if it is a problem of your own invention. Likewise, without a client, the reasons for reframing are likelier to stem from challenges you encounter than new understanding of the problem space. Of course, working with real clients can be challenging in other ways. Make sure your client understands that you have course deadlines and are just learning to design. Agree on the scope of work beforehand using a formal design brief.

Conclusion

While problem framing is typically treated as something that happens at the beginning of a design project, it is important to remember that it is a process that continues until the design is finalized. You may revisit and revise along the way, especially for short deliverables like problem statements and KWL charting. Prototypes, especially low fidelity prototypes, and evaluation often reveal the need for reframing. And, as contexts and needs change by location or over time, a solution may no longer function, and the problem can pop back open. In considering the iterative nature of problem framing, how will you use these tools to guide and document reframings of the problem?

Finally, my advice to you as new designers is this: Dwell with the problem. Wallow in some uncertainty. Stay tentative!

Additional Readings and Resources

Problem Framing Resources

- Gause, D. C., & Weinberg, G. M. (1990). Are your lights on? Dorset House.
- ISIXSIGMA
- Atlassian

Root Cause Tools

- Google Drawings
- Draw.io
- MindMeister
- Mindomo
- Coggle.it
- Edrawsoft
- MindMup
- LucidChart

Storyboarding Tools

- Storyboard That
- Pixton
- Witty Comics
- Strip Generator
- Make Beliefs Comix

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Vanessa Svihla

Vanessa Svihla profile picture

Figure 2.1.5: Dr. Vanessa Svihla is an assistant professor at the University of New Mexico with appointments in the learning sciences and engineering, and she directs the Interaction and Disciplinary Design in Educational Activity (IDDEA) Lab. Her research has been supported by the NSF and USDA, and she was selected as a 2014 National Academy of Education / Spencer Postdoctoral Scholar. Dr. Svihla received her MS (Geology) and PhD (Science Education) from The University of Texas at Austin. She served in the Peace Corps and was a post-doctoral scholar at UC Berkeley. She draws inspiration from her own practice in fashion design and instructional design, as her research focuses on how people learn when they design. She is particularly interested in how people find and frame problems, and how these activities relate to identity, agency and creativity.

2.2: Task And Content Analysis

Task and Content Analysis

Levi Posadas

Editor's Note

This is a condensed version of a larger chapter on Task Analysis that can be found at the Philosophies of Instructional Design website. It is printed here by permission of the author.

Task and/or content analysis is a set of activities that help instructional designers understand the domain (knowledge, skills, etc.) to be taught. It is a critical part of the instructional design process, solving at least three problems for the designer:

1. It defines the knowledge and skills required to solve the performance problem or alleviate a performance need. This step is crucial because most designers are working with an unfamiliar domain.
2. Because the process forces subject-matter experts to work through each individual step of what is required to solve a problem, subtle details of the knowledge and skills to be taught can be more easily identified.
3. During the process, the designer has the opportunity to view material from the learner's perspective. Using this perspective, the designer can often gain insight into appropriate instructional strategies for the materials they will ultimately create.

Task/content analysis does not begin in a vacuum. It begins with the needs or goals derived from the definition of the instructional problem. Designers should also consider what they uncovered during their learner analysis. An understanding of the learner's knowledge and background related to the instructional domain helps designers determine the beginning point for the analysis as well as the depth and breadth of analysis. The output of a task/content analysis is documentation of the content that could possibly be included in the instructional materials. This output then serves as input for developing detailed instructional objectives.

Preparing to Conduct a Task or Content Analysis

A task/content analysis can take many different forms. Designers most often work with one or more subject-matter experts (SMEs), individuals who are experts in the content area. The SME is our link to the instructional domain; we rely on this individual (or individuals) to provide accurate, detailed information for use in developing the instructional unit. Our task as designers is to help the SME elaborate on the content and tasks in a meaningful, logical manner.

In this chapter, we describe the different kinds of content structures designers might encounter in their work, and how each can require different types of strategies to analyze (and later teach) effectively. We then describe three specific techniques for analyzing these knowledge and skill structures: (a) a topic analysis well suited for defining cognitive knowledge; (b) a procedural analysis for use with psychomotor tasks, job tasks, or cognitive sequences involving a series of steps; and (c) a critical incident method, which is useful for analyzing interpersonal skills.

Content Structures

Six structures are often associated with a task/content analysis: facts, concepts, principles and rules, procedures, and interpersonal skills.

Facts

A fact is an arbitrary association between two things. For example, ‘‘The chemical symbol for potassium is K’’ is a fact that describes a relationship between potassium and K. Most topics include many facts because they are the building blocks or tools of any subject—the ‘‘vocabulary’’ the learner must master for understanding. But unless facts are arranged in structured patterns, they will be of limited use to a learner and are often quickly forgotten.

Concepts

Concepts are categories used for grouping similar or related ideas, events, or objects. For example, we might use the concept of soft drinks to categorize the aisle in the grocery store that contains colas, orange drink, root beer, and so forth. The concept of fruit would include apples, oranges, bananas, and dates, but not potatoes. We use concepts to simplify information by grouping similar ideas or objects together and assigning the grouping a name (e.g., fruit, islands, or democracies). Some concepts, such as fruit, are considered concrete concepts because we can easily show an example. Concepts such as safety, liberty, peace, and justice are abstract concepts because they are difficult to represent or illustrate.

Principles and Rules

Principles and rules describe a relationship between two concepts. In microeconomics, we can derive several principles from a supply-and-demand curve. For example, ‘‘as price increases, the supply increases’’ is a principle that describes a direct relationship between two concepts (i.e., price and supply) that increase and decrease together. ‘‘As price decreases, demand increases’’ describes a different relationship between price and demand that causes one to increase as the other decreases.

Procedures

A procedure is an ordered sequence of steps a learner must execute to complete a task. A recipe for making a cake or casserole is a procedure. Similarly, a procedure could be a series of steps needed to plant a rosebush, or it could be a complex series of cognitive processes required to debug a computer program or diagnose the flu.

Interpersonal Skills

This broad category includes behaviors and objectives related to interpersonal communication, for example the development of interviewing skills, solving group conflict, leading a group, or how to sit (e.g., appropriate body language) when being interviewed on television.

Topic Analysis

A topic analysis is used to define connections and relationships between the facts, concepts, principles, and rules that make up a knowledge domain. Such an analysis is typically done in layers, much like what an archaeologist finds when excavating a site. First, the top layer of soil is scraped away. Then layers of earth are removed, and each artifact’s identity and location are recorded. Similarly, a designer working with the SME carefully reveals the first layer of information while looking for indicators of knowledge structures (i.e., facts, concept, and principles). Once the structure is revealed, additional detail is gathered for each structure, and new information appears as the designer digs deeper into the content.

A topic analysis thus provides two types of information. First, it identifies the content that will be the focus of the intended instruction. Second, it identifies the structure of the components. We should note that during a topic analysis, the designer might also identify one or more procedures that require analysis. While the topic analysis is not suited for analyzing procedures, our next methodology, procedural analysis, would be appropriate. As you conduct a topic analysis, then, you should remain focused on identifying the facts, concepts, and principles that make up the domain.

Analyzing a Topic

Let’s examine a topic analysis example. Imagine we are designing a beginning carpentry course. The course includes an introductory module on different types of wood fasteners. To begin, we can ask an SME to describe the different fasteners. Our question prompts the following outline:

1. Nails
2. Screws
3. Bolts

The SME considered these three major categories adequate to describe the various types of fasteners. So we might next ask the SME to further define each category. He expanded our outline as we asked additional questions. To get started, we might ask from what material fasteners are made, how they are sized, and how they are used.

1. Nails
    1. Generally made from wire
    2. Range in size from 2-penny to 60-penny
        1. Length of nails 10-penny or less is determined by dividing size by 4 and adding 0.5 inch
            1. Example: 7-penny nail is 2.25 inches long
    3. Typically driven into one or more pieces of wood with a hammer or nail gun

2. Screws
    1. Made from steel
    2. Size determined by the gauge (thickness) and length
        1. Length varies from 0.25 to 6 inches
    3. Usually twisted into a hole with screwdriver
    4. Provide a more secure joint than nails
3. Bolts
    1. Made from steel
    2. Measured by length and diameter
        1. Available in fine or coarse threads
    3. Placed through a hole and then a nut is tightened from opposite side

Let's examine the content structure identified in the outline. Some of the facts identified in the outline are as follows:

1. Nails are generally made from wire
2. Bolts are made of steel
3. Bolts are measured by length and diameter
4. Screw length varies from .25 to 6 inches

The concepts identified in the topic analysis are:

1. Nail
2. Screw
3. Bolt

One procedure was identified in the task analysis:

Length of nails 10-penny or less is determined by dividing size by 4 and adding 0.5 inch.

Our SME helped us identify one principle in the content:

Screws provide a more secure joint than nails.

Next, we can ask the SME to provide detailed information on each fastener category, starting with nails. Once he finishes, we can organize the content using the following steps:

1. Identify the different content structures (facts, concepts, and principles; we might have also identified procedures, and interpersonal skills that we will also need to analyze using other procedures).
2. Group related facts, concepts, principles, and interpersonal skills. For example, in our full outline of wood fasteners, we would group all the information about nails, then the information about screws, and so forth.
3. Arrange the various components into a logical, sequential order.
4. Prepare the final outline to represent your task analysis.

A completed topic analysis on nails, then, could look like this:

1. Nails
    1. Generally made from wire
    2. Range in size from 2-penny to 60-penny
        1. Length of nails 10-penny or less is determined by dividing size by 4 and adding 0.5 inch
        2. Example: 7-penny nail is 2.25 inches long
    3. Size is written as 2d for "2-penny"
    4. Typically driven into one or more pieces of wood with a hammer
    5. Types of nails
        1. Common nails
            1. Most commonly used nail

        2. Available in sizes from 2d to 60d
            1. 8d size is most common
        3. Identified by flat head
        4. Used for general purposes
    2. Box nails
        1. Smaller in diameter than common nails
        2. Available in sizes ranging from 2d to 40d
        3. Also identified by its flat head
        4. Used in lumber that may split easily
        5. Often used for nailing siding
    3. Finishing nails
        1. Have a very small head that will not show
            1. Head can be sunk into wood and hole filled
        2. Available in sizes 2d to 20d
        3. Used primarily for finishing work and cabinetry
    4. Common brads
        1. Similar to finishing nails but much smaller
        2. Available in various lengths
            1. Length expressed in inches or parts of an inch
        3. Used for finishing work
    5. Roofing nails
        1. Similar to common nails but with a larger head
        2. Available in lengths from 0.75 inch to 2 inches
            1. Available in various diameters
        3. Used for roofing

How detailed should a topic analysis be? There is no strict guideline, but as a rule of thumb you can use your learner analysis as a guide, since this should describe the learners' prior knowledge of the content area. A course on home repair for apprentice carpenters, for example, will require a different amount of detail than a course for homeowners.

Topic Analysis Template

Procedural Analysis

A procedural analysis is used to analyze tasks by identifying the steps required to complete them. This technique can be used for both observable and unobservable procedures. You conduct a procedural analysis by asking an SME to walk through the steps of a process, preferably with the same equipment and in the same environment in which the task is performed. For example, if you are conducting a procedural analysis for repairing an electric meter, the SME should have an electric meter and the necessary tools to refer to during your interview.

Each step of a procedure analysis includes three questions:

1. What does the learner do?
    1. Identify the action in each step that the learner must perform.
    2. These actions are either physical (e.g., loosening a bolt) or mental (e.g., adding two numbers).
2. What does the learner need to know to do this step?
    1. What knowledge (e.g., temperature, pressure, orientation) is necessary?
    2. What does the learner need to know about the location or orientation of the components that are a part of this step (e.g., how to position a wrench to remove a hidden nut)?

3. What cues (tactile, smell, visual, etc.) inform the learner that there is a problem, the step is done correctly, or a different step is needed (e.g., a blinking light indicates you can release the starter switch)?

In the following procedural analysis, a designer visited a cabinetmaker and asked him how to prepare a piece of woodwork for the final finish. During the analysis, the designer asked him variations of the three questions described in the previous paragraphs to identify the steps, knowledge, and cues. As part of the analysis, the cabinetmaker informed him that someone who finishes furniture would already know the basics of sanding and using a paint sprayer. The designer's analysis produced the following steps:

1. Inspect all surfaces for defects.
   1. Tactile cue: Feel for dents, scratches, and other surface defects.
   2. Visual cue: Splits or cracks are normally visible.
2. Repair defects in surface.
   1. Use sand and glue to fill minor defects.
   2. Reject pieces that you cannot repair for rework.
3. Spray two coats of lacquer sanding sealer on all surfaces.
   1. Visual cue: Dry, misty appearance indicates too-light application.
   2. Visual cue: Runs or sags indicate too-heavy application.
4. Prepare for final finish.
   1. Allow a 20-minute minimum drying time for sealer coat.
   2. After drying, rub out all parts with #400 grit silicon carbide abrasive paper.
   3. Remove dust from all surfaces with air gun, then wipe with clean, lint-free cloth.
5. Complete the final finish.
   1. Spray two coats of finishing lacquer on all parts.
   2. Visual cue: Dry, misty finish indicates too-light application.
   3. Visual cue: Runs or sags indicate too-heavy application.
   4. Allow a minimum of four hours for second coat to dry.
6. Inspect final finish.
   1. Tactile cue: Feel for grit or runs that may not be visible.
   2. Rub out all surfaces with #000 steel wool.
   3. Remove dust from all finished surfaces with air gun and lint-free cloth.
   4. Apply a thin coat of wax to all finished surfaces.
   5. Buff all surfaces to high gloss.
   6. Visual cue: Wax becomes dull prior to buffing.

Procedure Analysis Template

The Critical Incident Method

The two methods we have described—topic and procedural analyses—work well with concrete content and highly structured tasks. Analyzing other processes, however, such as how to conduct an interview, resolve an interpersonal conflict, or close a sales opportunity, are more difficult because they vary from instance to instance. Although the instances share certain elements, typically a breadth of skills and techniques actually accounts for one's success. A procedural analysis works quite well for analyzing how to apply the final finish to a wooden table, for instance, because the basic process is repeated time after time, with variations due to size and type of wood. But closing a sale, however, depends on several conditions (e.g., personality of the buyer, financial status of the buyer) that change with each sale. There are also complex tasks that an SME might consider an ''art,'' for example, determining where to drill an oil well, predicting successful stocks or mutual funds to purchase, or determining which type of psychotherapy to use with a patient.

To define content for these types of instruction we need an analysis method that provides different points of view on the skills/processes involved. For example, we might interview a salesperson who uses a very calm approach and another who uses high-pressure tactics. This is what we call a *critical incident analysis*, or an interview technique where the designer interviews several individuals to provide a rich source of data about possibilities.

There are two, key questions to ask as part of a critical incident analysis: First, ask an SME to identify three instances when he or she was successful in achieving a goal. Second, ask the SME to identify three instances when he or she was not successful in achieving the same goal.

Next, ask additional questions to gather three types of information:

1. What were the conditions before, during, and after the incident?
    1. Where did the incident occur?
    2. When did it occur?
    3. Who was involved?
    4. What equipment was used, and what was its condition?
2. What did you do?
    1. What did you do physically?
    2. What did you say and to whom?
    3. What were you thinking?
3. How did this incident help you reach or prevent you from reaching your goal?

(Ideally, this process should then be repeated with other SMEs.)

An analysis of critical incident interviews will identify knowledge and techniques the SMEs use to accomplish their goals. But note that although the critical incident analysis provides a list of topics and procedures that experts used, it does not include a list of the steps or details for topics. But using the information from this analysis you can perform a topic and/or procedural analysis to further define the content for the instruction.

Critical Incident Analysis Template

Conclusion

Task/content analysis is a critical step of the instructional design process. It can be easy to neglect, or to carry out superficially, especially given the time it takes to capture the detail required to do it right. But skipping this analysis will likely cause problems in future phases of the design process, particularly when it is time to design instructional activities. If designers only have superficial understanding of the content, or only rely on their subject matter experts' tacit understanding of the content, they are unlikely to design instructional materials that support learners in actually mastering the desired learning outcomes. Instructional designers should ensure they reserve enough time in their design process to carry out their task/content analysis in an adequate manner.

Application Exercises

Like any other skill, becoming proficient at task/content analysis requires practice. If you don't have a current instructional design project you can practice on your own by:

1. Identifying a topic area you personally wish you knew more about and interviewing an expert to create a diagram of the knowledge structure.
    1. You may consider interviewing more than one expert to see what kind of unique structures emerge from their different point of views.
2. Identifying a simple skill and interviewing/observing an expert to create a diagram of how the skill is completed.
    1. If you interview another expert about the same skill, is there more or less variability in the results than you found with your topic analysis?
3. Identifying a complex interpersonal skill and conducting a critical incident analysis with an expert.
    1. If you interview another expert about the same skill, is there more or less variability in the results than you found with your topic or procedure analysis?

Documenting Instructional Design Decisions

Jill Stefaniak

Instructional designers are tasked with making countless decisions in every project they complete. Questions ranging from “Who is my learning audience?” to “How will this project be evaluated for effectiveness upon implementation?” all require the instructional designer to make a variety of decisions to ensure that their instructional design efforts are contributing to efficiency, effectiveness, and ease of learning (Morrison, Ross, Kalman, & Kemp, 2013). As the utility of instructional design continues to be recognized across industries, the complexities of design will continue to grow. With more options available in terms of how instructional solutions are to be designed and disseminated to a range of different learning audiences, the complexities of design decisions facing instructional designers are insurmountable.

There is a large body of literature in other design disciplines that outline strategies for engaging in decision-making and documenting design decisions. Many of these strategies lend themselves to the ID field, particularly with working on complex, ill-structured design problems. Marston and Mistree (1997) argue the importance of decision-making in design practices stating that decisions serve as markers to identify the progress that is made on designing a solution.

The purpose of this chapter is to help instructional designers differentiate between the different types of decisions they may be responsible for during a project. Various approaches for engaging in decision-making will be discussed and tools will be provided to assist the instructional designer with documenting their design decisions.

Types of Decisions

Instructional design problems can be classified as well-structured (Jonassen, 2000). Well-structured problems typically have one possible solution, whereas ill-structured problems may have multiple solutions. Instructional designers will often find themselves tasked with designing instructional solutions for problems of an ill-structured nature. While some problems may require a quick decision by the designer, other problems may be more complex; thus, requiring several interrelated decisions (Jonassen, 2011).

Decisions can be categorized according to types such as choices, acceptances/rejections, evaluation, and constructions (Yates & Tschirhart, 2006). Choices consist of selecting an option from a large set of options. Acceptance/rejection decisions consist of a binary decision where the option (or solution) is accepted or not. Evaluative decisions involve an individual assigning worth to a possible option and determining their level of commitment if they were to proceed with that option (Fitzpatrick, Sanders, & Worthen, 2011; Guerra-Lopez, 2008). Decisions of a more constructive nature involve trying to “identify ideal solutions given available resources (Jonassen, 2012, p. 343).

Table 1 provides an overview of their typology along with the types of decisions an instructional designer may encounter during a project.

Table 1

Decision Typologies as They Relate to Instructional Design

Type	Example of Instructional Design Decisions
Choices	An instructional designer has been asked to help a local museum with developing learning materials for their patrons. During their brainstorming meeting with the museum staff, they discuss the possibility of using audio headsets, mobile learning, QR codes, online learning modules, and face-to-face training programs as training options.
Acceptances/Rejections	An instructional designer submits a proposal to present their project at a national instructional design conference. Reviewers responsible for reading the proposal must decide to accept or reject the conference proposal.
Evaluation	An instructional design firm in a metropolitan city meets with a not-for-profit organization to discuss their training needs. During a few of the initial conversations, the firm realizes that their client would not be able to pay the typical fees they charge for their instructional design services. The CEO of the instructional design firm sees the impact that the not-for-profit has made in the local community and decides that they can offer a few of their services pro bono.
Constructions	An instructional design program discusses the options for offering two special topics courses to their students in the upcoming year. Program faculty discuss possible topics and discuss which ones might be of the most interest to their students. During their discussions, they identify potential instructors for the courses and look to see how this might impact regular course offerings and instructor assignments.

Jonassen (2012) suggests that decisions fall under two models of decision-making: normative and naturalistic. Normative models involve an individual evaluating the situation and considering several options before deciding on a solution that yields the optimal solution given any constraints or resources related to the situation. He further categorizes normative models of decision-making as falling into three categories (rational choice, cost-benefit, and risk assessment).

Rational choice models involve the instructional designer evaluating alternative options for addressing a problem and weighing the option to determine what is the most viable of the solutions. Oftentimes, the instructional designer will evaluate the strengths and weaknesses of each solution using decision-making tools such as SWOT or force field analyses. A cost-benefit analysis seeks to select solutions based on the potential for their return-on-investment. There may be instances where it is worth foregoing training if an organization cannot justify incurring the costs associated with training. A risk assessment model is when an instructional designer will evaluate the risks associated with not proceeding with a particular solution.

Naturalistic models are suggested to assist in the decision-making process when decisions are more contextually-embedded. These models “stress the role of identity and unconscious emotions in decision-making” (Jonassen, 2012, p. 348). Narrative-based models place value on the explanations that accompany the various decision options. More emphasis is placed on the explanation rather than the cost-benefit analysis associated with a particular solution. Identify-based decisions are centered around how any individual relates to solutions on a personal level. Table 2 provides examples of instructional design decisions that may fall under normative or naturalistic decision-making models.

Table 2

Examples of Normative and Naturalistic Instructional Design Decisions

Type of Decision-Making	Model	Examples in Relation to Instructional Design
Normative Decision-Making	Rational choice	A manufacturing company is looking to conduct Kaizen events as a means to create a lean manufacturing environment. To date, there have been many issues reported and logged by employees related to inefficiencies related to production. The manufacturing supervisors and the director of continuous improvement meet to rank the performance issues. They will begin by developing training and Kaizen events around the top three issues that have been prioritized by the team.
	Cost-benefit analysis	A call center is interested in investing in the development of new training modules to assist their call attendants on strategies to troubleshoot common calls they have been receiving about new products. Investing in training has the potential to reduce each customer call by five minutes.
	Risk assessment	A local hospital has sought input from its training department to explore whether training is needed regarding patient safety for their volunteers. The organization is looking at what the cost would be to host training sessions every month with incoming volunteers versus the risks of not training them on patient safety practices.
Naturalistic Decision-Making	Narrative-based	A sociology department at a research-intensive university is meeting to discuss if there is a need to modify and update their curriculum for their graduate programs. A faculty member has mentioned to the group that they do not believe the existing curriculum places enough emphasis on vulnerable populations. As they talk during the meeting, they keep referring to some existing students and asking the program faculty to consider what they would do if they were these students.
	Identity-based	The curriculum committee at a medical school is discussing options for offering graduate certificates in Patient Safety and Quality or Global Health in addition to their medical degree programs. Three of the members on the curriculum committee participated in global health trips during their medical training and recall it being a very engaging experience. They are more inclined to support the certificate in global health because they identify with that program on a personal level.

Normative Decision-Making Example: An Accident Occurs on the Plant Floor

Mike is an instructional designer who works in the Department of Employee Development for an automotive aftermarket manufacturer. Over the weekend, an employee had a fatal accident operating a piece of machinery during the night shift. Mike and his supervisor have been included in meetings to explore whether modifications are needed to the company's existing health and safety modules.

It is most likely that Mike and his supervisor will employ a normative approach to decision-making by conducting a risk assessment to determine the need for updating existing modules or developing new courses. The following are examples of some questions that Mike may ask during his meeting with the organizational leadership:

- How many accidents have occurred on the plant floor in the past year?
- How many of these accidents were related to the particular machine?
- What training had the injured employee received before operating the machinery?
- Are safety practices related to the machine covered in the existing health and safety training modules?

Application Exercises

Make a list of all of the potential options you might consider if you were to assist Mike with the project.

Naturalistic Decision-Making Example: Transitioning Human Resource Mandatory Training

Angela has recently been hired as an instructional designer and trainer in support of employee development initiatives for a local hospital. In a recent meeting that was held with managers in human resources, there was a discussion about whether mandatory training courses should be offered in an online format. At her previous organization, Angela remembers that there were a lot of issues with transferring courses to an online format and she wonders if the employee development team has the necessary manpower and resources to support these modules.

Application Exercises

How might Angela’s previous employment experience influence her position during this discussion about offering online training modules?

Fostering the Development of Instructional Design Decision-Making

Several studies have been conducted exploring the development of instructional designers' design judgment (Demiral-Uzan, 2015; Gray et al., 2015; Honebein, 2017; Korkmaz & Boling, 2014). These studies have explored how instructional designers engage in making decisions based on resources available in real-world settings. The results of these studies have supported the idea that instructional design is not limited to a linear approach for designing and developing instructional solutions; it is complex, and heavily influenced by contextual factors that are uniquely situated in relation to the project goals.

Other studies have sought to explore the role of experience and instructional designers’ abilities to make decisions. There are several differences inherent in terms of how novice instructional designers engage in decision-making compared to experts (Ertmer et al., 2008, 2009; Hoard, Stefaniak, Baaki, & Draper, 2019; Perez & Emery, 1995; Stefaniak, Baaki, Hoard, & Stapleton, 2018). Novice instructional designers are more apt to rely on instructional design models to guide their design process in a linear fashion whereas expert designers design in a more recursive manner. Several of the abovementioned studies also reported that novices tend to revert back to instructional design solutions they have used in previous projects; experts are more prone to customize solutions to meet the unique needs of their learning audience.

Several researchers in the instructional design field have suggested that an apprentice model can be beneficial to novice instructional design students as they are acquiring and developing design skills. The use of a cognitive apprenticeship provides a framework for instructors and expert instructional designers to model behavior and design practices in addition to providing the necessary instructional scaffolding to support instructional designers as they engage in design decision-making (Bannan-Ritland, 2001; Ertmer & Cennamo, 1995, Moallem, 1998; Shambaugh & Magliaro, 2001; Stefaniak, 2017)

Tools to Facilitate and Log Decision-Making During the Design Phase of Instruction

Instructional design is an iterative and recursive process that requires the instructional designer to continuously monitor and revisit their designs to ensure alignment between instructional components from conception to implementation. Table 3 provides an overview of various tools that an instructional designer can utilize throughout their design process to log and reflect upon their instructional design decisions. Also, examples of studies and resources that discuss the use of these tools in detail are included in the table.

Table 3

Overview of Tools to Assist Instructional Designers with Logging Decisions

Tool	Description	Examples of Studies and Uses
Design documents	A document that serves as a blueprint for the entire instructional project. This document typically includes information related to course goals, learning objectives, instructional strategies, assessments, project timelines, and budgets.	Boot, Nelson, van Merrienboer, and Gibbons (2007) Martin (2011) Piskurich (2015)
External representations	The knowledge and structure in the environment, as physical symbols, objects, or dimensions (e.g., written symbols, beads of abacuses, dimensions of a graph, etc.), and as external rules, constraints, or relations embedded in physical configurations (e.g., spatial relations of written digits, visual and spatial layouts of diagrams, physical constraints in abacuses, etc.)" (Zhang, 1997, p. 180).	Baaki and Luo (2019) Boling and Gray (2015) Fischer and Mandl (2005) Huybrechts, Schoffelen, Schepers, and Braspenning (2012) Luo and Baaki (2019) Verschaffel, de Corte, de Jong, and Elen (2010) Yanchar, South, Williams, Allen, and Wilson (2010)
Group repositories	Space where an instructional design team can track the progress of a project and share notes. This space is typically housed by an online platform.	Gustafson (2002) Spector (2002) Stefaniak, Maddrell, Earnshaw, and Hale (2018) Van Rooij (2010)
Rapid Prototyping	An instructional design approach that is used to create a sample of an instructional design product that is scalable according to the needs of the project. Rapid prototyping allows instructional designs to combine multiple phases of the instructional design process to facilitate discussions and decisions about results.	Roytek (2010) Tripp & Bichelmeyer (1990) York and Ertmer (2011)
Reflection journals	A journal where an instructional designer can log any ideas they might help, reactions to different phases of the instructional design process, or notes that might be beneficial for a future project. The use of a journal helps an instructional designer keep track of their thoughts and ideas that might not be suitable to be documented in a design document while still promoting a reflection-in-action mindset (Schon, 1983).	Baaki, Tracey, and Hutchinson (2017) Bannan-Ritland (2001) Gray et al. (2015) Luppicini (2003) Moallem (1998) Tracey and Hutchinson (2013) Young (2008)

Conclusion

While decision-making is recognized as a common form of problem-solving in instructional design practices, Jonassen (2012) contends that there is a need for empirical research to assess decision-making in our field. To date, there is a growing body of literature exploring the decision-making practices of instructional designers; however, we, as a field, have just begun to skim the surface. More studies are needed to explore the types and quality of decisions made by instructional designers of all levels in a variety of contexts. We know that contextual factors contribute to or hinder the effectiveness of instructional designers' final designs (Morrison et al., 2013; Smith & Ragan, 2005). Researchers have criticized that the role of context continues to be an aspect of design that still warrants further explanation and understanding (Tessmer, 1990; Tessmer & Wedman, 1995). This continues to be an issue facing our field. Additional studies on factors influencing instructional designers' abilities to engage in decision-making will better equip our field to prepare the future of instructional design (Ertmer et al., 2009; Jonassen, 2008; Stefaniak et al., 2018; Tracey & Boling, 2014).

In the meantime, instructional designers can continue to focus on cultivating their designer identity (Tracey & Hutchinson, 2016, 2018) by documenting their thoughts and making use of the tools mentioned in this chapter to track their design decisions during projects. Over time, the aspiring instructional designer will begin to identify patterns in terms of how they approach various types of design problems, identify and utilize design resources and space, and articulate their rationale to fellow designers and clients. This continual practice of design documentation will serve the field well by informing both theory and practice.

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Jill Stefaniak

Jill Stefaniak profile picture

Figure 2.3.1: Jill Stefaniak is an Assistant Professor in the Learning, Design, and Technology program in the Department of Career and Information Studies at the University of Georgia. Her research interests focus on the professional development of instructional designers and design conjecture, designer decision-making processes, and contextual factors influencing design in situated environments.

CHAPTER OVERVIEW

3: Creating

3.1: Generating Ideas

Generating Ideas

Vanessa Svihla

Brainstorming, ideation, generating ideas. These terms and the kinds of practices they refer to are familiar to many, even outside of design fields. As instructional designers, we use such techniques to come up with more ideas—and more creative ideas. But how do these techniques help designers develop ideas? And when and why should we use them?

In this chapter, I first discuss the typical purposes and desired outcomes for ideation. I review some common as well as new techniques and briefly discuss evidence of their effectiveness, in part to draw attention to the kinds of challenges designers face when using such techniques. Finally, I re-center the purpose of generating ideas as reframing the problem.

What Is Ideation? When and Why Do We Typically Generate Ideas?

Designers commonly generate ideas about possible solutions after the problem is initially framed. Or at least, typical texts on design suggest this is when designers should generate ideas. We will reconsider that later in this chapter.

Many ideation techniques focus on generating many ideas, going on the assumption that if you generate many ideas, some of them will surely be creative. This probabilistic reasoning is not always accurate, however. This is because even if we generate many ideas, they may still be similar to each other. Researchers who study ideation techniques argue that novelty comes from having dissimilar ideas. This means that variety is more important than quantity. But coming up with dissimilar ideas can be challenging because of *fixation*—the experience of getting stuck on previous ideas. Compared to designers who are not shown an existing solution, designers who are given an example tend to reproduce features from the example (Jansson & Smith, 1991), even when the example is known to be flawed (Purcell & Gero, 1996). Often, designers are unaware they have incorporated such features, and this is why overcoming fixation can be so challenging—it is often a covert process.

Research suggests that designers who have less diverse precedent to consider may be more prone to fixation (Purcell & Gero, 1996). Who has a less diverse precedent? Some may think this would be novice designers because they have not been exposed to the concepts and materials with which they are designing. But in some fields, like mechanical engineering and instructional design, we commonly encounter designs, but many of us do not encounter much diversity in those designs (e.g., a lot of sedans look like one another, and many school lessons look like one another). Repeated exposure to a limited set of ideas covertly shapes our vision of what could be. And, without deliberate engagement with diverse precedent, we might not be very influenced by that precedent.

New designers also tend to commit to design ideas prematurely (Rowland, 1992; Shum, 1991), and once committed, can feel invested and unwilling to change, a phenomenon referred to as *sunk cost* (Kahneman & Tversky, 1979). In my own teaching of design, I require messy, hand-drafted first versions of ideation and prototypes and impose a -10% penalty to any such assignment that looks to have been tidied up. This appears to help, but it is still very easy to fall in love with a first idea. Consider the following vignettes in Tables 1 and 2, in which a supervisor (Sunil) requests fire extinguisher training to comply with regulations and the design team (newcomer Noel, experienced Eli, and subject matter expert Marley) considers their options.

Vignette 1. Meeting With Supervisor

Sunil

Of course, we want to make sure our employees are exposed to proper fire extinguisher use. We have to comply with these new regulations ASAP.

Marley

Some units, like mine, have already been certifying employees because we really have to know how to use an extinguisher. But we rely on an external provider.

Eli

It seems like that won’t scale to the entire organization, given the cost you shared with us earlier.

Noel

We can just put together a short online training using the PASS model, with a quiz to certify them. I think the pass score should be rather high, though, right? Like 100%. I know we sometimes go with 80%.

Sunil

What is the difference between a pass model and pass score?

Noel

Oh! Sorry. The PASS model—I googled it before the meeting—is a mnemonic to use the fire extinguisher. It means pull the pin, um, aim, and sweep. I forget what the other S stands for, give me a sec—

Sunil

How long would it take you to put that together?

Eli

Before we get to that, I think we need to consider options.

In the vignette, who shows fixation? Premature commitment? What precedent might shape how the design team and supervisor evaluate design ideas? How might they overcome fixation and premature commitment? To answer that, let's look first at the origins of idea generation.

What Are Some Tools for Ideation?

In 1939, Osborn began developing techniques for more creative advertising. He devised classic brainstorming and published techniques based on years of practice (Osborn, 1957). He advocated for the following techniques as part of brainstorming:

- suspending critique
- considering wild ideas
- coming up with as many ideas as possible
- combining ideas, and
- working in a large group of designers.

Several of these ideas were later empirically challenged, especially group size (Mongeau & Morr, 1999). Generally, support has been found for more structured ideation methods (Crilly & Cardoso, 2017; Runco et al., 2011; Santanen, Briggs, & Vreede, 2004; Sosa & Gero, 2013; Yilmaz, Seifert, & Gonzalez, 2010). For instance, an early, somewhat more-structured approach was lateral thinking, meaning thinking in generative ways (as opposed to analytical "vertical thinking") (De Bono & Zimbalist, 1970). De Bono described general methods for lateral thinking, such as:

- generating alternatives with a pre-set quota (number of ideas),
- challenging assumptions by repeatedly asking why,
- suspending or delaying judgement, and
- restructuring or reorganizing elements.

In the vignette below, what techniques (from the bulleted lists above) do they use? Where do they stray from the guidelines for brainstorming and lateral thinking?

Vignette 2. Design Team Meeting: Classic Brainstorming in a Group

Eli

I am a little worried that if we just deliver a compliance training, Sunil will consider that sufficient, even for units like Marley's, because the cost savings will be so appealing. So, I think we should generate some ideas before we commit. So, let's come up with at least 20 ideas. Let's not evaluate them yet, just list any ideas that pop in.

Noel

Well, I think we should do the PASS model, followed by a quiz.

Marley

That makes me think about job aids. Like we could have a sign, maybe next to or on fire extinguishers?

Noel

Nice. And we should make the job aid similar to the training, so the instructional and transfer contexts are similar.

Marley

That's a good idea. We can use the same font and pictures even.

Eli

Sometimes asking "why" helps. Like, why do all employees need this training? Why don't they know how to use a fire extinguisher already?

Marley

In the certification course we take in my unit, people think they should aim at the top of the flames, but it's the base. So, we could focus on that aspect.

Noel

And that is also part of the PASS model. And they need it because of compliance though, right?

Eli

Let's really try to get some other ideas on the table.

Noel

We could make our own model. SAPS? APSS?

Marley

Or it could be just like a handout they get.

In this vignette, you may have noticed that although Eli encouraged them not to evaluate ideas, Noel and Marley reacted in evaluative ways to each other's ideas. Although they did not critique ideas, even providing positive evaluation can shape how others respond because it signals that poor ideas are unwelcome. This in turn can impinge on creative thinking.

Noel's suggestion to make their own model by rearranging the steps is something those of us who teach design see often. Coming up with flawed versions of existing ideas accomplishes two things well—it gets you toward whatever preset quota you need, and it guarantees your favorite idea won't be ruled out—but it does not lead to more creative ideas. Yet, this approach is common when ideation feels forced or artificial, as can happen when one designer prompts ideation that others do not see a need for (or when ideation is assigned, such as in an ID class!). Knowing when to deploy ideation techniques is critical, but this is learned through experience. For practicing designers, ideation is not always a formal step; they often generate ideas ad hoc. Experienced designers do not always find benefit from typical ideation techniques (Laakso & Liikkanen, 2012; Linsey et al., 2010; Sio, Kotovsky, & Cagan, 2015; Tauber, 1972; Vasconcelos & Crilly, 2016), but research suggests these may hold benefit for newcomers.

Below, I have summarized some common structured ideation techniques. I have included a couple that are not common in instructional design because methods developed in other design fields, like engineering and creativity, are transferrable outside of product design fields (Moreno, Yang, Hernández, & Wood, 2014). This is important in part because our most prominent design approach—ADDIE—has relatively little to say about ideation, and even newer models like SAM do not provide clarity about where new ideas might come from (Allen, 2012).

Take the fire extinguisher training problem described in the vignettes, and try out two of the techniques in Table 1 below.

Table 1

Common Structured Ideation Techniques

Technique	Outcomes	Use in ID

SCAMPER		
An elaboration of traditional brainstorming, this technique structures ideation by providing questions tied to actions that form the SCAMPER acronym: substitute, combine, adapt, modify/magnify/minimize, put to other uses, eliminate, and reverse/rearrange (Eberle, 1972). For instance, ask “What can I substitute?”	Studies suggest that SCAMPER may result in more high-quality novel ideas compared to unguided methods (Moreno, Yang, et al., 2014).	SCAMPER has been commonly used with elementary students. It is a particularly promising technique for making incremental changes to typical instructional settings, where major changes may be viewed as threatening or problematic.
Design Heuristics		
Based on expert performance in product and engineering design (Yilmaz, Daly, Seifert, & Gonzalez, 2015, 2016) this is a well-studied set of 77 strategy cards—such as add levels, adjust functions for specific users, repeat, compartmentalize, contextualize, build user community, change flexibility, scale up or down, and incorporate environment—for designers to use as inspiration as they generate ideas.	Design heuristics can support newcomer designers to develop more elaborated and practical ideas (Daly, Seifert, Yilmaz, & Gonzalez, 2016).	While many of the strategies are specific to engineering or product design, many are salient to instructional design, especially if we change “user” to “learner.” For instance, several focus on user agency, which we could frame as learner agency—allow the learner to customize, reconfigure, reorient. What other heuristics might we identify from expert ID practice? The list of ID heuristics could be a place to start (York & Ertmer, 2011).
Design-by-Analogy		
These methods include various forms—Synectics (Gordon, 1961), biomimicry—and include techniques like mapping related words in a network like a concept map or exposure to near or far examples. The latter mirrors intuitive as well as professional design practice in which designers rely on precedent. However it involves deliberately considering ideas that may be similar or wildly different as sources of inspiration. Common to engineering design, the TRIZ (Altshuller, 1996) approach involves first identifying “contradictions” then looking at ways others have resolved the same kind of contradiction.	Design-by-analogy methods can help designers produce more novel ideas (Moreno, Hernandez, et al., 2014) especially if the designers use far analogies (Chan et al., 2011) which can help them think more broadly about a problem (S. M. Smith & Linsey, 2011). TRIZ has led to more varied ideas (Belski, Hourani, Valentine, & Belski, 2014).	Although not commonly used in ID, this is a promising technique to overcome exposure to traditional precedent. Developing clarity about tensions is also promising. Common contradictions salient in instructional design are breadth versus depth, efficiency versus understanding, and convenience versus learning.
Nominal group		
In a group, individuals silently generate ideas. Each member shares ideas. After all have been shared, members clarify and evaluate ideas collectively then vote individually.	Compared to an unstructured group, nominal groups generate more ideas (Ven & Delbecq, 1974).	Nominal group techniques are beneficial when generating ideas with stakeholders or in groups with power imbalances because it opens space for all members to participate.

Bodystorming		
Rather than attempting to generate ideas removed from context, bodystorming involves acting out the problem and possible solutions *in situ* (Oulasvirta, Kurvinen, & Kankainen, 2003).	Bodystorming has been helpful when designing with new or unfamiliar learning technologies (B. K. Smith, 2014).	Although not commonly used (in ID or other fields), bodystorming can be particularly generative when considering the configuration of learning spaces, ways to arrange collaborating learners, and mobile learning.

Contrast the two techniques you tried out:

- Which did you prefer and why?
- Which led you to produce more ideas?
- Which do you think led you to generate more novel ideas?
- Which do you think led you to generate higher quality ideas?

If you found answering the last two questions more difficult, you are not alone. Researchers have long debated the best ways to measure novelty and quality of ideas. While counting the number of ideas generated is straightforward, as mentioned earlier, this does not necessarily result in better ideas. Novelty is often characterized by the variety or breadth of ideas of a single designer as well as the frequency of their ideas compared to other designers (Hernandez, Okudan, & Schmidt, 2012). Quality is sometimes measured as feasibility, usability (Kudrowitz & Wallace, 2013) or the degree to which needs are met without violating constraints.

Others have also considered characteristics such as ethics and empathy. This means evaluating the just distribution of risks and benefits for multiple and especially marginalized groups (Beever & Brightman, 2016). Although not commonly used, techniques that sensitize the instructional designer to the experiences of marginalized groups and connect this to their own experiences prior to generating ideas has potential for addressing persistent inequities and structural oppression (Kouprie & Visser, 2009; Visser & Kouprie, 2008). Such approaches also tend to more clearly change the problem space.

How Can Ideation Reshape the Problem Space?

So far, we have mostly focused on the solution space, but due to the ill-structured nature of design problems, ideation also changes the problem space (Cardoso, Badke-Schaub, & Eris, 2016) as designers reframe the problem during ideation (Daly, Yilmaz, Christian, Seifert, & Gonzalez, 2012). Designers sometimes relax constraints and this can reshape the problem space (Chan, Dang, Kremer, Guo, & Dow, 2014; Silk, Daly, Jablokow, Yilmaz, & Rosenberg, 2014). By temporarily ignoring a key constraint, sometimes we can notice something new about the problem space.

Similarly, my own approach—the Wrong Theory Protocol (WTP, https://edtechbooks.org/-IAVb)—likewise tends to reshape the problem space. In this approach, we ask designers to first come up with ideas that would cause harm and humiliation prior to generating beneficial ideas. I was inspired by a magazine article on artists and designers deliberately creating displeasing and wrong works (Dadich, 2014). When we first incorporated it into an ideation session, we noticed that the most humiliating ideas led to more empathetic insights and changed problem frames. Consider the vignette below to understand why this might be.

Vignette 3. Design Team Meeting: Wrong Theory Protocol

After individually generating harmful and humiliating ideas, the team discusses their insights:

Eli

I think my worst idea was locking the learner in a room with a small fire burning and a sort of Rube Goldberg fire extinguisher with terribly complex instructions. They first can't get it started, and once set in motion, the extinguisher has too many steps to get through and the fire grows and grows.

Noel

Wow. That's terrible. Mine was giving them a depleted extinguisher with no instructions and putting them on one of those weird game shows, where if they can't make the extinguisher go, they have to eat spiders.

Marley

Ew! You both had much worse ideas than me. I think mine was just lazy. I said just give them no instructions and wait for a fire, then put up a list in the hall of those who messed up. Eli, your wrong design makes me think of how—in some of our units, it could go really wrong if someone who got basic training used the wrong kind of extinguisher. Some of our labs have two or three kinds for different situations.

Noel

You know, at first, I thought, we just need to make sure everyone knows how to use a basic model, but now I wonder if that could actually lead to accidents. If we tackle this just as a compliance problem, we could make it worse.

In this vignette, how did the problem change as a result of insight gained from generating wrong ideas? Why do you think it changed?

In our work on WTP, designers' beneficial ideas, though not numerous, tend to be both creative and empathetic. We have several reasons for why WTP might work. Perhaps designers feel beholden to stakeholders after coming up with harmful and humiliating ideas? Or perhaps they simply gain empathy? Maybe they notice something new about the problem situation? Or, perhaps in absence of the pressure to be right, they are able to be more creative? Afterall, research on suspending judgment suggests that it is difficult to accomplish.

Conclusion

Instead of treating ideation as the tipping point between being problem- and solution-focused, try generating ideas across the depth and duration of your design process to help you frame the problem with empathy and design learning experiences that meet needs without unintentionally widening gaps. By depth, I mean that it can help to drill down and ideate on a particular aspect.

While this chapter introduced a few techniques, there are many more available.

Finally, ideation can be an effective tool when employed at any sticking point. Low fidelity prototypes, use-cases and early storyboards often reveal issues that can be dealt with through ideation. Even in pilot implementation, having ideation techniques ready-to-hand can avert disaster when issues come up. This kind of generative thinking—How can it work? How else could it work?—serves designers well throughout their design work.

Additional Readings and Resources

There are many texts that illustrate additional ideation/creativity techniques. I always recommend keeping an eye out for one that appeals to you.

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3.2: Instructional Strategies

Instructional Strategies

Joshua Hill & Linda Jordan

Editor's Note

This is a condensed version of a chapter on Instructional Strategies from the book Experiential Learning in Instructional Design and Technology, by Joshua Hill and Linda Jordan. It is printed here under a similar license as the original.

Introduction

A well designed course, whether it be face-to-face, blended, or online, must be well structured with careful attention to instructional strategies in the selection of instructional material, the planning of learning activities, and the selection of media. An ***instructional strategy*** describes the instructional materials and procedures that enable students to achieve the learning outcomes. ***Learning outcomes*** are what the student should know, or be able to accomplish at the end of the course or learning unit. Your instructional strategy should describe the instructional materials' components and procedures used with the materials that are needed for students to achieve the learning outcomes. The strategy should be based on the learning outcomes and information from the other previous instructional design steps. You can even base your strategy on how you or others have solved similar problems. You can save time and money by not re-inventing the wheel. However, be careful; a lot of existing instructional material is designed poorly. Use the instructional strategy as a framework for further developing the instructional materials or evaluating whether existing materials are suitable or need revision. As a general rule, use the strategy to set up a framework for maximizing effective and efficient learning. This often requires using strategies that go beyond basic teaching methods. For example, discovery-learning techniques can be more powerful than simply presenting the facts.

This chapter reviews some basic information to help you choose appropriate instructional strategies for the learning outcomes you hope your learners will be able to accomplish. Rather than reviewing specific details about any of the hundreds of instructional strategies that have been developed, this chapter describes considerations that should go into the selection of any instructional strategy.

Goal Analysis

Goal analysis includes classifying the instructional goal into the domain, or kind of learning that will occur. The domains can be *verbal information* where learners state, list, describe, name, etc., *intellectual skills* such as learning how to discriminate, identify, classify, demonstrate, generate, originate, create, etc., *psychomotor skills* where learners make, draw, adjust, assemble, etc., and *attitudes* such as making choices or decisions. If you used a guide like Bloom's Taxonomy when generating your learning outcomes, you likely have a good handle on the type of learning you hope will occur. Establishing the domain is important in determining what instructional strategies to use in subsequent steps.

Learning Domain Strategies

Each ***learning domain classification*** (i.e., verbal information, intellectual skills and cognitive strategies, psychomotor skills, and attitudes) is best taught with different instructional strategies.

Verbal Information

Verbal information is material, such as names of objects, that students simply have to memorize and recall.

When teaching verbal information:

- Organize the material into small, easily retrievable chunks.
- Link new information to knowledge the learner already possesses. For example, use statements such as "Remember how", or "This is like …". Linking information helps the learner to store and recall the material.
- Use mnemonics and other memory devices for new information. You may recall that the musical notes of the treble clef staff lines can be remembered with the mnemonic Every Good Boy Deserves Fudge.

- Use meaningful contexts and relevant cues. For example, relating a problem to a sports car can be relevant to some members of your target audience.
- Have the learners generate examples in their minds, such as create a song or game with the information or apply the knowledge to the real world. If the student only memorizes facts then the learning will only have minimal value.
- Avoid rote repetition as a memorization aid. Rote learning has minimal effectiveness over time.
- Provide visuals to increase learning and recall.

Intellectual Skills

Intellectual skills are those that require learners to think (rather than simply memorizing and recalling information).

When teaching intellectual skills:

- Base the instructional strategy and sequencing on an analysis such as a topic or a procedural analysis. Always teach subordinate skills before higher-level skills.
- Link new knowledge to previously learned knowledge. You can do this explicitly (e.g., the bones in your feet are comparable to the bones you learned about in your hands) or implicitly (e.g., compare the bones in your feet to other bone structures you have learned about).
- Use memory devices like acronyms, rhymes, or imagery for information such as rules or principles. You can use the first letters of words to help memorize information. For example, “KISS” means “Keep It Simple Stupid”. General rules can often be remembered through rhymes such as “i before e except after c”. Remember that rules often have exceptions. Tell your learners about the exceptions. Memory devices are best for limited amounts of information.
- Use examples and non-examples that are familiar to the student. For instance, when classifying metals, iron and copper are examples while glass and plastic are non-examples.
- Use discovery-learning techniques. For example, let students manipulate variables and see the consequences.
- Use analogies that the learners know. However, be careful that learners do not over-generalize or create misconceptions.
- Provide for practice and immediate feedback.

Psychomotor Skills

Psychomotor skills are those that require learners to carry out muscular actions.

When teaching psychomotor skills:

- Base the instructional strategy on an analysis such as a procedural analysis or a critical incident analysis.
- Provide directions for completing all of the steps.
- Provide repeated practice and feedback for individual steps, then groups of steps, and then the entire sequence.
- Remember that, in general, practice should become less dependent on written or verbal directions.
- Consider visuals to enhance learning.
- Consider job aids, such as a list of steps, to reduce memory requirements. This is especially important if there are many procedures or if the procedures are infrequently used.
- After a certain point, allow learners to interact with real objects or do the real thing. How much can you learn about swimming without getting wet?

Note that some skills involve other learning-domain classifications. For example, when learning how to operate a camcorder, many of the skills are psychomotor. However, deciding how to light an image is an intellectual skill. Also, note that the required proficiency level can affect the instructional strategy. There is a big difference between being able to imitate a skill and being able to automatically do a skill.

Attitudes

Attitudes involve how a student feels about the instruction, whether they will value or care about the material presented to them.

When teaching attitudes:

- Base the instructional strategy on the instructional design steps done earlier.
- If you can, show a human model to which the students can easily relate. One consideration is that it may be better if the model is of the same socioeconomic group.

- Show realistic consequences to appropriate and inappropriate choices.
- Consider using video.
- Remember that attitudes taught through computer technology are not guaranteed to transfer to the real world. If appropriate and possible, consider arranging for practice opportunities to make the choice in real life. Alternatively, use role-playing to reinforce the attitudes taught.

Note that it can be difficult to test whether the attitudes taught have transferred to real situations. Will learners behave naturally if they know that they are being observed? If learners have not voluntarily permitted observations, then you must consider whether it is ethical to make the observations.

Strategies to Sequence Learning Outcomes

Another aspect of your instructional strategy will be to determine the sequence of how the learning outcomes will be taught. In general, to best facilitate learning you should sequence the learning outcomes from:

- easy to hard
  - You could teach adding fractions with common denominators and then with different denominators. Your lesson could first deal with writing complete sentences and then writing paragraphs.
- simple to complex
  - As an example, teach recognizing weather patterns and then predicting the weather.
  - Cover replacing a washer and then replacing a faucet.
- specific to general
  - You could teach driving a specific car and then transfer the skills to driving any car. Similarly, you could cover adjusting the brakes on a specific mountain bike and then generalize the procedure to other mountain bikes
  - Note that some students like to learn through an inductive approach (that is, from the general to the specific). For example, students could be presented with a number of simple examples, and based on those, be asked to generalize a rule. That general rule can then be applied to solving specific examples. Since some students will not enjoy an inductive approach, do not use it all of the time. Rather consider an inductive approach as a way to provide some variation and occasionally address other learning preferences.
- concrete to abstract
  - As an example, teach measuring distances with a tape measure and then estimating distances without a tape measure. Cover writing learning outcomes and then evaluating learning outcomes.
- the known to the unknown
  - You could do this by starting with concepts learners already know and extending those concepts to new ideas. In other words, build on what has been previously taught.

Each of these methods of sequencing learning outcomes enables students to acquire the needed knowledge base for learning higher-level skills. Note that these guidelines are not black and white rules.

Strategies to Motivate Students - The ARCS Model

As described by Keller, motivation can be enhanced through addressing the four attributes of Attention, Relevance, Confidence, and Satisfaction (ARCS). Try to include all of the attributes since each alone may not maintain student motivation. Your learner analysis may have provided useful information for motivating students. You should build motivational strategies into the materials throughout the instructional design process. This is challenging since each learner is an individual with unique interests, experiences, and goals.

Attention

Gain attention and then sustain it. You can gain attention by using human-interest examples, arousing emotions such as by showing a peer being wheeled into an ambulance, presenting personal information, challenging the learner, providing an interesting problem to solve, arousing the learner’s curiosity, showing exciting video or animation sequences, stating conflicting information, using humor, asking questions, and presenting a stimulus change that can be as simple as an audio beep. One way to sustain attention is by making the learning highly interactive.

Relevance

Relevance helps the student to want to learn the material by helping them understand how the material relates to their needs or how it can relate to improving their future. For example, when teaching adult students how to solve percent problems, having them calculate the gratuity on a restaurant bill may be more relevant than a problem that compares two person's ages. You can provide relevance through testimonials, illustrative stories, simulations, practical applications, personal experience, and relating the material to present or future values or needs. Relevance is also useful in helping to sustain attention. For material to be perceived as being relevant, you must strive to match the learner's expectations to the material you provide.

Confidence

If students are confident that they can master the material, they will be much more willing to attempt the instruction. You will need to convince students with low confidence that they can be successful. You can do this through presenting the material in small incremental steps, or even by stating how other similar students have succeeded. Tasks should seem achievable rather than insurmountable. You should also convince students who are overconfident that there is material that they need to learn. You can do this by giving a challenging pre-test or presenting difficult questions.

Satisfaction

Satisfaction provides value for learning the material. Satisfaction can be intrinsic from the pleasure or value of the activity itself, extrinsic from the value or importance of the activity's result, for social reasons such as pleasing people who's opinions are important to them, for achievement goals such as the motive to be successful or avoid failure, or a combination of these. Examples of intrinsic satisfaction include the joy or challenge of learning, increased confidence, positive outcomes, and increased feelings of self-worth. Examples of extrinsic satisfaction include monetary rewards, praise, a certificate, avoidance of discomfort or punishment for not doing it, and unexpected rewards. Some evidence suggests that extrinsic motivation, such as a certificate for completing a course, does not last over time. Nonetheless, it is better to assume that some students need extrinsic motivation. To be safe, try to provide your learners with both intrinsic, which should have more of the focus, and extrinsic rewards. If the intrinsic motivation is high for all learners, you will not need to plan as much for extrinsic motivation. Note that satisfaction can be provided by enabling learners to apply the skills they have gained in a meaningful way. Remember to let the students know that the material to be learned is important. Consider increasing extrinsic motivation through quizzes and tests.

Strategies for Sequencing Instructional Events

As Robert Gagné described, that ***instructional events*** (gaining attention, informing the learner of the learning outcome, stimulating recall of prerequisites, presenting the material, providing learning guidance, eliciting the performance, providing feedback, assessing performance, and enhancing retention and transfer) represent what should be done to ensure that learning occurs. If you address each instructional event, you will have a solid foundation for creating effective instructional materials. You will need to determine what will be done for each instructional event for each learning outcome.

You can learn more about sequencing instructional events from another chapter in this textbook, Robert Gagné and the Systematic Design of Instruction.

Conclusion

The emphasis in this review of instructional strategies was on getting the fundamentals right. Regardless of what revolutionary tools or teaching approaches are being used, what we know of how people learn does not change a great deal over time, and we do know that learning is a process, and you ignore the factors that influence that process at your peril.

For learning leading to successful outcomes, it is important to remember that most students need:

- well-defined learning goals;
- instructional strategies linked with the appropriate learning domains;
- a proper sequencing of instructional events; providing a clear timetable of work, based on a well-structured organization of the curriculum;

- appropriate and engaging learning activities; with regular feedback
- manageable study workloads appropriate for their conditions of learning;
- a skilled instructor; regular instructor communication and presence;
- a social environment that draws on, and contributes to, the knowledge and experience of other students;
- other motivated learners to provide mutual support and encouragement.

There are many different ways these criteria can be met, with many different tools.

Remember these key takeaways when designing your instructional strategies:

- Learning domain classification (i.e., verbal information, intellectual skills and cognitive strategies, psychomotor skills, and attitudes) are best taught with different instructional strategies.
- Teach learning outcomes in the order that best facilitates learning.
- The four attributes of the Keller's ARCS Motivational Model are; Attention, Relevance, Confidence, and Satisfaction. Including all of the attributes may increase student motivation.
- The unique interests, experiences, and goals of each learner influence motivation.
- Instructional events include; gaining attention, informing the learner of the learning outcome, stimulating recall of prerequisites, presenting the material, providing learning guidance, eliciting the performance, providing feedback, assessing performance, and enhancing retention and transfer. (as reviewed in the chapter Robert Gagné and the Systematic Design of Instruction).

Application Exercise

You have been tasked with designing a university orientation course for freshmen community college students. Everyone at the institution is aware that students feel an orientation course is not necessary and that it is a waste of their time. Explain what portion of the ARCS Motivational Model might be applied into the design of the course to help students understand why this course is important for their success.

Instructional Design Prototyping Strategies

Jacquelyn Claire Johnson & Richard E. West

One of the differences between design as practiced in our field and traditional art is that our designs must not only be interesting, engaging, and even beautiful, but they must also be useful for someone—the end users or learners. Over 2,000 years ago, Marcus Vitruvius—a Roman architect—articulated that good architecture should rise to three ideals: *firmitas* (strength), *utilitas* (functionality), and *venustas* (beauty). In other words, a building should be strong and not fall down, it should accomplish its purpose (e.g. as a home or an office), and it should be beautiful to enjoy.

> *Instructional designers seek the same three ideals in our products. For us, we desire the learning environments we create to work well, teach well, and, well, be beautiful and enjoyable to experience!*

Prototyping is an essential skill and process for instructional designers to achieve these three goals. Despite careful and rigorous front-end analysis, user research, and attention to detail during development, it is nearly impossible to produce instruction that works perfectly the first time. However, through iterations of prototypes, we can evaluate how well our instructional designs are working, teaching, and being enjoyed by a group of potential users. This will increase the likelihood that final designs will be successful. In addition, digital technologies have reduced the cost of creating prototypes, which has led to a new focus on agile, lean, and rapid prototyping design models where prototypes are not a single step in the process, but instead, each stage of design development can be tested as a new prototype—and this continual refinement of the design through continuous evaluation may never cease (see Wiley & Bodily's chapter in this book).

How can we effectively prototype and test our designs? We can learn much about prototyping from other design fields. For example, it is standard practice to use visual representations of ideas—such as pictures—during the creative process in many design fields such as architecture (Bilda et al., 2006), film and cinematography (Teng et al., 2014), and engineering (Perry & Sanderson, 1998). This skill is so meaningful, graphic design instructors insist that it is vital to "equip students with the ability to make well-informed decisions about tool choice and tool use during design ideation" (Stones & Cassidy, 2010, p. 439).

Though graphic design is an inherently visual field, the use of prototypes has application in other design fields as well. For instance, extensive research demonstrates the usefulness of visuals in product development as a means of exploring problems and generating possible solutions. Prototypes help designers understand specific design challenges and make inferences about the situation (Suwa & Tversky, 1997). They also contribute to many aspects of problem solving (Dorst & Cross, 2001; Do et al., 2000). Research in cognitive psychology has established that the cognitive load of processing ideas is reduced for designers through the use of visuals.

Furthermore, studies show it is easier for designers to process complex ideas with visual prototypes rather than relying on working memory (Cash, StankoviÄ‡, & Štorga, 2014). Vicarious experiences can be provided through visuals, which allow designers to glean and evaluate the pertinent information without investing as much time or effort into creating the experience (Menezes & Lawson, 2006). Prototypes also can guide important design conversations "if they lead the team visually into a fruitful sequence of conversation steps" (Eppler & Kernbach, 2016, p. 96).

Key Prototyping Principles

Dam and Siang (2018) argued that during prototyping you should pay attention to the following:

- People—including those whom you are testing and the observers. Because we design for humans, we are particularly interested in how humans interact with and perceive the usefulness of our designs.
- Objects—including the prototype and other objects people interact with, because what people choose to do and the objects they choose to interact with can provide clues into why they like or do not like our design.
- Location—such as places and environments, because we can learn from where people choose to use designs, and why they use them in those locations, and what affordances those locations provide for using the design.

- Interactions—including digital or physical interactions between people, the objects, and the environment. This is particularly essential because the interactions we observe provide clues into how the design could be used, and any unintended outcomes.

Similarly in our field, Andrew Gibbons (2013) has argued that every instructional design is comprised of various layers, such as the following:

- *Content*, or the actual material to be learned
- *Strategy*, or the unifying framework about how the teaching/learning is theorized to happen, or how the tasks involved in learning should take place
- *Control*, or how students interact with and provide input back into the learning material
- *Message*, or the intended meaning the instruction is meant to communicate to the learner
- *Representation*, or how the layers of the design are presented to learners (visual, audio, touch, etc.)
- *Media-logic*, or the background structures that activate each component of the instruction at the proper time and in the proper way
- *Management*, or how data about people's use of the instruction is collected and managed to improve learning and communicate about outcomes to stakeholders.

A design prototype, then, should serve to test one or all of these components from Dam and Siang and/or Gibbons. In other words, a high fidelity prototype, created close before implementation, would likely try to test all of these components. An earlier prototype may focus on one or two, perhaps testing primarily the validity of the content or messaging layers, the ability of the learner to control the interface, or the reliability of the media.

Prototyping Stages and Goals for Each Stage

In our opinion, there are three key stages for prototyping, and there are different primary goals for each stage, as described in Table 1.

Table 1

Prototyping Stages and Goals

Prototyping Stage	Prototyping Goals
Static/paper—These prototypes can be created on paper or digitally, but typically are static and do not involve interactivity, graphic design, or other expensive features. These are often “Wizard of Oz” or paper prototypes, described below.	The primary goal is to test the logic of the design with users, experts, and clients. Do they think this is likely to succeed? Which aspects or attributes of the design do they think warrant full development? Does this design seem like a good answer to the instructional problem? Are we using the best content? What insights do they have now about how to present the final product (e.g. what media format, location, or scale should we aim for?)? This is also a good time to estimate the potential costs in time and money to develop the design, and to ensure all parties feel the scope is accurate.
Low fidelity product/process—These prototypes have minimal interactivity and visual storyboards instead of full graphics.	Low fidelity prototypes are produced to give users and clients a better idea about how a design may look and interact, and how instructional content and strategies will be presented. Things do not work perfectly, but the focus is on testing the ideas, interaction, and potential of the design.
High fidelity product/process—These prototypes should be nearly completed designs, and ready for rigorous internal testing.	First impressions often matter a great deal, so before launching a product with actual users, ready-to-launch prototypes should be rigorously tested internally or with a sample of users. This process is usually repeated multiple times with larger groups of people until there is confidence that most of the design bugs have been identified, the product works reasonably well, and users will be able to use the product as intended.
Beta or soft launch of the design—Many designers now choose to launch a design in beta form, allowing users full range of access to the design, but without a promise that everything will work perfectly.	The goal of this stage is to fully test all aspects of the design, including user satisfaction and implementation costs. However, by keeping the design in beta, there is still flexibility to redesign an aspect not working very well, and usually users will be more forgiving.
Full launch/implementation	Even when we feel a design is “done” or ready for launch, we continue to collect confirmative or “continuous” (Wiley and Bodily, 2020) evaluation data on how well it is working and make adjustments as needed.

Prototyping Strategies

There are many strategies to prototyping ideas. Essentially, whatever you as a designer can do to test out any aspect of your design is a prototype. For example, this can be something visual, tactile, auditory, or performance-related. Following are some of the most common prototyping strategies.

Sketching

Sketches are “rough drawings representing the chief features of an object or scene and often made as a preliminary study” (Sketches, n.d.). For an example of a sketch, see Figure 1. Because sketches are simple and easily created, they are used by designers in the automotive industry to develop new design concepts. Researchers studied six designers at the Ford design studio to understand the physical and mental processes these designers go through as they sketch. They compared the process of these professional designers to student designers to ascertain the differences between the two groups. Findings indicated that, when compared to novice designers, professionals have a greater understanding of physical dimension and used an iterative design approach in which they used sketches to facilitate problem solving and creative thought (Tovey et al., 2003).

Figure 3.3.1: *Sketch of Exhibit Design Layout*

Note. Many of the examples provided in this chapter come from museum exhibit design, which was the background of the lead author.

As illustrated by the automotive designers, sketches elucidate aspects of the parallel development of the designer and the product. Sketches allow designers to set out ideas spontaneously (Bilda et al., 2006; Segers et al., 2005) without investing much in terms of time (Rodgers et al., 2000; Stones & Cassidy, 2010) and money (McGown et al., 1998). Expert designers are more adept at using visuals, suggesting that visuals are often a part of their professional development (Bilda et al., 2006). These visuals also contribute significantly to the design process (Dörner, 1999; Jonson, 2005; Kavakli & Gero, 2001; Suwa & Tversky, 1997; Teng et al., 2014) and are said to be essential for conceptual designing (Bilda et al., 2006). Designers use sketches to focus their non-verbal thinking (Rodgers et al., 2000), consider the idea as both its component parts and as a whole (Bilda et al., 2006), and tap into the deeper meaning and implications of their ideas (Eppler & Kernbach, 2016). Sketching enlivens previously only imagined designs (Bilda et al., 2006; Tovey et al., 2003). Through sketching, designers can embody and explore ideas that are not fully developed (Rodgers et al., 2000), communicate the physical nature of an idea (McGown et al., 1998), and subsequently clarify its characteristics to determine what will and will not work (Dörner, 1999). All of these activities are critical in the product development process.

Storyboarding

Sketch methods lead to the creation of storyboards because key ideas and images can be created and then organized in a storyboard sequence (Teng et al., 2014). Storyboards are "a panel or series of panels on which a set of sketches is arranged depicting consecutively the important changes of scene and action in a series of shots" (Storyboards, n.d.). Storyboards are an exploration, analysis, and conceptualization tool generally used later in the design process once ideas from sketches have been evaluated and selected for development.

The development of storyboards often starts with a collection of individual drawings that represent single scenes, which are part of the whole design being drawn. Each separate depiction in the storyboard represents a specific scene or perspective. Taken together, they represent the sequence in which things will flow.

Storyboards are utilized in cinematography, live television, animation, and special effects to plan the details of how a story will be portrayed (Teng et al., 2014). In architecture, they are used to visualize presentations of projects by creating analog versions of proposed buildings that will later be digitally designed (Cristiano, 2007). In other design contexts such as industrial design, storyboarding is a way of visually recording social, environmental, and technical factors that affect the context of how end users will interact with the product (Martin & Hanington, 2012).

Storyboards were used by students at Georgia Institute of Technology in their industrial design classes. When working on a product development project to redesign travel luggage, students performed research about the needs of consumers as well as market standards as a basis for beginning their design project. After completing the research, students storyboarded their designs to show how luggage is handled through the whole travel experience from storage, packing, passing security, walking through the airport, boarding the airplane, loading it into the overhead bins, and ultimately back into storage. These storyboards facilitated discussions about various design features and how to prioritize them to meet user needs (Reeder, 2005b).

As this example demonstrates, storyboards can contribute to product development because they are drawn with the target audience in mind (Martin & Hanington, 2012) and visually describe how users will interact with the product. When designers examine design challenges in depth using storyboards, they can understand the complexity of the situation and consider individual portions of the situation while not losing sight of the whole (Reeder, 2005a). They can visually document how users will interact with the product and use this documentation to develop innovative product solutions that address the needs and expectations of users (Reeder, 2005a). In general, storyboards act as a visual budget, which helps the production process run more smoothly by planning and allocating resources effectively (Cristiano, 2007). Because nothing is fixed or unchangeable, storyboarding is a flexible way of trying out ideas and incorporating changes; ideas can easily evolve as they are drawn in storyboards (Glebas, 2013), as was the case with the exhibit pictured in Figure 2.

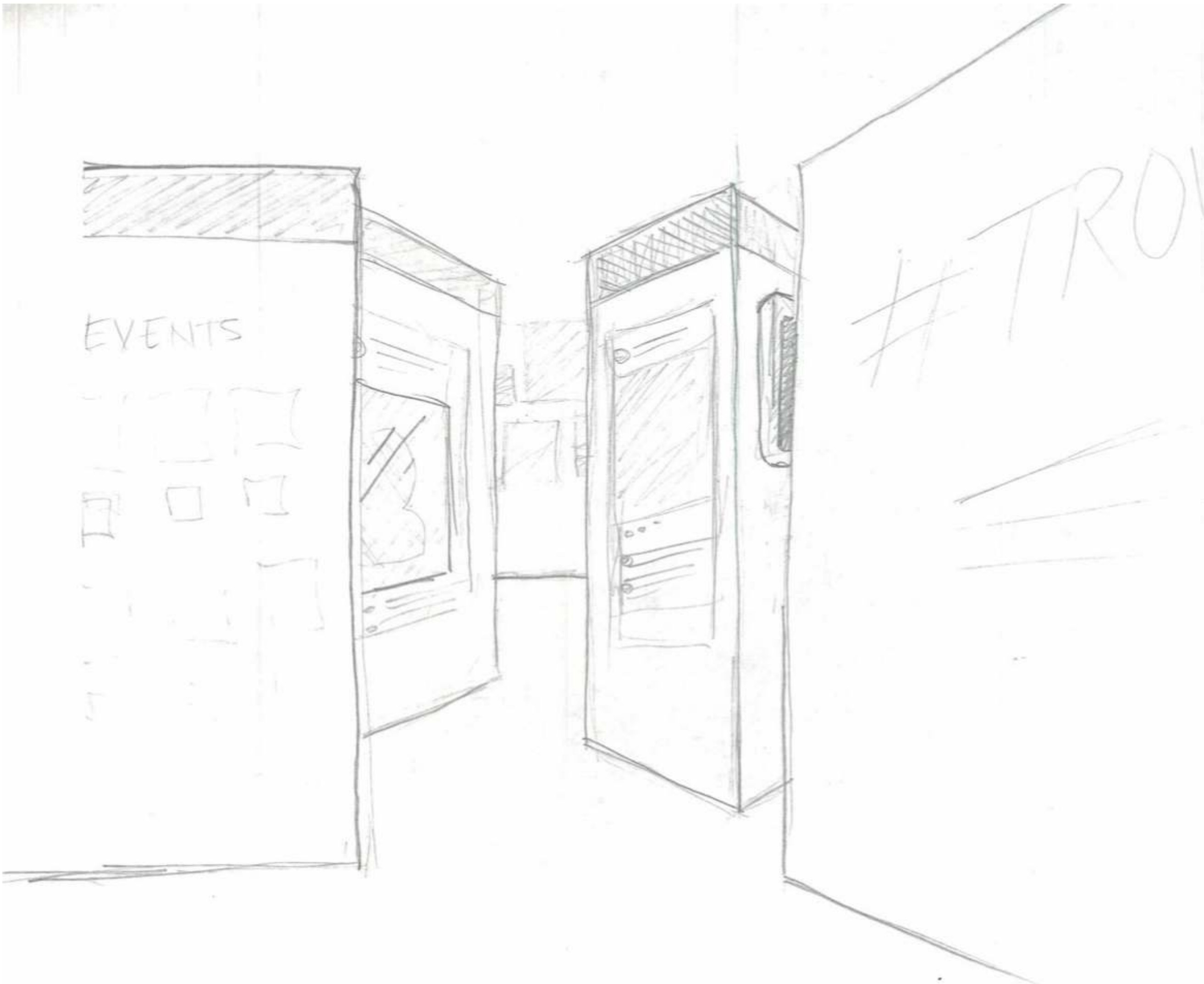

Figure 3.3.2: *Storyboard of Ostraka Layout*

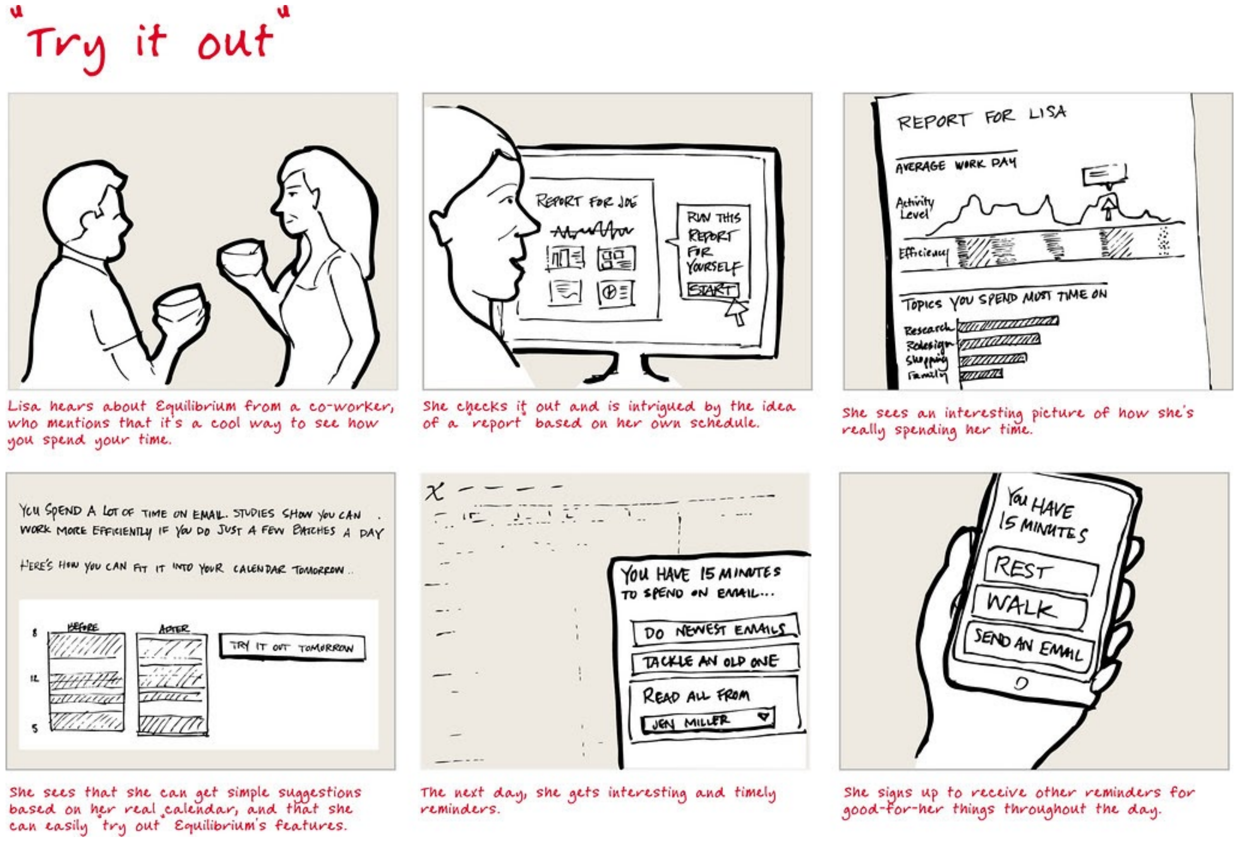

Figure 3.3.3: *Storyboard Example*

Note. CC-BY from Rosenfeld Media, available at https://edtechbooks.org/-kzST.

Product Builds

Product builds are any three-dimensional representation of an idea that an audience and designer can manipulate and experience. They can be as complex as working versions of a tool, 3-D prints, or even Lego/fabric-based lower fidelity builds. They can also be of varying levels of fidelity, as initial product builds may include a few layers of the design (such as the physical shape and visual coloring/representation). However, later prototypes can have increasing more fidelity, including prototyping various versions of audio, music, content, and dynamic interactivity to test how effective each new design element is.

Product builds are seen as an essential design activity because it allows designers to learn by doing as they explore ideas (Camere & Bordegoni, 2015). This is a practice common to many fields, including experience design (Buchenau & Suri, 2000), education (Barab & Plucker, 2002), engineering (Alley et al., 2011), social innovation (Brown & Wyatt, 2015), and instructional design (Merrill & Wilson, 2007).

As an example, engineers at a precision pump manufacturing organization were tasked with creating a new line of pumps for a food processing chain. The pumps needed to be more efficient and have fewer parts than the originals. The core design team was co-located and created prototypes to test their new designs. The use of prototypes contributed to the direct aural and visual communication team members had with each other. The prototypes were critiqued and approved, and in this way they structured the design process for the engineers (Perry & Sanderson, 1998).

As this engineering example illustrates, product builds are a valuable communication tool. They can provide a shared, tangible view of an idea and facilitate answering questions concretely (Yang, 2005). They can also be used to persuade others to adopt a new mindset because they tangibly demonstrate the merit of an idea. Prototypes can be a source of positive peer pressure to move forward with the development of ideas (Norris & Tisdale, 2013).

Product builds also reveal information about the designs through the process of fabrication. Creating prototypes reduces design risk because designers can learn about the product-to-be without investing the time and cost required for full production (Yang, 2005). This technique helps designers determine how to fulfill the tasks and requirements that must be accomplished for a given project

(Smith, 2014). Designers learn from the mistakes they make on prototypes and the feedback they receive about their prototypes, which then leads to improved designs, as was the case with the prototype pictured in Figure 4. This is an iterative process that continues until they reach a product that will accomplish the desired results.

Figure 3.3.4: *Product Build of an Early Iteration of a Museum Exhibit*

Bodystorming, or Role-Playing

Bodystorming is a method in which brainstorming is made physical. During bodystorming, role-playing and simulation with simple prototypes is done to create informative performances that illustrate what it might be like to use a product that is under development (Martin & Hanington, 2012). Bodystorming is a way of developing greater user empathy: designers immerse themselves in situations end users might experience and then focus on the decisions, emotional reactions, and interactive experiences users might have. This approach is based on the premise that the best way to understand an interaction is to experience it personally (Smith, 2014).

Participating in the interactions users might have can reduce the time designers spend studying documents of user observation. It allows them to tap into aspects that are unobservable because they have experienced these elements firsthand (Oulasvirta et al., 2003). This technique has the potential to help designers communicate better with their peers, clients, and end users because of the performance aspect of this type of visual (Burns et al., 1994).

Designers at the Helsinki Institute for Information Technology enlisted 10 researchers and industry representatives to use bodystorming to innovate ubiquitous computing technologies. They spent a full day bodystorming the interactions an elderly user group would have at an old age service house, subway station, the subway, the mall, and a grocery store. They identified problems related to activities performed at each of these locations and framed them as design questions. Those involved were split into two groups to perform the bodystorming. One researcher acted as a moderator, while another served as a group leader. These researchers recorded ideas that emerged and facilitated the experience. They found that bodystorming inspired researchers to become familiar with new contexts and improve their design abilities (Oulasvirta et al., 2003).

This example of bodystorming presents how this visual tool can support the product development process through facilitating communication across peers, clients, and users. Like the other forms of visual representation, it offers a shared perspective to all involved, which provides opportunities for further discussions (Burns et al., 1994). However, it contributes differently than other visuals. It allows designers to experience, discuss, and evaluate their ideas in context, and helps designers to understand how the settings in which a design is used can affect their intended use (Smith, 2014).

This approach is believed to be less error-prone than brainstorming because it allows designers to experience realistic constraints that can affect the user experience (Smith, 2014). In bodystorming, designers rapidly prototype ideas, which allows for immediate feedback on how the product works (Oulsavirta et al., 2003). Discussing the feedback brings up new issues for designers to explore (Flink & Odde, 2012).

Wizard of Oz Prototypes

In the movie/book, The Wizard of Oz, Dorothy and her companions seek the wisdom and power of the Great Oz to grant their wishes. However, what they thought was an all-powerful wizard was really a man behind the curtain, pulling levers and pushing buttons to give the effect of something magical happening. Similarly, in Wizard of Oz prototyping, the designer creates a low fidelity or paper prototype, but without the interactivity or dynamic responses from the system. Instead, when a user or prototype tester wants to do something, they indicate where they would go, or what they would click, and the designer provides the next low fidelity prototype example. In this way, they simulate the interaction that they will eventually build into the system. In essence, as Dam and Siang (2018) explained these are “prototypes with faked functions.”

Sometimes this “faking” can be more complex, with a human on one side of a screen typing responses to the user that appear to come from the computer. As another example, a popular experience at Disneyland theme parks is Turtle Talk with Crush (shown in Figure 5), where children talk to Crush, the popular turtle from Finding Nemo, through a computer screen. On the other side of the screen, the performers make Crush respond to the children in authentic ways that make Crush seem real. This perhaps also exemplifies an ethical issue with Wizard of Oz prototyping as many young children really do think Crush is real. Even with adults, some Wizard of Oz prototyping can appear realistic, and participants should be informed that they are not, in reality, interacting with a real product.

Figure 3.3.5: *Turtle Talk at Disney World*

Note. Photo CC-BY/SA from Josh Hallet and available at https://edtechbooks.org/-SmA.

User-Driven Prototypes

Dam and Siang (2018) described one final prototyping strategy, where instead of designers creating prototypes for users, the users create prototypes for the designers. They explained that this can be a way of understanding the users and developing empathy. "When you ask the user to design a solution, rather than provide feedback on a prototype, you can learn about the assumptions and desires that the user possesses. The purpose of a user-driven prototype is not to use the solutions that the users have generated; instead, it is to use their designs to understand their thinking."

According to Dam and Siang (2018), a designer sets up user-driven prototyping by asking users to design specifically to answer questions designers have. They provide the example of airport designers asking users to sketch or build what they think an ideal experience would look like.

Conclusion

Prototyping is an essential strategy for testing out emerging designs and refining ideas before expensive implementation launches. In addition, prototyping is an essential part of the design process itself because prototypes help to structure the collaborations on a design team and represent the distributed cognition of design teams and how ideas are negotiated by team members (Henderson, 1998). Thus, design cultures or styles are intrinsically tied to the way in which each constructs representations of their ideas. Such prototypes—e.g. sketches, drawings, bodystorming, etc.—are the heart of design work and constitute the space in which ideas are defined, refined, and negotiated. (Henderson, 1998, p. 141). A team's ability to create, interpret, and communicate with prototypes can facilitate or restrict how they interact as a group, making these prototypes "primary players in the social construction of the design culture or design style of the designing group" (Henderson, 1998, p. 140). Thus, it is essential that designers think deliberately about how they use prototypes as part of an effective team design culture.

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CHAPTER OVERVIEW

4: Evaluating

Design Critique

Brad Hokanson

Central to design and design education is the critique (Dannels, 2005; Gray, 2013). The methodology and practice of critique is how designs are improved and how design skills are developed in workplaces and within studio education around the world. It is where work is presented by a designer, criticized by others, its virtues and limitations debated, and the work improved.

By itself, designing is a challenge to any individual's abilities. Information must be gathered and analyzed and a guiding principle or idea must be developed and communicated to others. Designers must expose their work to the criticism of others and answer critiques with the quality of their arguments and improvement in the design. Critique looks at an idea—created through analysis and an inventive process, which is shared by the learner/designer—and advances its quality.

The design critique can provide instructional design with a means for intensifying the learning process as well as improving the design project itself. As a process, critique benefits the learner, other members of a class, and the critic.

Defining Critique

Used throughout the design and creative fields, "critique" is a formative, conversational method of interaction and assessment. It is the systematic and objective examination of an idea, phenomenon, or artifact. Critique is a semi-structured method of sharing work for evaluation and commentary by others; it is a discussion with a project focus. While there are a number of different forms and terms for the process, critique is used here to refer to formal and informal discussions involving design disclosure and criticism.

This writing focuses on the formative aspects of critique, and does not address final critiques or formal reviews, processes meant to conclude and evaluate a design project (see Figure 4). For less formal and individual scaled interactions, the terms "crit" and "desk crit" are commonly used. Here the focus is on critiques which happen during the design process.

Design critique can be compared with user testing. Both allow the evaluation of design projects and provide important feedback to the designer. Here the focus is on critiques which happen during the design process. In contrast, in user testing, most of the understanding of the quality of design work comes from observation of appropriate test users. Comments from the test users can be helpful, but often are limited by their experience with design or the project at hand. On the other hand, critique generally deals with peers or mentors with experience in designs of this project type.

In the first major studies of these interactions in the design studio, Donald Schön (1983, 1985, 1987) directly observed architectural education. His writing described the individual consultations between studio instructors and individual students. The intensity and focus of this type of learning event is the essence of an effective studio education, it is not didactic. At its most positive, a critique is meant to “coach” or “guide” the learner to a more effective answer, develop judgment, and model tacit design/problem setting and solving skills. Per Schön, “The student cannot be taught what he needs to know, but he can be coached” (1987, p. 17).

Forms of Critique

There are a number of different structures for critique. Blythman et al. (2007) describe a variety of critique forms which range from final reviews to industry presentations to individual critiques. In this writing three of these forms are described as central to design and education: desk critiques, peer crits, and group critiques. Each of these types is formative, designed to encourage and direct design progress, and are qualitatively the most effective.

Within a studio learning experience, the development of design skills is commonly sought through a form of informal critique or desk crit (see Figure 1). A desk crit is “… an extended and loosely structured interaction between designer and critic (expert or peer) involving discussion and collaborative work on a design in progress” (Shaffer, 2003, p. 5). In general, most of the activity during scheduled class time in a design studio will be individual students receiving criticism of their work from instructors or visitors.

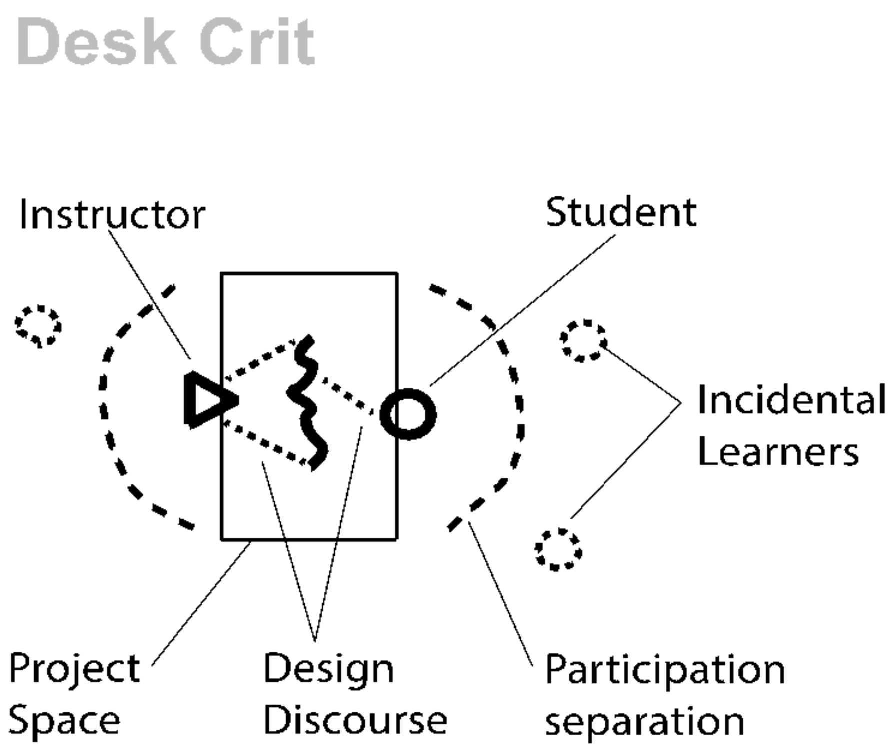
Desk Crit
Instructor
Student
Incidental Learners
Project Space
Design Discourse
Participation separation

Figure 4.1.1: *Desk Critique (illustration by the author, photo courtesy of University of Minnesota College of Design)*

“During a crit, a student describes his or her work to the professor…As students present possible solutions, the professor explores the implications of various design choices, suggesting alternative possibilities, or offering ways for the student to proceed in his or her exploration of the problem” (Shaffer, 2000, pp. 251–252).

The desk crit is a personal conversation between a designer and a critic (who may be a visiting professional, expert, or professor). The length varies with the discussion. “This model of social interaction between student and instructor involves a critical conversation about the student’s design, and usually involves both people working towards solving a problem” (Conanan et al., 1997, p. 2). It is inherently formative, guiding the work toward a more successful conclusion. It is also subjective, and when successful, provides not only objective answers but directions focused on developing the designer's ideas and thought process.

An important concept in effective critiques is the focus of the criticism on the work itself and not on the designer. A positive, formative atmosphere is essential to an effective critique; grading and evaluation occur elsewhere. Shaffer described this nature:

“The tone of desk crits was almost always supportive and nonjudgmental. On the other hand, pinups and reviews, although constructive, were quite blunt and sometimes extremely critical—particularly in the case of formal reviews. Judgment was, in effect, off-loaded from the more private desk crits to the more public presentations” (Shaffer, 2003, p. 2).

Non-participants also can benefit from the individual desk critique both through direct observation and through incidental listening to the process. While not as formalized as a lecture, within a studio space, frequently there are informal observers who gain from hearing another's desk critique.

Talking to two student designers at a time may be more effective as it allows designs to be compared and more designers to be critiqued in a given time period. It does, however, lack the focus and attention found through the individual critique.

While access to instructors is limited, other members of a class or team are available at any time to provide opinions, clarifications, and evaluations through a peer critique, inside or outside of formal meeting hours. This is the simplest form of critique in design, the "peer crit", where design work and ideas are discussed between colleagues (see Figure 2).

Peer Crititque

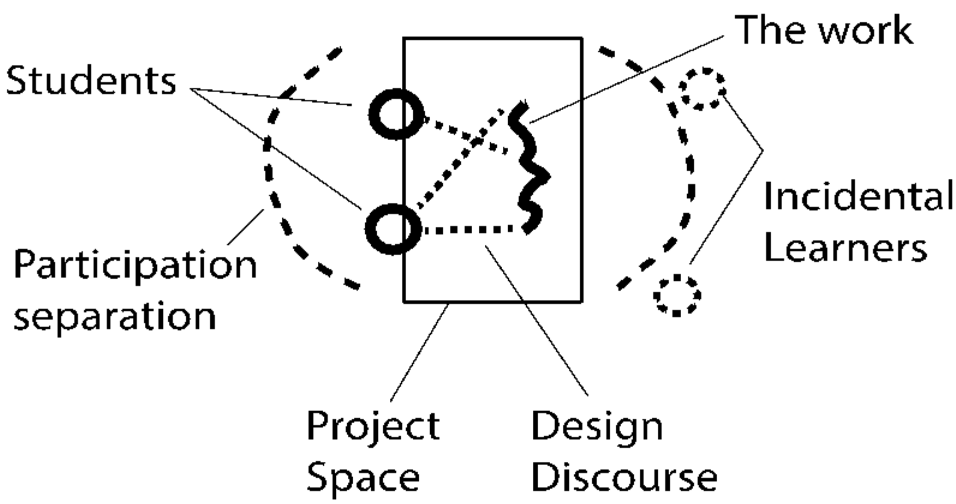

Figure 4.1.2: *Peer Critique (illustration by the author, photo courtesy of University of Minnesota College of Design)*

Any critique develops both the critic and designer. While they can provide an external review of one's design decisions, peer crits also provide the critic with the opportunity to extend their own skills. Peer critics review the validity and logic of a particular design idea or set of design choices. While peer crits may be the least formal format, they are the basis for an extended professional understanding of the use of critique. This practice occurs in a range of fields from graphic design to architecture to user-experience design.

An individual working session with a single student can change learners' minds and their thinking process, providing, as Shaffer describes it involves social scaffolding of learning the design process. At its core, critique as part of an educational experience is constructivist. While the focus is on an external project, the overall goal of the critique is to develop the designs skills of the learner.

"He [sic] has to see on his own behalf … Nobody else can see for him, and he can't see just by being "told," although the right kind of telling may guide his seeing and thus help him see what he needs to see." (Dewey 1974, p. 151)

The importance of the informal critique in the development of learners in the studio classroom is clear. Frequent engagement and discussion of ideas scaffold the experience, while the designer tacitly recognizes the value of engagement and collaboration with other professionals by seeking criticism from others.

Designers who participate in critique may do so as a critic or as one being critiqued. Both roles have cognitive benefits to the individual designer and to their broader understanding of design. Designs are developed conversationally, building from the initial ideas of the designer, but tested and improved through the argumentation like process of a critique. Criticism of the work can help improve the quality of the end-product. Over time, exposure to critique can also help develop thinking skills of the designer building their capability to analyze, anticipate, and respond. For a beginning designer, a first critique may be challenging and helpful comments may be rejected. Often the criticism of the work is conflated with criticism of the designer themselves, when they should be separated. Discussions must focus on the work, and not on the designer.

Small groups can also observe and participate in formative group critique as well, with selected projects serving to trigger discussion and interaction with all present. In studio format learning, intermediate group critiques can have much of the same coaching or generative functions as individual critiques. Whether as a group crit or pin-up, these can highlight specific milestones in a project development. While similar in form to final reviews or "juries", the distinguishing quality is one of development and advancing the work of the individual designer and benefiting the group from generalizable comments. It is inherently formative and positive.

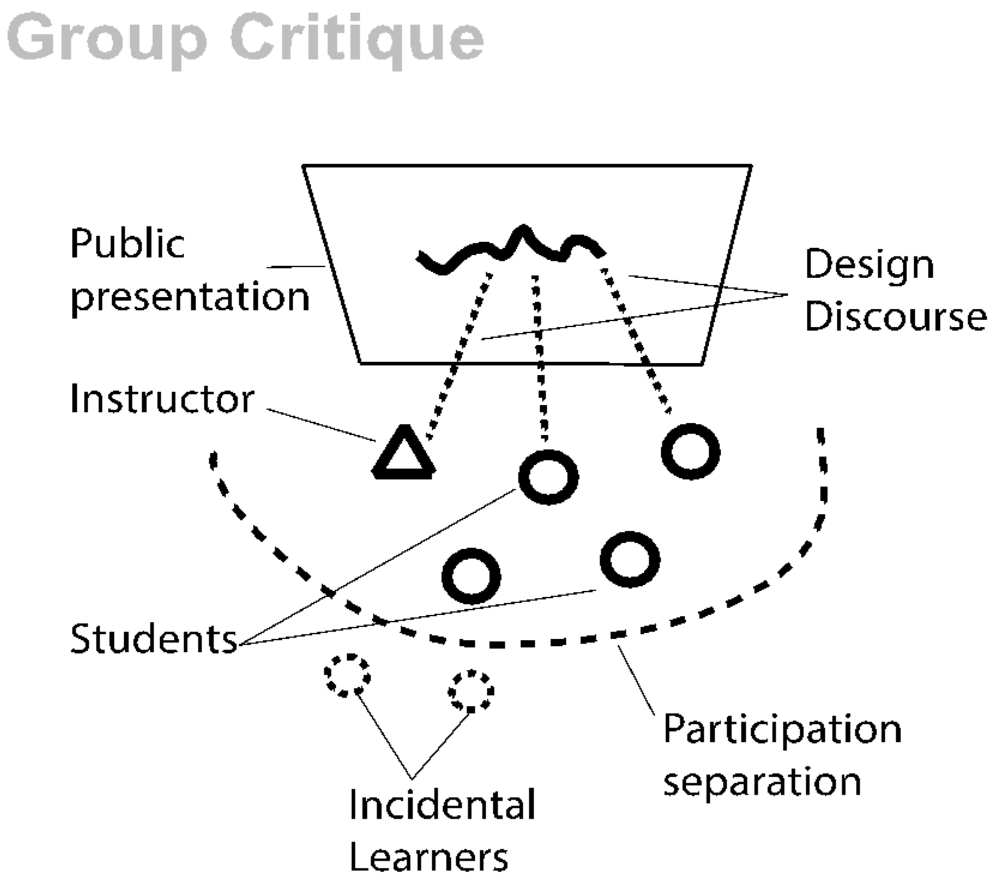
Group Critique
Public presentation
Design Discourse
Instructor
Students
Participation separation
Incidental Learners

Figure 4.1.3: *Group Critique (illustration by the author, photo courtesy of University of Minnesota College of Design)*

A general, but often tacit goal of design education is to instill a habit of critique, and an ongoing practice of generative evaluation of creative work. Critique supports reflection and engagement among designers of all types.

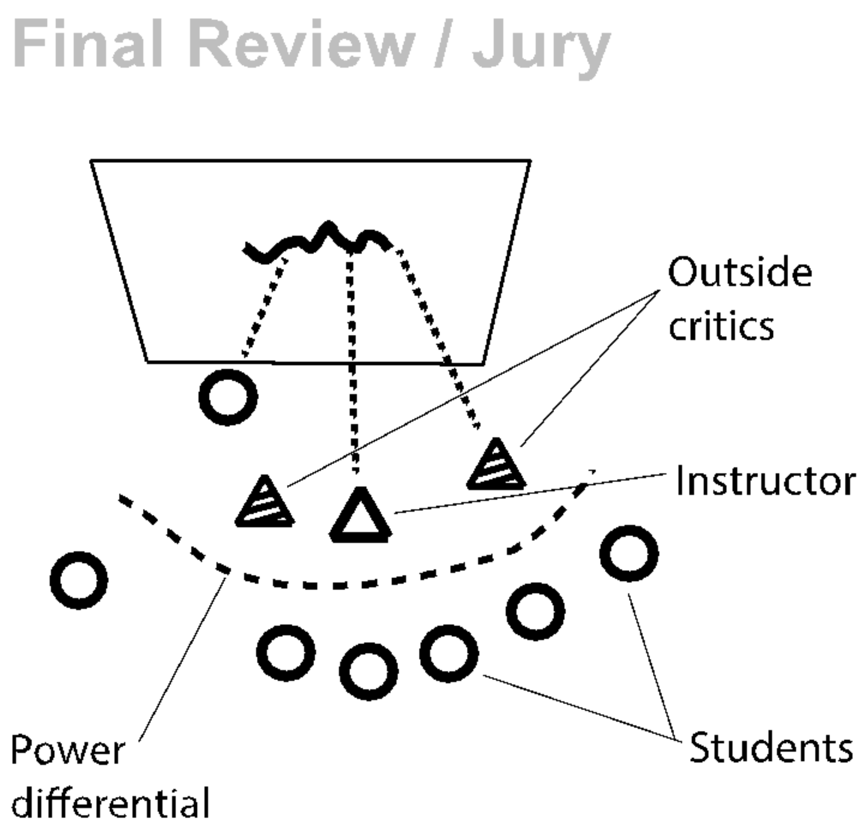
Final Review / Jury
Outside critics
Instructor
Students
Power differential

Figure 4.1.4: *Final Review (illustration by the author, photo courtesy of University of Minnesota College of Design)*

Use of Critique in Studio

Studio-based education is learning by designing, a rich and complex process. Designers in all fields examine problems, advance possible exploratory resolutions, and iteratively evaluate their own work as a regular part of the design process. This process occurs through personal reflection and evaluation, but it can also be improved through the interaction with others through as Shaffer calls "…a variety of structured conversations…" (2003, p. 5). An important aspect of learning design is developing the professional practice of seeking and giving critique; the formal and informal evaluation of the work. It is one of the consistent aspects across design programs and schools worldwide, and importantly, in design culture. As a generative format, the critique process focuses on the improvement and development of the design project.

The use of the studio model in instructional design has become increasingly common over the past ten years (Clinton and Rieber, 2010). Studios are based on the ideas of project-based learning and modeled directly from pedagogical methods in the creative fields such as studio art, architecture, and product design. "The originators of the studio curriculum [at the University of Georgia] … envisioned the learning of educational multimedia design to that of an art or architectural studio in which a group of people learn skills and develop expertise while working on authentic projects in a public space comprised of tools and work areas" (Clinton and Rieber, 2010).

Application in Instructional Design

Instructional design education can benefit from the models presented in studio-format classes. Instructional designers also can utilize the general concept of critique in various ways in design products of their own. However, not everyone is experienced with critique or even studio-based learning in an educational environment. Design schools have the advantage of a well-developed and expected critique model; the scaffolding is explicit and the instructors are well versed in the process.

It is valuable to start using and employing critique as a method as a learner, as an instructor, and as an instructional designer. The suggestions below intersperse these roles, describing critique from these three different orientations.

Designers, even those without experience in studio-based learning, can start by opening themselves to critique as an educational method. Beginning can be as simple as developing a habit of asking peers or friends for informal feedback on a project. The author's own second year architecture critic began the year by saying "You have to expose yourself.", encouraging our own sharing and interaction regarding design ideas. (Stageberg, 1973).

Peer critiques can be done at any time, whether during scheduled class time or at off-hours, exposing project ideas to others' opinions and assessments. Critique can also be done between designers, developing their skills of synthesis and evaluation, and expands the learning process…and importantly as a way to improve the design work itself. [An application exercise is included at the conclusion of this writing.]

Designers seeking input on their work can begin by specifically focusing the critique on areas for improvement. A peer critique should start with briefly describing the problem or design and outlining the objectives of the project. Present is an understanding of the immediate goal of the critique being improvement of the design solution (Gibbons, 2016). As with writing, the goal is to seek a larger understanding of the logic and tone as opposed to a copy edit.

While a critique is in progress, designers can help steer the direction of discussion to more important issues by focusing on discourse within the design work, and by seeking evidence and the reasoning behind any criticisms.

Critiquing a colleague, peer, or student helps in developing one's own reflective ability to analyze and criticize design work. Critiquing the work of others can help make one a better designer in the long term, and improve design projects in the present.

While giving a critique involves evaluating the work for errors and problems, it can also delve into the more philosophical and theoretical aspects of the project. For example, an instructional design could begin from a behavioral basis or a constructivist basis, which is a place for philosophical advocacy.

For instructors, individual critiques can be described as a regular system of tutoring individual learners, driven by attention and engagement. Critique is contemporary and formative feedback, engaging, and scaffolds the design process. The skills of critique should be consciously developed in learners both as recipients and for their role as critic. The critique model is extendable, as individuals can be paired or grouped as need be, building collaborative learning events. A formative critique is comparable to reviewing a written article draft for a colleague, building on their ideas and their thinking.

Critics or instructors themselves will need to begin by modeling a positive and formative approach to a constructive conversation. Faculty will need to have a consistent pattern of using critique for helping learners develop their ideas as well as their thinking process. Explicit standards for both the interaction and the quality of the work are helpful. Individual "desk" crits can be either private or public, and faculty can encourage other students to informally listen in. As individual critiques can be face-to-face or online, they can continue to allow others to participate or view. Establishing individual critiques as an educational practice in a course can build to conducting small group critiques as well.

Instructional designers have the opportunity to build into their designs open frameworks for critique. A framework can, for example, support student peer critiques, user testing of interactive designs, verbal critique of visual layouts, or a shared review of a colleague's writing. In most cases it would be important to develop critique skills in learners to help improve responses. The goal of any particular critique is progress toward improvement of the finished design, with the overarching goal of improving learner thinking. It is valuable for a learner or critic to review over all ideas and evaluate their validity and consistency, and to be present, positive, and engaged. Critique is a structure that can be built into instructional designs.

While critique is valuable for both face-to-face and online learning, there are challenges that exist with the increasing use of technology-enhanced learning. The fluidity of conversation, whether online or in-person adds much to a critique, even if done through sharing screens and talking synchronously, which is now possible with some course management systems. Critiques should be done in a manner providing the highest fidelity of communication possible; while face-to-face is valuable, most synchronous critique can be done through video conference software. A current example would be online music lessons connecting, say, a violin player in Japan with an instructor in Finland (Furui et.al., 2015; Nishimura, 2017).

Asynchronous critique may be less effective, but can still provide direction and formative assessment through mark-up and annotation. Unfortunately, there isn't the same interaction with a "Track Changes" review or with software such as VoiceThread as with a face-to-face conversation, but with investigation, structuring of the conversation could be improved. Online written texts can be combined with synchronous audio for editing sessions as well.

Conclusion

As with any educational practice, there are limits to the use of critique in education. More commonly, the limits on the use of critique are due to time and the one-on-one nature of an instructor critique. Modern economics necessarily constrains the amount of time spent reviewing, analyzing, and being involved with individual critiques. Lecture classes and objective evaluations are simpler and much more financially viable in 'presenting' a large class than is a single design instructor working with individuals in a smaller studio class. This is a continuing source of pressure on design departments. Pragmatically, class size and time limit the availability of critique as an educational method.

Critiques do vary in quality as well as scale. Some critiques are helpful and advance the work, others challenge the designer's thoughts, leading to new insight for future work. Other critiques, of course, are less successful, perhaps focusing on the traits of the designer and not on the design itself. Critiques which focus primarily on minor details, facts or factual error are often distracted from larger, more important issues. Critiques which are simplistic and present criticism without evidence are not helpful, nor are those which are overwhelmingly negative or positive. The goal of a good critique is to make the design and designer better, and not to express a power relationship.

The skills of the reviewer, whether educator or peer, are also important—recognizing the social and formative nature of the interaction. However, it is within the systemic role of instructional designers to extend a valued and effective model to the technology-enhanced learning of today.

Critique can be integrated into instructional design models and education. It can be the way instructional designers learn, and an important aspect of how they practice.

Application Exercises

As a concluding exercise for this writing, try the following process. At some point in a design project, whether with early sketches or more developed ideas, contact a peer who is working at a comparable scale. It might be the same type of project or one that has similar requirements and standards. Ask if they would be willing to critique your work, and offer the same input on theirs. Review the following process and set a reasonable time scale for the critique, with enough for discussion of both efforts.

For the critique itself, first give your colleague a brief outline of the current progress of your work and focus the critique on areas of concern you may have. Solicit a comparable set of information from your partner. Spend a reasonable amount of time examining the project, depending on the scope of the project and on your agreed upon time commitment. Take notes, and try to synthesize your understanding and experience with their work. With a goal of seeking to improve the work, discuss your findings with them, and in turn, learn of their findings. Restate what you heard in your own words to them for confirmation and clarification.

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The Role of Design Judgment and Reflection in Instructional Design

Ahmed Lachheb & Elizabeth Boling

As a student of instructional design (ID), or as a future ID practitioner, you will have to make many decisions that allow you to move forward in your design work. Such decisions will be informed in part by the particular situation you are dealing with, influenced by precedent design experience (see more about design precedent here), and inflected with your values and ideals. Making decisions is a fundamental human capacity. When designing, designers make decisions specific to design. The capacity to make solid design decisions is what distinguishes excellent designers from mediocre designers. So how can designers make solid decisions? The answer is through evoking good design judgments and constantly reflecting on their design work.

What is Design Judgment?

When designers face complex situations—a constraint, a problem with a client or another design stakeholder, a block in the design process—they need to make design judgments to reduce the complexity of the situation or solve the issue that has been encountered. Depending on the situation, a specific design judgment is invoked to make design decisions. In the area of general design theory, Nelson and Stolterman (2012) have identified design judgment as "essential to design. It does not replicate decision making but it is necessary" (p. 139). In this definition, the authors distinguish judgment from decision-making. Design judgments for them are the means to achieve "wise action" (p. 139), or—in other words—good design decisions. In this way, designers can think about design decisions as the "what and how," of design, whereas design judgments have to do with the "why" a design decision has been made (see Figure 1).

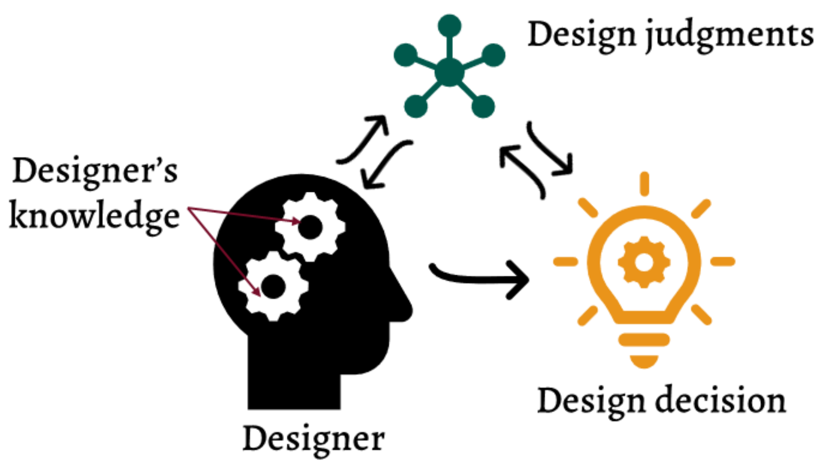

Figure 4.2.1: *How Are Design Judgments Related to Design Decisions?*

Design judgments rely on different types of logic than rule-based systems. For example, imagine you have been tasked to design an instructional module to be delivered online. You are now faced with the choice of making this instructional module in the form of video, or text, or text with visuals and a video. Eventually, you will make a decision about which form the instructional module will take. That is the design decision. What allows you to make such a decision are your design judgments (e.g. preference for videos over text, based on constraints you perceive in the design project or your past history as a designer). Design judgments are based on your own knowledge. This knowledge cannot be separated from you, the designer, but it is not arbitrary either. Your appreciation of media and understanding of time and tools are disciplined, based on intuitive but very rational logic, generated from "the particularity or the uniqueness of a situation" (Nelson and Stolterman, 2012, p. 141).

Designers’ Design Judgments

Nelson and Stolterman (2012) have proposed a construct comprising eleven design judgments that designers invoke. A summary of these design judgments is available in Table 1. We, as authors, recommend that you read more in-depth about these design judgments in Nelson and Stolterman’s (2012) book, The Design Way.

Table 1

General Summary of Design Judgments and Examples

Design Judgment	Definition	Example of Design Judgment in Action
Core	Designer's own value or thinking that can lead to invoke all other above design judgments	Designer advocates and insists on a designing discussions activity because they firmly believe that learning is interaction
Instrumental	Selecting and using design tools/means to reach established design goals	Drawing icons using a digital tool or using a paper and pencil, or selecting to use a MAC vs. a PC for design work
Framing	Defining the boundaries of the design project by emphasizing its focus and outcomes	Deciding whether to design an academic course, a workshop, a performance-support handout, etc.
Default	Generating "automatic" response to a situation without hesitation, and without too much thinking	Asking an SME to meet for a design project kick-off meeting because that is the first thing you do in all of your design projects, no matter what
Deliberated Offhand (DOH)	Recall of previous successful default judgments, consciously	Emailing an SME about a first meeting and providing them with options of when to meet and whether the meeting is face-to-face or online
Appreciative	Emphasizing certain aspects of a design, and backgrounding others	Appreciating the work a media developer has done but not emphasizing the challenging relationship they had with other project's stakeholders
Quality	Finding out the match/mismatch between aesthetic norms/standards and the particular proposed design artifacts	Discussing the quality of a slide deck presentation with a critical eye and through referencing branding guidelines of the organization and/or aesthetic design norms in regards to colors, visuals, and typeface, such as CARP principles
Appearance	Assessing the overall quality of the design	Examining the overall path of a learning experience in a course design, and stating whether it feels cumbersome, boring, clunky or smooth/friendly
Navigational	Considering a path/direction to follow in completing a design task	Consider inviting an external SME to provide expertise about a specific subject area that the current/available SMEs lack so you can fill a content gap that other SMEs and designers identified
Connective	Making connections of objects together for the specific design situation	Considering how a design of a lecture in an academic course is related to another learning activity/assessment, and whether there is a connection and or alignment between these two design objects or not
Compositional	Bringing all elements of design together to form a whole	Considering how to place learning objects within structures of modules to form a whole, complete, and smooth 16-weeks long academic course, in a way that lectures and discussions precede exams and major assignments

As a student of instructional design, there are the three of these design judgments that play a critical role in instructional design practice, and that will be examined more completely.

The first is *core judgment*—"buried deep within each individual, but unlike off-hand judgments, they are not easy to access" (p. 154). Designers invoke core judgments often in an unconscious manner because it stems from designers' own values or thinking that can be revealed through "why" questions (e.g., a designer advocates and insists on designing discussion activities because they firmly believe that learning is interaction—that is their core judgment). Core judgment is behind every other design judgment. It is, in a sense, our human capacity to have tacit knowledge, beliefs, and own philosophies. Designers invoke core design judgment to make design decisions, including those based on prior experience.

The second is *instrumental judgment*—"interaction with their [designers'] materials and the tools" (p. 152). Instrumental is used here to mean 'instrument' and not to mean 'important.' Designers invoke instrumental judgments to decide on which design tools to use or not, and how to use them for their design projects (e.g., drawing icons using a digital tool or using a paper and pencil). This judgment is one of the most invoked judgments as it is concerned with design tools—all kinds of means that designers use to design, regardless of their form—and because design tools encompass almost every design activity. Design tools could be abstract/theoretical or tangible, analog, or digital. If you are curious, you can read more about design tools in instructional design practice in Lachheb and Boling (2018).

The third is *framing judgment*—"defining and embracing the space of potential design outcomes … [it] forms the limits that delineate the conceptual container" (Nelson & Stolterman, 2012, p. 148). In evoking this design judgment, designers discuss the goal of their design project (e.g., designing an academic course, a workshop, a performance-support handout, etc.) in order to frame what the design project is about. Framing judgment is also invoked throughout the progress of a project that involves deciding what is important to focus on next.

Guidance to Develop and Invoke Design Judgments

You might be asking now, "What design judgments should I make? Which ones are the best design judgments? How will I know? How does a designer learn to make good design judgments?" These are very legitimate and important questions. Frankly, these questions are what actually spark many research studies on design practice; answering them is not as straightforward as one sometimes wishes.

First, it is important to think about these design judgments as not isolated units, but rather like pearls that are connected to each other with strings. If you take one pearl and you hold it up, then the other ones just hang as a cluster underneath because they are connected to each other (E. Stolterman, personal communication, November 18, 2013). Designers often invoke a number of design judgments together—always interconnected and often overlapping (see Figure 2). That being said, as you are practicing design, you will be making these design judgments at all times, most of the time unconsciously. Now that you read about them, you can think about them in a conscious manner and watch for when a design judgment you invoke does not lead to the desired result.

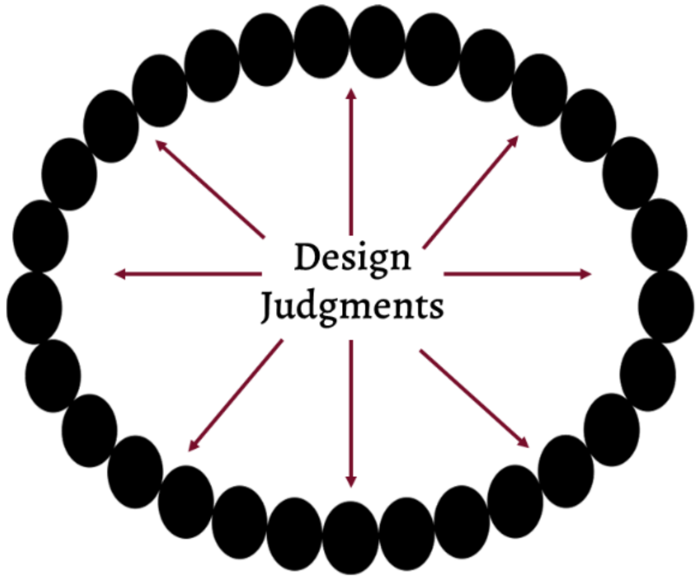

Figure 4.2.2: *How Are Design Judgments Interconnected?*

Second, all of these design judgments are important to help you navigate the complexities of your design projects. However, as mentioned earlier, the most important design judgments are core, instrumental, and framing. Core design judgment is connected to every design decision—there is always a personal belief behind every design decision you make. Instrumental design judgments are concerned with design tools—every aspect of your design projects involve using design tools of all kinds. Framing design judgment allows you to set up the whole design project for success or failure, from the very beginning—if you frame your design project incorrectly, there will be money and resources wasted, not to mention upset clients and supervisors. Third, knowing which design judgments are you evoking, what design judgment you should or you should not evoke, and how you learn to make good design judgments are always matters of deliberate reflection on your design practice—a topic addressed in the second part of this chapter.

Finally, as a designer, you will face many situations when you feel uncertain; you can make several design judgments but you are not sure what is the right choice to make. Uncertainty is a hallmark of the design profession and our advice is to embrace it, not to be afraid of it. We, the authors, also advise you to trust your instinct and remember your rigorous design training. Additionally, taking time to think and studying your design context should equip you with powerful insights to help you make the right choice (e.g., using the instructional theory framework to inform your design judgments). You can also seek mentorship and consulting from senior designers to help you deal with uncertainty, and ultimately make good design judgments.

Examples of Design Judgments Invoked by Instructional Design Students

Some researchers in the field have studied design judgments and how students of instructional designers invoke them (Demiral-Uzan, 2015; 2017, Korkmaz & Boling, 2014). From the studies of Demiral-Uzan (2015; 2017), the authors provide the following examples of design judgments invoked by ID students as they are designing instruction during graduate-level instructional design courses.

Example 1: An instructional design student was asked to design an instruction for their final project. This student decided to design a course for advanced Chinese ESL learners about business emails. This student invoked a framing and navigational design judgment because when asked by the researcher how they decided to design this instruction, they said: "How I came up with that specific topic and why is that, very simple. I mean, what's the most practical, more effective easy to me, something that I am at least familiar with, something I already know" (adapted from Demiral-Uzan, 2017).

Example 2: A group of instructional design students came together to discuss their group project in their instructional design course. Their discussion was focused on the content of the instruction and the flow of information they wish to present in the *instruction. A researcher observed and recorded their interaction. Each statement that a student says points to design judgments being invoked and overlapped:*

Student A: Should this go first or after the overview? (Appearance, Quality and Connective design judgment)

Student B: This comes after the content on my part. (Default, Appearance, Quality and Connective design judgment)

Student A: Your approach is different than mine, which is okay. For learners to understand what networking is, the definition of networking will come here first, then tell and show them what is networking is not. (Appreciative, Core, Quality and Compositional design judgment)
(adapted from Demiral-Uzan, 2015).

What is Design Reflection?

Reflection is the personal and the internal building of knowledge through considering and interpreting one's experiences or beliefs (Tracey et al., 2014). It is usually a method to solve problems, as well as to define and refine one's beliefs, values, and perspectives. Reflecting on your design work, its qualities, process, and outcomes, allows you to become aware of your tacit knowledge and learn from your design experience. Donald Schön—a prominent design scholar and a design educator—has identified two types of design reflections (Schön, 1983): (1) Reflection-in-Action; and (2) Reflection-on-Action.

Reflection-in-action is that internal dialogue that designers have as they are engaged in solving a particular design problem, or while using a specific design tool. For example, you could be working on designing a training program. You face a complex situation where the capacity of the software you are using to develop the training materials is not allowing you to create a specific interaction you wish to create. You could ask yourself something like "How do I get around this? Should I use another software or try to think of another way to create the interaction the client and I want to see?" This self-questioning is essentially the internal dialogue you could have, which constitutes "reflection-in-action." You could have this internal dialogue without being aware of it, as most of us think and reflect unconsciously and in silence. Eventually, reflection-in-action allows you to establish a ground to make decisions and work toward a resolution of the problem (Schön, 1983).

Reflection-on-action has to do with looking back at past design experiences, to make sense of what happened, what worked well, what did not work well, why taking one design approach seemed to be better than the other, etc. Many designers recognize reflection-on-action as what happens in design "post-mortem" meetings—a dialogue between designers who reflect upon their experiences, practices, and beliefs. Reflection-on-action dwells upon subjective interpretations of events, situations, and ideas. It is personal and can be hard to express. Nevertheless, this type of reflection is proven to be an effective practice to learn from past designer experience, so future design experiences are optimized. Additionally, when designers experience failure, only reflection-on-action could allow them to process that failure, learn from it, and essentially become aware of future modes of failure that might come their way.

An Example of a Design Reflection by an Instructional Design Student

Kaminski et al. (2018) has illustrated several design reflections written by ID students. One example is shared in this chapter, and you are encouraged to read more—as shared by Kaminski et al. (2018).

"One of the hardest lessons I learned from the instructional design course (and still struggle with), is articulating my decisions and actions onto paper. The best advice I received from Dr. Kaminski is to approach instructional design with the mindset that you are making something that another instructor (without any prior experience) can recreate. I think my difficulty comes from the many steps that I personally revisit and parts that I revise with research and experience. It is hard to describe all those directions that my mind takes to come to a final product. The picture I drew allows me to provide an abstract visual of all those steps. The student is the 'key,' the center of my purpose. As the 'doorknob, it is my responsibility to make sure all the working parts are in place so that the individual can open the door to knowledge. Begin by identifying the goals of the training event, analyze the learner, and the method for instruction, and verify the performance objectives. Start on outer edges and spiral toward the middle, and then through evaluation back out and spiral back in again until you get through the door. Goals are set – look at the learner and environment to

make it work. Facilitators need to address all the pieces and parts of the classroom component, so the facilitator ensures the student has what they need to open the door."

As you can see in this example, the student expressed how hard it was for them to make design decisions. The student reflected on what they believe to be the appropriate design moves, how to begin, and what the design should be focused on. Toward the end of the reflection, the student expressed a set of values and ideals—core design judgments.

Design Judgments and Reflection: Recommendations for Instructional Design Students

The Reflection Journal

Some designers keep a journal. Some designers turn parts of their journal into a blog or a website where they reflect on their design work publicly. Commit to a journal in the format you prefer–a simple notebook, a Google document, a blog, a video, a podcast. Start your first entry about the last design project you completed in class and address the following prompt (adapted from Tracey et al, 2014):

Describe a time when you felt totally uncertain while working on this design project. Try to remember how you felt and what was the greatest challenge(s) you faced because of the uncertainty you felt. What actions did you take to overcome such uncertainty? How did it go? Why did you take certain actions and not other actions? What did you believe to be happening vs. what actually happened? Knowing that you will feel uncertain in future design projects, how do you feel about becoming a designer?

Start writing the reflection post using descriptive language. You should not worry about grammar and typos at this stage. Let the words and thoughts flow and make their way from your head to the journal. Pay attention to how you felt and what thoughts you had at the moment. Think about if someone reads this reflection, will they understand what was going on in the design project? Will they get to feel how you felt? Don't limit yourself to formal writing. Write as you think and speak. Once you complete this first entry, share it with your ID faculty or another designer if you feel comfortable.

The following are some ways to document design reflections:

- Pick what you want to focus on for each reflection—a challenge with a designer, a moment of design failure, a harsh critique from a client, or an SME; you pick.
- Describe your design actions by addressing the Five Ws (What, When, Where, Why, Who).
- Elaborate on the "Why" part so you can reveal the design judgments you made that led to these design actions.
- Speculate on the "Why" when speaking about other's actions, unless you are certain.
- Conclude with what you have learned from this design project—what you will not forget to do next time? To what extent this design project will be similar to future projects you anticipate?

Exploring Your Core Design Judgments

People are surrounded by designs they use every day, and some they cannot live without. Commit to a week of noticing and collecting—through photographs—designs that you appreciate and designs that you do not like at all. These could be the items you use every day, such as your phone, the showerhead in your bathroom, a specific app, or a favorite frying pan in your kitchen, or anything else. Challenge yourself to notice as many designs as possible. Such design could include instruction or performance support materials around you (e.g., a flyer that teaches people how to wash their hands or the instructional book that comes with IKEA furniture). Take about an hour or more to write down notes about each design—why you appreciate it and why you do not. Keep asking yourself "why do I like/dislike this?" and record your answers. Repeat this activity until you cannot think of any more answers to. For example, the authors appreciate public libraries. We like them because we find the books we like to borrow and not buy, they are accessible to us, they are free, they are diverse, and they provide quiet places for us to concentrate. We can say more why we like public libraries, but essentially we like public libraries because *we believe in the noble cause of public goods, and public libraries represent such a cause*.

Now examine your answers to the "why" questions and try to think about how such answers represent values you hold. These could be transparency, ease of use, elegance, democratic, accessible, inclusive/exclusive, soft, strong, and so on. These values constitute your core judgments and influence all kinds of design judgments you make. You may not be able to access all of them completely, but you are aiming to heighten your awareness of what your design values really are. Once you have spent some time on this exercise, consider revisiting it in the future to see any change you might notice in terms of the values you have—write a reflection post on such change. You can focus the noticing experience on specific types of designs (e.g., phone apps), or you can mix designs together that you see belong to each other (e.g., instructional posters and cooking books). Essentially, noticing designs and why you appreciate them will become a somewhat automatic habit for you. By these means you can question and refine your judgement across a whole career.

Additional Information

Ways to document design judgments and decisions:

- Document your design through documents and project management tools—you will have an audit trail at the end of the project that helps you or anyone else to trace back what design decisions you have made.
- Use the margins of such documents to add comments/thoughts and explanations on design decisions you have made.
- Archive written conversations (emails, chats, etc.…) between you and other design stakeholders that include design decisions (and most likely your “defense” or such decisions).
- Leverage your design reflections, notes, and design documents to write a design a case which you can publish in the International Journal of Designs for Learning (IJDL).

Conclusion

You may have heard the common wisdom that to become a better professional, you should engage in at least 10,000 hours of practice in your profession. While there is truth in the advice that many, many hours of practice are required to develop expertise, the authors are also confident in an additional claim that there is more to expertise than just putting in a certain number of hours. Without deliberately reflecting on your design actions and the design judgments that lead to those actions, not even 10,000 hours of instructional design practice will be enough to make you an expert designer. Explicitly reflecting on your design judgments, in addition to reflecting on your practice, is what will help you become a more engaged and expert designer. Make reflection on your design judgments an intentional aspect of your efforts to develop your growing competence as a member of the instructional design profession.

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4.3: Instructional Design Evaluation

Instructional Design Evaluation

Cheryl Calhoun, Shilpa Sahay, & Matthew Wilson

Editor's Note

This is a remixed version of an earlier chapter on evaluation in instructional design that can be found at the ADDIE Explained website, and is printed here under the same license as the original.

Evaluation sits at the center of the instructional design model. It provides feedback to all other stages of the design process to continually inform and improve our instructional designs. In this chapter we will discuss the Why, What, When, and How of evaluation. We will explore several of the most cited evaluation models and frameworks for conducting formative, summative, and confirmative evaluations. It is important to note that instruction can occur in formal instructional settings or through the development of instructional products such as digital learning tools. Throughout this chapter we will discuss interchangeably instructional programs and/or products. Effective evaluation applies to all of these forms of instructional design.

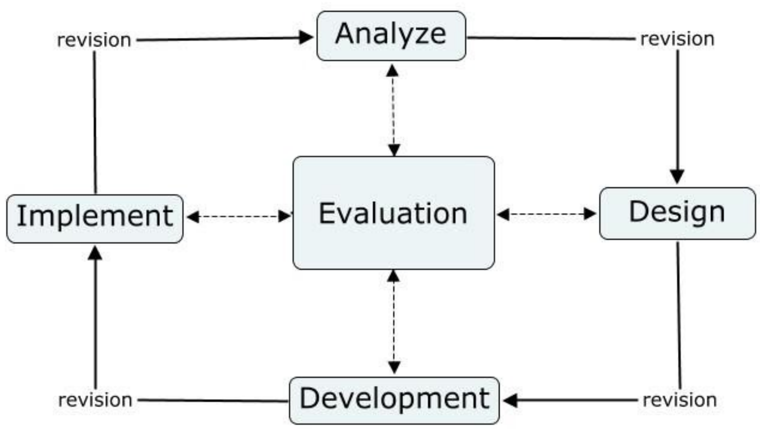

Figure 4.3.1: *ADDIE Model of Design (Fav203, 2012)*

Why Do We Evaluate?

Evaluation ensures that the instruction being designed both meets the identified need for instruction and is effective in achieving the intended learning outcomes for participants. It helps to answer questions such as:

- Are our instructional goals aligned with the requirements of the instructional program?
- Are our lesson plans, instructional materials, media, and assessments, aligned with learning needs?
- Do we need to make any changes to our design to improve the effectiveness and overall satisfaction with the instruction?
- Does the implementation provide effective instruction and carry out the intended lesson plan and instructional objectives?
- Have the learners obtained the knowledge and skills that are needed?
- Are our learners able to transfer their learning into the desired contextual setting?

These questions help shape the instructional design, confirm what and to what extent the learner is learning, and validates the learning over time to support the choices made regarding the design—as well as how the program holds up over time.

What Is Evaluation?

Evaluation is the process of reviewing both the instructional components and the resulting outcomes of instruction to determine whether instruction achieves the desired outcomes. Kirkpatrick's model of evaluation proposes four levels of evaluation: reaction, learning, behavior, and results (Kirkpatrick & Kirkpatrick, 2016). While this is a fairly simplistic model, it provides a framework for understanding evaluation and has provided a significant model of evaluation to the field of instructional design.

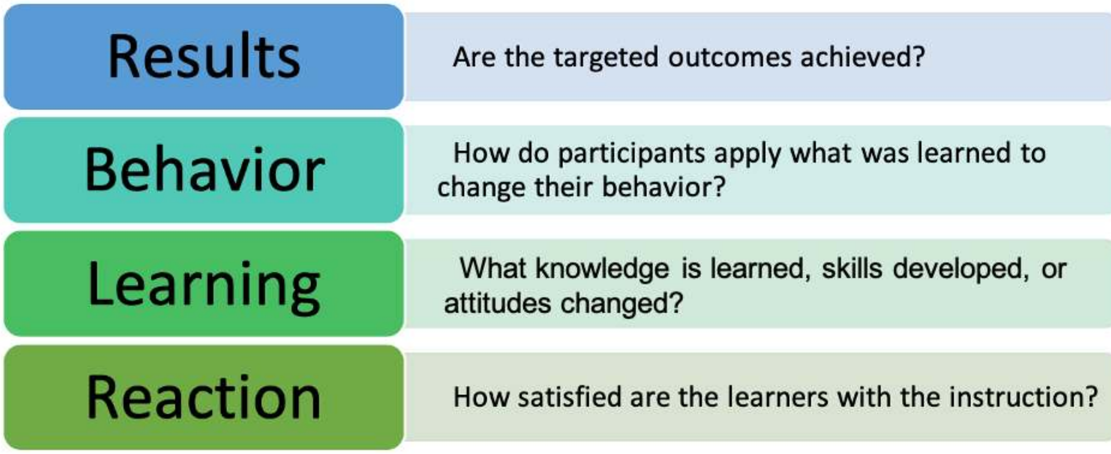

Figure 4.3.2: *Kirkpatrick's Model of Evaluation*

Reaction

In order to have effective instruction, one requires frequent feedback from the learners to check learning progress and monitor efficacy of the pedagogical process selected for instruction (Heritage, 2007). An instructional designer can evaluate both the teacher and the learner's reaction to a new pedagogical instruction. Once it is determined that there is engagement by the learners, one may assume that learners will not drop out due to their reaction to the quality or applicability of instruction. It also helps the evaluator to control the pace of the program as one moves ahead in the training phase. It leaves less frustration and vagueness in the evaluator's mind if one knows that all the learners are positively oriented towards undertaking the training.

Learning

Evaluating learning is an ongoing process in instructional development. It is important to evaluate whether materials developed solve the problems that were identified. When learners master the content of the training or exhibit proper learning through assessment, one can assume the effectiveness of the program and identify what did not work if the learning outcomes show adverse results. Several studies in the field of educational measurement have suggested that assessments and evaluations lead to higher quality learning. Popham (2008) called this new aspect of assessment in the evaluation process as "Transformative Assessment" where an evaluator identifies learning progression of the learners by analyzing the sequence of skills learned over the period of study program. This also helps the evaluator or the instructional designer to develop methods to assess how much the learners mastered the learning material.

Behavior

Attitudes and behavior are important indicators towards the acceptance and success of an instructional program. Dick, Carey, and Carey (2015) mentioned that an evaluator needs to write directions to guide the learner's activities and construct a rubric (e.g. a checklist or a rating scale) in order to evaluate and measure performance, products, and attitudes. A learner develops several intellectual and behavioral skills, and an evaluation can uncover what changes have been brought in the attitude and behavior of the learners.

Results

With every instructional product, evaluating results is the most significant task by an evaluator, and is done to determine how closely one has been able to achieve success in the implementation of the program. An evaluator conducts an evaluation in order to test the effectiveness of the instruction to create the desired learning outcome (Morrison et al., 2019). Morrison et al. (2019) suggested evaluators measure the efficiency of learning by comparing the skills mastered with the time taken; cost of program development; continuing expenses; reactions towards the program; and long-term benefits of the program.

When Do We Evaluate?

Three commonly used types of evaluation for instruction are formative, summative, and confirmative (Morrison et al., 2019; Ross & Morrison, 2010). Formative evaluation is conducted during the design process to provide feedback that informs the design process. Summative evaluation is conducted at the end of the design process to determine if the instructional product achieves the intended outcomes. Confirmative evaluation is conducted over time to determine the lasting effects of instruction. Each of these stages of evaluation is examined in detail here, both through the definition of the form itself and through a discussion of some of the key tools within each.

"When the cook tastes the soup that's formative; when the guests taste the soup, that's summative." – Robert E. Stake (M. Scriven, 1991, p. 169)

Formative

Formative evaluation occurs during instructional design. It is the process of evaluating instruction and instructional materials to obtain feedback that in turn drives revisions to make instruction more efficient and effective. One way to think about this is to liken it to a chef tasting his food before he sends it out to the customer. Morrison et al. (2019) explained that the formative evaluation process utilizes data from media, instruction, and learner engagement to formulate a picture of learning from which the designer can make changes to the product before the final implementation.

Boston (2002, p. 2) stated the purpose of formative evaluation as "all activities that teachers and students undertake to get information that can be used diagnostically to alter teaching and learning." Formative evaluation results in the improvement of instructional processes for the betterment of the learner. While making formative changes are best conducted during earlier stages of the design process, these changes may come later if the situation dictates it. According to Morrison et al., (2019), when summative and confirmative evaluations demonstrate undesirable effects, then the results may be used as a formative evaluation tool to make improvements.

Instructional designers should consider a variety of data sources to create a full picture of the effectiveness of their design. Morrison et al. (2019) proposed that connoisseur-based, decision-oriented, objective-based, and constructivist evaluations are each appropriate methodologies within the formative process. More recently Patton (2016) introduced developmental evaluation which introduces innovation and adaptation in dynamic environments.

Types of Formative Evaluation

Connoisseur-Based

Employs subject matter experts (SMEs) in the review of performance objectives, instruction, and assessments to verify learning, instructional analysis, context accuracy, material appropriateness, test item validity, and sequencing. Each of these items allow the designer to improve the organization and flow of instruction, accuracy of content, readability of materials, instructional practices, and total effectiveness (Morrison et al., 2019).

Decision-Oriented

Questions asked may develop out of the professional knowledge of an instructional designer or design team. These questions subsequently require the designer to develop further tools to assess the question, and as such should be completed at a time when change is still an option and financially prudent (Morrison et al., 2019).

Objective-Based

Through an examination of the goals of a course of instruction, the success of a learner's performance may be analyzed.

Constructivist

Takes into account the skills students learned during the learning process as well as how they have assimilated what is learned into their real lives.

Developmental

Responsive to context and more agile, allowing for quicker response and support of innovative designs (Patton, 2011).

Summative

Dick et al. (2015, p. 320) claimed the ultimate summative evaluation question is “Did it solve the problem?" That is the essence of summative evaluation. Continuing with the chef analogy from above, one asks, “Did the customer enjoy the food?" (M. Scriven, 1991). The parties involved in the evaluation take the data and draw a conclusion about the effectiveness of the designed instruction. However, over time, summative evaluation has developed into a process that is more complex than the initial question may let on. In modern instructional design, practitioners investigate multiple questions through assessment to determine learning effectiveness, learning efficiency, and cost effectiveness, as well as attitudes and reactions to learning (Morrison et al., 2019).

Learning Effectiveness

Learning effectiveness can be evaluated in many ways. Here we are trying to understand:

- How well did the student learn?
- Are the students motivated to change behavior?
- Did we engage the intended population of learners?
- Even, did we teach the learner the right thing?

Measurement of learning effectiveness can be ascertained from assessments, ratings of projects and performance, observations of learners’ behavior, end of course surveys, focus groups, and interviews. Dick et al. (2015) outlined a comprehensive plan for summative evaluation throughout the design process, including collecting data from SMEs and during field trials for feedback.

Learning Efficiency and Cost-Effectiveness

While learning efficiency and cost-effectiveness of instruction are certainly distinct constructs, the successfulness of the former impacts the latter. Learning efficiency is a matter of resources (e.g., time, instructors, facilities, etc.), and how those resources are used within the instruction to reach the goal of successful instruction (Morrison et al., 2019). Dick et al. (2015) recommended comparing the materials against an organization’s needs, target group, and resources. The result is the analysis of the data to make a final conclusion about the cost effectiveness based on any number of prescribed formulas.

Attitudes and Reactions to Learning

The attitudes and reactions to the learning, while integral to formative evaluation, can be summatively evaluated as well. Morrison et al. (2019) explained there are two uses for attitudinal evaluation: evaluating the instruction and evaluating outcomes within the learning. While most objectives within learning are cognitive, psychomotor and affective objectives may also be goals of learning. Summative evaluations often center on measuring achievement of objectives. As a result, there is a natural connection between attitudes and the assessment of affective objectives. Conversely, designers may utilize summative assessments that collect data on the final versions of their learning product. This summative assessment measures the reactions to the learning.

Confirmative

The purpose of a confirmative evaluation is to determine if instruction is effective and if it met the organization’s defined instructional needs. In effect, did it solve the problem? The customer ate the food and enjoyed it. But, did they come back? Confirmative evaluation goes beyond the scope of formative and summative evaluation and looks at whether the long-term effects of instruction is what the organization was hoping to achieve. Is instruction affecting behavior or providing learners with the skills needed as determined by the original goals of the instruction? Confirmative evaluation methods may not differ much from formative and summative outside of the fact that it occurs after implementation of a design. Moseley and Solomon (1997) described confirmative evaluation as maintaining focus on what is important to your stakeholders and ensuring the expectations for learning continue to be met.

How Do We Evaluate?

Formative Evaluation

Formative evaluation is an iterative process that requires the involvement of instructional designers, subject matter experts, learners, and instructors. Tessmer (2013) identified four stages of formative evaluation including expert review, one-to-one, small group, and field test evaluation. Results from each phase of evaluation are fed back to the instructional designers to be used in the process of improving design. In all stages of evaluation, it is important that learners are selected that will closely match the characteristics of the target learner population.

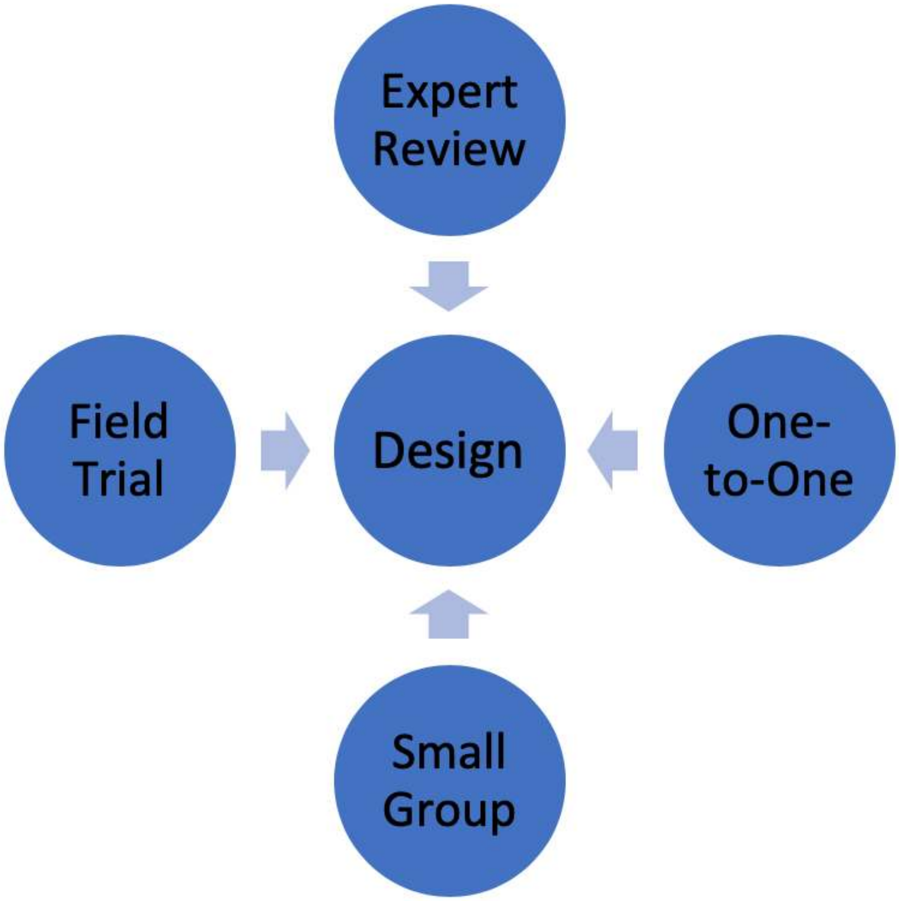

Figure 4.3.3: *The Cycle of Formative Evaluation*

Expert Review

The purpose of the expert review is to identify and remove the most obvious errors and to obtain feedback on the effectiveness of the instruction. The expert judgment phase can include congruence analysis, content analysis, design analysis, feasibility analysis, and user analysis. Results from expert review can be used to improve instructional components and materials before a pilot implementation. This phase is conducted with the instructional designer, the subject matter experts, and often an external reviewer. Target learners are not involved in this stage of evaluation.

Figure 4

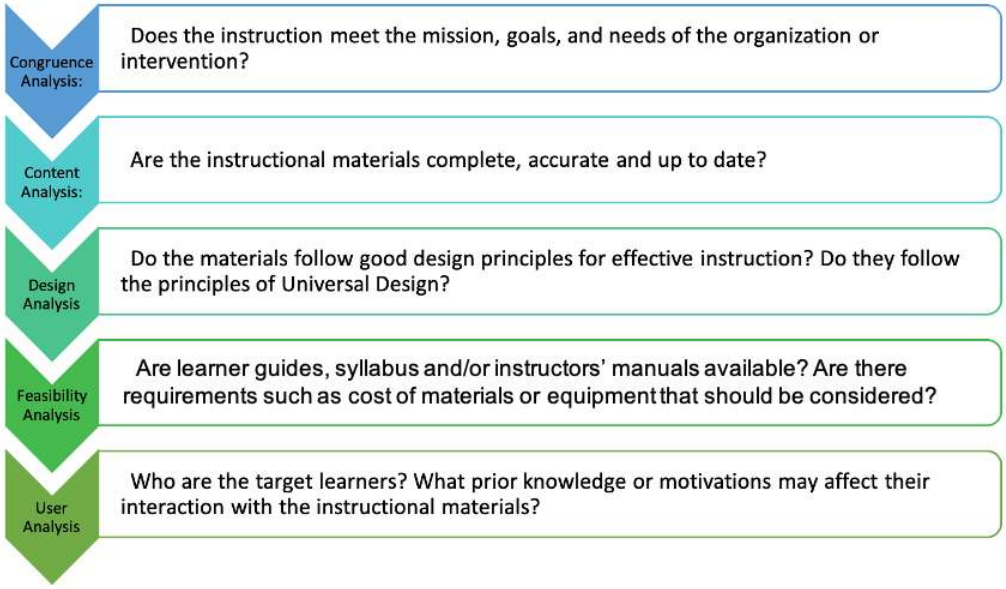

Figure 4.3.4: *The Expert Judgment Phase (Dick et al., 2015)*

One-to-One

The one-to-one evaluation is much like a usability study. During this evaluation, IDs should be looking for clarity, impact, and feasibility (Dick et al., 2015, p. 262; Earnshaw, Tawfik, & Schmidt, 2017). The learner is presented with the instructional materials that will be provided during the instruction. The evaluator should encourage the learner to discuss what they see, write on materials as appropriate, and note any errors. The ID can engage the learner in dialog to solicit feedback on the materials and clarity of instruction. There are many technological tools that can facilitate a one-on-one evaluation. The principles of Human Computer Interaction and User Center Design can inform the instructional design review (Earnshaw et al., 2017). In *Don't Make Me Think*, Krug (2014) described a process of performing a usability study for website development. The steps he provided are a good guide for performing a one-to-one evaluation. Krug recommended video recording the session for later analysis. If instruction is computer based, there are tools available that can record the learner interaction as well as the learner's responses. Morae from Techsmith (https://edtechbooks.org/-oPnH) is a tool that allows you to record user interactions and efficiently analyze the results.

Small Group

Small group evaluation is used to determine the effectiveness of changes made to the instruction following the one-to-one evaluation and to identify any additional problems learners may be experiencing. The focus is on consideration of whether learners can use the instruction without interaction from the instructor. In a small group evaluation, the instructor administers the instruction and materials in the way they are designed. The small-group participants complete the lesson(s) as described. The instructional designer observes but does not intervene. After the instructional lesson is complete, participants should be asked to complete a post-assessment designed to provide feedback about the instruction.

Field Trial

After the recommendations from the small group evaluation have been implemented, it is time for a field trial. The selected instruction should be delivered as close as possible to the way the design is meant to be implemented in the final instructional setting, and instruction should occur in a setting as close to the targeted setting as possible. Learners should be selected that closely match the characteristics of the intended learners. All instructional materials for the selected instructional section, including the instructor manual, should be complete and ready to use. Data should be gathered on learner performance and attitudes, time required to use the materials in the instructional context, and the effectiveness of the instructional management plan. During the field trial the ID does not participate in delivery of instruction. The ID and the review team will observe the process and record data about their observations.

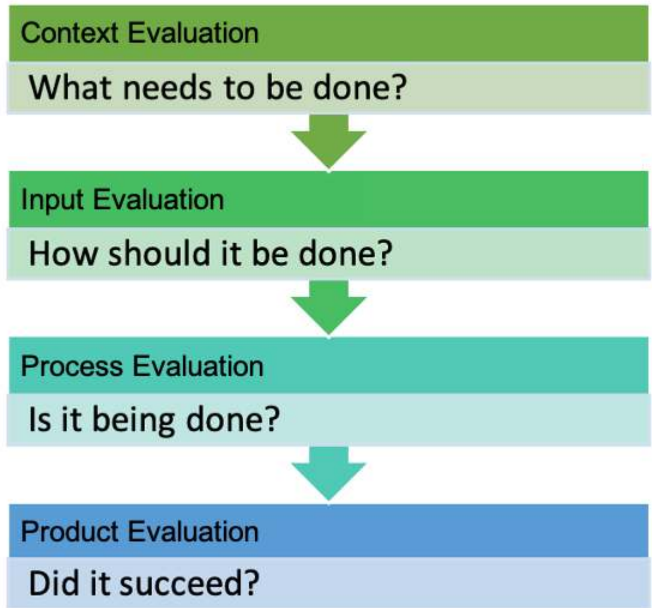

Figure 4.3.5: *Field Trial*

Summative Evaluation

The purpose of a summative evaluation is to evaluate instruction and/or instructional materials after they are finalized. It is conducted during or immediately after implementation. This evaluation can be used to document the strengths and weaknesses in instruction or instructional materials, to decide whether to continue instruction, or whether to adopt instruction. External evaluators for decision makers often conduct or participate in summative evaluation. Subject matter experts may be needed to ensure integrity of the instruction and/or instructional materials. There are several models we can consider for summative evaluation including the CIPP Model, Stake's Model, and Scriven's Model.

CIPP Model

The CIPP evaluation model by Stufflebeam (1971) describes a framework for proactive evaluation to serve decision making and retroactive evaluation to serve accountability. The model defines evaluation as the process of delineating, obtaining, and providing useful information for judging decision alternatives. It includes four kinds of evaluation: context, input, process, and product. The first letters of the names of these four kinds of evaluation gave the acronym - CIPP. The model provides guidelines for how the steps in evaluation process interact with these different kinds of evaluation.

The CIPP Model of Evaluation by Mallory Buzun-Miller

Stake’s Model

Stake in 1969 created an evaluation framework to assist an evaluator in collecting, organizing, and interpreting data for the two major operations of evaluation (Stake, 1967; Wood, 2001). These include (a) complete description and (b) judgment of the program. W. J. Popham (1993) defined that Stake's schemes draw attention towards the differences between the descriptive and judgmental acts according to their phase in an educational program, and these phases can be antecedent, transaction, and outcome. This is a comprehensive model for an evaluator to completely think through the procedures of an evaluation.

Dr. Robert Stake by Education at Illinois

Scriven’s Goal-Free Model

Scriven provides a transdisciplinary model of evaluation in which one draws from an objectivist view of evaluation (Michael Scriven, 1991a, 1991b). Scriven defined three characteristics to this model: epistemological, political, and disciplinary. Some of the important features of Scriven’s goal free evaluation stress on validity, reliability, objectivity/credibility, importance/timeliness, relevance, scope, and efficiency in the whole process of teaching and learning. Youker (2013) expanded on the model to create general principles for guiding the goal-free evaluator. Younker proposed the following principles:

1. Identify relevant effects to examine without referencing goals and objectives.
2. Identify what occurred without the prompting of goals and objectives.
3. Determine if what occurred can logically be attributed to the program or intervention.
4. Determine the degree to which the effects are positive, negative, or neutral.

The main purpose of the goal-free evaluation is to determine what change has occurred that can be attributed to the instructional program. By conducting the evaluation without prior knowledge of learning outcomes or goals, the evaluator serves as a check to see if the program produced the outcome desired by the instructional designer(s).

The Past, Present, and Future of Evaluation: Possible Roles for the University of Melbourne, by The University of Melbourne

Confirmative Evaluation

The focus of confirmative evaluation should be on the transfer of knowledge or skill into a long-term context. To conduct a confirmative evaluation, you may want to use observations with verification by expert review. You may also develop or use checklists, interviews, observations, rating scales, assessments, and a review of organizational productivity data. Confirmative evaluation should be conducted on a regular basis. The interval of evaluation should be based on the needs of the organization and the instructional context.

Conclusion

Evaluation is the process of determining whether the designed instruction meets its intended goals. In addition, evaluation helps us to determine whether learners can transfer the skills and knowledge learned back into long-term changes in behavior and skills required for the target context. Evaluation provides the opportunity for instructional designers to ensure all stakeholders agree that the developed instruction is meeting the organizational goals.

In this chapter we reviewed what evaluation looks like and its relationship within the instructional design process. We looked at several models of evaluation including Kirkpatrick's Model and the four levels of evaluation: Evaluating Reaction, Evaluating Learning, Evaluating Behavior, and Evaluating Results. We also looked at the three phases of evaluation including formative, summative, and confirmative evaluation, and introduced several different models and methods for conducting evaluation from many leading evaluation scholars.

Discussion

- Where does evaluation stand in the instructional design model? How will your flow chart look when you describe evaluation in relation to the other stages of instructional design?
- Describe the three stages of evaluation. Give an example to explain how an instructional designer will use these three stages in a specific case of a learning product.
- Which are the five types of formative evaluation methods mentioned in the chapter that assist in collecting data points for the initial evaluation? Which two of these methods will be your preferred choice for your formative evaluation and why?
- What will be the parameters to evaluate the success of the instructional training?
- What are some of the techniques to conduct formative and summative evaluation?
- Several models of evaluation have been discussed in the chapter. Discuss any two of these models in detail and explain how you will apply these models in your evaluation process.

Application Exercises

For the following exercises, you may use an instructional module that you are familiar with from early childhood, k-12, higher ed, career and technical, corporate, or other implementation where instructional design is needed. Be creative and use something from an educational setting that you are interested in. Be sure to describe your selected instructional module as it relates to each of these exercises. You may need to do some additional online research to answer these questions. Be sure to include your references in your responses.

1. Describe how you would conduct the three phases of the formative evaluation. Define your strategies, populations, and methodologies for each stage within the process.
2. Draw a diagram of the iterative formative evaluation process. What specific pieces of the instructional intervention are considered within each stage of the process? How is the data gathered during this process employed to improve the design of instruction?
3. Describe the context and learner selection process you would use for setting up a formative evaluation field trial. What special considerations need to be made to conduct this stage of evaluation effectively?
4. What materials should the designer include in a field trial? How do the materials used for field trials contrast with the one-to-one and small group evaluations?

You have been asked to serve as an external evaluator on a summative evaluation of a training model designed by one of your colleagues. Explain the phases of the summative evaluation that you may be asked to participate in as an external reviewer. Imagine you have created a rubric to help you evaluate the instructional intervention. What items might that rubric contain to help you effectively and efficiently conduct a review?

Group Assignment

Conduct an evaluation study to understand how successful an instructional intervention has been in achieving the goals of the designed instruction. Keep in mind the group project conducted in the previous development and implementation chapters and conduct an evaluation study to assess the success of achieving the goals and objectives of the instruction. To achieve these goals, you should conduct several rounds of evaluation:

- Conduct a one-on-one evaluation with a student from the target population. Make observations of the student's actions within the instruction and reactions to the materials, content, and overall design. Propose changes to the instructional intervention based on the sample student's feedback.
- Conduct a small group evaluation with a group of 3 to 5 learners. This evaluation should reflect the changes you made after the one-to-one stage and evaluate nearly operational materials and instruction. You must recruit an instructor to deliver instruction. Make observations and have the instructor administer a summative assessment after instruction. Analyze the data gathered and create a one-page report on the results.
- Implement a field test with an instructor and a student population of at least 15 people. Instructional materials, including the instructor manual, should be complete and ready to use. Gather data on learner performance and attitudes, as well as time required for instruction and the effectiveness of the instructional management plan. Observe the process and record data, and create a final report detailing the full evaluation cycle.

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4.4: Continuous Improvement Of Instructional Materials

Continuous Improvement of Instructional Materials

David Wiley, Ross Strader, & Robert Bodily

From time to time new technologies provide us with a qualitatively different ability to engage in previously possible activities. For example, 20 years ago it was already possible to publish an essay online. You simply used the command line program Telnet to login to a remote server, navigated into the directory from which your webserver made html files available to the public, launched the pico editor from the command line, wrote your essay, and manually added all the necessary html tags. Today, open source blogging software like Wordpress makes publishing an essay online as easy as using a word processor. Yes, it was possible to publish essays online before, but the modern experience is qualitatively different.

“Evaluate” is the final step in the traditional ADDIE meta-model of instructional design, and it has always been possible—if, at times, expensive and difficult—to evaluate the effectiveness of instructional materials. Modern technology has made the process of measuring the effectiveness of instructional materials a qualitatively different experience. Gathering data in the online context is orders of magnitude less expensive than gathering data in classrooms, and open source analysis tools have greatly simplified the process of analyzing these data.

Historically, any needed improvements discovered during the evaluation process would take a significant amount of time to reach learners, as they could only be accessed once new editions of a book were printed or new DVDs were pressed. Again, modern technology makes the delivery of improvements a qualitatively different exercise. When instructional materials are delivered online, instructional designers can engage in continuous delivery practices, where improvements are made available to learners immediately, as often as multiple times per day.

The modern approach to continuous improvement designed for use in the context of online services described by Ries (2011), called the “build - measure - learn cycle,” is illustrated in Figure 1.

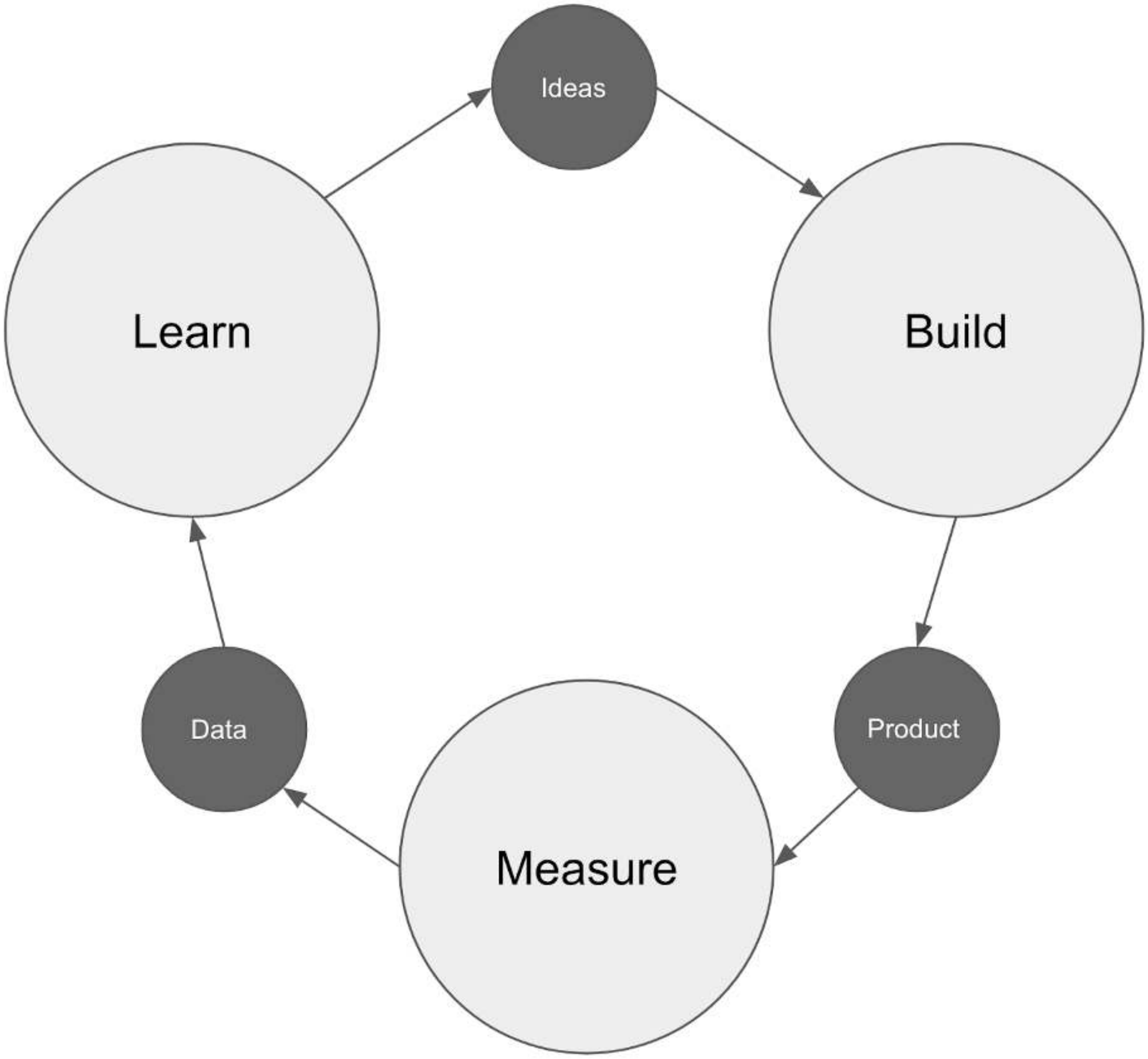

Figure 4.4.1: *The Build - Measure - Learn Cycle*

In this chapter we adapt the build - measure - learn cycle for use by instructional designers who want to engage in continuous improvement. Because our focus is on the improvement of instructional materials, our discussion below does not include a discussion of the creation of the first version of the materials. (The first version of the materials could be open educational resources created by someone else or a first version that you created previously.)

The chapter will proceed as follows:

- Conceptual Framework: We argue that all instructional materials are hypotheses, or our best guesses, informed by research, about what instructional design approach will support student learning in a specific context. Thinking this way will naturally lead us to collect and analyze data to test the effectiveness of our instructional materials.
- Build: We describe the implications of designing for data collection, together with the instrumentation and tooling that must be built in order to collect the data necessary for continuous improvement.
- Measure: We describe the process of analyzing data in order to identify portions of the instructional materials that are not effectively supporting student learning.
- Learn: We discuss methods to use when reviewing less effective portions of the instructional materials and deciding what improvements to make before beginning the cycle again.

- Technical Note: We briefly pause to discuss the role of copyright, licensing, and file formats in continuous improvement.
- Worked Example: We demonstrate one trip through the cycle with a worked example.
- Conclusion: We end with some thoughts about the imperative implied for instructional designers by the existence and relative ease of use of continuous improvement approaches like the build - measure - learn cycle.

Conceptual Framework

Instructional Materials Are Hypotheses

People who design instructional materials (who we will refer to as instructional designers throughout) make hundreds of decisions about how to best support student learning. Each decision is a hypothesis of the form “in the context of these learners and this topic, applying this instructional design approach in this manner will maximize students’ likelihood of learning.” The ways in which these individual decisions are interwoven together creates a network of hypotheses about how best to support student learning.

Hypotheses Need to Be Tested

It reveals a fatal lack of curiosity for an instructional designer to simply say “these materials were designed in accordance with current research on learning” without following through to measure their actual effectiveness with actual learners in the actual world. While designing instructional materials in accordance with research is a positive first step, to our minds the most important measure of the quality of instructional materials is the degree to which they actually support student learning. Questions of whether or not the materials are informed by research, are finished on schedule and on budget, are stunningly beautiful, render correctly on a mobile device, or were authored by a famous academic become meaningless if students who use the materials do not learn what the designers intended.

Initial Hypotheses Are Seldom Correct

Hypotheses need to be refined in an ongoing cycle of improvement. Data collected during student use of content and from assessments of learning can be used to identify specific portions of the instructional materials (i.e., specific instructional design hypotheses) that are not successfully supporting student learning. Once these underperforming designs (hypotheses) are identified, they can be redesigned, improved, and incorporated into a new version of the instructional materials. The updated collection of instructional design hypotheses can then be deployed for student use, and the cycle of continuous improvement can begin again.

Build: Designing for Data, Instrumentation, and Tools for Data Collection

In order to be able to engage in continuous improvement, instructional materials must be designed for data collection. There must be a unifying design framework that will allow data from a wide range of sources to be aggregated meaningfully. The method we will describe throughout this chapter organizes instructional materials around a network of learning outcomes. In this method of designing for data collection, all instructional materials (e.g., readings, simulations, videos, practice opportunities) are aligned with one or more learning outcomes. All forms of assessment, both formative or summative, are also aligned with one or more learning outcomes (this alignment must be done at the individual assessment item level.)

Once instructional materials have been designed for data collection, tools and instrumentation must be created so that the data can actually be collected and managed. The system that mediates student use of the instructional materials (e.g., a learning management system) must be capable of (a) expressing the relationships between learning outcomes, instructional materials, and assessments, (b) capturing data about student engagement with these instructional materials, and (c) capturing item-level data about student engagement with, and performance on, assessments. The data collected by the system should be able to answer questions such as, for any given learning outcome, what instructional materials in the system are aligned with that outcome? (If instructional activities are “aligned with” a learning outcome, student engagement with the instructional activities should support mastery of the outcome.) For any given learning outcome, what assessment items in the system are aligned with that outcome? (If assessments are “aligned with” a learning outcome, student success on these assessments should provide evidence that they have mastered the outcome).

Measure: Using RISE Analysis to Identify Less Effective Learning Materials

As described in Bodily, Nyland, and Wiley (2017), activity engagement data and assessment performance data can be analyzed together to identify learning outcomes whose aligned instructional materials are not sufficiently supporting student mastery (as demonstrated by performance on aligned assessments). The purpose of Resource Inspection, Selection, and Enhancement (RISE) analysis is to identify learning outcomes where students were highly engaged with aligned instructional materials, but simultaneously performed poorly on aligned assessments.

Each point in Figure 2 represents a learning outcome. The x-axis is engagement with instructional materials and the y-axis is assessment performance, both converted to z-scores. The bottom-right quadrant (high engagement, low performance) indicates which outcomes should be targeted for improvement and are numbered to indicate the order in which they should be addressed.

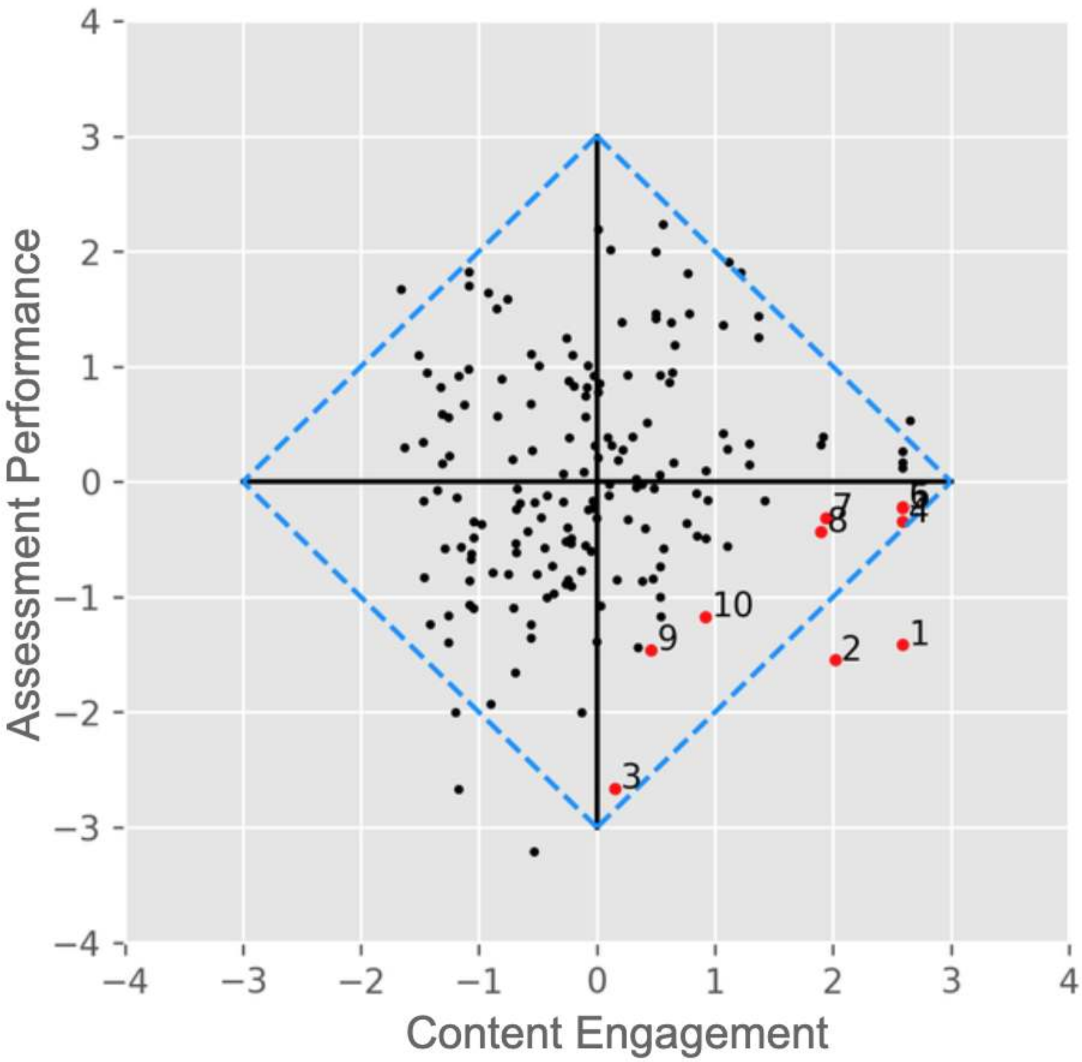

Figure 4.4.2: *A RISE Analysis Plot*

An open source software implementation of RISE analysis is described in Wiley (2018). This greatly simplifies the process of running RISE analyses, as long as appropriate data on learning outcome names, content engagement, and assessment performance are available.

Learn: Understanding Why Learning Outcomes End up in the Bottom Right Quadrant

Once learning outcomes are identified as being in the bottom right quadrant of a RISE analysis plot, the cause of the problem can be isolated. For brevity, we will refer to learning outcomes in the bottom right quadrant of a RISE analysis plot as "underperforming learning outcomes" below. The root of the problem can generally be identified in two steps.

The first step in isolating the problem with an underperforming learning outcome is evaluating assessments aligned with each learning outcome. Are the assessments accurately measuring student learning? Questions to ask at this stage include: are there technical problems with the assessment? Are items miskeyed? Are other sources of spurious or construct-irrelevant difficulty present? Are measures of reliability, validity, or discrimination unacceptably low? If the answer to any of these questions is yes, improvements should be made to problematic assessments, after which the instructional designer can stop working on this learning outcome and move onto the next. There is likely no need to make improvements to instructional materials aligned with this learning outcome.

If the aligned assessments are functioning as intended, the instructional designer can move on to the second step—reviewing the instructional materials to determine why they aren't sufficiently supporting student learning. This process is highly subjective and brings the full expertise of the instructional designer to bear. The instructional designer reviews the instructional materials aligned with the learning outcome and asks questions about why students might be struggling here. For example:

- Is there a mismatch between the type of information being taught and the instructional design approach originally selected? For example, if students are learning a classification task, are examples and non-examples provided without a specific discussion of the critical attributes that separate instances from non-instances?
- Is there a mismatch in Bloom's Taxonomy level between the learning outcome, the instructional materials, and the assessment? (For example, are the learning outcome and instructional materials primarily the *Remember* level, while the assessments require students to *Apply*?)
- Have the instructional materials failed to provide learners with an opportunity to practice in a no/low-stakes setting and receive feedback on the current state of their understanding?

We cannot list every question an instructional designer might ask, but we hope these examples are illustrative. Talking with students can also be incredibly helpful at this stage. These conversations are an effective way for the instructional designer to zero in on root causes of students' misunderstandings.

Once the instructional designer believes they have identified the problems (i.e., they have a new hypothesis about how to better support student learning), new or existing instructional materials and assessments can be created, adapted, or modified. Students can also be powerful partners and collaborators in creating improvements to the instructional materials (e.g., OER-enabled pedagogy as described by Wiley and Hilton (2018)).

When this (Build) process is completed, the new or improved materials can be released to students immediately. Once students are using the new version of the materials, this use will result in the creation of new data which the instructional designer can examine using RISE analysis (Measure). These analyses support the instructional designer in forming new hypotheses about why students aren't succeeding (Learn). When this continuous improvement process is followed, instructional materials should become more effective at supporting student learning with each trip through the cycle.

Technical Note: The Role of Copyright and File Formats

Before adaptations or modifications can be made, instructional designers must have legal permission to make changes to the instructional materials. Because copyright prohibits the creation of derivative works that are often the result of the improvement of instructional materials, one of two conditions must hold. In the first condition, the instructional designer (or their employer) must hold the copyright to the instructional materials, making the creation and distribution of improved versions legal. In the second condition, the instructional materials must be licensed under an open license (like a Creative Commons license) that grants the instructional designer permission to create derivative works (aka improved versions of the instructional materials).

Legal permission to create derivative works can be rendered ineffective if the instructional materials are not available in a technical format amenable to editing (e.g., HTML). ALMS analysis as described in Hilton, Wiley, Stein, and Johnson (2010) includes four factors to consider regarding the "improvability" of instructional materials. The first factor is *Access to editing tools*—is the software needed to make changes commonly available (e.g., MS Word) or obscure (e.g., Blender)? The second factor is the *Level of expertise required* to make changes—is the content easy to change (e.g., Powerpoint) or difficult to change (e.g., an interactive simulation written in Javascript)? The third factor is whether or not the instructional materials are *Meaningfully editable*—is the document a scanned image of handwritten notes (this text is not easily editable) or an HTML file (easily editable)? The final factor is *Source file access*—is the file format preferred for using the resource also the format preferred for editing the resource (e.g., an HTML file) or are the preferred formats preferred for using and editing the files different (e.g., PSD versus JPG)?

If the instructional materials you are working with do not belong to you or your employer, are not openly licensed, or are available only in file formats that are not conducive to adaptation and modification, you may not be able to engage in continuous improvement.

A Worked Example

Lumen Learning, a company that offers instructional materials for college classes that can be adopted in place of traditional textbooks, offers a Biology for Non-majors course in its Waymaker platform. This platform allows instructional designers to enter learning outcomes and align all instructional materials and assessment items with the learning outcomes. A RISE analysis was conducted using the content engagement data and assessment performance data for all students who took the Biology for Non-majors course during a semester. Among the top 10 underperforming learning outcomes it identified, the RISE analysis revealed that students were performing poorly on assessments aligned with the learning outcome "compare inductive reasoning with deductive reasoning" despite the fact that students were engaging with the aligned instructional materials at an above average rate (see outcome 1 in Figure 3 below). This learning outcome was selected for continuous improvement work.

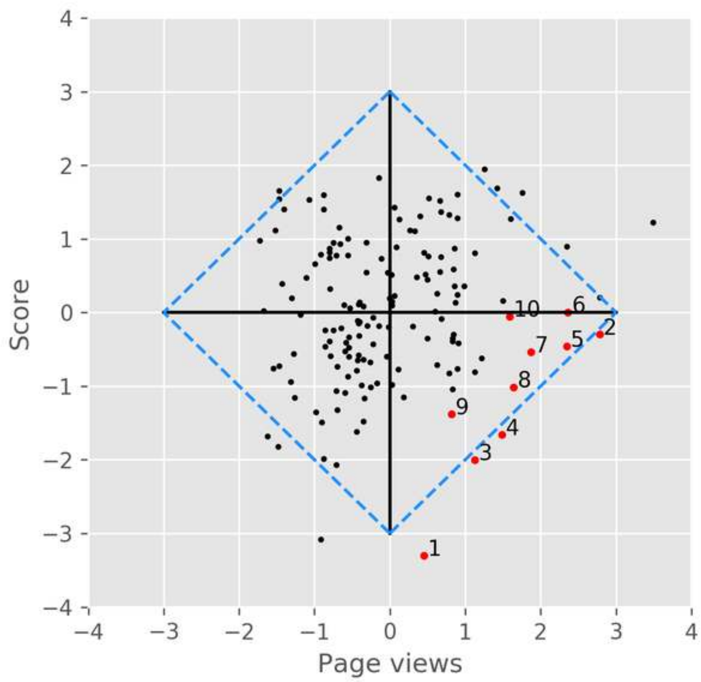

Figure 4.4.3: *Biology for Non-Majors RISE Analysis Plot*

A review of the aligned assessment items by an instructional designer revealed that the items appeared to be keyed correctly and free from other problems. Following this review of the aligned assessments, the instructional designer reviewed the aligned instructional materials guided by the question, "why are students who use these instructional materials not mastering the outcome?" The analysis revealed that the instructional materials for this outcome were comprised of two paragraphs of text content, each of which defined one of the terms. No other instructional materials were provided in support of mastery of this learning outcome and students appeared to be unable to remember which of these similar sounding terms was which.

The instructional designer decided to make minor edits to the existing paragraphs to improve their clarity and also to create an online interactive practice activity (Koedinger et al., 2017) in support of this learning outcome. This activity provided students with mnemonic tools to help them remember which term is which, and combined these mnemonics with practice exercises in which students classify examples as either inductive or deductive and receive immediate, targeted feedback on their performance. The online interactive practice activity can be viewed in context at https://edtechbooks.org/-QwUE.

These new and updated instructional materials are now integrated into the existing materials and are being used by faculty and students across the United States. After another semester is over, the RISE analysis will be rerun. This new analysis will either confirm that the improvements to the instructional materials have improved student learning, in which case other underperforming learning outcomes will be selected for continuous improvement, or they will confirm that there is still work to do to better support student learning of this outcome.

Conclusion

Modern technologies, including the internet and open source software, have radically decreased the cost and difficulty of collecting and analyzing learning data. Where evaluation alone was once prohibitively difficult and expensive, today the entire continuous improvement process is within reach of those who design instructional materials for use in online classes and other technology-mediated teaching and learning settings. While Ries (2011) described the build - measure - learn cycle as a way to rapidly increase a company's revenue, we see a clear analog in which similar approaches can be used to rapidly increase student learning. We now live in a world where it is completely reasonable to expect instructional materials to be more effective at supporting student learning each and every term.

We invite the reader to help us make this possible state of affairs the actual state of affairs by engaging in continuous improvement activities in their own instructional design practice. And in the spirit of continuous improvement, we further invite the reader to join us in developing and refining the processes described in this chapter—in part by completing the survey at the end of this chapter and providing us feedback on how the chapter can be improved.

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David Wiley

David Wiley profile picture

Figure 4.4.1:

Dr. David Wiley is the chief academic officer of Lumen Learning, an organization offering open educational resources designed to increase student access and success. Dr. Wiley has founded or co-founded numerous entities, including Lumen Learning, Mountain Heights Academy (an open high school), and Degreed. He was named one of the 100 Most Creative People in Business by Fast Company, currently serves as Education Fellow at Creative Commons, and leads the Open Education Group in Brigham Young University's instructional psychology and technology graduate program. He has been a Shuttleworth Fellow, served as a Fellow of Internet and Society at Stanford Law School, and was a Fellow of Social Entrepreneurship at BYU's Marriott School of Management

Robert Bodily

Robert Bodily profile picture

Figure 4.4.1:

Dr. Bob Bodily is a Senior Data Scientist and Educational Researcher at Lumen Learning. He focuses on building educational data pipelines, creating actionable reports, and generating insights to improve teaching and learning. His interests include using data to continuously improve course materials, building nudges to influence student and faculty behavior, and crowdsourcing educational content improvements and assessment items. He is currently working on educational technologies to improve teaching and learning at wadayano.com and statstest.com.

SECTION OVERVIEW

2: Instructional Design Knowledge

CHAPTER OVERVIEW

5: Sources of Design Knowledge

Learning Theories

Beth Oyarzun & Sheri Conklin

Learning theories are the foundation for designing instructional solutions to achieve desired learning outcomes. Analogies can assist in understanding new concepts, so imagine that you have purchased a new home and are considering the best options for furniture placement in the living room. Your desired outcome is a furniture arrangement that is aesthetically pleasing yet also functional. Many factors can play into the decision depending on how you view the problem, and there can also be more than one solution that meets the desired outcomes.

Similarly, theories and models provide a foundation and framework for any instructional design project. Theories serve as lenses to view the problem from different perspectives, much like interior design styles and preferences may affect decisions about which furniture to purchase for your new home based on your overall aesthetic. Models then provide guidance about how to build the solution or where to place the furniture in the home. Depending on the theory and model used, the solution might look different, much like a living room would look very different using modern vs. western-style decor with various arrangements. However, the desired outcomes can still be achieved. It is essential to conduct a thorough analysis to ensure the theory and/or selected strategy will support the desired outcomes and the targeted learners.

Learning theories help instructional designers understand how people retain and recall information and stay motivated and engaged in learning. There are three main families of learning theories and an emerging fourth: behaviorism, cognitivism, constructivism, and connectivism. Referring back to the house analogy, these could be different decorative styles (lenses) used to view a room in the house or to view an instructional problem and how to address it. Much like decorative styles have evolved and changed over time, so have learning theories. This chapter will define the four main families of learning and then explore some additional social and motivational learning theories that have derived from some of the families of learning.

Behaviorism

Behaviorism grew from the work of many psychologists in the early 20th Century, such as Watson (1913), Thorndike (1898), and Skinner (1953), who hypothesized that learning occurs through interaction with the environment. Hence, observable behaviors resulting from a response to a stimulus followed by a reward or punishment based on the behavior is how a behaviorist would condition learners to elicit the desired outcome. Conversely, if the stimulus is removed, then the behavior will stop over time. This phenomenon is called extinction.

This type of behavior modification can be considered conditioning. Two types of conditioning were defined by Pavlov (1960) and Skinner (1953): classical and operant respectively. An example of classical conditioning is Pavlov’s dog in which he trained the dog to salivate with a bell ringing by providing food every time a bell rang. Extinction occurred when the food was not delivered when the bell rang over time. Operant conditioning relies on positive and negative consequences occurring to shape behavior. This method is focused on changing the learner's external behavior using stimuli (an event that evokes a specific functional reaction) with positive and negative reinforcement. Reinforcements (positive or negative) are environmental responses that increase the probability of a behavior being repeated. Punishment, on the other hand, decreases the likelihood of a behavior being repeated, yet weakens the behavior. As an illustration, a simple way to shape student behavior is to provide feedback on learner performance. Through positive feedback (e.g., praise, compliments, encouragement), students are reinforced on learning a new behavior. Over time, as the performance improves, the feedback occurs less frequently until only exceptional outcomes are reinforced. Over time the behavior changes given the response to or removal of the stimulus. In the elementary school environment, operant conditioning methods are often used for behavior modification. Behavior charts in which learners earn stickers for displaying good behavior and have stickers removed for displaying bad behavior during the week is an example. A reward or punishment is delivered at the end of the week based upon the number of stars accumulated or removed. The rewards for learners might be a class party, or the punishment might be taking away privileges.

Behaviorist theory informs key aspects of the instructional design process such as the task analysis. The task analysis involves identifying observable behaviors or steps learners need to take to achieve the desired learning outcome. A designer often observes learners from various expertise levels completing the task to create a thorough task analysis to inform the design of instruction.

Behaviorism has been criticized due to the emphasis on external behaviors only, which led to the development of a new learning theory in the mid-1900s.

Cognitivism

A contrast to the external nature of behaviorism is the internal natured cognitivism learning theory. Cognitivism focuses on how the brain internally processes, retains, and recalls information based upon how the learner organizes information into existing knowledge schemas. Schemas are structures of existing information in the learner's mind. To ensure new information is retained for recall, instruction can be designed to enhance the probability that the new information will be added to the learner's existing schema. For instance, if the desired learning outcome is to explain the water cycle, then the instructor may use questions to have learners recall information in their existing schemas about water and weather by having them tell stories about storms, clouds, lakes, and oceans. Once they have activated those schemas, the instructor could then relate the new information about the water cycle to the stories they told, in order to help learners integrate this new information into their existing knowledge about water.

A common tool used by cognitivist learning theorists are taxonomies of learning outcomes that specify what mental processes are relied upon for various types of learning. Perhaps one of the more well-known and used taxonomies is Bloom's taxonomy (1956), which was later revised (Anderson & Krathwohl, 2001). The revised taxonomy has six levels: remember, understand, apply, analyze, evaluate, and create (see Figure 1). Using this taxonomy to identify the level of desired learning can assist in writing learning objectives, selecting appropriate instructional methods, and designing assessments to increase the probability that the desired learning outcome is achieved. The taxonomy relies on the use of action verbs to ensure learning outcomes are measurable. Many resources such as this one from the University of Nebraska-Lincoln provide a variety of verbs to use for each level of the taxonomy (Anderson & Krathwohl, 2001, available at https://edtechbooks.org/-nhUI).

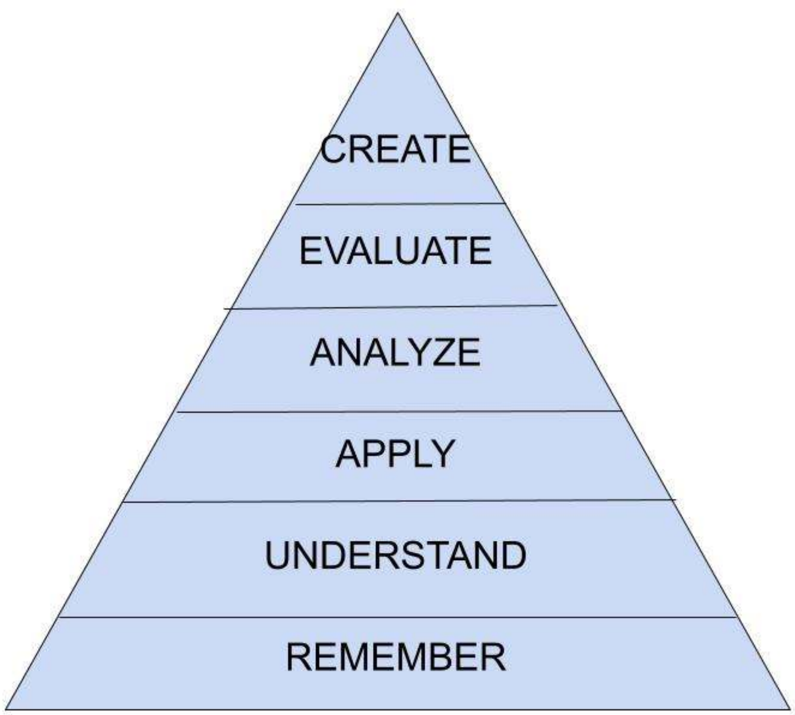

Figure 5.1.1: *Bloom's Revised Taxonomy*

For example, if the desired learning outcome were for a student to solve a simple algebraic equation, that would fall under the application level of Bloom’s revised taxonomy because the learners will apply previously learned concepts to solve the problem. The instructor may use the suggested verbs (eLearning Heroes, 2020, available at https://edtechbooks.org/-Ftt) to write a clear instructional objective such as "given an algebraic equation, the learner will solve the equation by selecting the appropriate method, showing work, and checking the solution." Next, the instructor would design assessment items that measure the attainment of that objective. In this case several equations would serve as assessment items (i.e. x + 5 = 7, x - 8 = 12, 7 + x = 9). Lastly, the instructional methods would be designed to align with the objective and assessment. Here, presenting examples with and without manipulatives, and practice problems with and without manipulatives, would be appropriate.

Cognitivism also brought about the shift from learning theory to instructional theory, which focused on the design of instruction instead of how learners process information or learners' behavior. This is an important shift that provided the foundation for the instructional design field. In 1971, a revolutionary project entitled TICCIT, an acronym for Time-shared, Interactive, Computer-Controlled Information/Instructional Television, was funded by the National Science Foundation and MIT research corporation to test computer-assisted delivery of instruction using a cognitive approach. This project produced learner-controlled instruction that was adaptive to learner choices (Gibbons & O'Neil, 2014). Other projects followed that similarly sought to apply new cognitive theories to emerging educational technologies, leading to the explosion of computer-assisted instruction applications.

Constructivism

Cognitivism added a new perspective based upon research of brain functionality during the learning process. However, another learning theory gained attention in the mid-1990s, which combined learner's interactions with the external environment and their internal learning process: constructivism. Constructivism is divided into two major schools of thought: cognitive constructivism and social constructivism.

Cognitive constructivism is based upon the work of Dewey (1938), Bruner (1966), and Piaget (1972). This theory revolves around the concept that learners construct their knowledge through individual personal experiences. For example, when learners are exploring complex concepts through project-based learning, some learners may grasp the concepts quickly while others may struggle. Facilitating knowledge development through probing questions to help learners identify where they are having difficulty is part of an inquiry method to alleviate misinterpretation. It can also help learners reflect on their knowledge, misconceptions, and progress. Anchored instruction is an example of a cognitive constructivist theory that incorporates instructional technology such as video (Bradsford et al., 1990). Anchored instruction suggests that learning is anchored in a realistic, evolving context with guiding resources available to help the learners solve the instructional problem presented. The Adventures of Jasper Woodbury is a mathematics video series that was designed using the anchored instruction theory (Cognition and Technology Group at Vanderbuilt, 1992, available at http://jasper.vueinnovations.com/).

Social exchange and collaboration are foci of the social constructivist theory grounded in the work of Vygotsky (1978). A major theme of social constructivist theory is that social interaction plays a fundamental role in the development of cognition. Vygotsky postulated that cultural development happens twice, first on the social level (between people), then later on the individual level (inside the mind). One example of social constructivist theory is the development of language. If you are building a house, you may have basic language skills but may be unaware of terms associated with construction. As you continue to work with your peers, you begin to learn various tools and terms associated with construction through your interactions with them. Think about learning another language. Language mobile applications now offer the ability to have conversations with a native speaker electronically. This social interaction allows learners to first hear and engage with correct grammar and pronunciation. Over time, the learner can begin to process and think in another language, using proper grammar and pronunciation.

This perspective deepens our experiences in the world and aids our construction of new knowledge through the exchange of ideas with others. Often group activities such as projects, experimentation, and discussions are utilized. Learners engage with the content and then decompress with one another to develop or construct meaning from various activities. The teacher acts as a guide or translator by setting up the instruction to allow the learners to explore concepts. As the learners explore the concepts, the teacher then assists the learners in translating what they have found into the learner's current state of understanding.

Quest Atlantis is an example of an instructional design and technology product based on social constructivist theory (Barab et al., 2005). The goal of Quest Atlantis was to provide an immersive learning environment that combined academics and play with interdisciplinary cultural quests that supports learning, development, and social transformation. Players created a persona and by completing quests they engaged in educational activities while interacting with other users and mentors. The authors described the design as socially responsive because the quests adapted to the decisions of the players.

Connectivism

Early in the 21st Century, a new learning theory emerged from the digital age: connectivism. Connectivism is based on the work of Siemens (2004) and is the first theory that defines learning as more than an internal and individual process (see https://edtechbooks.org/-oCyT for a republishing of this article). The connectivist theory posits that learning takes place when learners make connections between ideas located throughout personal learning networks (e.g., other individuals, databases, social media, Internet, learning management systems). The connection of the right individuals to the right resources can enhance the learning for all within the network.

Technology increases learners' access to information and their ability to be a part of a greater learning community (Siemens, 2004). There are premises around connectivism. One premise is that learners need to distinguish between important and unimportant information, as well as valid information, since there is a continuous flow of new information. If we go back to the house example, you are working on building your house, and you want to install a fireplace. You can go to the Internet and join a builder's community on YouTube or a Do-It-Yourself (DIY) forum. You may also be able to access reviews for various types of fireplaces and what has worked and what has not. Once you have built the fireplace, you can share your experience with these communities to enhance the experiences of others.

To summarize the four families of thought on learning theories, Figure 2 identifies some possible instructional methods for each learning theory presented so far.

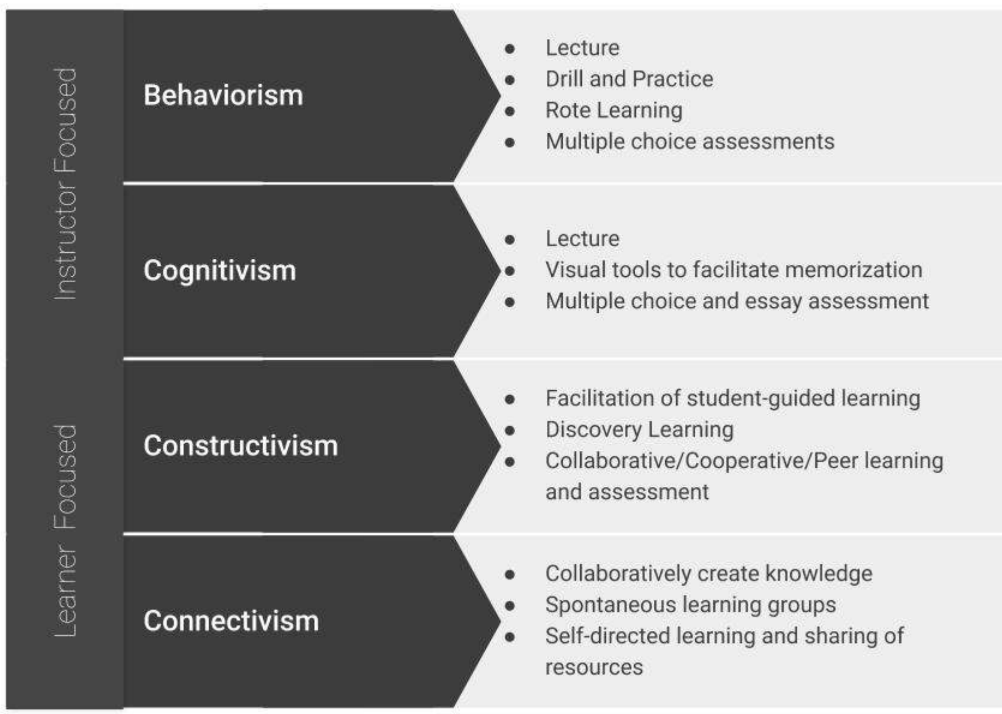

Figure 5.1.2: *Methods Used for Learning Theories Adapted from Morrison (2013)*

Additional Readings and Resources

1. Foundations of Learning and Instructional Design Technology Book - Chapters 9, 10, 11 and 19. (West, 2018)
2. Learning Theory and Instructional Design (Mcleod, 2003)
3. Understanding the practices of Instructional Designers through the lens of different Learning Theories (Yeo, 2013)
4. How People Learn I (National Research Council, 2000)

Social Learning Theories

As noted above, interaction with both individuals and the environment is embedded in learning theories. From these types of interactions, multiple social learning theories emerged during the late 1990s that enhanced or deepened some of the ideas from the major families of thought around learning at that time. We will discuss the following social learning theories: social cognitive theory, social development theory, collaborative learning, and cooperative learning.

Social Cognitive Theory

Social cognitive theory teaches that people learn by observing others and is based upon the work of Bandura (1986). He believed that people construct knowledge from learning from others' experiences. By observing others' behavior, learners derive conceptions regarding the behavior being modeled. This observation can happen directly or through the media. Reflection is a crucial component of this theory as once the learner observes the action, they reflect and determine whether this is something they want to incorporate or use. Four processes coincide with observational learning techniques: attention, retention, reproduction, and motivation. Within the social cognitive theory, motivation is seen as depending upon one's self-efficacy and agency. In order to proceed through all four processes, the learner must have the confidence to exhibit control over a desired behavior or self-efficacy. Social cognitive theory is rooted in the view of human agency in which individuals are agents proactively engaged in their development and can make things happen through individual actions. For example, if a learner struggles with learning a particular behavior or task, allowing the learner to work with another person that has mastered the behavior or task will allow the learner to view how the ideal behavior or task is performed successfully.

Collaborative Learning

Instructors and designers sometimes want learners to work together to construct new knowledge deliberately. Collaborative learning is a social learning theory that involves learners grouping themselves together to explore a concept or to work on a project collectively. Collaborative learning is a loosely structured, discovery learning approach in which learners have much control. It is an “umbrella” term that encompasses a variety of educational approaches involving joint efforts by learners working together. Group members capitalize on the skills of one another through the sharing of information and ideas that build towards a common group goal.

Cooperative Learning

Cooperative learning is a carefully structured type of collaborative learning. In both of these social learning theories, the instructor's role is that of facilitator, and the tasks for the groups should be open-ended and complex. Cooperative learning is rooted in social interdependence theories (Deutsch, 1949; Lewin, 1935). Johnson and Johnson (1989) conducted extensive research on defining the parameters of cooperative learning, which requires these five components: interaction, positive interdependence, group processing, individual accountability, and social skills. In other words, groups need to interact, depend on one another, monitor their progress, be responsible for their work, and be able to work together. For example, a team research project could require each team member to find several resources, and an annotated bibliography of those resources could be submitted individually (individual accountability). The team could then co-write and edit the research paper with all of the resources (interaction, social skills, and positive interdependence). The group could use a cloud-based text editor to ensure all team members are contributing in a timely fashion (group processing). Cooperative learning requires intentional planning by the instructor or the designer to ensure all five components are present.

Additional Readings and Resources

1. Collaborative vs. cooperative learning video (wufei87, 2018)
2. Social Cognitive Theory video (Bandura, 2010)

Motivational Theories

Keeping learners motivated and engaged is just as important as understanding how they learn best. Therefore, motivation and engagement theories are essential to include when discussing learning theory. We will discuss three motivation theories (self-determination, hierarchy of needs, ARCS), and one engagement theory (flow).

Self-Determination Theory

Self-determination theory is a motivational theory that suggests learners can become self-determined when their needs for competence, connection, and autonomy are satisfied (Deci & Ryan, 1985). Self-determination theory views internalization as a process for transforming external regulations into internal regulations and thereby integrating them into one's self (Deci, Eghrari, Patrick, & Leone, 1994). Social support, along with intrinsic and extrinsic motivators are important factors for developing self-determination. Extrinsic motivators can hinder self-determination, whereas intrinsic motivators can enhance self-determination. Intrinsic motivators such as joy and self-fulfillment allow learners to be autonomous and engage with learning. When learners complete their work or a challenge, they feel competent. Both competence and autonomy are components necessary to maintain intrinsic motivation. Extrinsic motivators can hinder self-determination, whereas intrinsic motivators can enhance self-determination. External motivators, such as being rewarded for making an A on a test, can hinder learning. Social support should be considered over extrinsic rewards to foster self-determination. For example, ensuring every member of a team can play a role and understand their contributions are valuable. Methods to complete that could be establishing roles based on team member talents and providing positive feedback. Allowing individual learners and teams to set their own learning goals can also be beneficial. Another example of utilizing intrinsic motivators is giving learners an assignment where learners teach the concepts to other learners (internal) rather than teaching the learners to take a test on the concepts (external). This type of motivation is fostered and encouraged by fostering autonomous support for the learners rather than controlling.

Maslow's Hierarchy of Needs

Creating an autonomous environment may not always motivate learners as there are basic needs that need to be in place before learners can begin to move in the direction of self-fulfillment. Maslow's hierarchy of needs (Maslow, 1943) is a second motivational theory. Maslow stated that some needs take precedence over others, such as basic needs for survival. Maslow developed a hierarchy stating the needs at the bottom should be met first and then move their way up (see Figure 3).

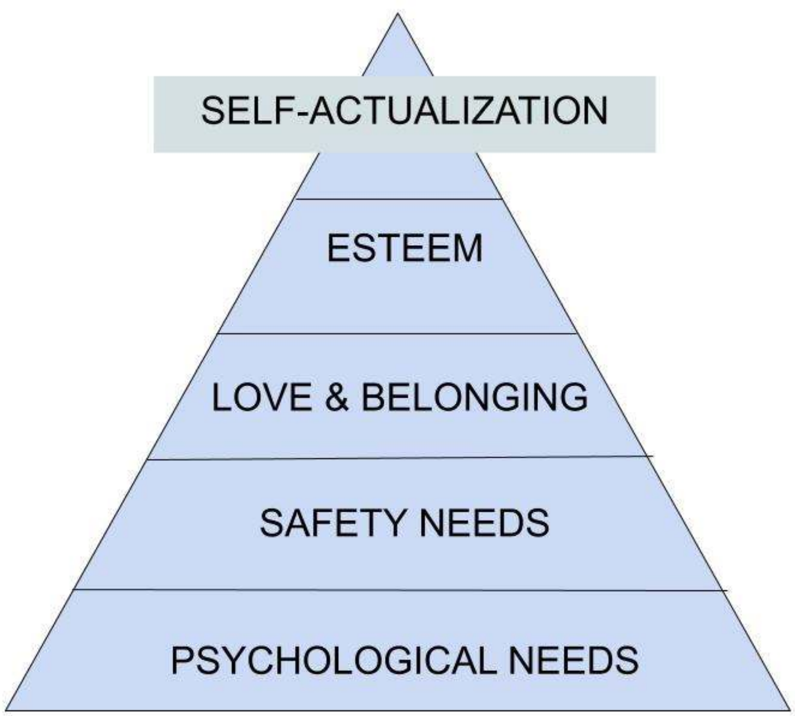

Figure 5.1.3: *Maslow's Hierarchy of Needs*

At the bottom of the pyramid are the physiological needs such as air, food, shelter. Next is safety needs, such as protection from the elements, order, and freedom from fear, followed by love and belongingness. Next, are esteem needs, which are achievement, mastery, and the desire for reputation or respect from others. Finally, the self-actualization needs are realizing personal potential or the ability or desire to become capable. Although the order of the needs seems rigid, they are flexible, depending on the external circumstances or individual differences. For example, if a learner is concerned about where they are going to sleep or eat that night, they will not be as inclined to learn new concepts as their basic needs are not met. However, if a learner who is well-fed and is loved and has a sense of belonging, whether it is part of a social group or family, they are more inclined to strive to learn new concepts.

Keller’s ARCS Model

Within the motivational theories, there are models that provide guidance to assist designers in planning to ensure learners’ motivation. For example, Keller’s Attention, Relevance, Confidence, and Satisfaction (ARCS) is a motivational model that can be used to guide instructional planning to be intentionally motivational for learners (Keller, 1987). This model focuses on promoting and sustaining motivation throughout the learning process. First, gain the attention of the learner by piquing their curiosity. Games, roleplay, humor, or the use of inquiry are all techniques to gain learner attention, particularly when introducing a new concept. Next, to increase the learner’s motivation, relevance needs to be established. To establish relevance, you need to present the worth of knowledge gained, what does it mean to the learner? How will this knowledge directly affect the learner? Next, provide confidence and give the learners control over their learning while providing feedback. The instructor can achieve this by providing the learner’s opportunities for short term wins and small steps of growth during the learning process. Finally, the learning needs to be rewarding or satisfying in some way, either from a sense of achievement or external means; however, without patronizing the learner through over-rewarding easy tasks.

Flow

Once a learner’s attention is gained, the instructor or designer’s focus should turn to keep the learner engaged. Flow is an engagement theory that is sometimes described as “being in the zone.” Flow was defined by Csíkszentmihályi (1990), who was inspired by watching artists, athletes, chess players, and others who become immersed in completing tasks. Flow tends to happen when someone is engaged in an activity they enjoy, either due to their skill level or other intrinsic stimuli. Csíkszentmihályi defined 10 components of flow, but not all 10 have to happen for flow to occur. These 10 components are: (1) clear and challenging goals, (2) strong concentration, (3) intrinsic motivation, (4) serenity feeling, (5) timelessness, (6) immediate feedback, (7) a balance between challenge and skill level, (8) feeling of control, (9) loss of awareness of other needs, and (10) complete focus. To create flow for learners, designers should allow some choice of activity to build on the learner’s strengths and interests and strive to match and personalize the challenge level of the learning to the learner’s abilities. “Genius Hour” (West & Roberts, 2016) is an example of applying Flow theory to education. In this approach, learners are given an hour each day, or every other day, to be “geniuses" in whatever topic they are excited about. They work for an extended period of time to complete a major project in their area before sharing their ideas with the class or families. These types of projects often produce substantial learning benefits by encouraging conditions where learners are more likely to be in flow.

Conclusion

Learning theories and models are tools that help to shape and guide learning. Like decorating a living room in a new house, various tools can be employed to move an empty room to one with a functional design and a pleasing look and feel to the designer and client. Instructional designers can rely on learning theories and models to design learning solutions that meet the needs of their clients. The theories and models also give designers language and structure to communicate their designs and research to give evidence that their designs will be effective. Consider if you were the client that bought the house and received several proposals from interior designers for the living room decorations. Proposal 1 was a diagram and a budget. Proposal 2 had a narrative description that justified the attached diagram and budget. The justification was based on their interior design philosophy and detailed how the diagram would prove to be functional for the client. Provided the design philosophies match, you would probably select proposal 2. Using instructional design theories and models helps guide your design or learning solution and helps justify your design solution as an effective one for potential clients.

Additional Readings and Resources

1. Foundations of Learning and Instructional Design Technology Book - Chapters 12, 13, 14 and 16. (West, 2018)
2. Development and use of the ARCS model in instructional design article (Keller, 1987)

3. Flow TED talk (Csikszentmihalyi, n.d.)
4. Edward Deci—Self-determination theory (Deci, 2017)

Application Exercises

1. Create a reference guide or chart of theories, characteristics, methodologies, and how you may best apply them to your own design context and situation.
2. Create a timeline of the evolution of learning theories.

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5.2: The Role Of Theory In Instructional Design

The Role of Theory in Instructional Design

Trudy K. Christensen

Editor's Note

This is a version of Christensen, T. K. (2008). The role of theory in instructional design: Some views of an ID practitioner. *Performance Improvement*, *47*(4), 25–32. https://doi.org/10.1002/pfi.199, and has been republished here with permission from the publisher.

> *This article describes how an experienced instructional designer thinks about and uses learning theories to inform instructional design decisions. It uses a vision metaphor to provide a simple heuristic framework for identifying the nature of instructional problems and relating different types of problems to useful theoretical perspectives, methods of instructional analysis, and assessment strategies. Finally, it provides a synopsis of major learning theory perspectives and situations that could be addressed by applying models and strategies representing the different theoretical perspectives.*

There has been considerable discussion in recent years about the role that learning theories play in instructional design practice (Wilson, 2005; Christensen & Osguthorpe, 2004; Reigeluth, 1999; Hannafin, Hannafin, Land, & Oliver, 1997; Bednar, Cunningham, Duffy, & Perry, 1992). Do instructional designers actually think about and apply the theories they learned in college? Are these theories really useful? In a recent survey of over 100 instructional designers, about half of the designers indicated that they regularly use specific learning or instructional theories or research to make instructional strategy decisions (Christensen & Osguthorpe, 2004). This study did not reveal, however, when and how instructional practitioners use these theories. What theories do they think about? How do they think about the theories? Do they use more than one theory at a time? How do they use these theories to inform their decisions? After almost 25 years of instructional design practice, I have developed some ways of thinking about learning theories that have proven useful for me. I have shared these ideas with students and other designers over the years, and many have found them helpful. I share them here as a type of think-aloud exercise, not to claim they are the only way to think about and apply theory to instructional practice but as a type of heuristic that might help novice designers. I encourage other experienced practitioners to reflect on and record their strategies for applying theory to practice as a means of documenting and comparing best practices.

When I design instruction, I do not usually start with a particular theory. My main focus is the problem and the problem situation. I start by considering the nature of the instructional problem and then ask: "What theory or models would be most useful and appropriate to help address this problem?" Deciding on a theoretical perspective early in the design process not only helps later when it comes to designing the instruction, but also serves as a guide for deciding how to analyze the learning tasks or content and how to assess learning.

What Is the Nature of the Problem?

I have found it useful to use a vision metaphor when considering the nature of instructional problems. I decided on this metaphor because I am very conscious of vision issues since I have poor eyesight and come from a family of eye doctors. One time I visited my eye-doctor brother for help with my worsening vision. In the process of discussing what would be the best solution for my problems, he mentioned that he is continually confronted with a range of trade-offs and alternatives when trying to come up with the most appropriate prescription for his patients. He described one occasion when a woman walked into his office with a thread and needle and simply stated, "Doctor, I want glasses that will help me thread this needle." That was all she seemed to care about. She had specific and measurable criteria for the solution, and in no time he was able to determine the most appropriate prescription for her.

My brother admitted that these kinds of cases are the most straightforward to solve. But most often he must devise an all-purpose prescription that will allow his patients to perform in many situations—some known, but most of them unknown. This is when it is more difficult to determine the appropriate solution. It is usually less clear in these cases what the optimal solution should be because it is impossible to evaluate the adequacy of the prescription in all the potential situations where the glasses may be needed.

I often think of instructional problems according to the continuum shown in Figure 1. On one end of the continuum are problems that are usually fairly easy to describe: the nature of the task can be defined, and the conditions under which it must be performed can be specified. I call these training problems. On the other end of the continuum are the problems that may require a more all-purpose prescription, where it is not possible to define or anticipate all the task requirements or the conditions under which the tasks may need to be performed. I refer to these types of problems as education problems. The importance of evaluating the overall goal or nature of an instructional problem at the outset should not be underestimated. Other designers have advocated a similar strategy. For instance, Wilson, Teslow, and Osman-Jouchaoux (1995) advise:

Distinguish between educational and training goals. Acknowledge that education and training goals arise in every setting. Schools train as well as educate; and workers must be educated—not just trained in skills— to work effectively on the factory floor. Discerning different learning goals in every setting provides a basis for appropriate instructional strategies. (p. 149)

I refer to the middle of the instructional problem continuum as the preparation domain. Problems that fall near the center are not as focused or easily measured as the training problems, but they still represent more readily definable ranges of needs than the education problems. For example, using the vision metaphor, if someone came to the doctor and asked for help passing the driver's vision exam so that she would later be able to drive, that would be a preparation problem. Preparation problems represent an intermediate range of goals—ones that may be necessary to achieve the more application-oriented ends of training and education. Preparation goals undergird or provide critical prerequisite skills or knowledge for training and education. Clearly many instructional problems have elements of all of these instructional goals, but I try to identify the overriding goal, the goal with the highest priority, in the problem situation I am addressing. This helps me focus and optimize my efforts throughout the remaining design process.

How Does Learning Theory Relate to the Different Types of Problems?

It is important to remember that unlike the field of physics, which has been fairly successful in finding unifying theories to help guide work in that area, there is no one unifying theory of learning or instruction. Many theories have been devised over the years, with varying degrees of success in guiding practice. As these theories prove inadequate to explain or help with some types of learning, they usually fall out of favor. This is just what Thomas Kuhn (1996) in his famous treatise, The Structure of Scientific Revolutions, would predict. Most often there is a current favorite theory or paradigm that guides practice in education. However, we should not be so eager to use a particular theory just for the sake of being current. We may be ignoring or overlooking some effective and important strategies for the situation at hand. Many of the earlier learning paradigms and theories (e.g., behaviorism) are still useful for certain types of learning problems.

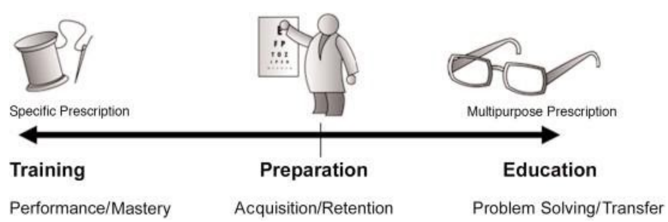

Figure 5.2.1: *Continuum of Instruction Problems*

Many theories and models of learning and instruction have been developed over the years—so many that it is often difficult to assimilate and remember them all, let alone use them to help guide instructional practice. Fortunately, some educational psychologists group these theories and practices into three or four main categories. For instance, Ormrod (2008) categorizes learning theories according to three main perspectives of learning: cognitive psychology, behaviorism, and social cognitive theory. Woolfolk (2007) describes four main views of learning: behavioral, information processing, psychological/individual constructivist, and social/situated constructivist views.

Figure 2 summarizes my synthesis of different learning theory perspectives as they relate to instructional design and metaphors that I have found useful. The figure also lists assumptions regarding the nature of knowledge underlying each perspective, as well as the role of the instruction, the role of the learner, and the main instructional and motivational strategies suggested by these perspectives. When reading about a new idea or model, I ask myself, "What are the assumptions underlying this model, and where would it fit under these major theoretical perspectives?" Finally, I ask, "Does this theory or model reveal a useful new idea that distinguishes it from others?" Then I try to remember that idea so I can apply it in my designs if appropriate.

Figure 3 shows the theoretical perspectives that seem to have the most to say about each type of problem. Training problems, as I have defined them, represent more limited, specific behaviors or tasks to be completed under definable conditions. Therefore, many of the strategies underlying behaviorism are still very useful to help address these types of problems. In addition, some aspects of social cognitive theories (e.g., Bandura, 1986), such as vicarious reinforcement and modeling, can be useful to address many training problems. Learners benefit from seeing others model specific tasks or behaviors and noting the consequences of correct or incorrect actions.

	Behaviorism	Information Processing	Social Cognitive	Constructivism: Cognitive	Constructivism: Social
Main Metaphor	The black box—focuses on inputs and outputs (behaviors); not worried about what is happening inside	The computer—focuses on how information is processed, stored, and retrieved from memory	The video camera—focuses on effects of personal observations on behavior and cognitive processes	The rhizome—focuses on rootlike (unlimited) growth and development through interaction with environment and others (Driscoll, 2005, p. 388)	
Nature of knowledge	Knowledge is "out there" and needs to be acquired and used	Knowledge is "out there" and needs to be acquired by connecting it to knowledge already stored "inside"	Knowledge is negotiated from experience and reason	Knowledge is individually constructed through interaction with the environment and others	Knowledge is coconstructed through interaction with others
Role of the learner	Performer—acquires and demonstrates use of knowledge	Processor—uses strategies to acquire, retrieve, and use information	Observer/copier—learns by observing others	Explorer—interacts with the environment and others to make individual discoveries	Collaborator—creates meaning through social negotiation, interaction, and cooperation
Role of instruction	Convey knowledge and change behavior by managing and supervising the learning environment	Transmit knowledge by guiding students toward an "accurate" acquisition of knowledge	Model and reinforce behaviors to help students set and achieve meaningful goals	Provide experiences and resources so students gain personal understanding	Provide meaningful social contexts for coconstructing knowledge
Main instructional strategies	Define behaviors Provide practice opportunities Correct mistakes (consequences, feedback)	Organize and present information Demonstrate strategies Manage memory load Identify and correct misconceptions	Model and reinforce behaviors (directly and vicariously) Help set personal goals Show how to monitor own behaviors	Create "puzzlement" Provide opportunities to experiment and articulate ideas	Create a social learning environment Provide opportunities to interact and articulate thinking
Main motivational strategies	Provide positive (or negative) reinforcement—use rewards or disincentives to shape behavior	Make connections with prior knowledge and experience (schemas)	Encourage belief in self (self-efficacy) through direct and vicarious reinforcement; set personal goals and monitor progress (self-regulation)	Stimulate interest or curiosity in an anomaly	Create authentic, inherently challenging situations

Figure 5.2.2: *Major Learning Theory Perspectives and IImplications for Instructional Design*

Instructional Problems

Specific prescription ← → Multipurpose prescription

	Training	Preparation	Education
Goals	Performance/ mastery	Acquisition/retention	Problem solving/transfer
Useful theoretical perspectives	Behaviorism Social cognitive (vicarious learning)	Information processing Social cognitive (modeling)	Constructivism: cognitive, social Social cognitive (self-regulation)
Type of instructional analysis	Job analysis, procedural analysis, skill analysis	Content analysis, learning analysis	Cognitive task analysis, activity analysis
Assessment strategies	Performance assessment or mastery tests	Domain-referenced tests	Alternative assessments, including portfolio assessment, holistic scoring, authentic assessments

Figure 5.2.3: *Instruction Problem Types and Related Goals, Theoretical Perspectives, Types of Instructional Analysis, and Assessment Strategies*

Many preparation problems may be addressed by strategies suggested by an information-processing perspective that focuses on the capabilities and limitations of human memory and cognitive processes. These theories (e.g., Norman, 1982) suggest strategies for presenting and chunking information for optimal encoding and retrieval, assimilating new information into existing schemas, and encouraging and enhancing meaningful learning. In addition, as social cognitive theory suggests, learners may benefit from having others model how to apply effective learning strategies for remembering, understanding, and extending ideas.

Constructivist approaches, both cognitive and social, provide strategies for addressing many education problems. They suggest ways of helping learners develop expertise and problem-solving skills to function effectively in complex, social, unpredictable, and nuanced real-world environments. In addition, education problems may be addressed by emphasizing aspects of social cognitive theory that focus on strategies for helping students become self-regulated learners—able to define problems effectively, identify possible solutions, predict consequences, choose best solutions, identify how to carry out the solution, implement solutions, and evaluate results (Bandura, 1986).

To some, this high-level synopsis may sound like a gross overgeneralization, but it helps me address a vast and complex array of theories, models, and strategies. This high-level approach is just a heuristic. When I design, I still may draw from multiple theories or perspectives to address a particular problem. For instance, I might decide to use a particular social constructivist strategy such as team-based learning (Michaelsen, Knight, & Fink, 2004) as my main strategy to help students learn to solve real-world problems by coconstructing knowledge as learning teams. But in the process of implementing this approach, I might also incorporate the use of incentives, such as posting team scores or giving extra points for exceptional team performance, motivational strategies derived from behaviorist theories.

How Do the Theoretical Perspectives and Problem Types Guide My Design?

It is important to remember that there is no formula for great design. By definition, this is a problem-solving process that cannot be described step-by-step. Nevertheless, Figure 3 summarizes what I think the major theoretical perspectives and learning goals generally imply for the type of assessment strategies and analysis techniques most appropriate for each problem type. The instructional analysis strategies listed—job, procedural, and skill analysis; content analysis; learning analysis; cognitive task analysis; and activity analysis—reflect the main categories of analysis outlined by Jonassen, Tessmer, and Hannum (1999). Job, procedural, and skill analyses are frequently the best approaches to use for training problems because they involve creating specific task, skill, or procedural descriptions as they relate to an organizational context or larger system. For preparation problems, content and learning analyses, which focus on hierarchical relationships among concepts, principles, tasks, or behaviors, are useful strategies for analyzing content or skill domains that may be prerequisites to training or problem-solving tasks. These approaches focus more on ways of representing content for optimal retention and retrieval rather than sequencing tasks for actual performance. Finally, cognitive task analysis (CTA) techniques and strategies are best suited to capture the explicit and implicit knowledge that experts use to perform complex tasks (Clark, Feldon, van Merriënboer, Yates, & Early, 2007). CTA is often used to create expert systems and complex simulations. In addition, activity analysis, based on activity theory, is frequently used to analyze education problems. Activity analysis focuses on understanding the rich contexts in which people live and work; it is used to examine the activities in which experts engage, the tools they use, and the social context and interrelationships among participants in real-world environments (Jonassen et al., 1999).

Thinking in terms of the instructional problem continuum shown in Figure 3 also helps to identify useful assessment strategies. Training problems generally lend themselves to performance assessment or mastery-testing strategies. Performance assessment "is assessment based on observation and judgment" (Stiggins, Arter, Chappuis, & Chappuis, 2004, p. 191). The main goal in using performance assessment is to describe a skill or task and the criteria that will be used to judge the performance. This type of assessment may use checklists, rating scales, or rubrics to measure achievement or mastery.

Since it is often not practical or even possible to test mastery of large areas of underlying content knowledge or expertise, preparation problems are frequently assessed by sampling from a domain of potential terms, concepts, and principles that represent critical content underlying an area of study. This approach is sometimes referred to as domain-referenced assessment. According to the technical definition, domain-referenced assessment "requires the specification of rules that determine membership in the domain and a procedure for sampling individual elements so that inferences can be made from the sample to the domain" (Gipps, 1994, p. 82). I use this term more loosely to describe an attempt to sample from a content domain by using a table of specifications or other forms of systematic analysis to represent critical content in an area of study. Typically, domain-referenced assessment uses standard written test item formats, such as multiple-choice, true-false, or short-answer questions, to test learner knowledge or understanding. Finally, education problems lend themselves to alternative forms of assessment, including holistic assessments, or portfolio or authentic assessments, where the goal is to measure the application of principles and concepts through the production of outcomes or performance of behaviors in realistic, complex settings.

To illustrate how the three main problem categories I have defined could be applied to different settings and situations, Table 1 shows how I might use the problem types to categorize representative situations, examples, and instructional models.

Table 1	Example Situations, Applications, and Models Related to Different Types of Instructional Problems		
	Types of Instructional Problems		
	Training	Preparation	Education
When to use	To improve performance on a specific job or task To know or learn skills to achieve mastery To know how to use a new product, process, or skill to some required level of mastery or proficiency To achieve automaticity in a critical skill	To gain fluency in the vocabulary, concepts, skills, and strategies of a particular subject area To promote in-depth understanding of a subject matter or content domain To acquire critical prerequisite concepts necessary for performing a job or pursuing a profession To provide needed background knowledge for completing a task or solving a problem	To know how and when to apply content or process knowledge under differing circumstances To be able to solve a variety of unique problems To learn how to work cooperatively to solve problems in a given area
Examples	To learn • The features and functions of a new computer program • How to handle a new machine • The steps of a new development process	To learn about • Human anatomy in preparation for a health care profession • Different types of computer networks to become a systems analyst • Various learning theories to become an educator • Mathematical concepts and principles in preparation for a science career	To learn • How to diagnose a disease • How to conduct a technical systems analysis for a large corporation • How to apply principles of physics to daily life
Useful teaching or instructional models	Bloom's mastery learning model (Bloom, 1976) Programmed instruction (Skinner, 1968) Personalized systems of instruction (Keller, 1968)	Ausubel's meaningful reception learning (1978) Gagné's theory of instruction (1985)	Cognitive • Discovery learning (Bruner, 1966) Social • Cognitive apprenticeship (Collins, Brown, & Newman, 1989) • Goal-based scenarios (Schank, 1992) • Problem-based learning (Savery & Duffy, 1995)

			• Team-based learning (Michaelsen et al., 2004) • Service-learning (Campus Compact, 2003)

When Might It be Useful to Combine Approaches?

Now that I have differentiated problem types and theoretical approaches, I want to highlight a connective thread that has emerged in recent years to help me tie these approaches together when circumstances allow. The emphasis on situated cognition (Wilson & Myers, 2000) proposed by social-constructivist approaches to learning has implications for combining strategies from the different learning perspectives. Situated cognition suggests that learning should be taking place in the context in which it is used. Therefore, when I am creating learning environments to address educational needs, I try to find ways of incorporating preparation activities into the setting where the problem solving takes place. Strategies for accomplishing this goal include using simulations, apprenticeships, internships, service-learning, and other approaches. The implication of this perspective for both training and educational goals has also led to an emphasis on work-based, just-in-time learning. With the increasing speed and accessibility of electronic media, this notion has become the basis of a new field emphasizing the design and development of electronic performance support systems (Gery, 1991). Whenever possible, I watch for opportunities to use an electronic performance support system or even non-electronic job aids to help learners achieve preparation objectives in training and educational contexts.

If I were to show the implications of situated cognition on the problem continuum, I would show more preparation goals being addressed at the ends of the continuum in the performance contexts, as illustrated by Figure 4. This means learners would have ready access to important supporting skills or knowledge in the same context where they are performing the training task or trying to solve problems.

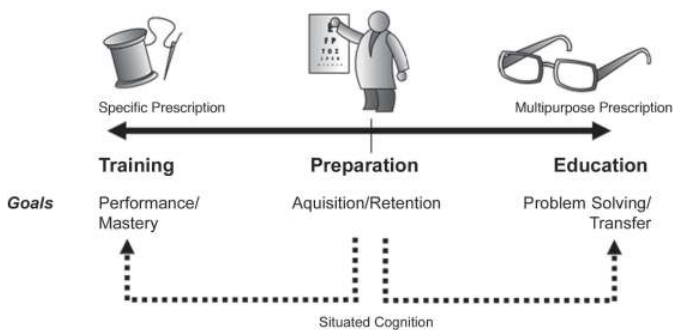

Figure 5.2.4: *Situated Cognition and the Problem Continuum*

Summary and Implications for Practice

In summary, I use learning theory to guide design by first deciding on the nature of the instructional problem and the main goal of the instruction. Then I decide which theoretical perspective or perspectives best match the needs of the situation. Next, I often investigate specific teaching models that reflect the theoretical perspectives I have determined are most useful and appropriate for addressing the problem. I may apply a particular model or simply rely on basic strategies related to the different theoretical perspectives to help guide, inform, and justify my design. I also watch for opportunities to use technology to help support and achieve preparation goals in performance contexts. HPT professionals who use this type of process can balance instructional decisions with the time, cost, and contextual constraints of the situation.

In reflecting on the use of theory in instructional design practice, I tend to concur with Wilson and Myers's (2000) assessment of the way practitioners generally use theory:

> *Most clinical psychologists are reportedly "eclectic" in their stance towards the various theories of psychotherapy. Many teachers and instructional designers take the same non-committal stance toward theory. They prefer a menu or toolbox metaphor instead of an application/consistency metaphor. Practitioners tend to be opportunistic with respect to different theoretical conceptions. This stance toward theory might be termed "eclectic" or*

> *"grab-bag," but we prefer to think of it as problem- or practitioner-centered. People rather than ideologies are in control. The needs of the situation rise above the dictates of rules, models, or even standard values. (p. 82)*

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Making Good Design Judgments via the Instructional Theory Framework

Peter C. Honebein & Charles M. Reigeluth

Many instructional designers who design innovative learning experiences, and then conduct research that investigates the usefulness of those learning experiences, fail to fully apply the instructional theory framework as a design foundation. This reduces the usefulness of their designs and ultimately leads to learners and other stakeholders not fully adopting and benefitting from the designer's learning experiences.

The aims of this chapter are to (1) help both designers and researchers improve the usefulness of their instructional designs and subsequent research, and (2) reduce diffusion barriers that impact the dissemination and adoption of learning experiences. The sections of this chapter include:

- Real Instructional Designers Use Theory
- Using the Instructional Theory Framework for Good Design
- Conclusion

Formally linking instructional design and research to the instructional theory framework and its related design principles enables designers and researchers to answer questions about the relative advantage, compatibility, complexity, observability, and trialability of their innovations (Rogers, 2003).

Real Instructional Designers Use Theory

What is a theory? Simply put, it is a set of ideas about how something might work. For example, Darwin's theory of evolution contains the ideas of genetic variation and natural selection, among a host of others. In the education field, learning theory is a set of ideas about how people learn, such as behaviorism, cognitivism, and constructivism. However, what should most interest instructional designers is instructional theory, a set of ideas for how best to help people learn.

Here is a simple example of an instructional theory: Drill-and-practice is a useful method for efficiently helping a learner memorize such things as the names of all the U.S. states. This theory contains the idea of an instructional method (drill-and-practice) to help a person remember things. How well will it work? We will not know until we actually deliver our instructional theory to learners in the intended type of situation.

Yanchar et al. (2010) suggested some instructional designers feel that instructional theory has little relevance in how they design instruction: "There is clearly an uneasiness about the applicability of theories and other conceptual tools in everyday design work" (p. 41). Honebein and Honebein (2014), on the other hand, suggest designers do use instructional theory, "but their usage of theory is tacit—e.g. not apparent, even to them" (p. 2).

Thus, the number-one job for instructional designers is to create or modify instructional theories more overtly in a way that meets a client's requirements. To accomplish this, designers should consider using the instructional theory framework (Honebein & Reigeluth, 2020; Reigeluth & Carr-Chellman, 2009a), illustrated in Figure 1.

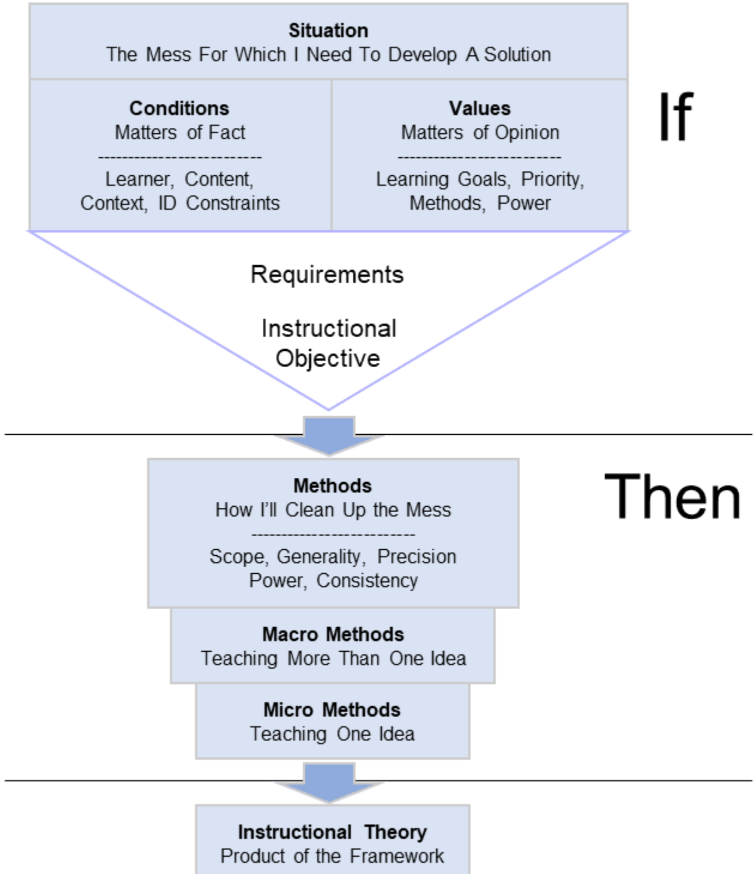

Figure 5.3.1: *A Simple Representation of the Instructional Theory Framework in Action*

Note. We call the product (outcome) of this framework an instructional theory.

The instructional theory framework is a design theory, a set of ideas focused on how to "create" instruction rather than "describe" instruction. Central to this idea of creating things is the concept of a method, which encapsulates the know-how a designer uses to create something.

There are several categories of methods that instructional designers use in their design work, such as process methods (e.g., ADDIE), instructional methods (e.g., demonstrations and practice with feedback), media methods (e.g., words, pictures, or video to communicate content), and data-management methods (e.g., gradebooks and learning management systems). While the instructional theory framework guides all of these types of design decisions, our specific interest in this chapter is instructional methods, for example lecture and project-based instruction, which promote learning.

Designers use the instructional theory framework as a way to select instructional methods that promote learning. To select the most useful instructional methods, designers rely on the instructional situation to guide them. Front-end analysis (the "A" part of ADDIE) is where the instructional theory framework begins its journey to deliver value. As shown in Figure 1, the instructional situation has two parts: conditions and values.

Conditions are matters of fact about the situation that a designer can elicit empirically and objectively from stakeholders and documents. Conditions include information about:

1. Learners, such as number, demographics, geographics, psychographics, and behaviors, potentially represented as "personas"
2. Content, the subject matter the learning experience will teach
3. Context, which reflects place, resources, and tools
4. Instructional development constraints, which includes money, time, and person-hours

This type of information is usually what designers and clients focus on collecting during front-end analysis.

However, what designers often fail to collect during front-end analysis is information about values. Values are matters of opinion that are subjective in nature. For example, a client might say “I hate lectures and I don’t want them in my course!” In that statement, the client is expressing a value—an opinion—that is true for them but may not be true for others. A designer elicits values empirically and multidimensionally from a variety of stakeholders. Values can have a huge impact on the success of an instructional design project. The instructional theory framework specifies four unique types of values:

1. Values about learning goals, which reflect different opinions stakeholders have about what the learners should learn
2. Values about priority, which reflect different opinions about whether a learning experience should favor effectiveness (mastering the behavior), efficiency (delivering the lowest time or cost), or appeal (whether people like the learning experience or not)
3. Values about methods, which reflect what instructional methods stakeholders see as being most useful (or not)—the “I hate lecture” example above
4. Values about power, which reflect which stakeholders should have the most power to get their way regarding the learning-experience design.

Like conditions and values, instructional methods have their own unique characteristics, such as:

1. Scope, which describes whether a method teaches a single idea (micro) or multiple ideas (macro)
2. Generality, which describes whether the designer should use a method broadly or only within specific narrow situations
3. Precision, which reflects the detail to which a designer specifies a method, in terms of its parts, kinds, and criteria
4. Power, which describes how much a method contributes to attaining a learning goal
5. Consistency, which describes how reliable a method is in attaining a learning goal within a specific situation.

Once a designer understands the situation (conditions and values), the designer uses their knowledge of the situation in combination with method characteristics to select the best methods. In other words, the instructional theory framework is like a conditional heuristic (Figure 1) whereby a manager or client gives a designer a situation (a mess), and the designer must then consider the conditions and values to select methods that enable the designer to create a solution that cleans up the mess.

The framework shown in Figure 1 is a pattern that produces and characterizes all instructional theories. Essentially, an instructional theory is the product of the instructional theory framework. It contains a collection of one or more instructional methods that best fit one or more designated situations. An instructional theory is different from learning theories, such as behaviorism, cognitivism, and constructivism. As shown in Figure 2, learning theory descriptively explains the “what happens” of the learning process, typically what might be going on in one’s head. For example, a cognitivist learning theory suggests that information received by a learner is first processed in short-term memory, and then transferred to long-term memory. Also, notice that a learning theory does not include any methods.

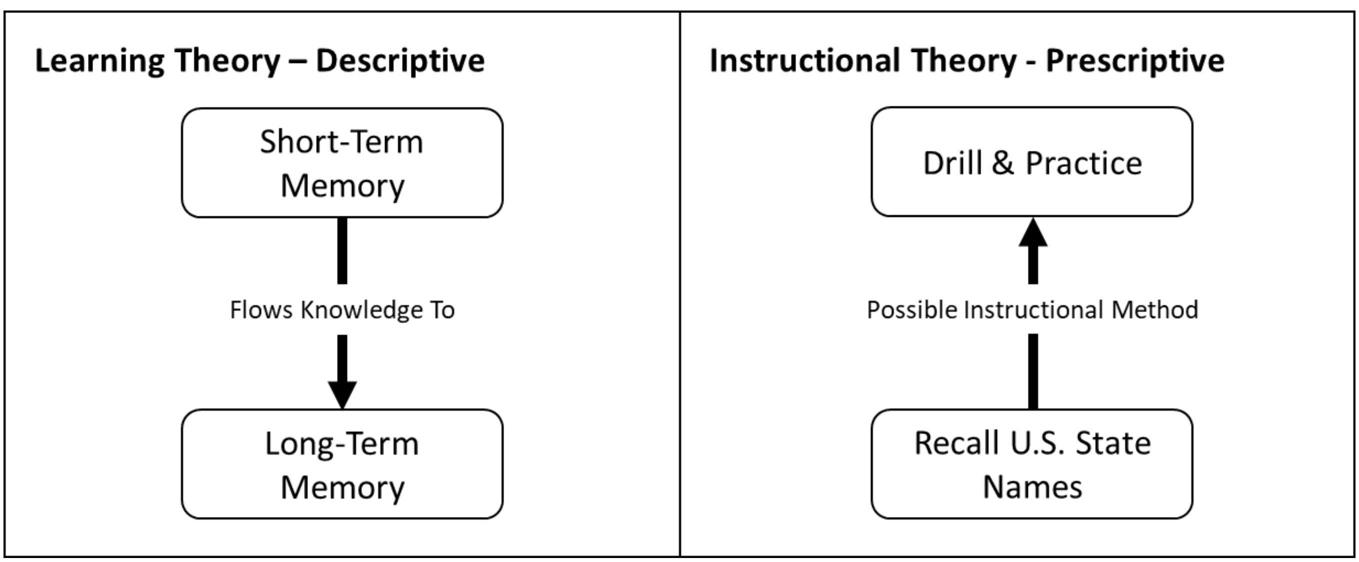

Figure 5.3.2: *Learning Theory Describes the “What Happens” of Various Learning Processes*

Note. The arrow indicates the flow of knowledge. Instructional theory prescribes possible methods for "how" one might effectively, efficiently, and appealingly learn. The arrow indicates that drill & practice is a possible instructional method that enables a learner to recall U.S. state names.

Examples of instructional theories include those summarized in the four volumes of the "Green Book" (Instructional-Design Theories and Models) (Reigeluth, 1983; Reigeluth 1999; Reigeluth & Carr-Chellman, 2009a; and Reigeluth et al. 2017), such as Shank and colleague's (1999) goal-based scenarios, and Huitt and colleague's (1999) direct approach to instruction. Instructional theories do not need to be published in a book to be instructional theories. Because instructional theory is situational, anyone can create instructional theories for situations that are narrow or wide in scope, and they can improve, change, or "mash up" existing instructional theories in any way they want to fit the situation. In fact, we believe that all people have their own personal theory of instruction, often as tacit knowledge, based on their experiences as a learner or instructor. The challenge for designers is to improve and expand their personal instructional theories.

Using the Instructional Theory Framework for Good Design

Applying the instructional theory framework is not hard. In some regards, the instructional theory framework is like a checklist of good practices. To elaborate our ideas about how to use the framework, we have synthesized six core principles that will help instructional designers embrace the ideals of the instructional theory framework:

1. Understand learning experiences as complex systems
2. Value learning-experience-design fundamentals
3. Practice unbiased consideration of instructional methods
4. Respect the instructional design iron triangle
5. Differentiate between methods and media
6. Know your personal instructional design theory

These principles facilitate the transition between situations and methods that leads to superior instructional solutions, as well as demonstrating a solution's value. We suggest instructional designers find renewed inspiration to embrace the instructional theory framework through these six principles.

Understand Learning Experiences as Complex Systems

Instructional designers conduct the work they do in a living, self-organizing, complex system (You, 1993; Rowland, 1993, 2007; Solomon, 2000, 2002; Honebein, 2009). What this means is that learning experience designs will behave in ways that designers cannot predict or expect; their nature is emergent "…in that [it is] shaped and developed over time through an evolutionary process" (Honebein, 2009, p. 29). For example, an instructor can design and teach a class one semester, and then the very next semester teach the same class again, and the experience for the instructor, the learners, and any other stakeholders will likely be different.

Reigeluth and Carr-Chellman's (2009b) and Honebein's (2019) explorations of the "galaxy" question, which is about whether some instructional methods have universal properties, provide evidence to support the proposition that the instructional theory framework represents a complex system. Merrill (2002, 2009) has argued that some instructional methods are universal, that they are present in all good instruction, such as his first principles. However, those principles are described on a very imprecise level. The implementation of any of those principles will vary from one situation to another, making any reasonably precise description of the principle situational, in recognition of the complexity of instructional situations. Furthermore, given that the instructional theory framework provides categories for conditions, values, and methods, the permutations of instances for each category a learning-experience designer could combine is immeasurable. In other words, situations and methods represent a complex system (Honebein & Reigeluth, 2020).

This idea of complexity is expanded upon philosophically by Cilliers (2000), who distinguishes a system as simple, complicated, and complex based upon the distance from which one observes that system. For example, an aquarium seen in one's home, observed as a decoration, is simple. That same aquarium can seem complicated when observed by a person who needs to repair it, in terms of heaters, pumps, tubes, and chemicals. The aquarium becomes complex when a person observes the aquarium as an ecosystem, with an immeasurable number of variables.

What does this mean for designers? It means that designers should be comfortable knowing their design situation qualitatively, whereby a variety of learning-experience "experiences" are possible due to the number of elements present in a situation and the interaction between those elements (Honebein & Reigeluth, 2020).

Value Learning Experience Design Fundamentals

A design fundamental is a "good practice" that one expects a learning-experience designer to overtly apply when designing a learning experience. For us, learning-experience-design fundamentals focus on three key instructional design practices: (1) clearly synthesized situations (conditions, including the nature of the content, and values) that should be stated as instructional objectives, (2) aligned assessments, and (3) formative evaluation that demonstrates a learning experience can achieve the mastery standard specified in the objective.

Instructional Objectives

When a learning-experience designer conducts an instructional analysis, the designer gathers data about the situation in the form of conditions and values. The designer then synthesizes the situation's primary, actionable factors into a form that enables the selection of instructional methods, an instructional objective.

A well-formed instructional objective has three parts: the conditions for performing the behavior, the behavior, and a standard of performance (criteria for mastery). There are specific rules for each part that maintain logical consistency and hierarchy of the instructional objective (Mager, 1984). In instructional theory framework terms, the specification of mastery is called values about goals, and since it is a value (a matter of opinion), a designer can define it quantitatively, qualitatively, or some mixture of both.

Aligned Assessments

Instructional designers must specifically link and align instructional objectives with assessments. Assessments not only confirm mastery of desired behaviors, but also provide data about formative improvements.

What is typically missing in criterion-referenced assessments is an indication of acceptable mastery. For example, learning experience "A" might report test performance of 83%, while learning experience "B" might report test performance of 89%. If the instructional objective guiding both learning experiences lacks mastery criteria, it becomes very difficult to assess the efficacy of each learning experience across the outcomes of effectiveness, efficiency, and appeal. Designers must identify acceptable mastery so that other designers and researchers can assess the improved learning effects within the context of efficiency and appeal. You can learn more about this in the Measuring Student Learning chapter.

Formative Evaluation

Learning-experience design must be more about "improving" and less about "proving". Research methods to prove the usefulness of an instructional method or theory make little sense when the instructional situation surrounding the learning experience can vary so much that the level of usefulness does not generalize (Honebein & Reigeluth, 2020; Reeves & Lin, 2020). What makes more sense is research that aims to improve the instructional theory, such as formative evaluation using single-subject techniques (Brenneman, 1986) or expert reviews, and formative research (Reigeluth & An, 2009; Reigeluth & Frick, 1999). This improvement orientation is particularly important when a method or theory is at a relatively early stage in its development. However, the iterative nature of research to improve also allows a general method to be tailored to a specific situation. This enables designers to, over time, offer multiple versions of the general method for different situations. Designers can learn more about this in the Continuous Improvement of Instructional Materials chapter.

When designers implement a learning experience (delivery to actual learners), they should collect formative data about all three metrics: its effectiveness, efficiency, and appeal. From that point, the learning experience may undergo any number of formative improvements over various iterations in its design lifecycle. Why? Because the learning experience will never be perfect; the situation (a complex system) is always changing, forcing the learning experience to change and adapt to deliver the right proportions of effectiveness, efficiency, and appeal. Thus, designers must not only consider the changes in methods and the resulting changes to effectiveness, efficiency, and appeal, but also how the changes in the situation influence the various effects of those methods.

What do these three design fundamentals mean for designers? It means that no matter where you work or who your clients are, you will have core data that enables you to defend your designs against nit-picking know-it-alls. And if the client has new or additional data, you will have a structure by which to collaboratively improve the design rather than a fight to prove a design.

Practice Unbiased Consideration of Instructional Methods

Instructional designers must adopt a mindset that considers all instructional methods as having unknown or neutral usefulness until the instructional situation is known. It is only at this time when data is present that a designer can assess an instructional method's usefulness (Honebein, 2016, 2019).

This practice helps avoid philosophical bias. Honebein's research showed that designers have a pre-existing bias toward certain instructional methods; the instructional theory framework calls this values about methods. For example, as shown in Figure 3, many designers view authentic tasks as very useful, whereas those same designers view peer-based or cooperative methods as less useful. This type of biased thinking can lead designers to reject instructional methods that might be very useful in a given situation, just because those methods are incompatible with their biases. There are situations in which behaviorist methods (e.g., drill and practice) are useful and many situations in which they are not.

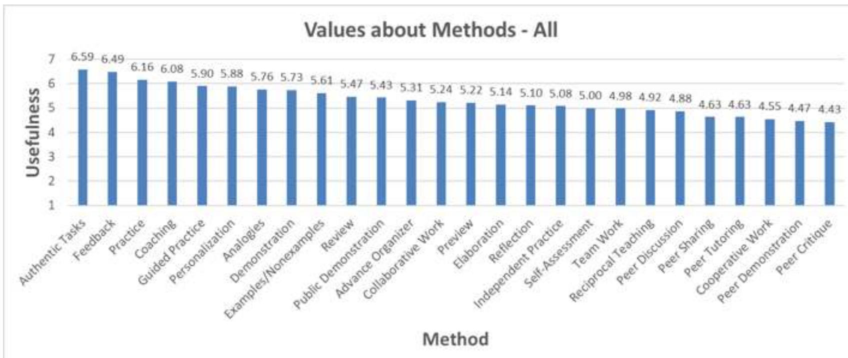

Figure 5.3.3: *Chart Illustrating Designer Bias*

Note. Instructional designers in introductory and capstone instructional design courses at two different universities were asked to rate the usefulness of various instructional methods in the absence of any type of "condition." This chart illustrates designer bias (values about methods), where more useful (powerful) methods are to the left, and less useful methods are to the right. If there was no bias, all bars in the chart should be the same, at 3.5. From Honebein (2019).

What does unbiased consideration of instructional methods mean for designers? It means that the solution to a thorny instructional design situation might just be an instructional method that you or your client hates. So, anytime you find yourself saying, "I hate lectures," watch Randy Pausch's Last Lecture (20+ million viewers), and find the hidden value and inspiration present in all instructional methods.

Respect the Instructional Design Iron Triangle

All instructional designs involve some sort of sacrifice (Gropper & Kress, 1965; Tosti & Ball, 1969; Clark & Angert, 1980; Hannifin & Rieber, 1989). Honebein and Honebein's (2015) research into this topic suggested that an instructional design iron triangle likely exists in all instructional design projects (see Figure 4). The theory of the iron triangle is that if you have three competing factors, you can only maximize two of them; you always sacrifice one. In instructional design, the competing factors (outcomes) are effectiveness, efficiency, and appeal. For example, if a designer favors effectiveness and appeal, the designer will sacrifice efficiency. Favoring efficiency and appeal sacrifices effectiveness, and favoring effectiveness and efficiency sacrifices appeal.

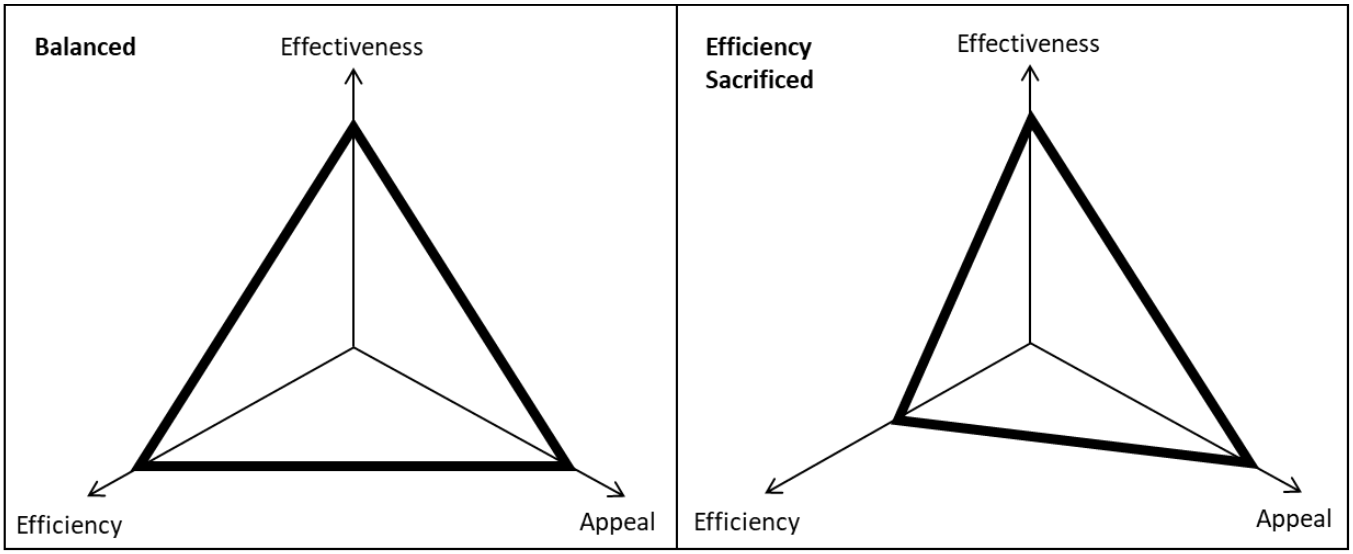

Figure 5.3.4: *The Instructional Design Iron Triangle*

Note. The triangle depicts the three outcomes (or constraints) associated with instructional methods: effectiveness, efficiency, and appeal. An instructional theory, model, or method typically involves the sacrifice of one or more of the outcomes.

What does the iron triangle mean for designers? It means that you'll always have to give up something in your designs, and that is okay. Perfect is the enemy of the good.

Differentiate between Methods and Media

Methods and media have a unique influence on effectiveness, efficiency, and appeal. We have already defined instructional methods earlier in this paper. Examples of instructional methods include lecture, drill and practice, and apprenticeship, as well as others depicted in Figure 3. Media is, of course, the communication channel that carries instructional methods to learners (Heinich et al.1989). Media itself is a method, and as such one should differentiate between instructional methods and media methods. Media methods include such things as words, diagrams, pictures, films, models, and realia—organized across categories of enactive, iconic, and symbolic (Bruner, 1966).

There has been much debate in our field about how instructional methods and instructional media contribute to effectiveness, efficiency, and appeal (Clark, 1985, 1986, 1994). Following Clark's arguments and our own design experiences, we feel that instructional methods influence effectiveness, efficiency, and appeal, whereas instructional media influence only efficiency and appeal.

Why should the designer be aware of this point of view? Because as designers explore our field's research to help construct their own personal instructional theory, they will find studies and examples that describe what Tennyson (1994) calls "big wrench" solutions, which take the form of a panacea. Big wrenches, which are typically media methods, are sprinkled throughout the history of our science, from Thomas Edison's "motion pictures" which promised to make books obsolete, to today's mobile game-based learning (mGBL) solutions. The studies and examples may suggest it is the media method that drives effectiveness, whereas in reality it is more likely the instructional method that does.

What does this mean for designers? It means that you should be cautious about media in terms of touting its influence on effectiveness. No one doubts its strong impact on efficiency and appeal. As noted previously, learning experiences are complex systems that mash together a variety of methods to deliver results. A designer may never know what design element (or more likely, combination of elements) served as the secret sauce for effectiveness. But more than likely, it will be an instructional method (or combination of instructional methods).

Know Your Personal Instructional Design Theory

For more than 15 years now, the authors have taught a capstone instructional theory framework course for graduate students at Indiana University. The course culminates in students writing their own personal theory of instruction (see the application exercise below). In writing their personal theory paper, students consider the conditions (learner, content, context, constraints) and values (about goals, outcomes, methods, power) associated with their situation, and discuss the instructional methods that reflect their "stamp" as a designer.

Application Exercise

Your Task:

Write a reflection paper that outlines your personal theory of

instruction. This should be an in-depth, APA-style paper that answers the questions

below and provides citations and references describing the literature that has

influenced your personal theory of instruction.

1. What is the nature of the situation (conditions and values) that governs your instructional design work?
2. How do you think you are "wired" to design instruction?
3. What "stamp" does the instruction you design have, in terms of the methods you use, that enables others to recognize it was you who designed it?

Rubric for Quality:

- Paper is equal to or less than eight, single-spaced pages.
- Paper is logically structured in APA style, with clear sequence and clear organization of thoughts. Reader can read it once quickly and comprehend its contents.
- Paper is free of grammar and spelling errors.
- Cites/references in APA style literature from readings to support positions and ideas described in the personal instructional theory.
- Clearly describes the personal instructional theory through the situation-methods structure.
- Clearly discusses and references the theoretical foundations and influences of the personal theory.
- Gives an example of the "stamp" one would see on instruction one would design.

The activity our students complete should be an activity that all designers regularly engage in as well, since the activity is all about drawing a line in the sand about your design principles (Brown & Campione, 1996; Stolterman & Nelson, 2000; Collins et al., 2004; Boling et al., 2017). We see such design principles connected to important emerging ideas from the above authors related to design character, design judgment, core judgment, and accountability. As we understand these terms, one's design character represents inherent, assumed responsibilities for both creative process and outcomes. Design judgment involves creativity and innovation, integrating multiple forms of judgment associated with those aims. Stolterman and Nelson (2000) refer to design judgment as "an act of faith" (p. 8). After a designer experiences the results of their design judgments, design judgments contribute to core judgment, in which certain judgments over time become fixed and very hard to change. For example, the learning-experience-design fundamentals we discuss in this paper are, for us, core judgments. Ultimately, designers must be accountable for their designs in terms of effectiveness, efficiency, and appeal, and avoid the temptation to move, hide, or remove accountability to some other stakeholder. The aggregate of these ideas represents one's design character and one's belief "in his or her capacity to make good judgments" (p. 8). That belief is reinforced in terms of how one reflects on their actions.

What does this mean for designers? We think one's design principles were meant to be dynamic, not static. As the comedian Groucho Marx once said, "Those are my principles, and if you don't like them …, well, I have others." Groucho was wise, as he appears to have known the instructional theory framework's foundational idea that situation drives methods, or in this case, principles. Whether a learning-experience designer is eclectic or orthodox in their adoption of learning theories and instructional methods (Yancher & Gabbitas, 2011; Honebein & Sink, 2012), the designer's choice of methods must be dependent on the situation. Designers should not assume even Merrill's (2002, 2009) first principles to be appropriate in all situations (Honebein, 2019). It is through the ideas of formative evaluation, design research, and reflection-in-action/reflection-on-action that one's principles increase and decrease in strength.

Conclusion

The instructional theory framework is a cornerstone that must guide our field's practice and research. The foundations of situation and methods are simple, logical, and aligned with good practice. Philosophically, the instructional theory framework addresses both the objective world (conditions) and the subjective world (values), which mimics what instructional designers encounter in the real world. It provides designers a means to assess and articulate their design judgment, enabling them to be more confident in assuming accountability (Stolterman & Nelson, 2000). And as shown by Honebein and Honebein (2014, 2015) and Honebein (2017, 2019), the instructional theory framework functions as expected. The instructional theory framework's key benefit is that it guides designers in creating learning experiences that have a higher relative advantage (effectiveness, efficiency, and appeal), better compatibility, lower complexity, easier observability, and actionable trialability.

However, a word of advice: avoid using the "theory" word when you are talking with your clients and subject-matter experts about how you design learning experiences. It will scare them. Keep it as your little, tacit secret.

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The Nature and Use of Precedent in Designing

Elizabeth Boling

As a student, or as a practicing designer, you may have noticed that moment when, even if you are following a detailed model, you have to figure out what is this material, this experience, this system I am designing actually going to be? Whether you have consciously done so or not, you have turned to your own memories, your store of precedent knowledge, in order to tackle these questions. Precedent knowledge is a form of knowledge specific to the activities and goals of design—and you do have some, whether you realize it consciously or not. When you do understand what precedent is and think about how you obtain it and use it, you have increased both the discipline and the imagination that you bring to the act of designing.

Precedent as a Form of Design Knowledge

One of the fundamental elements of design knowledge is precedent (Lawson, 2004; Lawson, 2019). Unlike in law, where the term precedent refers to the accretion of decisions made over time and constraining future decisions, in design precedent refers to the store of experiential (episodic) memories each designer accumulates over time—expanding their future possibilities for actions or decisions. And unlike in science, where past discoveries or established facts form a solid foundation of knowledge which must be accepted or definitively proven incorrect, precedent knowledge in design is gathered by individual designers through their experiences of the world. Each designers' store of experiences is unique to that designer. Even when multiple designers share the same experiences, they do not necessarily pay attention to the same aspects of those experiences, or recall them later in the same way. Some designers possess more experience and some less; no single designer's store of experiences is comprehensive or the same as any other one, and none can be transferred in an abstract way to another designer. Consider something you have experienced yourself, something that left a vivid memory with you. If you want to share this memory with someone else, you will likely use concrete means to do so—photos, video, audio—providing you have those means. If you do not, it can be difficult to transmit to another person the quality of what you have experienced. Now think about how you might share a career full of design experiences with another designer. You might summarize your memories as principles, or as lessons learned, but this would not reproduce for that other designer what you know. Some design knowledge, like principles, can be stated in abstract form for the benefit of others. But precedent knowledge, a designer's store of experiences, cannot be communicated easily or completely to someone else.

In architecture education, building precedent knowledge has long been a highly structured activity, overtly and rigorously pursued by means of memorization (Lawson, 2019), and of the requirement to refer to celebrated structures from the past in support of, or in contrast to, decisions made in the present (Eastman, 2001). Conflict persists over the canon, the body of works deemed worthy of this intensive study. Some argue that the canon is narrow and discriminatory (Gürel & Anthony, 2006), while others bemoan moves in architecture education to eliminate the canon because they argue that the benefits of this form of education outweigh the drawbacks (Breitschmid, 2010).

Although fields like instructional design do not maintain a canon, less formal means of noting, storing, and applying precedent knowledge in architecture also exist. Reviewing publications across multiple fields in which design is the primary practice, it is possible to see that building and using precedent knowledge is common across all of them (Boling et al., 2019), although the term precedent is not always the term used and sometimes the references are just brief glimpses of how precedent is actually used. For example, Rowe (1987) talks about architects and other designers using literal analogies, "borrowing known or found forms" either in canonic form ("'ideal' proportional systems" as in the architectural canon), or iconic form ("objects from the natural world … imagery from some scene, painterly conception, or narrative account of real or imagined circumstances") (p. 80-83).

In the canonic form of precedent use, an architect may use forms (columns, arches, proportions) from classic structures in a current design. Without an existing canon in instructional design, it does not make sense to offer an example of canonic precedent use by instructional designers. Consider, however, examples of the iconic use of precedent. Madhavan (2015) quotes engineer John Shepherd-Barron, inventor of the ATM cash dispenser as saying, "I hit upon the idea of a chocolate bar dispenser, but replacing chocolate with cash" (p. 70), and Zimmerman (2003) mentions in passing that the graphics in his widely-known video game SiSSY FiGHT were "inspired by Henry Darger's outsider art and retro game graphics" (p. 178). And as an instructional designer, a coinstructor and I used our experiences with buffet restaurants to offer multiple mini-lessons on technology to our students, letting them choose a "plateful" of learning in the multimedia production class we were developing.

How Precedent Is Collected

Goldschmidt (2014, p. 1) addresses the way informal, or iconic precedent is collected, saying the “designer possesses a ‘prepared eye’ which is able to take advantage of stimuli it encounters, randomly or intentionally, in any environment.” In other words, building precedent knowledge is a disciplined practice in which the preparation of experience allows designers to notice more that is potentially useful and relevant to them than novices or non-designers do. To picture this, imagine that an instructional designer working for an insurance company takes her children to a theme park where employees explain to guests, quickly but clearly, how to enter each ride and buckle themselves in safely. This designer is experiencing a happy day with her kids as many parents do, but because she is a designer, she is also noticing these just-in-time instructions. Without knowing when she might retrieve and use this memory, she stores it automatically; she has developed the habit of noticing and remembering experiences that may be relevant to her work.

Within the mind of each designer, precedent knowledge is structured over time into multiple schemata; “precedent stored in the form of episodic schemata is used by experts to recognize design situations for which gambits are available” (Lawson, 2004, p. 1). Lawson does not imply that precedent knowledge becomes, or should become, abstract knowledge by being transformed into generalized principles. He discusses schemata as patterns in which the original experiential elements remain intact as potential “gambits,” or design actions, recognized as possibly applicable to the immediate design situation. Considering the instructional designer who took her children to the theme park, it is likely that when she noted park employees giving instructions to guests as they boarded rides, she did not simply store that memory. This memory probably joined memories of experiences she had stored previously as part of a schema that might be thought of as, perhaps, "super-condensed instructions." It may also have joined other schema, possibly "scripted instructions easy for employees to learn," or "minimal scripts."

The Nature of Precedent Knowledge

Drawing on the discussions of precedent in the literature, and the ways in which designers refer to precedent, it is possible to consider the nature of this special form of knowledge.

Precedent Is Concrete

As noted, precedent knowledge is composed of the memory of experiences, not the abstract meaning we impose on those experiences. These experiences can be ones in which an object was held and used, a building walked through or lived in, a class taken or taught, an ocean beheld or sailed upon. They may, with equal validity, be vicarious, formed through encountering pictures, diagrams and narratives that represent designs to those who are not interacting with the designs directly. Whatever way this form of knowledge has been acquired, it is stored the same way that memories of a vacation trip or a day at school would be. It contains the details that struck the designer at the time of the experience, making it flexible in the ways that it can be used because more than one aspect of the experience can be related to a new design situation.

Precedent Is Neither Good or Bad; Its Value Is Determined When It Is Used

Precedent knowledge is neutral. The original precedent experience may have been a positive or negative one, and the designer recalling that experience may have thought at the time, “That’s a weak design,” or “That’s a great design.” We call the knowledge itself neutral, however, because later it will not be confined to use as an exemplar or as a cautionary tale. A weak, or even a failed, design can yield an affordance or an analogy that proves useful in a future design situation. In some situations, therefore, a designer might need to know whether an instructional design was proven to be effective when it was implemented. However, in many more designs its value as precedent is dependent on what it offers as part of a schema, or of multiple schemata, as inspiration for a design action or as a way to frame a new design problem.

Precedent Is Relevant When It Is Used; It May or May Not Be Relevant When It Is Collected

The relevance of any precedent memory to the work of the designer who holds that memory is determined at the time the precedent is used. As we will see in the discussion of precedent knowledge in use, designers sometimes seek examples of design intentionally to use them right away as models or inspirations for the work at hand. However, they also notice and store memories of designs continuously without knowing how they are going to use those memories later. This means that the exact relevance, even the vague relevance, of much precedent knowledge cannot be assessed in advance. In order to have precedent knowledge available when it is needed, designers who have been trained and encouraged to do so form the habit of attending to their environments with a generalized focus on potentially useful experiences, but also with a productive lack of boundaries as to which experiences they should note.

Precedent Can Be Used Repeatedly, and May Be Used Differently Each Time

As a form of knowledge that is simultaneously detailed and non-specific, precedent offers rich possibilities that can be connected by the designer to multiple design situations. Unlike case-based problem-solving-in which there is a match between the problem and the case being used to solve, or illuminate, it-design precedent does not have to be well-matched to the situation where it is being used. In some cases, there may be little to indicate that the precedent is related to the design situation at all. As we will see during the discussion of precedent in use, it is the designer who perceives the possibility that precedent knowledge affords an insight, a possibility for addressing a design problem (a gambit), or a bumper that pushes their thoughts in a new direction. Therefore, the designer's perception may be different in a precedent memory based on the current design situation than based on a previous one. Because this knowledge has not been abstracted into a fixed, declarative form, the designer is free to use it differently each time they recall it.

Precedent Knowledge in Use

In a current study of precedent knowledge across the literature in multiple fields of design, Boling et. al. (2019), have identified several primary modes of precedent use.

Linear

A linear use of precedent is one in which the bridge between precedent and a design decision or action (Lawson, 2019) is conscious, direct, and simply connected to the design. A designer might face a situation in which a particular style of design is required and look for examples of that style in order to perceive and reproduce its key elements. An instructional designer may have framed a project as one for which many precedent examples already exist and decide, appropriately, that drawing on one or more prior designs known to be effective will provide a reasonable template. Similarly, designers may seek, or draw upon, precedent knowledge to understand what a class or type of design looks like, sounds like, or how it is constructed. This happens when, for example, an inexperienced designer is preparing to develop a student workbook and collects examples of existing workbooks to learn more about how this class of design is put together. This is a kind of deliberate reverse-engineering in which the application of the precedent experience is determined in advance.

Field-Specific Sources and Validation of Judgment

Using the architectural canon, or less systematized bodies of recognized precedent (sometimes the bodies of work produced by famous designers), designers can draw on precedent knowledge that they share with many other designers and use it to guide or validate their own design decisions or actions. In this type of use, schema within the body of precedent knowledge may be less personal to an individual designer than understood across a professional community. A majority of precedent experiences for many of these designers may be vicarious-gathered through photographs and descriptions made available during their studies, found in curated collections published in books and periodicals. A product designer, for example, may be well aware of a shift toward rounded surfaces and complex "dashboards" of buttons on household appliances because designs like these appear in trade magazines and win professional design awards. They do not refer to any single prior design when they develop a dishwasher for the manufacturer employing the designer, but the widely-known schema informs their design and they refer to that schema to support their decisions. It may be difficult to picture this form of precedent use among instructional designers because the field does not now build, or disseminate, organized bodies of precedent, or acknowledge individual practitioners to the extent of making them famous.

Direct Model for Invention

Engineers in particular use precedent knowledge in a combinatory way, incorporating precedent designs directly into new ones when subsystems are required for a complex situation and existing examples can be used with minimal adaption. In what is termed *normal design*, when the requirement for invention is low, Vincenti (1990) describes a special form of precedent termed *normal configurations*, in which the designer’s experience includes both the elements directly usable for the situation and examples of how those elements will work together. Every engineer who needs to include a pump in a design does not re-invent the pump if there is an existing pump design compatible with the larger system being created. It is easy to observe a similar form of precedent use among program designers who maintain, share and draw upon libraries of code. Instructional designers may recognize that this form of precedent use shares characteristics with reusable learning objects.

Abduction/Analogic Reasoning/Inspiration

Cross (2011) explains that abductive thought suggests "what may be," instead of figuring out what must be (deduction) or determining what is (induction) (p. 33). The abductive use of precedent involves allowing the experience of what exists to suggest possibilities for that which is still to be designed. To understand this use of precedent, consider an instructional designer who is a relay runner in their off-time. They are working on a web-based design for a high-enrollment college course in which undergraduates are supposed to be learning collaboratively. As they consider that students are not always excited about group work, it occurs to the designer that the feeling of handing off a baton during a relay race is both intense (motivating) and positive (satisfying). Without literally building the course as a relay race, the designer decides to try dividing the class into small teams and incorporating "hand-off-ness" into the process of working together. The students will set a goal for their final assignment together, then use an online collaborative writing tool that is open to each of them sequentially for additions and revisions until they complete the assignment. Still inspired by their running experience, the designer builds in some practice in sequential writing ("handing off") as part of smaller assignments during the semester.

While many fruitless forays may be conducted into one's store of precedent, or there may be only a tenuous connection between a possibility discovered there with the problem in hand, abduction is not just random exploration. Because precedent tends, with experience, to gather into schema (Lawson, 1994), analogic use of precedent is likely a key factor in the efficacy of abductive thought. Analogic reasoning "is a method of activating stored schema based on the identification of connections, parallels, or similarities between, what are typically perceived as dissimilar items" (Daugherty & Mentzer, 2008, p. 9). In the case of what we perceive as inspiration, analogic reasoning utilizing multiple schema may occur and, because these processes are not linear (not propositional or easily converted into rationalized form), they appear to be—or are experienced as—unexplainable leaps from what is known to something entirely new. Consider again the instructional designer inspired by their experiences as a relay runner. Let's suppose that in addition to being a relay runner currently, the designer also participated in improvisational theater as a high school student and performed in a short-lived jazz ensemble during college. Each of these experiences involves handing off from one participant to another (a baton, a story line, a musical theme), and by the time they begin designing this college course, the designer's use of the schema for handing off may not have been a conscious design act as described above. They may have experienced the idea of sequential authorship in this online class as something that "just came to them;" they drew on a schema for parallels between it and their design problems that are not obvious on the surface and were not deliberately sought.

Problem Framing

Dorst and Cross (2001) discuss how a "problem-solution pair is framed" (p. 435) by designers, defining the design situation by considering the insight that a possible solution can provide. Such possible solutions are drawn from, or suggested by, the designer's store of precedent knowledge. In this use of precedent, the designer's knowledge is not being used to guide specific design actions, but to explore, understand and define the situation overall. Many designers can bring to mind the point in a project where someone throws out an idea; "what if we put together something like a kit that the instructors in the field could use to assemble lessons on the fly? Like Ikea™ lessons!" The project may or may not follow this direction, but considering the idea can bring to light factors in the design situation that may or may not have been evident before—or suggest new information that a project team may need to gather which was not considered previously.

Design Talk

As designers work together, they engage in design talk, a specialized form of discourse described by Fleming (1989), of which a central component is discussion of the object (or system, or experience) being designed. Lawson (1994) offers a vivid description of such talk among architects in which they all used a single term derived from separate but overlapping, bodies of precedent knowledge and probably from experiential memories the team also shared. While a comparative lack of precedent dissemination in instructional design can limit this element of design talk, you may be able to recognize a discussion in which team members share an educational background and use terms like "WebQuest" or "MOOC" that carry an entire set of experiential meanings for the participants.

Design Models and Precedent

Design models are one of the most widely discussed forms of design knowledge discussed and used in the field of instructional design (Smith & Boling, 2009). These are a declarative form of knowledge, meaning that they are abstract and fixed; they can be passed from one person to another through explanation and memorization. Such models are useful (Branch, 2009), but they do not serve the same purpose for designers that precedent knowledge serves. In fact, without the judgment of designers (Archer, 1965; Holt, 1997; Merrill; Vickers, 1983; Gibbons et al. 2014; Smith and Boling, 2009) and their precedent knowledge, design models are not actually effective. Discussion of design judgment may be found elsewhere (Boling et al., 2017; Dunne, 1999; Gray et al., 2015; Nelson & Stolterman, 2014). Here we will consider the role that precedent knowledge plays within design models.

In each model of design that exists, and there are many (e.g.; Archer, 1965; Dick et al., 2000; Dubberly, 2019; Gustafsen & Branch, 2002; Lawson & Dorst, 2009; Morrison et al., 2012; Reigeluth & Carr-Chelman, 2009), close examination will uncover a point at which many aspects of a design situation may be known, but all the rational sources of knowledge and decision-making have reached the limits of their usefulness. The results of analysis, and the application of established principles or prescriptions, may have precluded some design moves, or implied fruitful directions for others (Krippendorf, 2005). But now—what to do precisely? What, exactly, will come to exist that did not exist before all the preparation was done?

Bruce Archer's (1965) early, influential, and detailed engineering design model, created at the start of high excitement regarding systematic design, was presented as a long diagram that extended for yards, and included a short text of fifteen pages explaining it. Of those fifteen pages, ten are devoted to discussing the human activity and perspective actually required to make the model function, pointing specifically to the one place in the model where nothing but the human designer can bridge from one step to the next by saying, "there is no escape for the designer from the task of getting his own creative ideas" (p. 11). And where do those ideas come from? Archer explains that looking at other people's end results (designs) "including phenomena and artefacts in … unlikely fields," and "a rich, wide and fruitful experience … as well as the capacity for flexibility and fantasy in thought" (p. 12) are required; in other words, building and using precedent knowledge.

Looking at a more recent and familiar prescriptive model for developing instruction, consider the 4C-ID Model, focused specifically on designing instruction for complex tasks, and summarized by van Merriënboer et al. (2002).

Figure 1

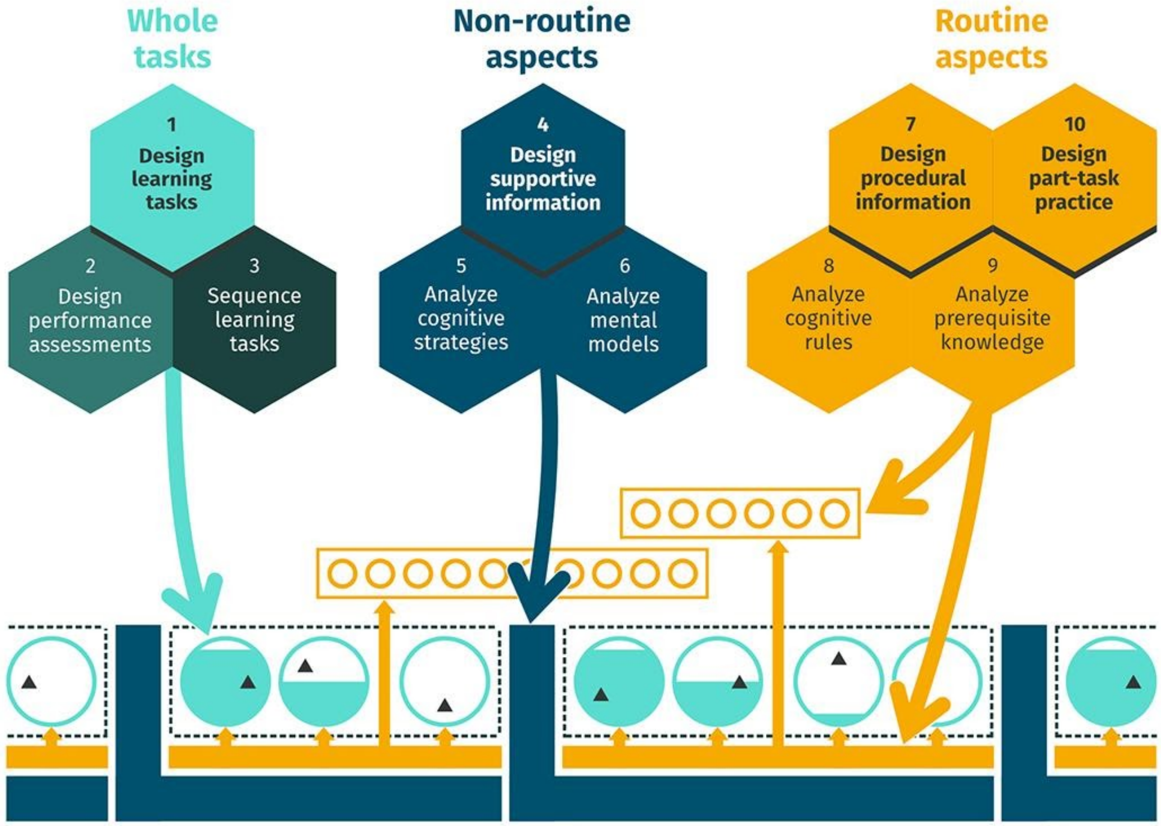

Figure 5.4.1: *Ten Steps of the 4C/ID Model. Obtained From www.4cid.com*

This model is quite detailed, focusing on prescriptions for breaking down complex skills, providing practice of part-tasks and whole-tasks, and providing materials for support and for just-in-time information. Explanations for using the model do not address explicitly, as Archer did, what is required from designers to carry out the steps of the model. If we examine it, though, we will see that the model can only be used when designers employ precedent knowledge.

For example, in the case example the authors provide, the complex task to be learned is literature searching. They describe a scenario in which a designer has, in step 1, broken down “literature searching” into several “task classes,” and specified that “learners receive three worked-out (good) examples of literature searches (step 4). Each example contains an elaborate search query in which Boolean operators are used” (p. 56). Guidelines are offered as to what a task class may be, and the characteristics that practice items or informational materials should have. However, neither the model nor the explanation of it acknowledge the invention required to move from knowing what kind of example is to be offered, to actually inventing this example—or to deciding the nature of the event in which the examples will be introduced and used.

The very language—“learners receive”—masks what actually has to happen; unless the appropriate worked-out example of a literature search is readily available, one must be made to exist where previously it did not. Even if the appropriate example is readily available, its relationship to this instructional event must be created. While this is not a criticism of the model, it is important that designers recognize the additional forms of knowledge they need to use such models.

Conclusion

While precedent knowledge interacts with other forms of knowledge that designers possess (like their knowledge of guidelines, theories or principles), it is different in important ways. Designers need to understand those differences so that they can build and use this knowledge effectively.

Application Exercises

The Noticing Journal

The beginning of a disciplined practice in accumulating and using precedent knowledge is to develop the simple habit of noticing. Commit to a week of noticing and challenge yourself to notice as many kinds of instruction or performance support around you as you can for that week. Jot down a note about each one, or take a photo with your phone, so that you can see how many have built up over the week.

Not sure where to begin? Consider how many things you use or see in a day that carry instructions on them -- shampoo, instant noodles, fire extinguishers, bus and subway maps, vending machines. Pay attention to digital experiences like videogame and software tutorials, or website navigation instructions. Don't limit yourself to formal instruction either. Did you overhear a parent teaching something to a child or a child showing a parent how to use a smartphone app? It all counts!

Once you have spent a week on this exercise, consider continuing with it, adding items as you come across them. While noticing precedent becomes automatic at some point, there is no harm in remaining conscious of the discipline of noticing.

Exploring Your Existing Store

Set aside 30 minutes to an hour in a quiet place where you can bring to mind past experiences. Begin with the earliest learning experiences you can remember. From the perspective of an instructional designer, call up as many as you can. Don't worry if some of them are negative. Precedent knowledge is built from all experiences, not just exemplary ones. While I recall a great experience with the SRA Reading System in 4th grade, that same year yields the painful memory of "math races" in which two students had to run to the blackboard and solve a problem written there quickly, trying to beat each other to the answer.

As you bring these memories of learning to mind, resist the urge to try to turn them into lessons learned, to diagnose what happened, or to draw conclusions about what happened. What you are doing right now is just taking stock of how many experiences you already have in your store of precedent, and recognizing that it belongs to you. You have probably been using it; you may well be conscious of that. And if you have not been, then this exercise may prove illuminating!

As with the first exercise, consider spending 30 minutes this way more than once. You probably have more than 30 minutes of learning memories!

Deconstruct Your Present

If you are studying in school now, begin to take note of the way one of your courses is structured and of the materials you are using in this class. Don't stop there, though. The experience of a course is not the same thing as a syllabus or a textbook. It is the experience that you remember and that forms part of your precedent knowledge. Write the story of this class—take several pages to do so. While this is your experience, pretend that you are an observer trying to give someone else a vicarious experience of what it is like to be in the course.

As an example, a short time ago I participated in a square dancing club as a student for a year. While the structure of the lessons was straightforward—3-4 new calls introduced each week, with several repeated each time as a refresher, and each student dancing with an experienced partner—the experience of these lessons would take more time to describe. The experienced dancers were uniformly elderly and enthusiastic. Every student was greeted warmly at the start of the session, encouraged and praised throughout each dance, and treated to homemade goodies by the members of the club. Actually, concentrating on learning and dancing at the same time is surprisingly strenuous, so the goodies were welcome. So was the encouragement! While the steps we were learning were each pretty simple, they were not called out in a set order. The caller changed the sequence constantly and more than one student stepped on more than one toe. Every so often the entire group came to a halt when one or more students swirled left instead of right. In these instances, I'm sure some of the experienced dancers were frustrated but no one complained and we all formed up to begin again. I could go on for several more pages, explaining in more detail about the sequence of the steps we learned and how the caller handled the dances, what the room was like, the "final exam." Once you get started on this exercise, you will find that you have plenty to say as well.

If you are not studying right now, you can choose a learning experience that, like mine, took place over an extended period. Or, if you teach, complete the exercise using one of your own courses, trying to keep that observer perspective. And no matter what experience you use for this exercise, once you have completed it, read it over and ask yourself what kind of schema this experience may be, or could be, part of. You are not trying to abstract this experience, but to consider what others come to mind and what patterns they might both be part of. There could be several or many.

NOTE: As you carry out these exercises, focus on the fact that you are building awareness of your design knowledge and thinking. These exercises are not intended to become part of your design process; although I have recommended repeating them for the sake of building awareness, they will not tell you what to design or how to design. They will strengthen abilities you already have and use.

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5.5: Standards And Competencies For Instructional Design And Technology Professionals

Standards and Competencies for Instructional Design and Technology Professionals

Florence Martin & Albert D. Ritzhaupt

Students entering the field of instructional design must possess a wide array of competencies to be successful in their future roles (Ritzhaupt & Martin, 2014). Competencies are the knowledge, skills, and abilities professionals need in their roles, while standards speak to a pre-defined level of quality or attainment of those competencies. Competencies and standards are essential aspects to advance professionals in this field. Several professional organizations guide the development of competencies and standards. They also have certification programs for instructional designers and instructional programs. In this chapter, we review the instructional design standards and competencies both from professional organizations and those proposed by researchers who guide the educational preparation of instructional designers and also support their academic and work experiences.

Competency and Standard

In this section, we review the term competency and standard before we introduce instructional design competencies from professional organizations and from research. Richey et al. (2001) defined competency as "a knowledge, skill or [ability] that enables one to effectively perform the activities of a given occupation or function to the standards expected in employment" (p. 26). Spector and De la Teja (2001, p. 2) refer to the term competency as "a state of being well qualified to perform an activity, task or job function" and competency refers to the "way that a state of competence can be demonstrated to the relevant community." Thus, competencies are specific to a community of endeavor in which professionals determine the competencies valuable to the profession. As competencies are identified and developed, professionals express these competencies as standards to assist professionals, professional associations, academic programs, and the larger community to better understand the domain of interest.

The KSA framework, comprised of Knowledge, Skills, and Abilities, has been used by researchers to study competencies in the field. Ritzhaupt et al. (2010) used the KSA framework to categorize educational technology competencies into knowledge, skills and abilities statements. Figure 1 illustrates this framework in light of three domains used to characterize the field: creating, using, and managing. The KSAs represent the core processes and resources used by those practicing in the field, which are the creation of instructional materials, learning environments, and instructional products using systematic approaches and based on research to improve learning and performance. Using refers to selecting, using, and implementing educational technologies and processes to support student learning and to enhance their pedagogy. Management refers to managing people, processes, physical infrastructures, and financial resources to create diverse learning environments and provide supportive learning communities to improve learning and performance (AECT Standards 2012, 2008).

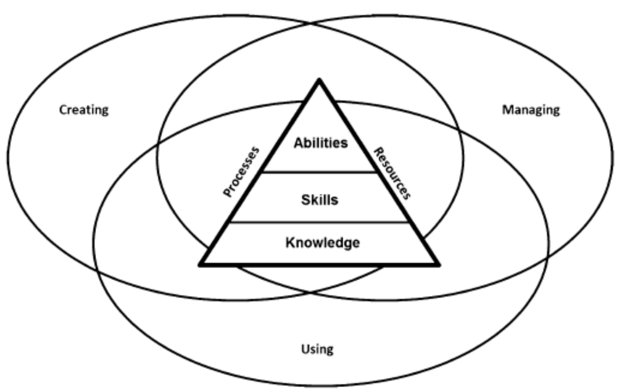

Figure 5.5.1: *Knowledge, Skill, and Abilities Statements for Educational Technologists (Adapted from Ritzhaupt et al., 2010)*

Standards are critically important to establish a foundation for a field. For instance, the field of project management established the well-known American National Standards Institute's (ANSI) Guide to The Project Management Body of Knowledge (PMBOK), which is used as the basis for the Project Management Professional (PMP) certification program and as the official body of knowledge for the profession.

Instructional Design and Technology Competencies and Standards From Professional Organizations

The field of instructional design is comprised of several professional organizations, several of which define competencies and standards for the profession. Table 1 provides a summary of these professional organizations and the following section provides more details about each. Each organization has a different focus and provides standards and competencies for their relevant programs. Students should be reminded that these standards and competencies serve as ideal frameworks, and should not be discouraged by their scope.

Table 1

Professional Organizations Who Publish Instructional Design and Technology Standards

Professional Organization	Website Address
International Board of Standards for Training, Performance and Instruction	http://ibstpi.org/
International Society for Performance Improvement	https://www.ispi.org/
Association for Talent Development	https://www.td.org/
Association for Educational Communications and Technology	https://www.aect.org/
Online Learning Consortium	https://onlinelearningconsortium.org/
International Society for Technology in Education	https://www.iste.org/
University Professional and Continuing Education Association	https://upcea.edu/

International Board of Standards for Training, Performance and Instruction (IBSTPI)

http://ibstpi.org/

Ibstpi Vision: To be the leader in setting international standards in the areas of training, instruction, learning, and performance improvement.

Ibstpi Mission: Develop, validate, and promote implementation of international standards to advance training, instruction, learning, and performance improvement for individuals and organizations.

Ibstpi has competency sets for various learning and development roles, including the instructional designer. They also have competency sets for other roles such as training manager, evaluator, instructor, and learner. For the instructional designer, Ibstpi (2012) developed 22 competencies across five domains.

1. Professional Foundations
2. Planning and Analysis
3. Design and Development
4. Evaluation and Implementation
5. Management

Each of these competencies has detailed performance statements and a level of expertise (essential, managerial and advanced) identified for each of them. Ibstpi goes through a rigorous development model to identify and validate these competencies. The steps in the model include preliminary analysis of job roles, identification of foundational research, competency drafting by directors and experts, validation study design, translation of research instruments in multiple languages and implementation worldwide with working professionals, data analysis and competency validation, publishing final competencies and performance statements and disseminating the competencies to practitioners, researchers and organizations.

International Society for Technology in Education (ISTE)

https://www.iste.org/

ISTE Vision: ISTE's vision is that all educators are empowered to harness technology to accelerate innovation in teaching and learning, and inspire learners to reach their greatest potential.

ISTE Mission: ISTE inspires educators worldwide to use technology to innovate teaching and learning, accelerate good practice, and solve tough problems in education by providing community, knowledge, and the ISTE Standards—a framework for rethinking education and empowering learners.

ISTE has developed well-adopted standards for students, teachers, administrators, coaches, and computer science educators. The ISTE standards are widely accepted in the K-12 community, and have been transformed into assessment systems (Hohlfeld et al., 2010) and a new professional credential offered by ISTE known as the ISTE Certification, which is a vendor neutral teacher certification based on the ISTE Standards for Educators. The ISTE Standards for Educators can be accessed at https://www.iste.org > standards for more information.

They include:

1. Learner: Educators continually improve their practice by learning from and with others and exploring proven and promising practices that leverage technology to improve student learning.
2. Leader: Educators seek out opportunities for leadership to support student empowerment and success and to improve teaching and learning.
3. Citizen: Educators inspire students to positively contribute to and responsibly participate in the digital world.
4. Collaborator: Educators dedicate time to collaborate with both colleagues and students to improve practice, discover and share resources and ideas, and solve problems.
5. Designer: Educators design authentic, learner-driven activities and environments that recognize and accommodate learner variability.
6. Facilitator: Educators facilitate learning with technology to support student achievement of the ISTE Standards for Students.
7. Analyst: Educators understand and use data to drive their instruction and support students in achieving their learning goals.

International Society for Performance Improvement (ISPI)

https://www.ispi.org/

ISPI Vision: Performance improvement practices are recognized globally as an essential part of every organization's competitive strategy.

ISPI Mission: ISPI and its members use evidence-based performance improvement research and practices to effect sustainable, measurable results and add value to stakeholders in the private, public, and social sectors.

ISPI has proposed 10 Human Performance Practitioner Standards for instructional designers who assume the specialized role of performance consultants. The ten standards include,

1. Focus on Results or Outcomes
2. Take a Systemic View
3. Add Value
4. Work in Partnership with Clients and Stakeholders
5. Determine Need or Opportunity
6. Determine Cause
7. Design Solutions including Implementation and Evaluation
8. Ensure Solutions' Conformity and Feasibility
9. Implement Solutions
10. Evaluate Results and Impact

In addition to the practitioner standards, ISPI also has accreditation standards for organizations and programs/courses. ISPI certifies practitioners though a rigorous peer-review process and with the opportunity for the practitioners to be re-certified every three years.

Association for Talent Development (ATD)

https://www.td.org/

ATD Vision: Create a World That Works Better

ATD Mission: Empower Professionals to Develop Talent in the Workplace

ATD certifies professionals in learning and performance (CPLP) and associate professionals in talent development. The Certified Professional in Learning and Performance (CPLP) candidates are tested on ten (10) areas of expertise and include:

1. Performance Improvement
2. Instructional Design
3. Training Delivery
4. Learning Technologies
5. Evaluating Learning Impact
6. Managing Learning Programs
7. Integrated Talent Management
8. Coaching
9. Knowledge Management
10. Change Management

ATD also has a competency model for learning and development through which they identify roles, areas of expertise, and foundational competencies for professionals in learning and performance.

Association for Educational Communications and Technology (AECT)

https://www.aect.org/

AECT Vision: We seek to be the premier international organization in educational technology, the organization to which others refer for research and best practices.

AECT Mission: Provide international leadership by promoting scholarship and best practices in the creation, use, and management of technologies for effective teaching and learning.

Januszewski and Molenda (2007) defined Educational Technology as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (p.1).

AECT has developed standards for educational technologists in five areas. These standards can be accessed from the AECT website.

1. Content Knowledge
2. Content Pedagogy
3. Learning Environments
4. Professional Knowledge and Skills
5. Research

For each of the standards, there are several indicators provided. AECT certifies graduate certificate programs in higher education who prepare educational technologists based on these standards.

University Professional and Continuing Education Association (UPCEA)

https://upcea.edu/

UPCEA is a leading association of professional, continuing and online education. Their goal is to provide high quality, professional, continuing and online education programs of practice in higher education.

UPCEA® Purposes:

- To promote quality in professional and continuing higher education.

UPCEA has seven standards identified to provide excellence in online learning leadership.

1. Internal Advocacy
2. Entrepreneurial Initiative
3. Faculty Support
4. Student Support
5. Digital Technology
6. External Advocacy
7. Professionalism

Online Learning Consortium (OLC)

https://onlinelearningconsortium.org/

OLC® Vision: Setting the global standard in online and digital learning

OLC® Mission: Creating community and connections around quality online and digital learning while driving innovation

OLC's Five Pillars of Quality Online Education include:

1. Learning Effectiveness
2. Scale
3. Access
4. Faculty Satisfaction
5. Student Satisfaction

Instructional Design and Technology Competencies From Research

In addition to the professional organizations, several researchers have examined instructional design competencies and standards over the years. Table 2 below provides details of researchers and the competencies and standards examined for various instructional design professionals. These articles can be used to plan professional development, academic programs, and learning experiences for our professionals and emerging professionals.

Table 2

Instructional Design and Technology Competencies From Research

Authors	Audience	Research Method	Competencies Identified
Tennyson (2001)	Instructional Technologists	Development of competency worksheet	Educational foundations, instructional systems design methodology, and instructional design process experience
Liu, Gibby, Quiros, and Demps (2002)	Instructional Designers	Interviews	Problem-solving and decision-making skills
Brown, Sugar and Daniels (2007)	Media Producers in entry-level multimedia production	Biennial Survey	Authoring applications media producers regularly use and attributes that are most important to the choice of an authoring application
Kenny, Zhang, Schwier and Campbell (2007)	Instructional Designers	Literature Review	Communication skills, knowledge of instructional design models, problem-solving/decision-making skills, and technology skills
Ritzhaupt, Martin and Daniels (2010)	Educational Technologists	Job Announcement Analysis and Survey of Professionals	Multimedia competencies for educational technologists
Lowenthal, Wilson and Dunlap (2010)	Instructional Designers	Job Announcement Analysis	Instructional design experience, communication skills and collaboration skills
Wakefield, Warren and Mills (2012)	Instructional Designers	Job Announcement Analysis	Communication and interpersonal skills, managing multiple instructional Design projects, specific traits, and collaborative skills
Ritzhaupt and Kumar (2015)	Instructional Designers in Higher Education	In-depth Interviews	Solid foundation in instructional design and learning theory, possess soft skills and technical skills, and have a willingness to learn on the job
Kang and Ritzhaupt (2015)	Educational Technologists	Job Announcement Analysis	Instructional design, project management, technical skills, and soft skills
Ritzhaupt, Martin, Pastore and Kang (2018)	Educational Technologists	Survey of Professionals	Instructional design, development, facilitation, assessment, evaluation, communication, problem-solving, and interpersonal skills

Learning theory also guides ethical decision-making when engaged in the creation of a wide-array of learning solutions. Professionals must also stay abreast in emerging learning technologies and should possess both the ability to learn independently and the commitment to lifelong learning. Other knowledge, skills, and abilities were identified in these studies, but these areas noted were frequently observed and noted.

Conclusion

Professional competencies and standards are helpful ways to communicate the value-add of our professionals to stakeholders outside of our community in various professional contexts (e.g., healthcare), to assist our professionals and emerging professionals in planning professional development and lifelong learning (e.g., which webinar to attend), and to guide our academic programs to align with the expectations of the needs in our field (e.g., selecting which topics to cover in an instructional design course). While no list of competencies and standards is complete, those enumerated in this chapter provide readers a glimpse of the status of the profession as described by our professional organizations and existing research literature. Students entering the profession should spend time on learning these competencies and standards to identify career paths and professional development opportunities. We conclude the chapter with some independent learning activities for your edification.

Application Exercises

1. How should professional competencies and standards be identified, documented, and used by professionals in our field? What forms of research methods have been used to identify and document these competencies and standards? Write a brief overview of how you think competencies and standards should be developed in our profession by reviewing the existing articles listed in Table 2.
2. Read three of the recent articles listed in Table 2. Using the competencies and standards provided in these articles, write a short list of professional learning outcomes for yourself to achieve in the next calendar year.
3. Explore one of the professional organizations discussed in this chapter to identify more detailed information about the organization, including when the professional organization hosts its annual conference, the cost of membership, the list of readings available with membership, and any of professional learning (e.g., webinars) provided by the organization for its members.
4. Some scholars, such as Ritzhaupt and Martin (2010; 2014; 2018) have expressed the competencies of professionals using knowledge, skill, and ability statements. Using this approach, search and identify 10 instructional design professional position announcements using tools like indeed.com. After identifying the announcements, code the knowledge, skill, and ability statements found in these announcements.

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CHAPTER OVERVIEW

6: Instructional Design Processes

6.1: Design Thinking

Design Thinking

Vanessa Svihla

Editor's Note

This is a condensed version of a chapter originally published in the open textbook Foundations of Learning and Instructional Design Technology. It is printed here under the same license as the original.

Introduction

Many depictions of design process, and a majority of early design learning experiences, depict design as rather linear—a "waterfall" view of design (Figure 1). This depiction was put forward as a *flawed* model (Royce, 1970), yet it is relatively common. It also contrasts with what researchers have documented as expert design practice.

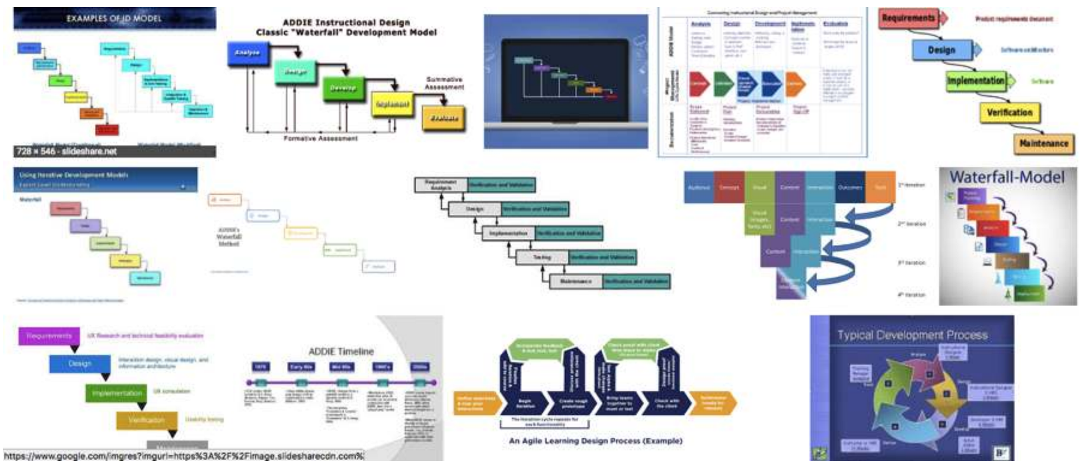

Figure 6.1.1: *Google Image Search Results of Design as a Waterfall Model*

Fortunately, as instructional designers, we have many models and methods of design practice to guide us. While ADDIE is ubiquitous, it is not a singular, prescriptive approach, though it is sometimes depicted—and even practiced—as such. When we look at what experienced designers do, we find they tend to use iterative methods that sometimes appear a bit messy or magical, leveraging their past experiences as precedent. Perhaps the most inspiring approaches that reflect this are human-centered design and design thinking. However, most of us harbor more than a few doubts and questions about these approaches, such as the following:

- Design thinking seems both useful and *cool*, but I have to practice a more traditional approach like ADDIE or waterfall. Can I integrate design thinking into my practice?
- Design thinking—particularly the work by IDEO—is inspiring. As an instructional designer, can design thinking guide me to create instructional designs that really help people?
- Given that design thinking seems to hold such potential for instructional designers, I want to do a research study on design thinking. Because it is still so novel, what literature should I review?
- As a designer, I sometimes get to the end of the project, and then have a huge insight about improvements. Is there a way to shift such insights to earlier in the process so that I can take advantage of them?
- If design thinking methods are so effective, why aren't we taught to do them from beginning?

To answer these questions, I explore how research on design thinking sheds light on different design methods, considering how these methods originated and focusing on lessons for instructional designers. I then share a case to illustrate how different design methods might incorporate design thinking. I close by raising concerns and suggesting ways forward.

What is Design Thinking?

There is no single, agreed-upon definition of design thinking, nor even of what being adept at it might result in, beyond *good design* (Rodgers, 2013), which is, itself, subjective. If we look at definitions over time and across fields (Table 1), we see most researchers reference design thinking as methods, practices or processes, and a few others reference cognition or mindset. This reflects the desire to understand both what it is that designers do and how and when they know to do it (Adams, Daly, Mann, & Dall'Alba, 2011). Some definitions emphasize identity (Adams et al., 2011), as well as values (e.g., practicality, empathy) (Cross, 1982). In later definitions, design thinking is more clearly connected to creativity and innovation (Wylant, 2008); we note that while mentioned in early design research publications (e.g., Buchanan, 1992), innovation was treated as relatively implicit.

Table 1

Characterizations of Design Thinking (DT) Across Fields, Authors, and Over Time

Design research field characterizes DT (1992)	*IDEO president introduces DT to the business world, 2008*	*Stanford d.school (2012) & IDEO (2011) introduce DT resources for educators*	*Education researchers characterize DT for education research & practice, 2012*	*Design researchers continue to develop nuanced characterizations of DT in practice, 2013*
"how designers formulate problems, how they generate solutions, and the cognitive strategies they employ." These include framing the problem, oscillating between possible solutions and reframing the problem, imposing constraints to generate ideas, and reasoning abductively. (Cross, Dorst, & Roozenburg, 1992, p. 4)	"uses the designer's sensibility and methods [empathy, integrative thinking, optimism, experimentalism, collaboration] to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity." (Brown, 2008, p. 2)	"a mindset." It is human-centered, collaborative, optimistic, and experimental. The "structured" process of design includes discovery, interpretation, ideation, experimentation, and evolution (d.school, 2012; IDEO, 2011)	"analytic and creative process that engages a person in opportunities to experiment, create and prototype models, gather feedback, and redesign" (Razzouk & Shute, 2012, p. 330)	"a methodology to generate innovative ideas." These include switching between design tasks and working iteratively. (Rodgers, 2013, p. 434)

Additional Reading

For another great summary of various approaches to design thinking, see this article by the Interaction Design Foundation. This foundation has many other interesting articles on design that would be good reading for an instructional design student.

https://edtechbooks.org/-nh

Where Did Design Thinking Come From? What Does It Mean for Instructional Designers?

Design thinking emerged from the *design research* field[1]—an interdisciplinary field that studies how designers do their work. Initially, design thinking was proposed out of a desire to differentiate the work of designers from that of scientists. As Nigel Cross explained, "We do not have to turn design into an imitation of science, nor do we have to treat design as a mysterious, ineffable art" (Cross, 1999, p. 7). By documenting what accomplished designers do and how they explain their process, design researchers argued that while scientific thinking can be characterized as reasoning inductively and deductively, designers reason *constructively* or *abductively* (Kolko, 2010). When designers think abductively, they fill in gaps in knowledge about the problem space and the solution space, drawing inferences based on their past design work and on what they understand the problem to be

Lesson #1 for ID

Research on design thinking should inspire us to critically consider how we use precedent to fill in gaps as we design. Precedent includes our experiences as learners, which may be saturated with uninspired and ineffective instructional design.

A critical difference between scientific thinking and design thinking is the treatment of the problem. Whereas in scientific thinking the problem is treated as solvable through empirical reasoning, in design thinking problems are tentative, sometimes irrational conjectures to be dealt with (Diethelm, 2016). This type of thinking has an *argumentative grammar,* meaning the designer considers suppositional if-then and what-if scenarios to iteratively frame the problem and design something that is valuable for others (Dorst, 2011). As designers do this kind of work, they are jointly framing the problem and posing possible solutions, checking to see if their solutions satisfy the identified requirements (Cross et al., 1992; Kimbell, 2012). From this point of view, we don't really know what the design problem is until it is solved! And when doing design iteratively, this means we are changing the design problem multiple times.

Other design methods that engage stakeholders early in the design process, such as participatory design (Muller & Kuhn, 1993; Schuler & Namioka, 1993) and human-centered design (Rouse, 1991) have also influenced research on design thinking. While these approaches differed in original intent, these differences have been blurred as they have come into practice. Instead of defining each, let's consider design characteristics made salient by comparing them with more traditional, linear methods. These methods tend to be iterative, and tend to bring stakeholders into the process more deeply to better understand their experiences, extending the approach taken in ADDIE, or even to invite stakeholders to generate possible design ideas and help frame the design problem.

When designing *with* end-users, we get their perspective and give them more ownership over the design, but it can be difficult to help them be visionary. As an example, consider early smartphone design. Early versions had keyboards and very small screens and each new version was incrementally different from the prior version. If we had asked users what they wanted, most would have suggested minor changes in line with the kinds of changes they were seeing with each slightly different version. Likewise, traditional approaches to instruction should help inspire stakeholder expectations of what is possible in a learning design.

Lesson #2 for ID

Inviting stakeholders into instructional design process early can lead to more successful designs, but we should be ready to support them to be visionary, while considering how research on how people learn might inform the design.

Designers who engage with end-users must also attend to power dynamics (Kim, Tan, & Kim, 2012). As instructional designers, when we choose to include learners in the design process, they may be uncertain about how honest they can be with us. This is especially true when working with children or adults from marginalized communities or cultures unfamiliar to us. For instance, an instructional designer who develops a basic computer literacy training for women fleeing abuse may well want to understand more about learner needs, but should consider carefully the situations in which learners will feel empowered to share.

Lesson #3 for ID

With a focus on understanding human need, design thinking should also draw our attention to inclusivity, diversity, and participant safety.

We next turn to an example, considering what design thinking might look like across different instructional design practices.

Design Thinking in ID Practice

To understand how design thinking might play out in different instructional design methods, let's consider a case, with the following three different instructional design practices:

- Waterfall design proceeds in a linear, stepwise fashion, treating the problem as known and unchanging
- ADDIE design, in this example, often proceeds in a slow, methodical manner, spending time stepwise on each phase
- Human-centered design prioritizes understanding stakeholder experiences, sometimes co-designing with stakeholders

A client—a state agency—issued a call for proposals that addressed a design brief for instructional materials paired with new approaches to assessment that would be "worth teaching to." They provided information on the context, learners, constraints, requirements, and what they saw as the failings of current practice. They provided evaluation reports conducted by an external contractor and a list of 10 sources of inspiration from other states.

They reviewed short proposals from 10 instructional design firms. In reviewing these proposals, they noted that even though all designers had access to the same information and the same design brief, the solutions were different, yet all were *satisficing*, meaning they met the requirements without violating any constraints. They also realized that not only were there 10 different solutions, there were also 10 *different* problems being solved! Even though the client had issued a design brief, each team defined the problem differently.

The client invited three teams to submit long proposals, which needed to include a clear depiction of the designed solution, budget implications for the agency, and evidence that the solution would be viable. Members of these teams were given a small budget to be spent as they chose.

Team Waterfall, feeling confident in having completed earlier design steps during the short proposal stage, used the funds to begin designing their solution, hoping to create a strong sense of what they would deliver if chosen. They focused on details noted in the mostly positive feedback on their short proposal. They felt confident they were creating a solution that the client would be satisfied with because their design met all identified requirements, because they used their time efficiently, and because as experienced designers, they knew they were doing quality, professional design. Team Waterfall treated the problem as adequately framed and solved it without iteration. Designers often do this when there is little time or budget[2], or simply because the problem appears to be an *another-of* problem—"this is just another of something I have designed before." While this can be an efficient way to design, it seldom gets at the problem *behind* the problem, and does not account for changes in who might need to use the designed solution or what their needs are. Just because Team Waterfall used a more linear process does not mean that they did not engage in design thinking. They used design thinking to frame the problem in their initial short proposal, and then again as they used design precedent—their past experience solving similar problems—to deliver a professional, timely, and complete solution.

Team ADDIE used the funds to conduct a traditional needs assessment, interviewing five stakeholders to better understand the context, and then collecting data with a survey they created based on their analysis. They identified specific needs, some of which aligned to those in the design brief and some that demonstrated the complexity of the problem. They reframed the problem and created a low fidelity prototype. They did not have time to test it with stakeholders, but could explain how it met the identified needs. They felt confident the investment in understanding needs would pay off later, because it gave them insight into the problem. Team ADDIE used design thinking to fill gaps in their understanding of context, allowing them to extend their design conjectures to propose a solution based on a reframing of the design problem.

Team Human-centered used the budget to hold an intensive five-day co-design session with a major stakeholder group. Stakeholders shared their experiences and ideas for improving on their experience. Team Human crafted three personas based on this information and created a prototype, which the stakeholder group reviewed favorably. They submitted this review with their prototype. Team Human-centered valued stakeholder point of view above all else, but failed to consider that an intensive five-day workshop would limit who could attend. They used design thinking to understand differences in stakeholder point of view and reframed the problem based on this; however, they treated this as covering the territory of stakeholder perspectives. They learned a great deal about the experiences these stakeholders had, but failed to help the stakeholders think beyond their own experiences, resulting in a design that was only incrementally better than existing solutions and catered to the desires of one group over others.

The case above depicts ways of proceeding in design process and different ways of using design thinking. These characterizations are not intended to privilege one design approach over others, but rather to provoke the reader to consider them in terms of how designers fill in gaps in understanding, how they involve stakeholders, and how iteratively they work. Each approach, however, also carries potential risks and challenges (Figure 2). For instance, designers may not have easy access to stakeholders, and large projects may make more human-centered approaches unwieldy to carry out (Turk, France, & Rumpe, 2002).

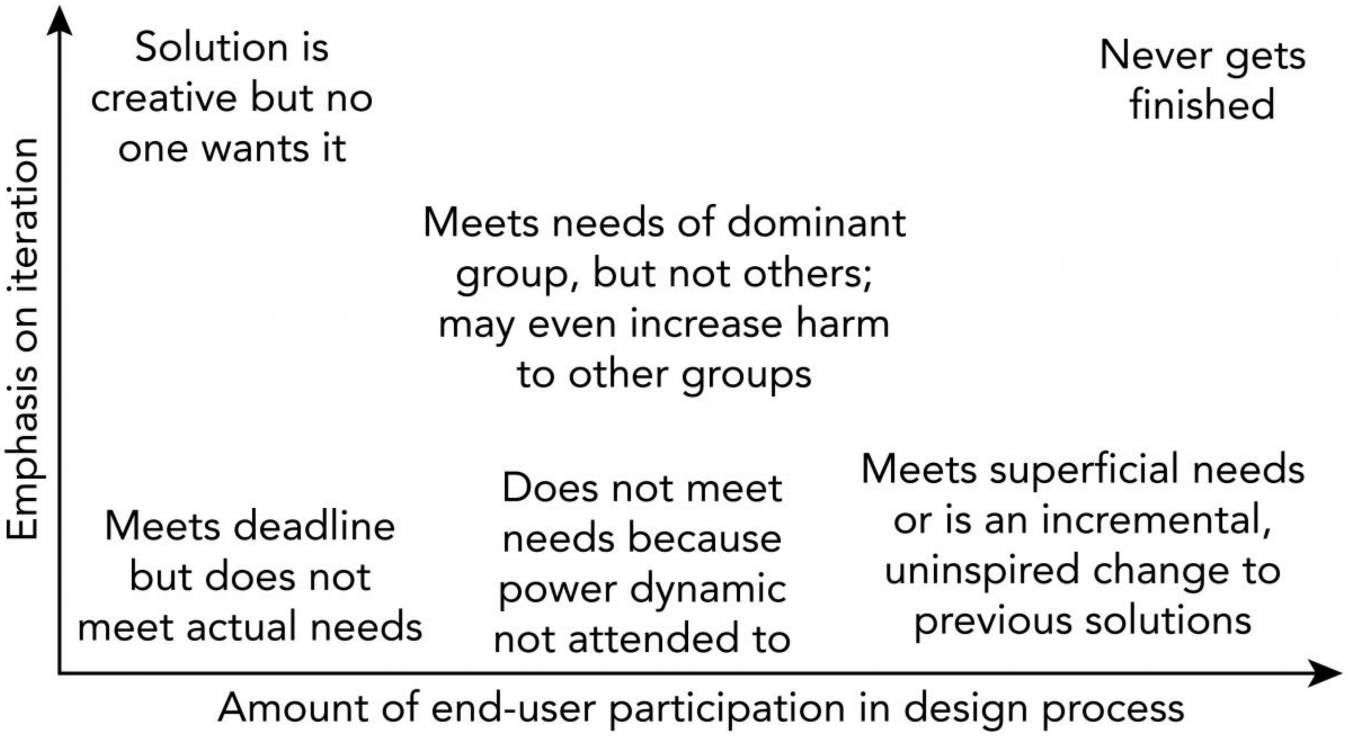

Figure 6.1.2: *Risks and Pitfalls Associated with Different Levels of End-User Participation and Iteration*

Critiques of Design Thinking

While originally a construct introduced by design researchers to investigate how designers think and do their work, design thinking became popularized, first in the business world (Brown, 2008) and later in education. Given this popularity, design thinking was bound to draw critique in the public sphere. To understand these critiques, it is worth returning to the definitions cited earlier (Table 1). Definitions outside of the design research field tend to be based in specific techniques and strategies aimed at innovation; such accounts fail to capture the diversity of actual design practices (Kimbell, 2011). They also tend to privilege the designer as a savior, an idea at odds with the keen focus on designing ***with*** stakeholders that is visible in the design research field (Kimbell, 2011). As a result, some have raised concerns that design thinking can be a rather privileged process—e.g., upper middle class white people drinking wine in a museum while solving poverty with sticky note ideas—that fails to lead to sufficiently multidimensional understandings of complex processes (Collier, 2017). Still others argue that much of design thinking is nothing new (Merholz, 2009), to which researchers in the design research field have responded: design thinking, as represented externally might not be new, but the rich body of research from the field could inform new practices (Dorst, 2011).

These critiques should make us cautious about how we, as instructional designers, take up design thinking and new design practices. Below, I raise a few concerns for new instructional designers, for instructional designers interested in incorporating new methods, for those who teach instructional design, and for those planning research studies about new design methods.

My first concern builds directly on critiques from the popular press and my experience as a reviewer of manuscripts. Design thinking is indeed trendy, and of course people want to engage with it. But as we have seen, it is also complex and subtle. Whenever we engage with a new topic, we necessarily build on our past understandings and beliefs as we make connections. It should not be surprising, then, that when our understanding of a new concept is nascent, it might not be very differentiated from previous ideas. Compare, for example, Polya's "How to Solve it" from 1945 to Stanford's d.school representation of design thinking (Table 2). While Polya did not detail a design process, but rather a process for solving mathematics problems, the two processes are superficially very similar. These general models of complex, detailed processes are *zoomed out* to such a degree that we lose the detail. These details matter, whether you are a designer learning a new practice or a researcher studying how designers do their work. For those learning a new practice, I advise you to attend to the differences, not the similarities. For those planning studies of design thinking, keep in mind that "design thinking" is too broad to study effectively as a whole. Narrow your scope and *zoom in* to a focal length that lets you investigate the details. As you do so, however, do not lose sight of how the details function in a complex process. For instance, consider the various approaches being investigated to measure design thinking; some treat these as discrete, separable skills, and others consider them in tandem (Carmel-Gilfilen & Portillo, 2010; Dolata, Uebernickel, & Schwabe, 2017; Lande, Sonalkar, Jung, Han, & Banerjee, 2012; Razzouk & Shute, 2012).

Table 2

Similarities Between "How to Solve it" and a Representation of Design Thinking

Polya, 1945 How to solve it	***Stanford's d.school design thinking representation***
Understand the problem	Empathize, Define
Devise a plan	Ideate
Carry out the plan	Prototype
Look back	Test

My second concern is that we tend, as a field, to remain naïve about the extant and extensive research on design thinking and other design methods, in part because many of these studies were conducted in other design fields (e.g., architecture, engineering) and published in journals such as *Design Studies* (which has seldom referenced instructional design). Not attending to past and current research, and instead receiving information about alternative design methods filtered through other sources is akin to the game of telephone. By the time the message reaches us, it can be distorted. While we need to adapt alternative methods to our own ID practices and contexts, we should do more to learn from other design fields, and also contribute our findings to the design research field. As designers, we would do well to learn from fields that concern themselves with human experience and focus somewhat less on efficiency.

My third concern is about teaching alternative design methods to novice designers. The experience of learning ID is often just a single pass, with no or few opportunities to iterate. As a result, flexible methods inspired by design thinking may seem the perfect way to begin learning to design, because there is no conflicting traditional foundation to overcome. However, novice designers tend to jump to solutions too quickly, a condition no doubt brought about in part by an emphasis in schooling on getting to the right answer using the most efficient method. Design thinking methods encourage designers to come to a tentative solution right away, then get feedback by testing low fidelity prototypes. This approach could exacerbate a new designer's tendency to leap to solutions. And once a solution is found, it can be hard to give alternatives serious thought. Yet, I argue that the solution is not to ignore human-centered methods in early instruction. By focusing only on ADDIE, we may create a different problem by signaling to new designers that the ID process is linear and tidy, when this is typically not the case.

Instead, if we consider ADDIE as a scaffold for designers, we can see that its clarity makes it a useful set of supports for those new to design. Alternative methods seldom offer such clarity, and have far fewer resources available, making it challenging to find the needed supports. To resolve this, we need more and better scaffolds that support novice designers to engage in human-centered work. For instance, I developed a *Wrong Theory Design Protocol* (https://edtechbooks.org/-ub) that helps inexperienced designers get unstuck, consider the problem from different points of view, and consider new solutions. Such scaffolds could lead to a new generation of instructional designers who are better prepared to tackle complex learning designs, who value the process of framing problems ***with*** stakeholders, and who consider issues of power, inclusivity, and diversity in their designing.

Concluding Thoughts

I encourage novice instructional designers, as they ponder the various ID models, approaches, practices and methods available to them, to be suspicious of any that render design work tidy and linear. If, in the midst of designing, you feel muddy and uncertain, unsure how to proceed, you are likely exactly where you ought to be.

In such situations, we use design thinking to fill in gaps in our understanding of the problem and to consider how our solution ideas might satisfy design requirements. While experienced designers have an expansive set of precedents to work with in filling these gaps, novice designers need to look more assiduously for such inspiration. Our past educational experiences may covertly convince us that just because something is common, it is best. While a traditional instructional approach may be effective for some learners, I encourage novice designers to consider the following questions to scaffold their evaluation of instructional designs:

- Does its effectiveness depend significantly on having *compliant learners* who do everything asked of them without questioning why they are doing it?
- Is it a design *worth* engaging with? Would you want to be the learner? Would your mother, child, or next-door neighbor want to be? If yes on all counts, consider who *wouldn't*, and why they wouldn't.
- Is the design, as one of my favorite project-based teachers used to ask, "provocative" for the learners, meaning, will it provoke a strong response, a curiosity, and a desire to know more?
- Is the design "chocolate-covered broccoli" that tricks learners into engaging?

To be clear, the goal is not to make all learning experiences fun or easy, but to make them worthwhile. And I can think of no better way to ensure this than using iterative, human-centered methods that help designers understand and value multiple stakeholder perspectives. And if, in the midst of seeking, analyzing, and integrating such points of view, you find yourself thinking, "This is difficult," that is because it *is difficult.* Providing a low fidelity prototype for stakeholders to react to can make this process clearer and easier to manage, because it narrows the focus.

However, success of this approach depends on several factors. First, it helps to have forthright stakeholders who are at least a little hard to please. Second, if the design is visionary compared to the current state, stakeholders may need to be coaxed to envision new learning situations to react effectively. Third, designers need to resist the temptation to settle on an early design idea.

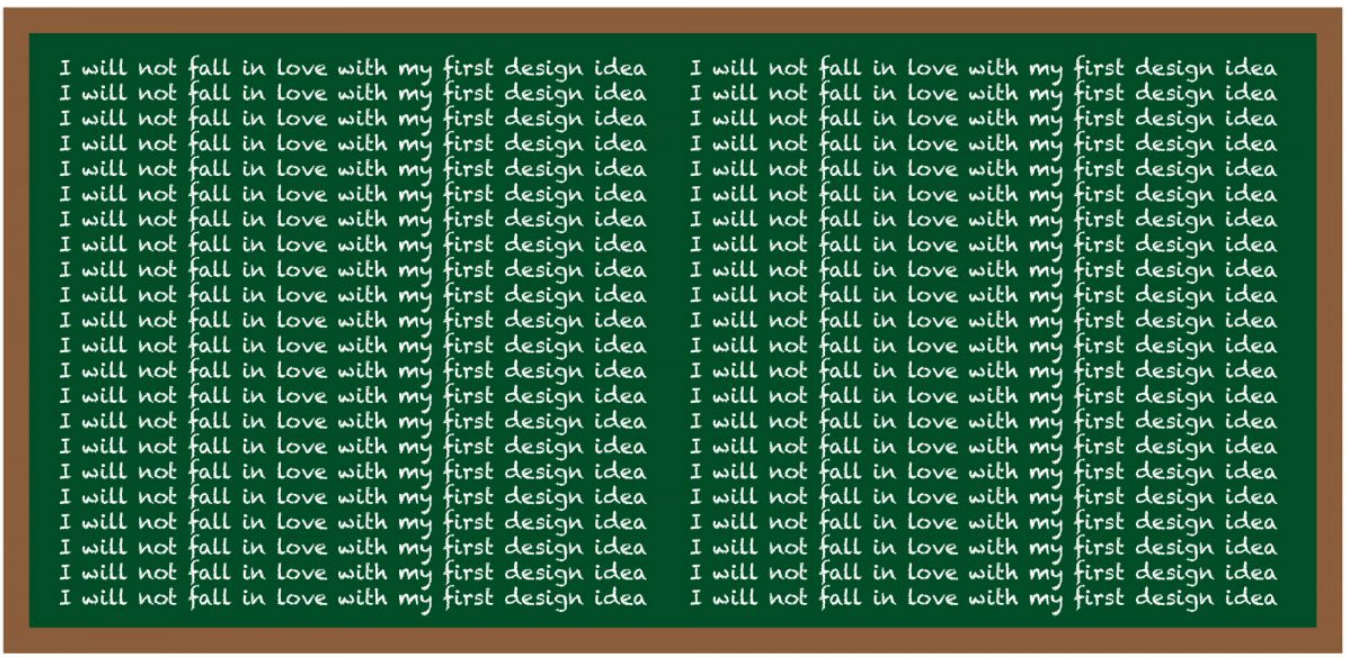

Figure 6.1.3: *Designers Need to Resist the Temptation to Settle on an Early Design Idea*

Finally, I encourage instructional designers—novice and expert alike—to let themselves be inspired by the design research field and human-centered approaches, and then to give back by sharing their design work as design cases (such as in the *International Journal of Designs for Learning*) and by publishing in design research journals .

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6.2: Robert Gagné And The Systematic Design Of Instruction

Robert Gagné and the Systematic Design of Instruction

John H. Curry, Sacha Johnson, & Rebeca Peacock

To begin any study of instructional design, it is beneficial to examine the roots of the field. Where did the field originate? How did we develop into a field of study and practice? As your study continues, you can better see how the knowledge base of the field began, how it progressed, and how it was researched and when, which will help you gain a better understanding of the process and practice of instructional design as well as the field as a whole. Specifically, understanding the origins of the systematic design of instruction will give the learner a greater appreciation for today's more robust design theories and models.

As the United States entered World War II, they faced an enormous problem: How were they going to train so many troops? The numbers are staggering. The military trained over 16 million troops. In addition, the technology of the war had changed drastically from World War I, and the troops needed to be trained on all the skills necessary to complete their tasks at hand, and FAST. They did not have the luxury of time—the training needed to be done quickly, effectively, and efficiently.

After the war ended, cognitive psychologists, many of whom had served in World War II themselves, began studying how to apply the training lessons from the war to other instructional settings to help people learn better. Combining the work of those researchers, the systematic instructional design process was born.

Gagné's Conditions of Learning

Conditions of Learning

Robert Gagné was working on his Ph.D. in Psychology when World War II began. While assigned to Psychological Research Unit No. 1, he administered scoring and aptitude tests to select aviation cadets. After the War, Gagné joined the Air Force Personnel and Training Research Center where he directed the Perceptual and Motor Skills Laboratory. He held multiple academic positions throughout his career, ranging from the Connecticut College for Women to Princeton to Florida State University. His experiences in the military and training there guided much of his research. In 1959, he participated in the prestigious Woods Hole Conference, a gathering of outstanding educators, psychologists, mathematicians and other scientists from the United States in response to the Soviet Union launching the Sputnik satellite. The results of the conference were published in Bruner's The Process of Education (1961). Four years later, Gagné published The Conditions of Learning (1965).

Taxonomy of Learning Outcomes

Gagné posited that not all learning is equal and each distinct learning domain should be presented and assessed differently. Therefore, as an instructional designer one of the first tasks is to determine which learning domain applies to the content. The theoretical basis behind the Conditions of Learning is that learning outcomes can be broken down into five different domains: verbal information, cognitive strategies, motor skills, attitudes, and intellectual skills (see Figure 1).

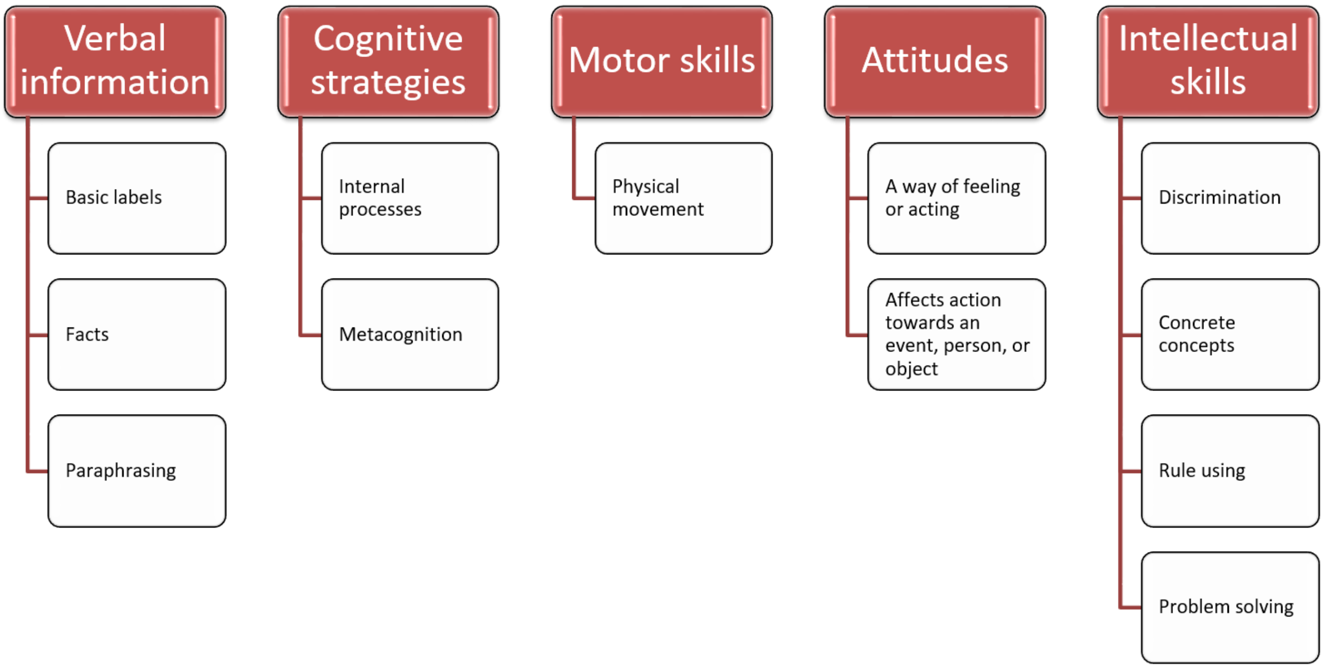

Figure 6.2.1: *Gagné's Domains of Learning*

Verbal information includes basic labels and facts (e.g. names of people, places, objects, or events) as well as bodies of knowledge (e.g. paraphrasing of ideas or rules and regulations). Cognitive strategies are internal processes where the learner can control his/her own way of thinking such as creating mental models or self-evaluating study skills. Motor skills require bodily movement such as throwing a ball, tying a shoelace, or using a saw. Attitude is a state that affects a learner's action towards an event, person, or object. For example, appreciating a selection of music or writing a letter to the editor. Intellectual skills have their own hierarchical structure within the Gagné taxonomy and are broken down into discrimination, concrete concepts, rule using, and problem solving. Discrimination is when the learner can identify differences between inputs or members of a particular class and respond appropriately to each. For example, distinguishing when to use a Phillips-head or a flat-head screwdriver. Concrete concepts are the opposite of discrimination because they entail responding the same way to all members of a class or events. An example would be classifying music as pop, country, or classical. Rule using is applying a rule to a given situation or condition. A learner will need to relate two or more simpler concepts, as a rule states the relationship among concepts. In many cases, it is helpful to think of these as "if-then" statements. For example, "if the tire is flat, then I either need to put air in the tire or change the flat tire." Finally, problem solving is combining lower-level rules and applying them to previously unencountered situations. This could include generating new rules through trial and error until a problem is solved.

Nine Events of Instruction

Beyond his assertion that not all learning is equal, Gagné also theorized an effective learning process consisting of nine separate and distinct steps or events (see Figure 2). These events build naturally upon each other and improve the communication supporting the learning process. The events facilitate learner engagement as well as retention of the content being presented. For an instructional designer, they provide a framework or outline to structure the delivery of instructional content.

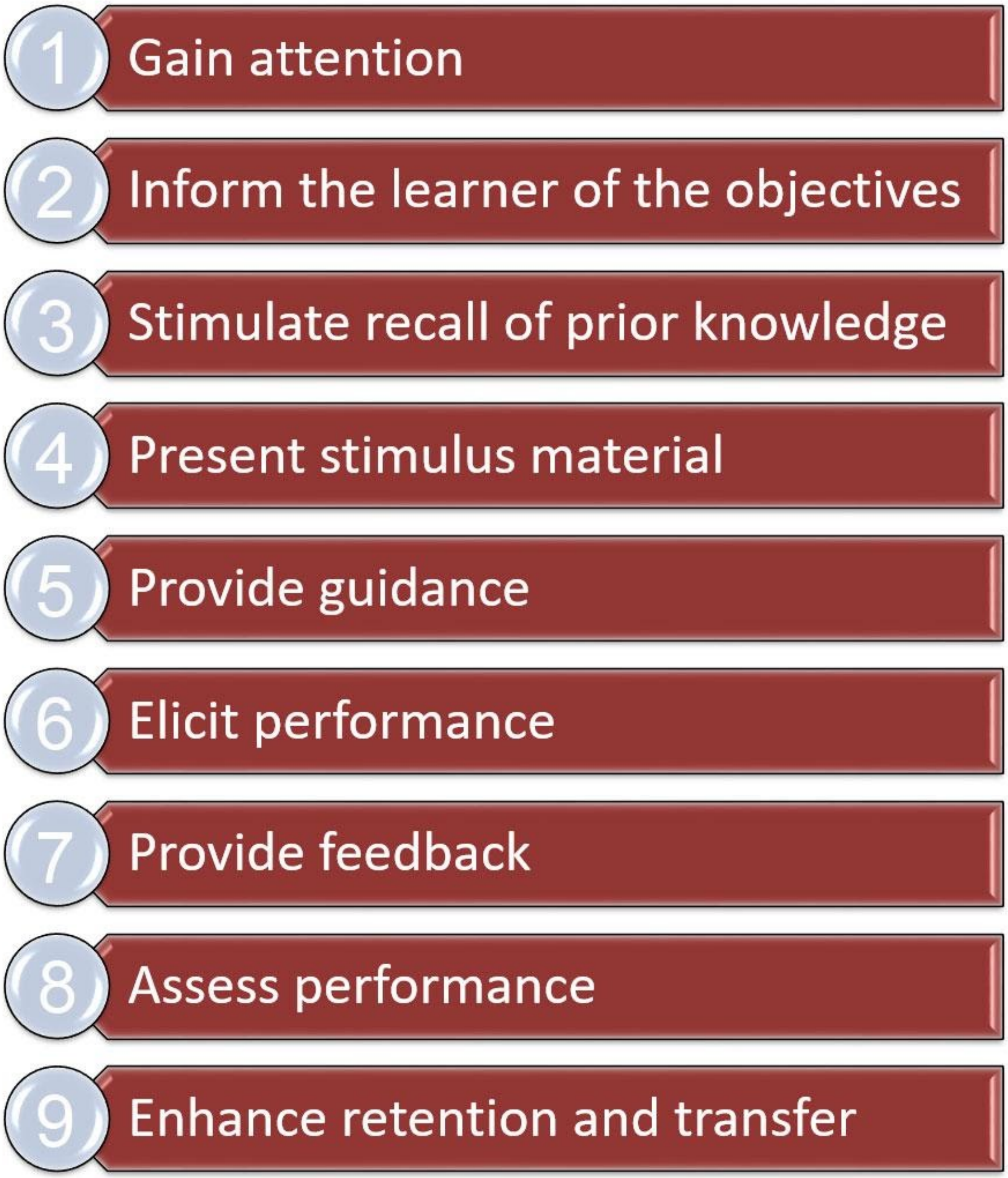

Figure 6.2.2: *Gagné's Nine Events of Instruction*

Event one: Gain attention. Before learning can happen, the learners must be engaged. To gain the learners' attention, any number of strategies can be employed. It could be as simple as turning the lights on and off, the teacher counting down, or the teacher clapping three times. Other options could include a discussion prompt, showing a video, or discussing current events.

Event two: Inform learners of objective. Once learners are engaged, they are informed of the objective of the instruction, which gives learners a road map to the instruction. It allows them to actively navigate the instruction and know where they are supposed to end up. This could be written on a whiteboard in front of the class, highlighted on materials, spoken verbally, or posted clearly in an online context.

Event three: Stimulate recall of prior learning. Stimulating recall of prior learning allows learners to build upon previous content covered or skills acquired. This can be done by referring to previous instruction, using polls to determine previous content understanding (and then discussing the results), or by using a discussion on previous topics as a segue between previous content and new content.

Event four: Present the stimulus material. Presenting the stimulus material is simply where the instructor presents new content. According to Gagné, this presentation should vary depending on the domain of learning corresponding to the new content.

Event five: Provide learner guidance. Providing learner guidance entails giving learners the scaffolding and tools needed to be successful in the learning context. Instructors can provide detailed rubrics or give clear instruction on expectations for the learning context and the timeline for completion.

Event six: Elicit performance. Eliciting performance allows learners to apply the knowledge or skills learned before being formally assessed. It allows learners to practice without penalty and receive further instruction, remediation, or clarification needed to be successful.

Event seven: Provide feedback. Hand in hand with eliciting performance in a practice setting, the instructor provides feedback to further assist learners' content or skill mastery.

Event eight: Assess performance. Following the opportunity to practice the new knowledge or skill (events five, six, and seven), learner performance is assessed. It is imperative that the performance be assessed in a manner consistent with its domain of learning. For example, verbal knowledge can be assessed using traditional fact tests or with rote memorization, but motor skills must be assessed by having the learner demonstrate the skill.

Event nine: Enhance retention and transfer. Enhancing retention and transfer gives the learner the opportunity to apply the skill or knowledge to a previously unencountered situation or to personal contexts. For example, using class discussion, designing projects, or by writing essays.

The Nine Events: Explained by Training Cats

Gagné's Impact on Instructional Design

The impact Robert Gagné had on the field of instructional design cannot be understated. For example, from his initial work we can trace the evolution of the domains of learning from the Conditions of Learning through other theories such as Merrill's Component Display Theory (1994), to Smith and Ragan's Instructional Design Theory (1992), to van Merrienboer's complex cognitive skills in the 4C/ID model of instructional design (1997). Beyond that, Gagné's Nine Events of Instruction also paved the way for a systematic process for designing instruction. For the first time, those designing instruction had a process to follow, a blueprint. And almost 60 years later, Gagné's work still serves as the basic framework all instructional designers who use systematic processes follow.

ADDIE

In 1965, the United States Air Force created their first major instructional system. By 1970, the system had grown into a full Five-Step Approach to designing instruction (US Air Force). The five steps for designing instruction were: Analyze system requirements; Define education training requirements; Develop objectives and tests; Plan, develop, and validate instruction; and Conduct and evaluate instruction. Reflexive within this circular model was feedback and intervention. This model gave way to the conceptual framework known as ADDIE, upon which the majority of subsequent systematic instructional design (ID) models are inherently based. It consists of five phases: Analysis, Design, Development, Implementation, and Evaluation (see Figure 3). Each of these phases builds on the previous phase to systematically identify and clarify an instructional problem, develop and implement a solution, and evaluate the effectiveness and efficiency of the solution. Additionally, evaluation occurs throughout the other phases to inform the design of the instruction.

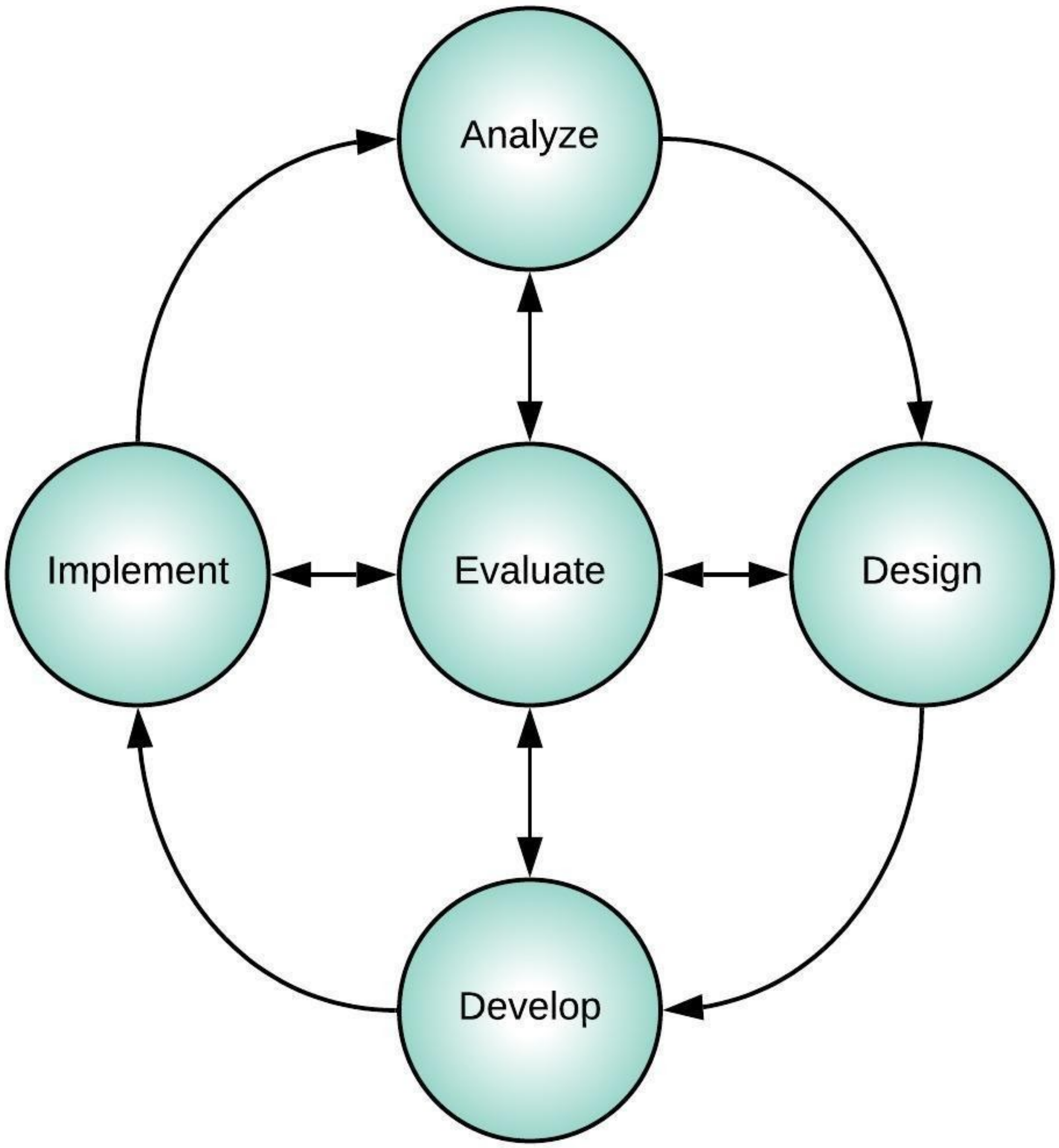

Figure 6.2.3: *The ADDIE model*

The systematic process of designing instruction begins with the analysis of a problem to determine whether instruction is a possible solution. The analysis phase includes analyzing the needs, tasks, and learners in order to clarify the problem, goals and objectives of the instruction, the learning environment, and learner characteristics. Based on the results of the analyses, the instructional designer clarifies the instructional problem and identifies the instructional goals and objectives. During the design phase, the instructional designer writes the learning objectives and chooses an ID model. The development phase consists of creating all instructional materials. Implementation is when the instruction is delivered to learners either in a formative or summative setting.

The evaluation phase is reflexive with formative evaluation, which consists of ongoing feedback as the instruction is designed and developed, and summative evaluation consisting of the final evaluation after full implementation. These phases are discussed more in-depth in their respective chapters.

Dick and Carey Model

Working from the conceptual framework of the ADDIE model and building upon a systematic approach to instruction like Gagné's Conditions of Learning, the Dick and Carey Model is one of many systematic instructional design processes. While each model may have its own individual process, they also have many characteristics in common such as attention to detail and precision. The Dick and Carey model is comprised of nine stages incorporating elements from previous design models as well as elements from behaviorism, cognitivism, and constructivism (see Figure 4). This model provides the designer with a process that incorporates flexibility and allows the designer to make appropriate adaptations for their particular situation.

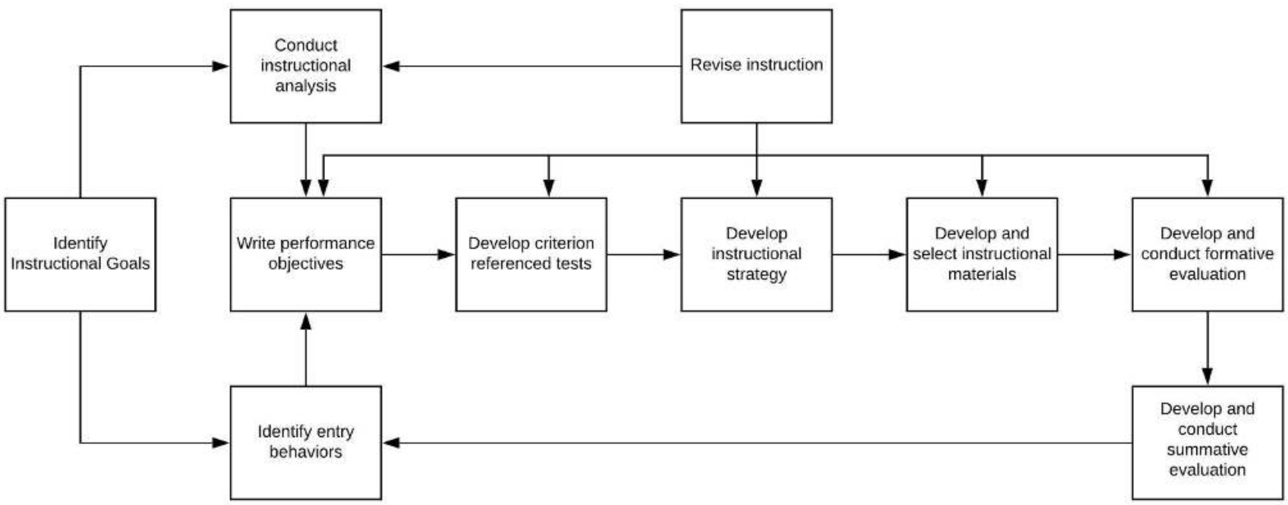

Figure 9.2.4: *The Dick and Carey model*

Instructional Goals

Instructional goals can be set using a variety of methods; however, the key is to determine whether instruction truly is the solution or if there are other factors that may be contributing to a performance issue. The designer's job is to sift through many points of data to get to the root of the problem. For example, employees in auto manufacturing may not be meeting company-defined benchmarks due to poor training, but it could also be due to poorly defined processes that take too much time to complete. In education, students may fall behind on benchmarks due to poor teaching, but it could be that teachers are required to cover too many topics and the students are not able to retain all of this information. To help gather this information, instructional designers perform a performance analysis and needs assessment.

Performance analysis. In a performance analysis, the designer will compare a desired performance outcome to the current performance level and identify a performance gap. This process involves reviewing data to identify the gap. Some designers will use a SWOT (strengths, weaknesses, opportunities, threats) analysis framework to help define this gap.

Needs assessment. In a needs assessment, the designer works to identify what the learners will need in order to bridge the identified performance gap. Some methods to help identify this gap can be performance data, including tests, observations, interviews, surveys, and even doing the work of the learner to help identify challenges or opportunities.

Instructional Analysis

Once goals have been established, it is important to map out the step-by-step process students will need in order to achieve these goals. In an instructional analysis it often helps to use a flow-chart to map out each skill into its smallest step but also to identify any additional steps or skills, often called subordinate skills, that must be mastered before mastering the main skill.

Entry Behaviors and Characteristics

It is also essential to identify the behaviors and characteristics of the learner in order to provide the optimum learning experience. This involves determining what the learner already knows or can do—these are called entry skills. However, it is also important to gather information on their attitudes toward learning, their motivation for learning, education backgrounds, ability levels, and personal characteristics such as age or experience with technology.

Performance Objectives

Performance objectives are what the learner will be able to do following instruction. While there are variations on how to write performance objectives, a general rule is to include a condition, a behavior, and a criterion. Many designers use Bloom's Taxonomy or Mager's ABCD model to help define measurable behaviors in their objectives. Ultimately, objectives should be specific and measurable.

Criterion-Referenced Test Items

Criterion-referenced test items are used to measure the performance objectives. These items can be used on assessments such as pre- and post-tests as well as performance-based measures such as performance observations using rubrics or attitude changes.

Instructional Strategy

When the assessment has been defined, the designer can work on mapping out an instructional strategy. The designer will need to review and sequence the content into a meaningful lesson. They will also need to decide on the types of learning experiences and activities they want the learner to engage in. As described earlier in this chapter, Gagné's Nine Events of Instruction is one method for structuring a learning experience.

Instructional Materials

Once the instructional framework is developed, appropriate materials are created. This can include using existing print or media materials or creating new materials. This should be an iterative process, gathering feedback and making improvements. Some designers will provide rough draft outlines to graphic or multimedia designers for development.

Formative Evaluation

As mentioned previously, formative evaluation is used to help a designer measure the effectiveness of their instructional strategy and materials. The designer will work with individuals and groups to review the instruction and identify weaknesses and/or gaps. The materials are revised based on this input to make sure the instruction is appropriate and clear for the learners.

Summative Evaluation

Finally, the instruction is reviewed by experts and field-tested. The objective is to ensure that the instruction targets the necessary skills defined in the instructional analysis and produces the desired results in the field.

Conclusion

The study of instructional design is eclectic and full of history. From its roots in cognitive psychology and the training of troops in World War II to the rise of the systematic instructional design models, researchers have worked to provide those designing instruction a process by which not only could they create meaningful instruction more quickly, but also to consider the diversity of learners and learning contexts as well as the difference in the types of content to be learned.

If a student of instructional design looks critically at the models and theories in the field, it is not very hard to trace the continuing influence of these early researchers into today's current practices. For example, Gagné's domains of learning influenced Merrill's Component Display Theory (Merrill, 1983), as Merrill had similar categories of learning, but gave them different names. However, the idea that all content falls into one distinct domain of learning shifted with the research of van Merrienboer (1997) who wrote about complex cognitive skills that have aspects of multiple domains. The same can be said of the systematic instructional design models. The Conditions of Learning led to the Air Force model (Department of the Air Force, 1993) and the ADDIE framework. The ADDIE framework gave way to other instructional design models like the Smith and Ragan (1992); ASSURE (Heinich, Molenda, Russell, and Smaldino, and 2001); and the Morrison, Ross, and Kemp (2012). Most recently, David Merrill (2002) distilled the similarities in each model down to what he termed the "First Principles of Instruction," a model that encompasses all the others and provides a new framework for designing problem-based instruction.

The influence of Robert Gagné and the systematic instructional design models on the field of instructional design is clear. What was new in the 1950s and 1960s is now accepted unilaterally and generally implemented: not all instruction is equal; there are different domains of learning and each should be presented and assessed appropriately; and an intentional design process should lead to more effective and efficient instruction.

Application Exercises

1. Consider the different ID models in this chapter. What are the benefits of using these processes? What are the challenges with using these processes?
2. Compare and contrast the ID models in this chapter. How might the differences in each model impact the overall design process?
3. Consider instruction you have participated in at school, work, or in the community. Describe how you would apply Gagne's Nine Events of Instruction to improve that instruction.
4. You have been asked to design instruction for a large company on their new telephone system. Use either ADDIE or the Dick and Carey Model to describe the steps you would take to provide this instruction. Be specific and use the language of the model to frame your discussion.

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6.3: Designing Instruction For Complex Learning

Designing Instruction for Complex Learning

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Editor's Note

This is a condensed version of Frerejean, J., van Merriënboer, J. J. G., Kirschner, P. A., Roex, A., Aertgeerts, B., & Marcellis, M. (2019). Designing instruction for complex learning: 4C/ID in higher education. *European Journal of Education*, *54*(4), 513–524. https://doi.org/10.1111/ejed.12363, and is printed here under the same license as the original.

Continuing technological and societal innovations create high demands on the field of education. In order to deal with increasing globalisation, multidisciplinarity, mobility and the complexity of current and future jobs, a strong emphasis is placed on quality and efficiency at all levels of education and training (European Union, 2009, 2018). To prepare learners for a job market that is continually evolving, it is imperative that educational programmes provide them with an extensive knowledge and skills base that they can apply flexibly when encountering unfamiliar tasks in daily practice. This requires different instructional design approaches, including a shift away from objectives-based design approaches towards more task-centred approaches in an attempt to better address the learning of complex cognitive skills and professional competencies.

The objectives-based approach breaks down tasks into their constituent parts and describes desired outcomes for each of these part-tasks in learning objectives which are often classified according to a taxonomy such as Bloom's revised taxonomy (Anderson & Krathwohl, 2001) or Marzano and Kendall's taxonomy (2007). Bloom's revised taxonomy, for example, classifies objectives in the cognitive domain in six categories based on remembering, understanding, applying, analysing, evaluating and creating. These taxonomies result from the idea that different instructional methods are needed to reach objectives in different categories. Teaching concepts and principles (e.g., understanding what a scientific paper is and how it is structured) requires different instructional methods from teaching the application of procedures (e.g., carrying out a literature search for a paper). This objectives-based approach is suitable for tasks where there are few relations between the objectives. However, it is less effective for those that require an integration of knowledge, skills and attitudes and the coordination of sometimes many different constituent skills (van Merriënboer & Dolmans, 2015). First, the *compartmentalisation* of learning into separate categories of objectives and using separate methods for declarative, procedural and affective learning is ineffective because carrying out a complex professional task requires more than just the stacking of these constituent elements. Instead, carrying out complex tasks generally requires an *integration* of knowledge, skills and attitudes in so-called competencies. Instruction should therefore focus on developing an interconnected knowledge base that allows one to activate different kinds of knowledge when confronted with new and unfamiliar tasks (Janssen-Noordman, van Merriënboer, van der Vleuten, & Scherpbier, 2006).

Second, the objectives-based approach of teaching complex skills leads to *fragmentation*. Because it breaks up the complex tasks into separate isolated parts, students only learn a limited number of skills at the same time. Instruction is focused on parts of the task and provides little opportunity to learn how to *coordinate* the performance of these separate parts into a coherent whole when confronted with a professional task (Lim, Reiser, & Olina, 2009). In an attempt to address these problems of fragmentation and compartmentalisation, task-centred approaches centre learning on whole real-world (i.e., authentic) problems or professional tasks as a way to better connect the learning setting to the workplace setting and foster the necessary skills. This holistic approach advocates creating educational programmes that contain sequences of learning tasks that are based on authentic professional tasks. Examples of task-centred models are cognitive apprenticeship (Brown, Collins, & Duguid, 1989), elaboration theory (Reigeluth, 1999), first principles of instruction (Merrill, 2002) and the four-component instructional design model (4C/ID model) (van Merriënboer, 1997).

This chapter provides a brief summary of the 4C/ID model and illustrates its application in higher education by describing an educational programme that was designed using the model. The chapter concludes with a short reflection on the educational programme that was developed, a list of important considerations for implementing task-centred curricula and a look at future developments in task-centred learning.

Four-Component Instructional Design (4C/ID)

The basic assumption of the 4C/ID model is that educational programmes for complex learning or the teaching of professional competencies (i.e., the integration of knowledge, skills, and attitudes and coordination of skills and their constituents) can be described in four components, namely learning tasks, supportive information, procedural information and part-task practice (see Figure 1).

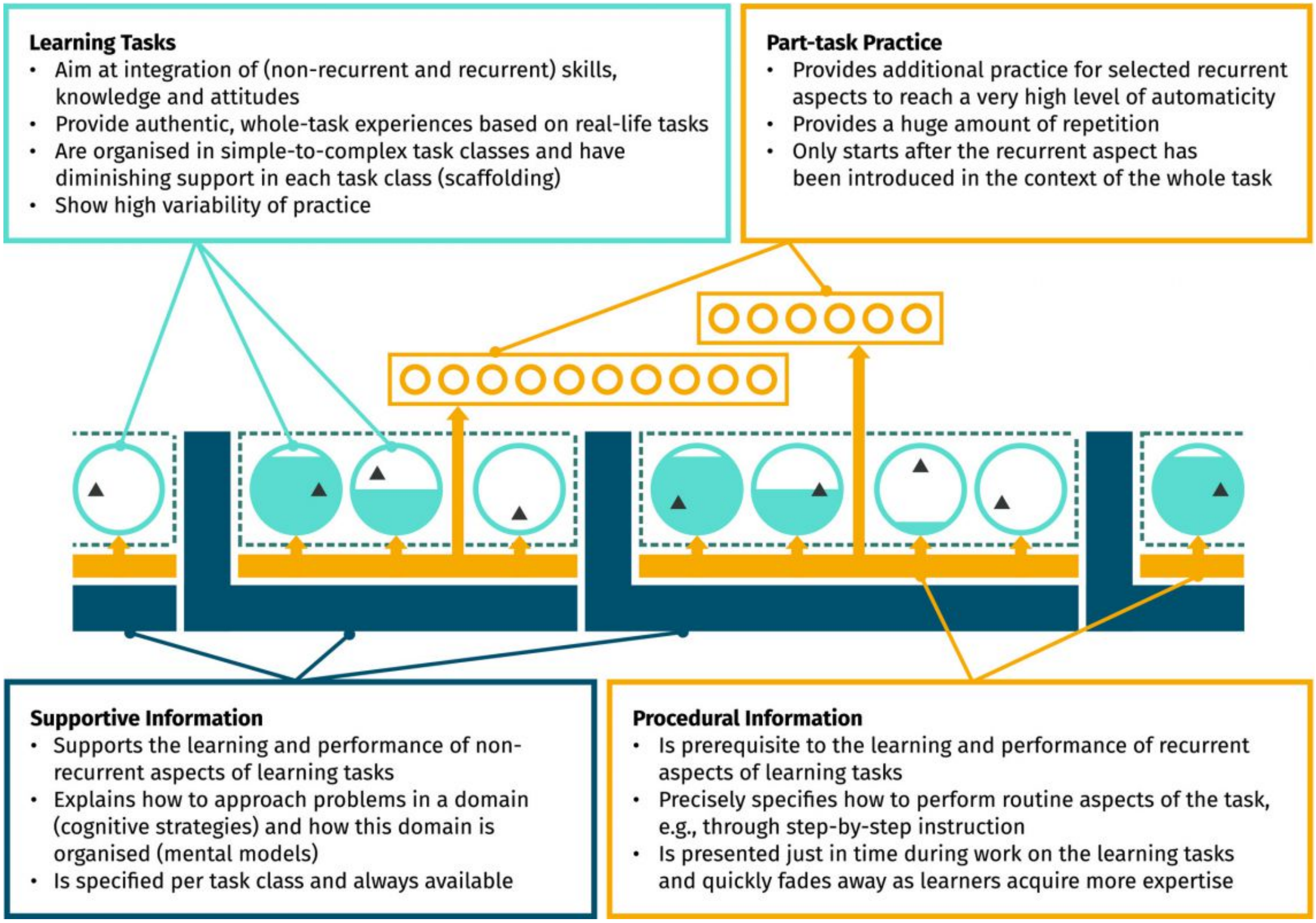

Figure 6.3.1: *Overview of 4C/ID model, Based on Van Merriënboer and Kirschner (2018)*

Learning tasks form the backbone of the instructional blueprint and are based on authentic real-life situations that are encountered in practice because this helps the learner to acquire the knowledge, skills and attitudes in an integrated fashion. Learning tasks can be projects, tasks, cases, problems, or other types of assignments. Importantly, they show a variation that is representative of the variation in tasks in professional or daily life because this “variability of practice” will help in the transfer of learning. Learning tasks of equal complexity are grouped together, creating task classes that are sequenced from simple to complex. Learners start with the simplest tasks that a professional could encounter and end with tasks at the level of complexity that a recently-graduated student should be able to handle (van Merriënboer, Kirschner, & Kester, 2003). While working on these tasks, the teacher and the instructional materials provide the necessary support and guidance to help learners to carry out the tasks to completion. In a process of scaffolding, this support and guidance are gradually withdrawn until the learners are able to independently carry out tasks of a certain level of complexity before engaging in more complex tasks (i.e., the next task class). The three other components are logically connected to this backbone of learning tasks.

While Figure 1 may suggest a linear path through these learning tasks, the model allows for extensive flexibilisation and personalisation of learning. Learners may be given the opportunity to select different paths through the designed learning tasks, based on their interest or demonstrated proficiency. One way to support this dynamic selection is by using electronic development portfolios that help students and teachers to monitor progress and make informed decisions on future learning tasks that fit the learner's level and needs (Beckers, Dolmans, & van Merriënboer, 2019; Kicken, Brand-Gruwel, van Merriënboer, & Slot, 2009).

The second component, supportive information, is often referred to as “the theory” and includes information to develop mental models and cognitive strategies that are necessary to complete the learning tasks. Supportive information aims at non-recurrent aspects of the task that deal with problem-solving, reasoning and decision making. It can be presented in the form of lectures, workshops, or study materials and is available for students to study before or while they carry out the learning tasks. These first two components help students to acquire highly-structured knowledge, or cognitive schemas. Learning tasks stimulate the construction of such schemas through *inductive learning*: a process whereby students learn from mindful abstraction from concrete experiences and examples. Supportive information helps schema construction by *elaboration*: acquiring new knowledge and linking it to the existing knowledge base.

The remaining two components stimulate the *automation* of schemas and the development of automatic, task-specific procedures that can be applied without much demand on cognitive resources. Procedural information aims at recurrent and procedural aspects and provides step-by-step instructions when the learner performs those aspects. Part-task practice, the fourth component, can be included to provide repeated practice to train routine skills until they can be performed automatically. (For a more extensive description of the model, see van Merriënboer, 1997; van Merriënboer et al., 2003; or van Merriënboer & Kirschner, 2018).

A 4C/ID Approach to a Blended Course in Android App Development

Developing mobile applications is a typical complex skill, as it requires extensive knowledge of programming languages, databases, development environments, etc. It also requires multiple skills, such as operating the development software, writing clean and correct codes, and/or designing a user interface. A professional, critical and creative attitude is necessary to translate clients' wishes into a working application. Therefore the development of mobile applications lends itself well to teaching with a task-centred approach. The Amsterdam University of Applied Sciences in the Netherlands designed a course on Android app development using the 4C/ID model (www.android-development.app).

Traditionally, the design of such courses starts from the “theory”. Teachers begin with a clear picture of the information their students should know and design a series of lectures to “transmit” this theory to the students. In addition, they design homework assignments to practise with single, small aspects of the whole task. For example, these assignments could focus on how to use loops in the programming language or creating, reading, updating, and deleting information in a database. Teachers then mix lectures with small practice items until all topics have been covered. This follows the approach of traditional design models: starting with the presentation of theoretical knowledge and coupling it to specific practice items. The 4C/ID model topples this approach: it starts by specifying professional tasks, translates these into learning tasks and only then investigates which “theory” should help students to complete these learning tasks.

In their description of the design of the course, Marcellis, Barendsen, and van Merriënboer (2018) elaborate on the use of 4C/ID and the Ten Steps to achieve a blended design consisting of the four components. The learning tasks form the backbone of the curriculum. These are not small practice items focused on a particular aspect of the task (i.e., using loops or updating a database). Instead, learning tasks are whole tasks, based on professional practice, grouped in task classes that grow in complexity. The first task class starts with the least complex (i.e., simplest) whole tasks. For example, the very first task asks the student to develop a single-screen app that simulates a dice roll and asks the user to guess whether the next roll will be higher or lower. Subsequent task classes include learning tasks of increasing complexity, imposing more demands on the user interface, interaction modes and handling of data. At the end of the course, students are asked to create multi-screen applications that retrieve information (e.g., movie information, recipes) from remote locations and allow the user to view, swipe, and manipulate these data.

Students receive strong support and guidance when starting learning tasks in a new and more complex task class. The design achieves this by employing modelling examples and imitation tasks at the start of each task class. The teacher demonstrates the development of an application while thinking aloud and asks students to build an identical application on their computers. In subsequent tasks, students receive partially-completed applications they must finish (i.e., completion tasks), while the final tasks in a task class are conventional tasks without any support and guidance. Hence, support gradually decreases as the student progresses through the task class.

Supportive information helps students with the non-recurrent aspects of the task by providing domain knowledge (e.g., how databases work) and systematic approaches to developing apps (e.g., demonstrations by the teacher). Procedural information helps with the recurrent aspects (e.g., using the development environment or automatic highlighting of incorrect programming syntax). For the designers, providing supportive and procedural information constituted a serious challenge, as both are subject to frequent and unpredictable changes. For example, development software is frequently updated with changed functionality and programming languages continually evolve, requiring programmers to learn new syntax and unlearn old methods. To make sure that the supportive and procedural information reflect the most recent conventions and rules in the domain, the course designers depended less on pre-prepared lectures or recorded videos and instead referred students to a list of external sources, including manuals and Android developer documentation. Not only is it easier to keep a list of links up to date, it also creates a more authentic situation where students learn to study official documentation, as they would do in practice.

As the course is intended for students from all over the world who are studying full-time or part-time, the designers chose a blended design where learning tasks, supportive information and procedural information resided in an online learning environment. Classroom activities can be followed by students on-site and include modelling examples, imitation tasks in small groups and feedback sessions led by the teacher. Other learning tasks are presented in the online learning environment and are performed individually by students. Student evaluations show that students perceive the learning tasks as very helpful for learning how to develop an Android app. The modelling examples specifically contribute to understanding how to approach a certain challenge in Android app development, especially when they not only show the actual coding, but also make explicit the reasoning behind each step. In addition, students perceive the classroom sessions in which they discuss theory using guided questions as beneficial. This Android app development course illustrates a well-executed application of fundamental 4C/ID principles leading to a course design that is strongly informed by educational research.

Conclusion

Designing educational programmes using the 4C/ID model is different from designing using objectives-based approaches. It requires task-centred thinking which may be challenging for designers, teachers and faculty who are schooled and experienced in objectives-based instructional design. The 4C/ID model is well-aligned with the concept of competency-based education, but it stresses that competencies should always be clearly related to the professional tasks the student is expected to carry out after completing the programme. An educational programme taking a competency framework as a backbone for its development and assessment may still hamper the transfer of learning to the workplace if the learning activities in that programme are not strongly based on professional tasks. Designing task-centred learning environments therefore requires assigning equal weight to tasks on the one hand and to the competencies required to carry out these tasks on the other. The Ten Steps approach starts the design by specifying professional tasks to serve as a basis for designing learning tasks. The professional and learning tasks are then explicitly linked to the competencies that are necessary to carry out those tasks up to standards, for example by generating a matrix with tasks at one end and competencies or standards at the other. As seen in the example provided in this chapter, this shifts the balance from the atomistic, compartmentalised and fragmented teaching of isolated objectives towards integrative acquisition of knowledge, skills and attitudes.

Concerning the design and implementation of task-centred curricula, Dolmans, Wolfhagen, and van Merriënboer (2013) identify 12 common pitfalls and tips that may help to make such (re)designs work. The four most significant deal with building infrastructure, multidisciplinary teaching teams, continuous progress monitoring and involving students. First, in task-centred designs, a series of whole-tasks forms the backbone of the programme. Therefore, the main educational activities consist of small group meetings in which students collaboratively work on these learning tasks. To facilitate this, there should be sufficient small group rooms available that are equipped with all the necessities such as whiteboards, projectors, and high-speed wireless Internet. Other facilities could be necessary, such as lecture halls, simulation labs, or individual reading and studying rooms, but they are present in most schools. It is more often the lack of sufficient small group rooms that impedes the implementation of task-centred learning.

Secondly, task-centred curricula require the design of a series of learning tasks for an integrative acquisition of knowledge, skills and attitudes. Content that was previously taught separately by different teachers must now be taught in an integrated fashion and teachers should therefore work together in multidisciplinary teams that preferably also include outside domain experts working in the field. These experts can help to align the educational programme with practice and ensure the relevance of the tasks, tools and required knowledge. Teaching staff should also be prepared to adopt different roles, as teachers in task-centred curricula generally have a tutoring or coaching role in order to facilitate small group learning or skills training. They may also be involved in whole-task design and continuous assessment. If teachers are unfamiliar with these new roles, faculty development programmes may be needed to prepare staff members for this change.

Thirdly, in the Ten Steps approach, the assessment programme is developed simultaneously with the design of learning tasks because assessment drives learning. In a task-centred curriculum, assessment should not be used solely for making pass/fail decisions for separate courses. Instead, it should allow for the monitoring of individual student progress at the level of the whole curriculum. This can be done by using electronic development portfolios that combine multiple assessment results and provide a dashboard that informs both students and teachers of the students' progress and improvement. This approach no longer relies on traditional assessment arrangements, such as fixed-length semesters with pre-planned exam weeks.

Lastly, students themselves should play an important role in the design of the whole curriculum and of individual learning tasks. Involving students in the design process provides valuable insights into the curriculum's strengths and weaknesses, as they are the only ones to experience the curriculum. As it is crucial that students experience the learning tasks as meaningful and useful, their perceptions are very informative for designers. Thoroughly informing students of the ideas behind the task-centred curriculum may also benefit implementation, as those students can become advocates of the reform. Furthermore, just as teachers have different roles in a task-centred curriculum, students also need to be prepared for their new roles. They need to function in small group meetings and learn how to actively contribute to group discussions, how to act as group leaders or scribes and how to provide effective feedback to peers. As is the case with faculty development, such student training preferably extends over a prolonged period.

To conclude, dealing with current and future developments in the job market requires that educational programmes produce lifelong learners who are equipped with the knowledge, skills and attitudes to deal with familiar and unfamiliar complex tasks in their domain. The way these programmes are designed must therefore match this goal of creating learners who are able to transfer their knowledge from the learning to the professional setting. Task-centred instructional design models such as the 4C/ID model stimulate this process by prescribing learning methods that lead to a rich knowledge base allowing for creative applications of knowledge in new and innovative settings. Additionally, they create a strong alignment between education and practice by blending learning in the educational setting with learning in the workplace. This encourages cross-institutional and international collaboration when designing educational programmes, which is especially important in those settings where tasks require international and interdisciplinary work, such as the banking, aviation, or tech sector. A clear implication for educational policy is that collaboration between employers and higher education must be strengthened: A two-way interaction is needed where educational institutions not only prepare students for the job market, but where employers also bring state-of-the art knowledge, future job requirements and tasks to the educational institutions.

Future Developments

In the book *Ten Steps to Complex Learning*, van Merriënboer and Kirschner (2018) present an extensive systematic approach to design task-centred educational programmes with the 4C/ID model, based on evidence from research on education and learning going back to the late 1980s. They also identify several important directions for advancing the model. Future developments will focus on the integration of new educational technologies (e.g., blended programmes, gamification), dealing with large learner groups (e.g., learning analytics, customisation), teaching domain-generalisable skills (e.g., intertwining domain-general and domain-specific programmes) and promoting motivation and preventing negative emotions. With research on these topics now maturing, designers can look forward to an expanded set of guidelines to design effective, efficient, and enjoyable programmes for complex learning.

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Curriculum Design Processes

Bucky J. Dodd

Whether you realize it or not, we experience curriculum every single day. Curriculum influences the most obvious learning situations like classroom lessons and workplace training sessions, but it also influences a variety of less-obvious situations such as how we learn about products, how we learn from online tutorials (yes, to an extent this applies to using YouTube to fix a leaky faucet!), and how organizations plan large-scale change efforts. Curriculum influences how people learn and grow from very young ages and continues to shape learning experiences throughout our lives.

The purpose of this chapter is to provide a survey of curriculum design processes across diverse educational and professional contexts and to highlight essential curriculum design skills embedded in these processes. Curriculum design is a core pillar of how we educate, train, and engage in formal learning experiences. At the core of curriculum design is a mental model for how people learn and a design representation for how knowledge and skill transfer occurs from theory into practice.

For emerging professionals in the instructional design field, curriculum design is one of a series of core competencies that are necessary for professional success (Burning Glass, 2019). In the most basic of terms, curriculum design is the process of planning formal learning experiences. Yet, there are many tacit criteria that differentiate between effective and ineffective curriculum design processes. For the purposes of this chapter, we will examine curriculum design as a strategic-level process for how learning experiences are designed. This differentiates from instructional design processes, which tend to involve more operational-level processes. For example, you can differentiate curriculum design from instructional design as curriculum design is more “big picture thinking” while instructional design is concerned with more tactical decisions within instructional materials and interactions.

Defining Curriculum Design

Curriculum design is operationally defined for this chapter as the intentional planning, organization, and design of learning strategies, processes, materials, and experiences towards defined learning and/or performance outcomes. Curriculum design is concerned with much more than learning materials. In one sense, curriculum design is creating a holistic plan for the environments where learning happens. This includes considering the physical, digital, social, and psychological factors that define the spaces and places where people learn (American Educational Research Association, n.d.).

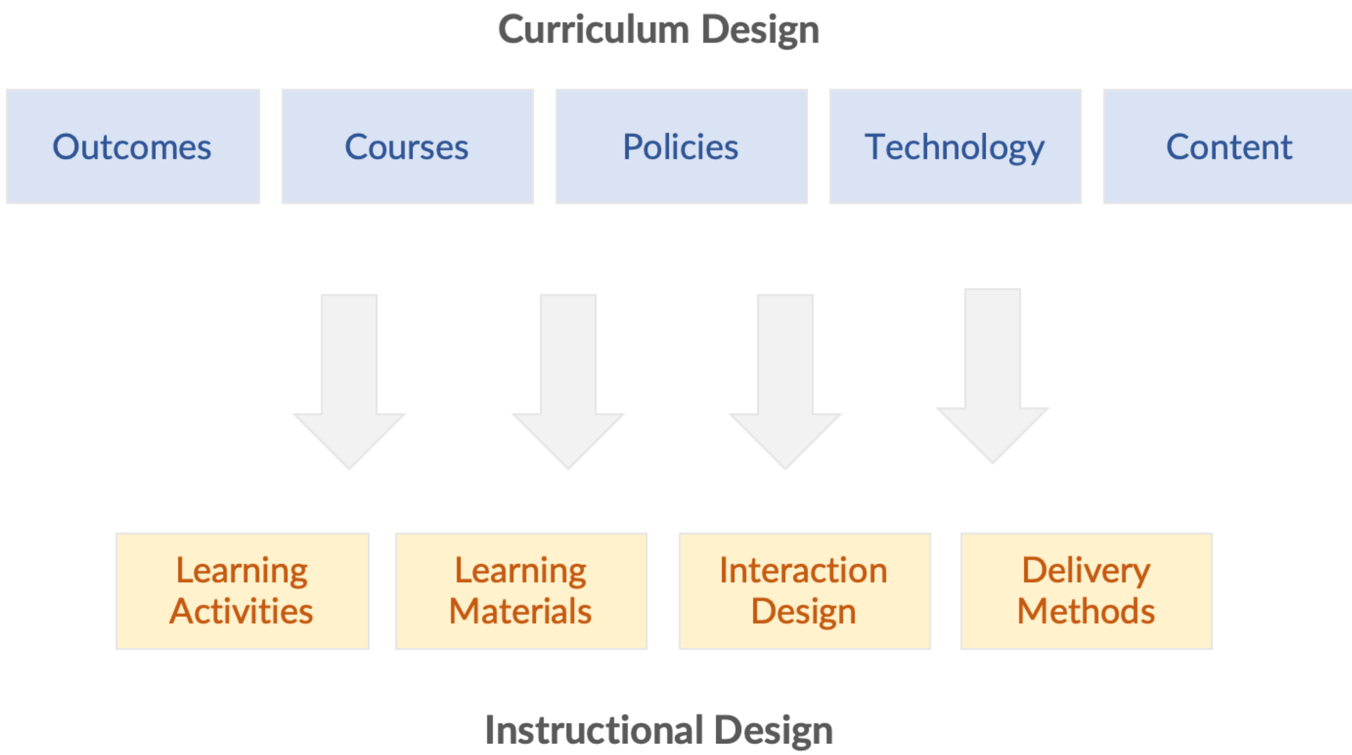


Figure 6.4.1: *Diagram Illustrating Elements of Curriculum Design vs. Instructional Design*

Curriculum design is a team sport. The teams who engage in curriculum design processes are comprised of people with diverse areas of expertise. Typically, a curriculum design team will include subject matter experts (e.g. faculty member), curriculum coordinator/director, curriculum oversight groups, instructional design and development specialists, and teaching/facilitation personnel. Depending on the nature of the curriculum, this can also include information technology specialists, organizational development specialists, data and research specialists, and senior leadership.

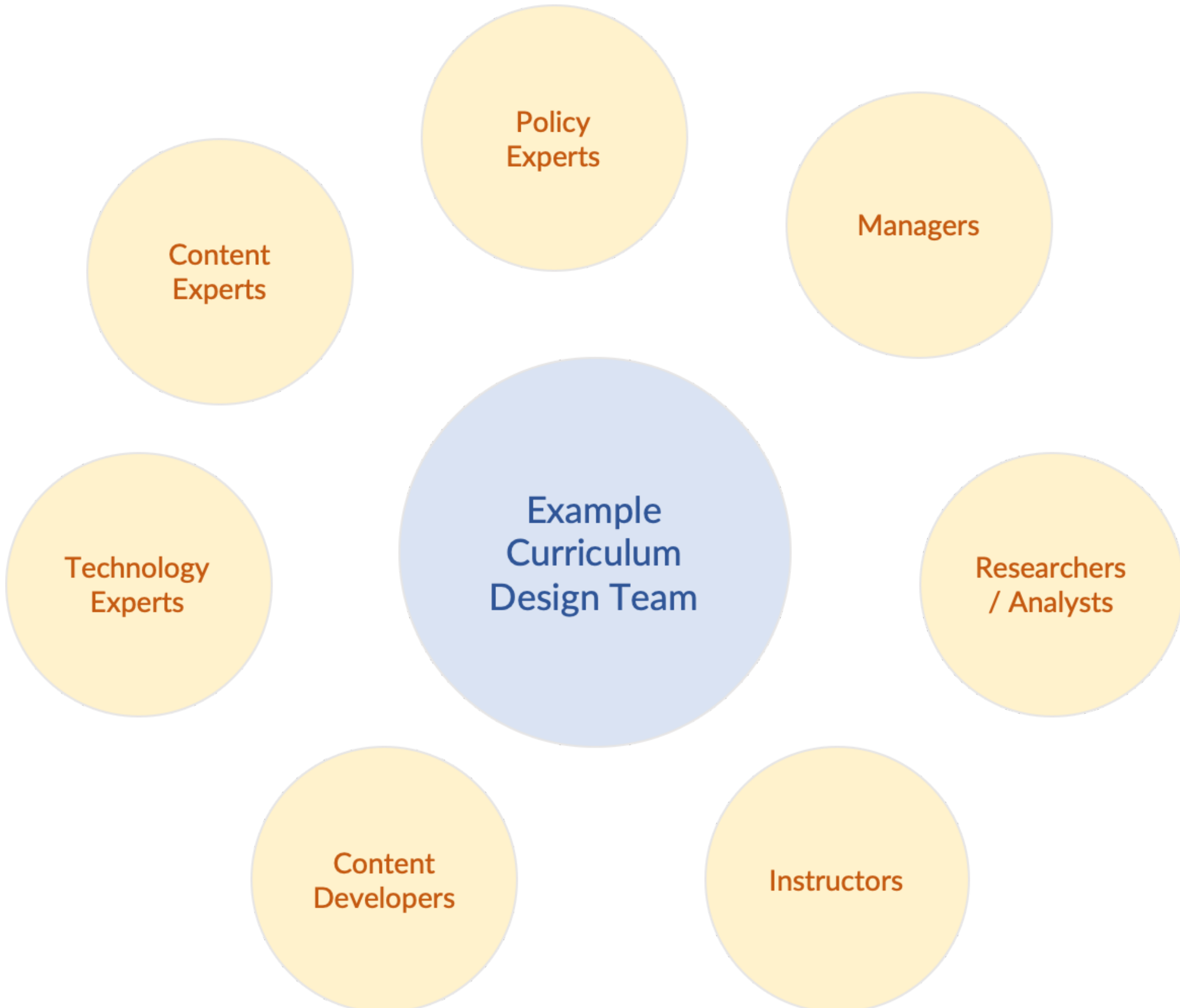


Figure 6.4.2: *Diagram Illustrating an Example Curriculum Design Team*

Curriculum design, when done well, is a process that is collaborative, results-oriented and transforms diverse ideas into a focused vision for learning.

Designing Curriculum with the End in Mind

The primary goal of curriculum design is aligning learning strategies, materials, and experiences to defined outcomes. From this standpoint, good curriculum should be results-focused and efficient. To accomplish this, curriculum designers often use tools such as learner personas, needs analysis, and existing assessment data to determine the scope of a project. From there, it becomes important to develop learning strategies that connect to the characteristics of the intended learners to help them reach the desired outcomes.

Designing curriculum with the end in mind involves managing, designing, and organizing learning objectives, competencies, and standards within a curriculum. The process of designing curriculum with the end in mind is commonly referred to as "backward design" (Wiggins & McTighe, 1998). The major concept important to curriculum designers is that instead of starting with content or topics (common historical practice by many educators), backward design starts with the outcomes and then works backwards to address the content, topics, strategies, and materials.

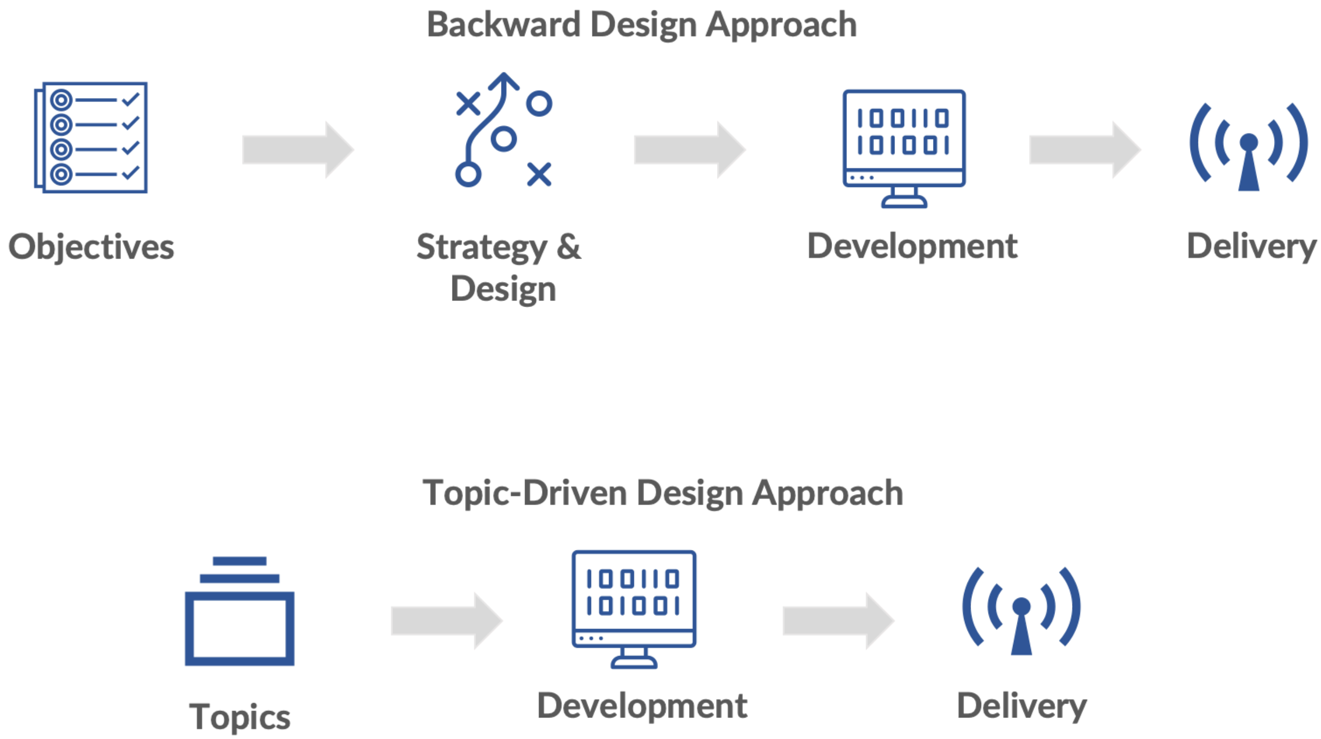


Figure 6.4.3: *Diagram Comparing Design Approaches*

One of the key tools important to backward design is the use of learning objectives taxonomies. One of the most widely used of these taxonomies is Bloom's Taxonomy (Bloom, 1956). Bloom's Taxonomy organizes learning objectives based on a "level of learning." The revised version classifies these as: remember, understand, apply, analyze, evaluate, and create. These levels describe cognitive learning processes that are demonstrated through various forms of behaviors.

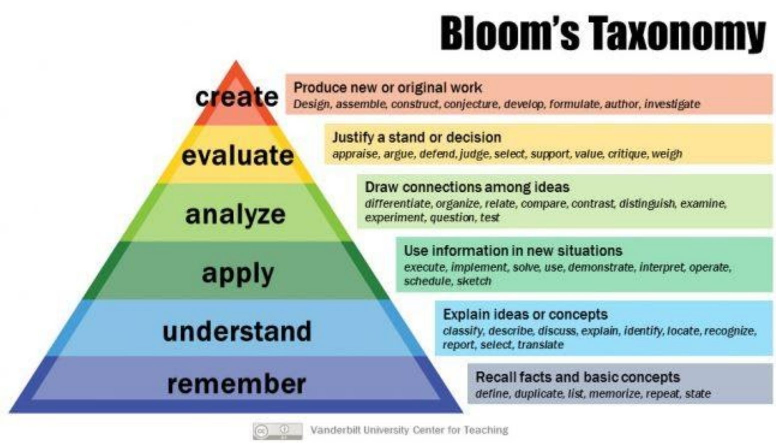


Figure 6.4.4: *Bloom's Taxonomy (Source: https://edtechbooks.org/-dpW)*

Taxonomies like Bloom's provide a framework for organizing types of learning outcomes and selecting appropriate curriculum strategies for a specific level of learning. For example, a learning objective at the understand level will likely be designed far differently than an objective at the evaluate or create levels. This not only influences the types of strategies used, but also the alignment of curriculum elements and appropriate level of learner (i.e. novice, intermediate, advanced).

Standards and competency frameworks are common resources curriculum designers use in the process of conducting their work. These frameworks vary across countries and disciplines; however, they often serve a common purpose of aligning curriculum to common outcomes and learning/performance goals (e.g. Common Core Standards, Talent Develop Capability Model).

Representing and Mapping Curriculum

Curriculum design can be a complex process that includes many different forms of data, information, and goals. On a practical level, curriculum designers often use forms of representations or diagrams to help manage the complexity and decision-making processes. Curriculum representations provide a method for communicating and collaborating with others during the curriculum design process. This often includes representing plans for how curriculum will be organized and made available to the learner.

When mapping curriculum, there are several major and interdependent variables of curriculum that can be important to visualize. These variables are referred to as design "layers" (Gibbons, 2014). While there can be many different aspects important to represent in curriculum design processes, the following list outlines major considerations, or design variables.

- Outcomes—the intended learning or performance result from the curriculum
- Content—the topics or information included in the curriculum
- Instructional Strategies—how the curriculum is organized, structured, and/or presented to achieve a defined result
- Technology—the digital or analog tools used to support the curriculum delivery, development, or assessment
- Data—how metrics and data elements are captured, organized, stored, and represented
- Media—the physical or digital assets used to present curriculum to the learner
- Policy—the guiding principles, rules, or regulations that frame the design of the curriculum

These "layers" represent the essential variables that effective curriculum designers consider when working on curriculum projects and initiatives. Each of these layers are interdependent and should be considered in concert with one another and not independently. For example, both outcomes and content should align to ensure the content being presented supports learners as they work towards achieving specified learning outcomes.

In the process of designing curriculum layers, curriculum designers often use representation tools and methods to organize ideas and communicate this information to stakeholders. While there are many different approaches to representing curriculum, the following list highlights common frameworks used in the curriculum design field.

- "The Canvas." Canvas tools are analog or digital documents that organize various elements of curriculum design decisions in a single visual field. The purpose of curriculum canvas documents is to provide a structured way of organizing ideas at a conceptual level and establishing a common vision for the curriculum. Canvas tools are often used to support collaboration and brainstorming processes; however, they can also be used as a way to organize individual ideas and communicate those to others in structured ways.

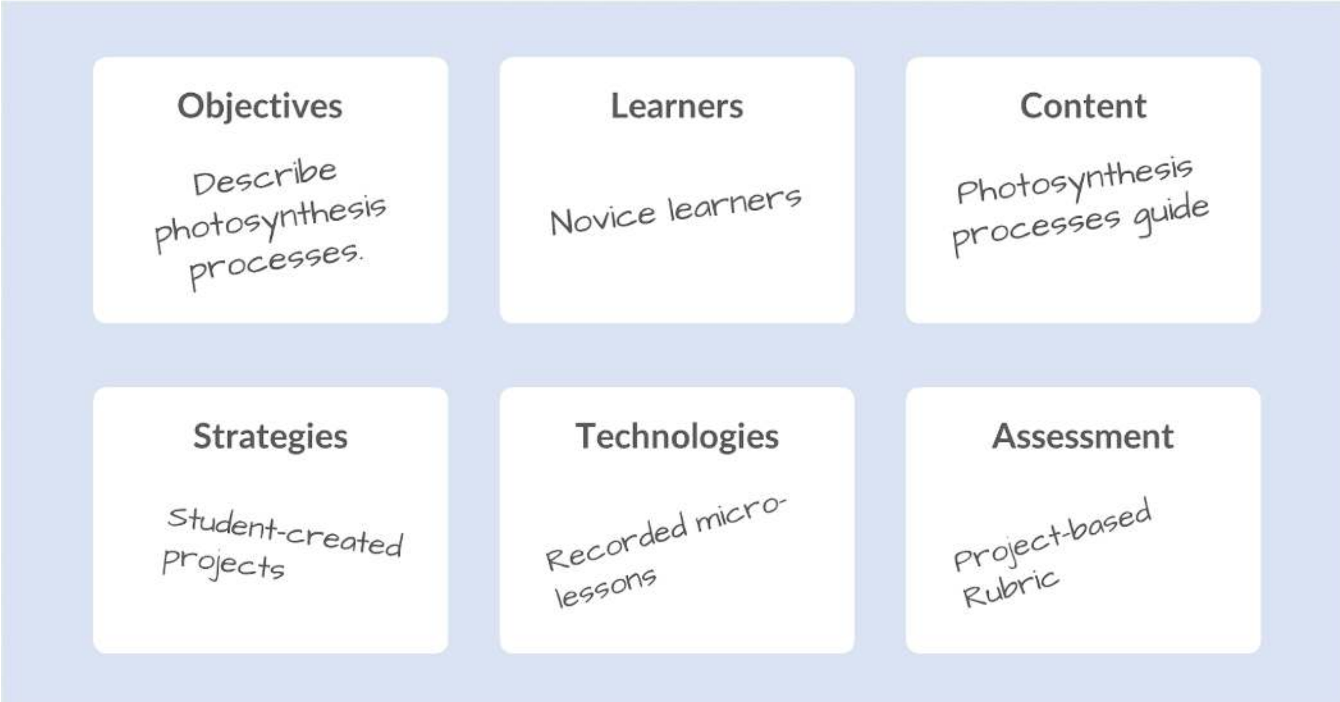
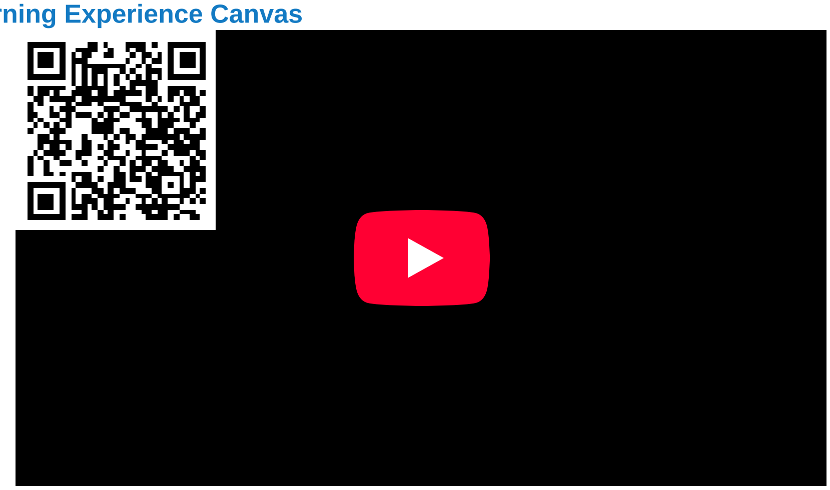


Figure 6.4.5: *Conceptual illustration of a Canvas Curriculum Planning Tool*

Visit http://www.lxcanvas.com/ for an example of a canvas-based curriculum design tool. The following video explains the elements of the Learning Experience Canvas.

Elements of the Learning Experience Canvas



- “The Lesson Plan.” Lesson plans are one of the most common forms of curriculum representations across various education and training contexts. There are many, many different formats and approaches to creating curriculum lesson plans. These can range from simple outlines, to structured documents that represent many elements of curriculum including learning outcomes, instructional sequence, facilitator prompts, time markers, and teaching notes. How a lesson plan should be created is largely dependent on the intended uses and audiences for the documents.

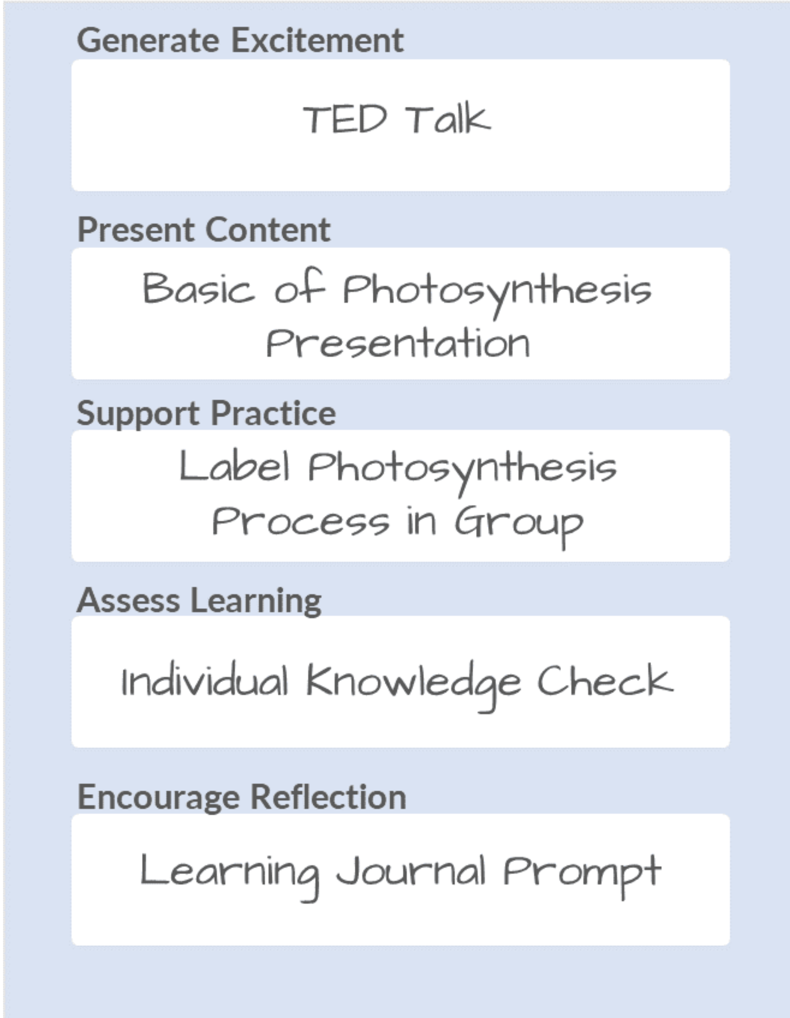


Figure 6.4.6: *Conceptual Illustration of a Lesson Plan*

Visit https://edtechbooks.org/-TTeu for example lesson plan formats.

- "The Curriculum Matrix." Curriculum matrices are documents that represent relationships and alignment between key variables in the curriculum. This representation is often presented as crosstabulation tables that have one variable across the top row and another down the left column. Next, relationship indicators are placed in the interesting cells to show a relationship between the two variable elements. A curriculum matrix representation is commonly used to show how learning outcomes are represented across courses or units in the curriculum.

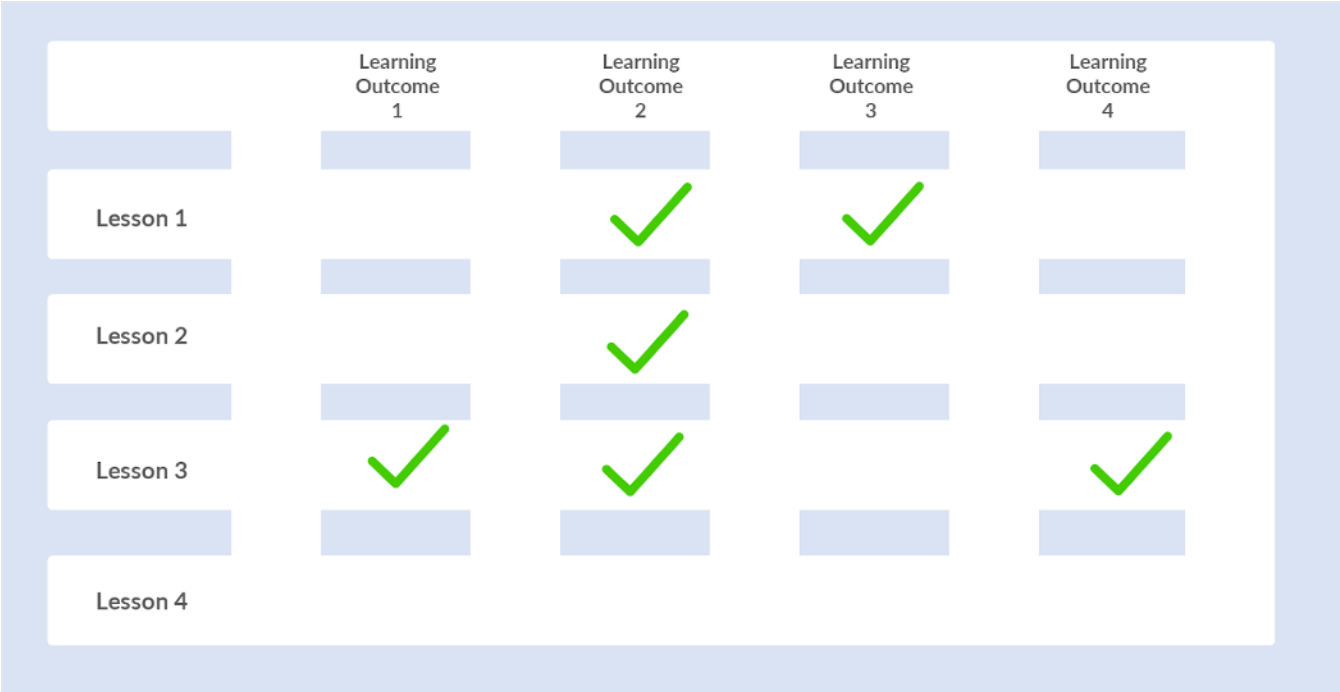


Figure 6.4.7: *Conceptual Illustration of a Curriculum Matrix*

Visit https://edtechbooks.org/-Jewdb for an example curriculum matrix.

- “The Blueprint.” Blueprint-style curriculum representations integrate a number of design variables in a single diagram, or “blueprint.” The primary purpose of this type of representation is to create documentation that can be used to develop and implement curriculum. Blueprint representations often contain instructional elements organized in segments and sequences as well as production notes to guide how the curriculum should be developed and/or implemented. They often also represent relationships between the various curriculum elements. For example, a blueprint may note that a learner must complete a certain set of exercises successfully at a given mastery level before progressing to the next set of exercises. The blueprint represents the curriculum design strategy in an actionable format.

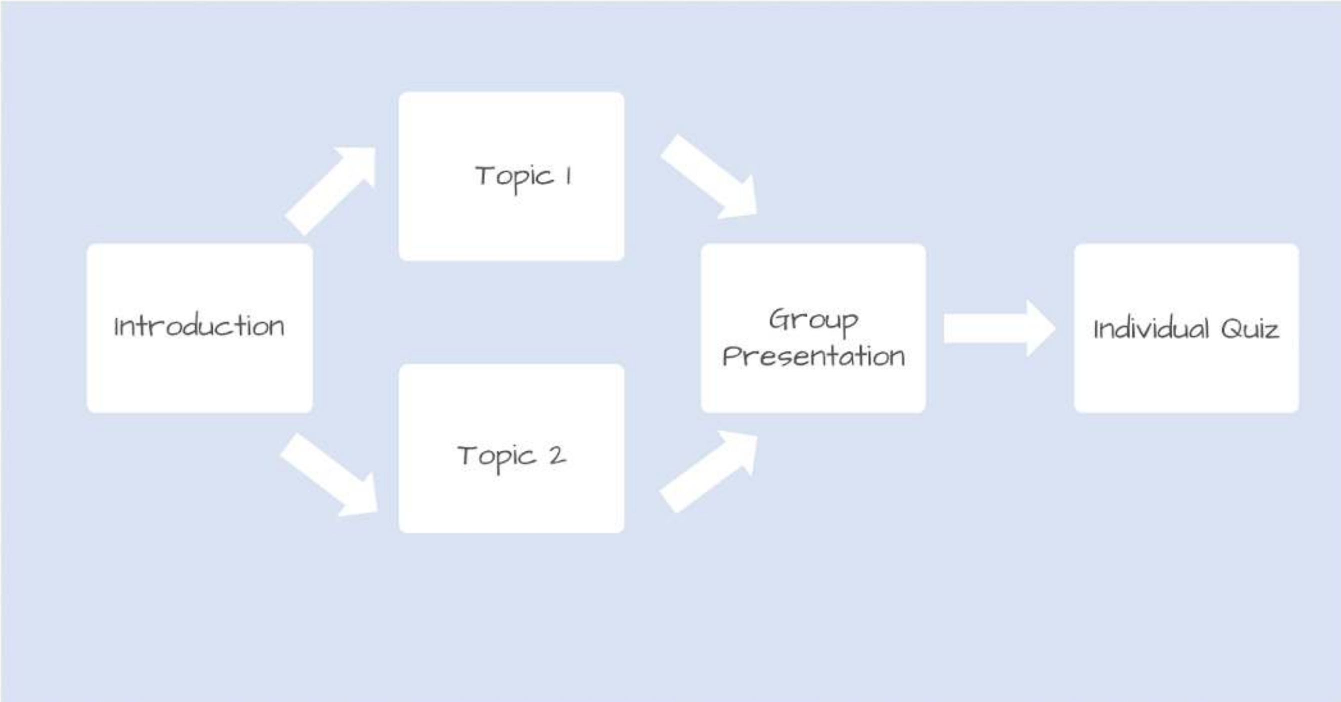


Figure 6.4.8: *Conceptual Illustration of a Blueprint Curriculum Diagram*

Visit https://edtechbooks.org/-LyV for an example curriculum blueprint.

Comparing and Selecting Curriculum Mapping Tools

Selecting the most appropriate curriculum mapping method is often determined based on the current phase and goals of the curriculum design process. The following table compares the curriculum mapping tools discussed in this chapter and presents selection considerations.

Table 1

Comparison of Curriculum Mapping Tools

	Canvas	Lesson Plan	Matrix	Blueprint
Uses	Use early in the design process for brainstorming and ideation	Use to plan and facilitate specific lessons	Use to align curriculum to outcomes Use for assessment of learning outcomes	Use to plan the sequence and arrangement of curriculum
Pros	Encourage group collaboration and interaction	Common format for many professionals in education and training	Clearly shows alignment between curriculum and outcomes	Visually shows curriculum elements, flows, and sequence.
Cons	Can lack specifics needed to implement curriculum	Some may see lesson plan as limiting creativity or adaptability of curriculum	Some matrix documents can be very complex which may limit their application in practice	Blueprints can be visually complex and unfamiliar for some audiences.

Learning Environment Modeling™—A Method for Creating Curriculum Blueprints

A particularly critical challenge faced by many curriculum designers is the lack of a generally accepted design language and system in the field (Gibbons, 2014). For example, many design professions have a language to represent their work so that the audience versed in the language can easily understand and build from their work. Architects, engineers, and software programmers are all examples of professionals that use design languages to communicate ideas.

Learning Environment Modeling™ was created to advance a solution to the absence of a shared design language for curriculum and instructional design. At the core of Learning Environment Modeling™ is a language that represents five "building blocks" of curriculum, four learning contexts, three transitional actions, and two standard notations. These language elements are combined together in a blueprint that shows how the curriculum is to be organized and implemented.

Visit https://edtechbooks.org/-rqn to learn more about Learning Environment Modeling™ and how it can be used to design curriculum.

Over the previous several years, a number of digital platforms have become available on the market to manage curriculum design processes. While these platforms vary in strategy, most seek to increase efficiency and provide a common digital hub for managing information and communication about curriculum processes. These platforms are currently distinct from content authoring tools used for creating materials, in that they focus solely on the curriculum organization and design, rather than content development and delivery. In addition to standalone curriculum design platforms, many learning management systems are incorporating similar features as part of their capabilities.

Examples of Curriculum Design Platforms

- Coursetune
- eLumens
- Synapes

Examples of Learning Management Systems with Integrated Curriculum Design Capabilities

- Moodle
- Canvas
- Brightspace by D2L
- Blackboard

Innovation Considerations for Curriculum Design Processes

As innovations in learning design and technology are created and scaled, curriculum design processes must adapt to ensure these methods remain grounded in effective learning practices. This section discusses several innovation trends and their possible implications on curriculum design processes.

One of the foundational innovations influencing curriculum design processes is a shift from individual-focused design to team-based curriculum design. Curriculum design is becoming more and more a "team sport" where people from diverse backgrounds, professions, and areas of expertise work together to create curriculum. The increasing influence of technology continues to not only incorporate new backgrounds (e.g. technologists), but also allows people from all around the world to collaborate on curriculum more efficiently. Successful curriculum design professionals are master facilitators across different types of contexts and through the effective use of collaborative technologies.

In addition to curriculum design becoming more collaborative, it is also becoming a more strategic and holistic activity. Traditionally curriculum was viewed like a product that was self-contained and independent. As such, curriculum design processes mirrored product development cycles and approaches. As organizations, learning needs, and technologies change, curriculum design is moving more towards a holistic perspective of learning environment design. This mindset goes beyond curriculum as a product, and more about designing the collective spaces and places where people learn at a strategic level. While this may seem like semantics at first, the implications for how curriculum is designed and connected with other elements in a learning environment is profound.

Moving from curriculum design to learning environment design requires a systems thinking perspective that involves not only designing elements in the learning environment, but also designing how those elements interact together. A good example of this is the emergence of blended learning as a common instructional practice. Blended learning is the combination of classroom and digital learning experience in a unified strategy. Curriculum designers must not only be considered with the design of classroom curriculum and digital curriculum, but also how they interact together in a unified learning environment.

The broad adoption of mobile devices have also caused innovations in curriculum design. For example, designing curriculum that is responsive across different types of devices with different screen sizes is a basic innovation influencing the field. In addition, designing curriculum for other mobile device features such as geo-positioning, imaging, and content creation capabilities offer exciting and often challenging situations. Many modern mobile devices now have immersive virtual space capabilities such as virtual reality and augmented reality. These capabilities highlight the need for new curriculum design approaches that have not traditionally been required. Mobile and extended reality learning capabilities will continue to be a major consideration for tomorrow's curriculum designers.

In addition to collaborative design processes, mobile learning, and extended reality innovations, one of the more profound innovations influencing curriculum design processes is adaptive learning. Adaptive learning is a general concept that describes the process of providing learners with dynamic learning experiences based on their prior performance (Educause, 2017). This is commonly used for recommending remediated learning experiences and encouraging peak learning performance. The reason adaptive learning is such a profound innovation for curriculum design processes is because it introduces the dynamic layers that have not traditionally been used. For example, a curriculum designer would create a defined path for learners to follow based on assumptions and requirements set forth in the design process. Adaptive learning shifts this decision making to programmatic algorithms or a more complex map of learning experience options. This requires curriculum designers to think and make design decisions about much more complex and dynamic learning environments.

Conclusion

Curriculum design processes are essential to effective learning experiences across education and professional contexts. Without effective curriculum design processes, learners often lack the structure and guidance necessary for optimal learning and organizations lack the ability to effectively measure results and optimize their return on investments. While we have all experienced curriculum, the process of designing curriculum is changing, becoming more complex, and incorporating new technologies and strategies. One of the most profound shifts is expanding the scope of curriculum design to consider how curriculum connects to broader and more networked learning environments. Curriculum design is an essential skill for emerging education and learning professionals and will continue to be a dynamic, innovative, and exciting field of practice for years to come.

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6.5: Agile Design Processes And Project Management

Agile Design Processes and Project Management

Theresa A. Cullen

Due to the changes in and flexibility of computing today, software engineering and instructional design have made major changes in their approach to development. This evolution to a knowledge economy required processes to change from approaches where planning and communication happen up front to more agile processes where projects are completed in smaller chunks with greater communication between team members and clients. Adopting these agile processes may enable instructional designers to create more flexible designs that better meet the needs of clients and allow for greater collaboration with others involved in the development process (e.g., UX designers, programmers, media production).

What is Agile Development?

Agile development has its roots in a document written by 17 people at a retreat in 2001, when a group of software developers met together to decide how projects should be approached. They were frustrated by static lists of tasks that were developed early in projects that could not easily be changed, creating a process that lacked flexibility and feedback. This kind of static list was known within the industry as “Waterfall,” referring to the slow trickle of development that happens from a prescribed list of designs (Nyce, 2017). The group had championed different approaches during their extensive careers, but it was not until they came together in 2001 that they laid the groundwork that would change how many products were designed. They agreed that good programming and design had 12 key principles. As agile processes have been adopted by other fields such as business, education, health care, finance, and marketing (Oprins et al., 2019), the foundation of the approach has been based on these 12 principles, which make up the Agile Manifesto (Beck et al., 2001):

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer’s competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7. Working software is the primary measure of progress. Agile processes promote sustainable development.
8. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity—the art of maximizing the amount of work not done—is essential.
11. The best architectures, requirements, and designs emerge from self-organizing teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

Summary of the 4 Values of the Agile Manifesto

Agile has become a generic term for processes that adhere to the agile principles laid out in this Agile Manifesto, much like ADDIE is a basic process for instructional design or design thinking is a generic process for approaching design projects. For example, there are different instructional design approaches (e.g., Dick and Carey; Morrison, Ross, Kemp, and Kalman; and Smith and Regan), but they all include basic principles such as needs analysis and evaluation. The same is true of agile processes, as there are different approaches to realize the key components of the agile manifesto in practice.

One of the most prevalent agile approaches is called Scrum, which is used by businesses both in software engineering and other areas. The value of Scrum is that it has clear roles for different individuals and a variety of agile processes used in design. Even as agile processes are repackaged in a variety of products (Scrum, Adaptive Project Development [ADP], Kanban, etc.) they all adhere to these 12 principles that define agile development (Portman, 2019). Key components present in all products include constant communication with the client, support for the development team, a focus on deliverables that are fast enough to produce forward motion, and a focus on developing a reliable and robust product.

Review of Agile Principles

To examine designing through an agile framework, let’s look at some key components of Scrum. Scrum is defined as “a framework within which people can address complex adaptive problems, while productively and creatively delivering products of the highest possible value.” (Schwaber & Sutherland, 2017). The Scrum processes and roles defined in Table 1 support agile processes in practice.

Table 1

Key Terms Related to Scrum Processes

Backlog	A list of tasks that need to be completed as part of the project. This list is prioritized by team members at the beginning of each sprint. The backlog allows the team to communicate priorities with a client and accurately predict the timeline of a project.
Sprint	A short interval of time (often two weeks) where the team decides on a set of backlog tasks to achieve as a team. An example sprint dashboard, representing the backlog and completed items on a project, is shown in Figure 1. An example sprint team is shown in Figure 2.
Sprint Retrospective	As in all agile processes, reflection is an important part of Scrum. At the end of each sprint, the Scrum team takes time to review how the processes went and make plans to improve processes in the future. They ask questions like, “What did we do well and what should continue?” or “What could we improve?”.
Stand Up	A daily meeting that is designed to last 15 minutes or less to update the team on accomplishments, problems, and status. It is called a stand up because it is meant to be kept short by having everyone stand during the meeting. During the meeting, team members ask questions like, “What did I do yesterday?”, “Am I blocked by anything?”, or “What do I plan to do today?”.
Scrum Master	The person managing the Scrum team who makes sure that all team members are getting the resources they need and adhering to the team plan.
Definition of Done	This is an agreed-upon level of fidelity for product production in each sprint. The team must agree what is the expectation of each team member’s work.
Product Owner	This is the person who is responsible for the backlog. They work to develop an accurate timeline and keep the project on track. The Product Owner cannot be the Scrum Master.
Scrum Team	All of the people involved with the design of the product. This could include developers, UX designers, QA, and instructional designers, given the project. Different sprints could have different team members.

Scrum Basics and Roles

Figure 6.5.1: *Example Sprint Dashboard*

Note. "Sprint dashboard" by Tiendq is licensed under CC BY-NC-ND 2.0

Figure 6.5.2: *Example Sprint Team*

Note. "The Agile PM Game (Aug '11)" by VFS Digital Design is licensed under CC BY 2.0

Need for Agile Processes in Instructional Design

By nature of their work, instructional designers (IDs) collaborate with diverse groups such as UX designers, programmers, media creators, and a variety of subject matter experts. It is to be expected that instructional design processes may be influenced by those other fields and IDs may even be required to use processes from other disciplines such as programming. One problem that many teams find is the need for quick results and to maintain good communication with a client throughout the design process. Adnan and Ritzhaupt (2018) summarized the criticism that traditional instructional design approaches like ADDIE are not flexible and are less able to produce dynamic projects—especially those that require flexibility and updating. The flexibility of an agile approach allows for both speed of design, but also better repurposing and tailoring for different design problems. Being knowledgeable about agile processes in both instructional design and other fields will enable better team collaboration and client communication (Oprins et al., 2019).

Fernandez and Fernandez (2006) examined agile versus traditional approaches to project management. In a traditional approach, instructional designers may meet with a client at the beginning of a process, and then create designs, only to unveil them when the project is done. They found that these traditional or waterfall approaches did not meet the needs of the fast-changing markets and the need to have products available quickly to stay competitive. They found that business practices were changing towards shared responsibility and team collaboration. Leaders were no longer in charge of projects, but instead they were in charge of teams that have different skills but were all committed to making the client's project a reality. Agile is a mindset above all else that includes shared responsibility and design, regular client communication, and embracing change throughout the process.

While an agile approach is different from traditional instructional design approaches, our field has a history of flexible design approaches too. The most notable was rapid prototyping, proposed by Tripp and Bichelmeyer in 1990. Rapid prototyping comes from software engineering's approach to design where they create prototypes, test them, and then quickly revise them based on the results. Tripp and Bichelmeyer (1990) argued that instructional problems cannot be defined fully at one time and therefore a new flexible approach would allow for more adaptability and response to deep learning issues that become apparent through the design process.

There are many similarities between rapid prototyping discussed in 1990 and agile processes now, specifically, the focus on the product and being open to change in design through regular communication with clients. That is not to say that most instructional designers do not communicate with clients regularly, but rather that choosing an agile approach places the client at the forefront while still not conflicting with key components of the instructional design process like establishing need, breaking down learning processes, and designing effective evaluation.

Now that you have some of the terminology and history, let's compare traditional instructional design approaches to agile approaches in Table 2. Using the ADDIE acronym to compare how each method approaches important tasks in designing effective instruction allows us to see that both approaches deal with the same information and issues and both can produce effective instruction.

Table 2

Comparison of Traditional Instructional Design to Agile Processes

Task	Traditional Instructional Design	Agile Processes
Client Involvement	Utilizes a single or a few major delivery points and feedback points with the client.	Relies on delivery points to the client in short time intervals (often 2 weeks). Focuses on constant iterations.
Analysis	Perform needs and task analysis at the beginning of the design process. Emphasizes depth.	Generates user stories throughout the process to illustrate needs which are revisited at the beginning of each sprint. Emphasizes speed.
Design	Communicates overall design by producing design documentation at the beginning of the process that is used throughout the entire process.	Communicates overall design by creating a backlog of tasks that the development team chooses from to set goals for each sprint. Design is revisited at the end of each sprint.
Development	Produces large parts of a project at once based on learning objectives or content topics. Emphasizes producing a complete learning unit.	Produces small components of content throughout the process focused on delivery to address items in the backlog. Emphasizes forward movement on content development.
Implementation	Implements a complete project or complete module with all parts of instruction and assessment complete.	Releases completed components at the end of each sprint. In a web or app-based design, the team can “push out” parts of the project regularly. The release may not produce a complete product at every update, but instead focuses on continual improvement of released content.
Evaluation	Evaluated as a complete unit with feedback from users and clients.	Engaged in constant evaluation due to the retrospective process at the end of each sprint. Project is constantly going through feedback loops and adjusting based on client and updated user stories at each sprint.

An Example of Scrum in Practice

At a university where I worked, our Information Technology department used Scrum processes to manage large projects. The department set out to redesign the student and faculty portal. They started by having focus groups of faculty and students about how they used the existing tools and what they thought was missing. This would be very similar to learner and needs analysis processes in instructional design. The team used these focus groups to create user stories. Each user story highlighted a different stakeholder and what they needed from the product they were designing. Then, the Product Owner took that feedback and created a backlog of tasks with different priorities that had to be completed (see Figure 3 for an example backlog). They created these with input from all members of the team with a goal of forward movement and the ability to release improved functionality at regular intervals.

For example, in this project, the first sprints focused on interface design. Members of the sprint team included people from marketing and web design to make sure that the overall look matched the brand and other components used by faculty and students. After several sprints to design the look, the product owner moved people down the list of priorities to begin to design the functionality. Not all tools were redesigned at once. In fact, the Scrum team decided to focus on student tools first like enrollment and financial services. About halfway through the year-long project, members of the Scrum team visited faculty and student meetings to ask for input on what they had designed so far. They announced that it would be several months until faculty functions would be the priority in the backlog and continued to refine student functions based on feedback.

Throughout the process, the Scrum team published new tools and functions in the portal and had students and faculty start using them. They gained feedback, reflected on what they had already designed and changed their priorities and the product moving forward. Redesigning an entire university records and communication portal is a major undertaking, but by using Scrum processes the team was able to show results and continue to tailor their product to their stakeholders. They were also able to push out different usable products throughout the year without waiting for the entire project to be finished.

Backlog for Portal Project

In Progess	Soon	Future	Completed
Faculty: Advising	Student: Billing	Parent: Billing	Overal Interface Design
Faculty: Course Listing	Faculty: Book requests	Adminisitrator: Reports	Log in and authentication
	Faculty and Student: LMS launch	Student: Jobs	Student Feature: enroll
		Student: Organizations	Student Feature: advising
January 2 - 15	January 20- February 4th	February 7th - 21st	Oct 1 - present
Retrospective: January 16	Retrospective: February 5th	Retrospective: February 22nd	
Product Owner communicates with client and reviews backlog for next sprint.	Product Owner communicates with client and reviews backlog for next sprint.	Product Owner communicates with client and reviews backlog for next sprint.	

Figure 6.5.3: *Example Backlog for the Portal Project*

Conclusion

Following more agile processes can be a choice by an instructional designer, or it can be part of a company's culture. Agile processes are not at conflict with good practices in instructional design. In fact, steps like creating a backlog that prioritize features, gaining customer feedback on designs during the process, and being reflective is good practice. Taking an agile approach to instructional design can benefit the team dynamic and instructional product. The team dynamic is improved through improved client communication, flexibility, and creating components that could be better reused in other projects with similar user stories. Tripp and colleagues (2016) found that a workplace that embraces agile processes could increase job satisfaction among its employees. Fernandez and Fernandez (2006) found that agile made projects more adaptable and able to produce products faster. Oprins and colleagues (2019) point out having an agile approach emphasizes the importance of people in an organization, builds empathy, and guards against automation. Agile processes, when followed, can improve team communication and keep team members from pursuing dead ends or wasting important time because all of the team were not "on the same page."

There are also downsides to following agile processes. Regular communication with team members and clients takes time and can slow down some aspects of design. Since agile processes are designed to always be flexible, it can be frustrating to live in constant change, even if it produces a better product. For many, following agile processes requires a change in approach and communication style which can be difficult. Finally, agile is a buzzword: There are many companies that say that they use agile processes but do not have trained individuals, necessary resources for team members, and do not embrace the agile mindset. This kind of workplace can be incredibly frustrating because it can produce unpredictable results. Agile processes take commitment from all stakeholders and the leaders of an organization or company.

Next Steps

Instructional designers have many opportunities to become more knowledgeable of agile processes.

First, there are many resources available about agile processes and thought processes available online. In addition to the Agile Manifesto itself, many Scrum professionals start with the Scrum guide (https://edtechbooks.org/-rZPW) to learn about agile processes in practice.

Second, talk to people working in the industry. Reach out to alumni from your instructional design program and ask them about the project management processes that they use.

Third, for those interested in pursuing an agile philosophy further, consider pursuing a professional certification as a Scrum Master (https://edtechbooks.org/-jNf). The certification can be earned after taking a short workshop about agile processes and then passing an exam. The workshops can range from $1000 to $5000, but the training produces a certification that can be included on a resume or LinkedIn profile.

Takeaways

As an instructional designer, you will work with a variety of teams within a company (instructional designers, content experts, trainers, HR, etc.). Understanding different ways that projects are managed within a company not only makes you more valuable within the organization, a better team member, but also helps you to be more flexible to your approach to instructional problems. Many companies that have adopted this approach would value instructional designers who are both aware of and have practiced agile approaches to be able meet the changing needs of the organization and its clients. If this is the way that you enjoy working, then become more knowledgeable on agile processes and look for a company that clearly integrates it into their culture.

Links and Resources

- Scrum Guide (A good place to start) https://edtechbooks.org/-rZPW)
- Scrum Alliance (https://edtechbooks.org/-jNf).
- Agile Instructional Design Course on LinkedIn Learning https://edtechbooks.org/-XDT

Agile Activities

Following are six activities designed to help you think critically about agile processes:

1. (A collaborative slides version of this activity is available view only at https://bit.ly/agileactivity. To be able to edit, choose *make a copy* from the file menu, then save it to your own Google Drive.)

An instructional design project on training about workplace bullying was handed to a team that had been designed in a traditional way. The new team uses agile processes. How could they break down this project into smaller chunks (aka create a backlog) to allow for prioritizing parts of the task and providing logical places to stop and receive feedback from the client throughout the process?

- The tasks developed by the traditional team included:
- Explain terminology: bullying, bystander, and victim.
- Outline the roles that each individual takes in a bullying incident.
- Outline what employees should do if they witness bullying.
- Outline what employees should do if they experience bullying.
- Create a design for the look of the materials to create consistency between a face to face and online learning module.
- Create a list of resources available for additional information and training.
- Outline the company policies on bullying.
- Outline the processes for reporting bullying.
- Create example stories or cases with different perspectives (bully, bystander, and victim).
- Develop face-to-face workshop that will last 90 minutes.
- Develop an online tutorial that can be used to document compliance.
- Develop discussion questions for in person training.
- Develop quiz questions for an online module which can be recorded for compliance.
- Create a video with a bullying scenario from the workplace for in person training.
- Create a video with a bullying scenario for the online training.
- Develop a script and support materials for a face-to-face facilitator.

After breaking up the task into smaller groups, then plan the backlog. Many companies use a table design to show the progression of a project. Assign priorities to the groups you created above and explain why you arranged them that way.

In Progress	Soon	Future	Completed

Did the original team forget any task they might need? What were the tasks? How does this agile process help to refine the project and identify gaps?

2. You are designing a remote learning activity to be used by a teacher for a middle school classroom. Create a user story for the stakeholders involved. Think about parent, student, teacher, and curriculum coach. Explain what their needs may be and think about how your design may need to incorporate those needs.

3. Agile teams have been shown to be more effective than traditional teams. Why do you think this is the case?

4. Explain how agile processes value the relationship with the client.

5. At the end of a sprint, an agile team takes time to do a retrospective before starting the next group of tasks. How does scheduling time to reflect on a project in process increase efficiency when designing?

6. Read over the agile manifesto. Give examples of how it honors collaboration and the value of stakeholders.

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CHAPTER OVERVIEW

7: Designing Instructional Activities

7.1: Designing Technology-Enhanced Learning Experiences

Designing Technology-Enhanced Learning Experiences

Bohdana Allman & Richard E. West

The field of instructional/learning design has at times been conflicted about the role of technology in helping students learn (see the classic debate between Richard Clark and Robert Kozma in the "media debate" of the early 1990s—Clark, 1994; Kozma, 1994). While this debate effectively moved the field away from considering digital technologies as the primary variable affecting student learning, these technologies still play an important role in how we learn about, design for, and evaluate learners. In the 21st Century, as networked technologies undergird nearly all human activities, it is nearly impossible to conceive of most instructional situations being devoid of technology entirely.

Indeed, technology may be considered an important layer in most instructional systems, similar to how architectural buildings comprise various layers from the framing to the electrical to (nowadays) the technological. Gibbons (2014) articulated this layered approach to instructional design, arguing that just as multiple layers work together to support the purpose of the building, various design layers must similarly work together within instructional products. As we attend to different elements within instructional design layers, we should consider the content, purposes, and instructional strategies as well as how the instruction is represented and controlled through available technology tools. This enables us to design more effective and purposeful instructional solutions and promote powerful learning experiences.

In this chapter, we attempt to provide suggestions for making instructional design decisions that utilize available digital technologies effectively. We will begin by discussing what instructional technologies are, and how we can incorporate them into our designs. We will review design layers that are particularly relevant when using technology to design instruction and discuss the importance of analyzing the technology's affordances and matching them to the underlying pedagogical purposes. We will include a discussion about utilizing different models to focus the technology choices on student learning. We then conclude with some challenges to be aware of when integrating technologies into our designs.

What Is an Instructional Technology?

The field of learning and instructional design considers "technology" to be any tool that extends human capability or assists us in achieving a desired learning outcome. In this definition, the technology or tool does not need to be digital. Experts in the field of educational technology often adopt the terms "hard" and "soft" technologies. In this dichotomy, hard technologies refer to machine-based or digital technologies, such as a computer or a web-enabled app, while soft technologies are human-driven processes, methods, and theories that similarly extend or improve our abilities to teach or learn. As an example, in the second edition of the Handbook of Educational Communication Technology, (Jonassen, 2004), there was a section for chapters on "hard" technologies, such as television, virtual reality, and internet-based learning, and a separate section for "soft" technologies such as programmed instruction and game-based learning.

Many of the chapters in this textbook are, in fact, discussing "soft" technologies to support designing instruction (see particularly the sections on instructional design knowledge and processes). However, this dichotomy is becoming less relevant, as hard and soft technologies are increasingly considered simply "strategies" for influencing learning and typically involve some combination of process, pedagogy, and digital tools. Our chapter continues to merge these ideas together by discussing "hard" digital technologies specifically, but with strong consideration for their pedagogical fit.

How Can Instructional Technologies Influence Learning?

As mentioned above, technologies are tools that extend human capability, including learning. In the past, educators and instructional designers viewed technologies as primarily hard technologies, a medium to learn *from*. This view was associated with the teacher-centered instruction or transmission model of education and associated theories. The focus was typically on content transmission, practice of basic skills through repetition, reinforcement of desired behaviors, and evaluation of how accurately the learners could respond to pre-programmed questions. The technology may have allowed for some interaction with peers and instructors, but mostly the learner individually interacted with the content in isolation. The learner's role was to acquire provided information and reproduce it for evaluation. The instructor's primary roles were to manage the content and evaluate learners' work.

This perspective is still valuable for some tasks and types of instruction. However, alone, these types of activities have only limited power in actively engaging learners in the meaning-making process necessary for successful learning and transferring knowledge to new situations.

As an alternative, Jonassen (1996) envisioned instructional technologies as mindtools that students learn *with*, not from, requiring attention to the underlying strategies for using the technology, i.e., soft technologies, in addition to the medium, i.e., hard technologies. This perspective acknowledges that technologies do not directly mediate learning. Learning is mediated by thinking, collaboration, and dialogue facilitated by a variety of tools. Technologies as mindtools support learners as they interpret and organize their knowledge, engage in critical thinking about the content, and actively participate in knowledge construction. Examples of such tools are semantic and conceptual maps (Hwang et al. 2011, visualization tools (Huang, 2020), microworlds and simulations (Warren & Wakefield, 2013), and even emerging technologies such as robotics (Mikropoulos & Bellou, 2013).

Building on this idea of mindtools, and reflecting a general trend in education toward a learner-centered paradigm, the instructional technology field began using technology to mediate meaningful learning experiences and to focus on supporting the learner and the process of learning. Terms such as learning design and technology-mediated instruction reflect this shift in thinking. As Ertmer and Ottenbreit-Leftwich (2013) explained, “technology integration is no longer an isolated goal to be achieved separately from pedagogical goals, but simply the means by which students engage in relevant and meaningful interdisciplinary work” (p. 176).

Learning experiences are now designed with greater emphasis on our understanding of how people learn (Bransford et al., 2000). Learners are viewed as active agents who bring their own knowledge, past experiences, and ideas into the learning process, which impacts how they learn new information. As learners engage in the learning process, they construct and negotiate new meaning individually and with others. The goal of learning is to gain new understanding, broaden perspective, and apply knowledge in practice rather than to reproduce a specific set of facts. The instructor facilitates the interactions among peers to promote deeper understanding and acts as a guide and a mentor rather than “a sage on the stage.”

In this approach, technologies are used more intentionally as tools that mediate learning in a variety of ways. In this chapter, we will briefly discuss three powerful ways that technology can improve learning through (1) simulating authentic human activity, (2) enhancing interaction among people, and (3) enriching the learning process.

Technologies Can Simulate Authentic Human Activity

Learning, and especially learning of complex professional skills, is optimal when it is contextualized and situated in real-life experiences and authentic activities. Certain approaches use varied technology tools to mimic real-world situations to support learning. For example, computer simulations and problem-based learning (PBL) use technology to create conditions that are similar to real life and encourage the learner to gain new knowledge and skills through repeated practice and solving authentic problems. Inquiry-based learning (IBL) encourages the learner to actively explore the material, ask questions, and discuss possible solutions modeling the real-life process of examining issues and systematically looking for answers. Another similar approach, project-based learning (PjBL) engages learners in authentic and complex projects, often developing a tangible product, enabling learners to actively explore real-world problems and gain deeper knowledge and skills. In all these methods, technologies can be used to create authentic or near-authentic problem-solving scenarios and simulations. Additionally, easier replication of digital problem scenarios enables multiple practice opportunities, and using the actual technological tools of the discipline supports learners as they develop professional skills to practice problem solving while in school.

Technologies Can Enhance Interactions

Digital technology has a tremendous potential to enable interactions and connections between people. Whereas individuals were previously limited by space and time constraints, they can now interact through near ubiquitous access and connection to each other. This has led to the development of several theories of digitally mediated social interaction, such as the Communities of Inquiry framework. This theory describes learning as happening within a community where technology enables different types of human presence:

- social presence (the feeling of being connected and present with each other, for example through video or text discussions designed for students and instructors to learn about each other),
- cognitive presence (the feeling of being intellectually present in the community, growing and developing meaning through interaction, for example through online question and answer sessions or group collaboration via shared documents), and

- teaching presence (the feeling of being supported by a teacher designing and facilitating the interactions and content, for example through well-designed online curriculum and opportunities for feedback).

Collaborativism (Online Collaborative Learning Theory) is another model of online learning that creates opportunities for meaningful learning experiences through technology (Harasim, 2017). In this process-oriented model, collaborative technology enables students to actively work together, create knowledge, and learn to use the language, analytical concepts, and activities of the discipline while being supported by an experienced educator who helps them move through three stages. In stage 1 (Divergent Thinking), students engage in discussions about a specific problem or a topic. They generate ideas, questions, responses, and solutions based on their personal perspectives and experiences and share them in a group setting. During stage 2 (Idea Organizing), conceptual changes and convergence of different ideas begin as students clarify, organize, and narrow down options through reflection, analysis, and negotiation of ideas that were shared previously. During Stage 3 (Intellectual Convergence), the group is actively engaged in the co-construction of knowledge. Everyone contributes as the group works on a joint knowledge product or solution, which may later extend to an authentic application or be further refined through another collaborative learning cycle.

Technologies Can Enrich the Learning Process

Technologies have a powerful potential to enrich and transform the learning process in ways that may be difficult or impossible without these tools. For example, online and collaborative technologies offer unique affordances that go beyond connecting learners across time and space by enabling easy access to multiple perspectives from diverse populations and across the globe. The asynchronous and recorded character of technology-mediated exchanges enables coherent organization of thoughts, clear and authentic expression, and deep analysis and reflection, which in turn facilitates deeper learning and enhances theory-to-practice connection. The opportunity to create multidimensional and multidisciplinary responses presents authentic evidence of a deeper understanding that goes beyond “correct” answers. Technology also enhances participation opportunities for all types of learners, not just for the traditional mainstream student. Those that may be timid, need more time, or are learning the language are automatically provided with additional support to access the material and interactions in ways that meets their needs. Furthermore, through its flexibility, technology provides access to learning for many non-traditional students as well as busy professionals who may not be able to gain credentials or participate in ongoing professional development in more traditional ways.

How Should We Incorporate Technology In Our Designs?

Entire handbooks have been written about the topic of how to effectively design learning through the support of technologies (see, for example, Bishop et al., 2020; Dillon, 2020; Mayer, 2014; and Stanley, 2013). This chapter cannot expound on all of these theories and ideas, and truthfully, the path of an instructional/learning designer is one of continuous learning—particularly in the area of instructional technologies because these technologies are continually evolving. However, we present two key ideas that will guide you in making wise technology choices in your design work, namely: (1) align technology with pedagogy and (2) focus on what students will do with the technology.

Principle 1: Align Technology with Pedagogy

The quality and accessibility of technology-mediated learning experiences is an issue of both technology and pedagogy. Whether we design a single learning experience, a course, or a full program, strategic orchestration of desired results, assessments, and instructional methods with intentional use of technology are essential. Understanding by Design (UbD) or Backward Design (McTighe & Wiggins, 2005; see also Dodd, 2020, in this book) is a useful framework that helps designers align these essential elements, focus on student learning, and attend to the underlying pedagogy. Rather than the content, materials, or tools dictating what the student should learn, designers pinpoint the most important ideas, knowledge, and skills that the students should learn, and identify appropriate assessments and pedagogies for supporting student learning..

Pedagogy

Pedagogy refers to principles and practices guiding instructional action with a goal to support learning.

Recognizing that technology is a strategic tool encourages designers to deliberately align technology with underlying pedagogical strategies. Any design can be visualized as having two main layers: a *physical layer* and a *pedagogical layer* (see Figure 1). Each layer has distinct core attributes that make the design functional. Core attributes within the physical layer exemplify the surface features of presentation and delivery of instruction and influence access and cost. The pedagogical layer core attributes represent the underlying pedagogical structures and strategies, enable learning to take place, and contribute to successful achievement of learning outcomes (Graham et al., 2014). To increase the effectiveness of any instructional design, the layers and its core attributes should be aligned during the design and development process.

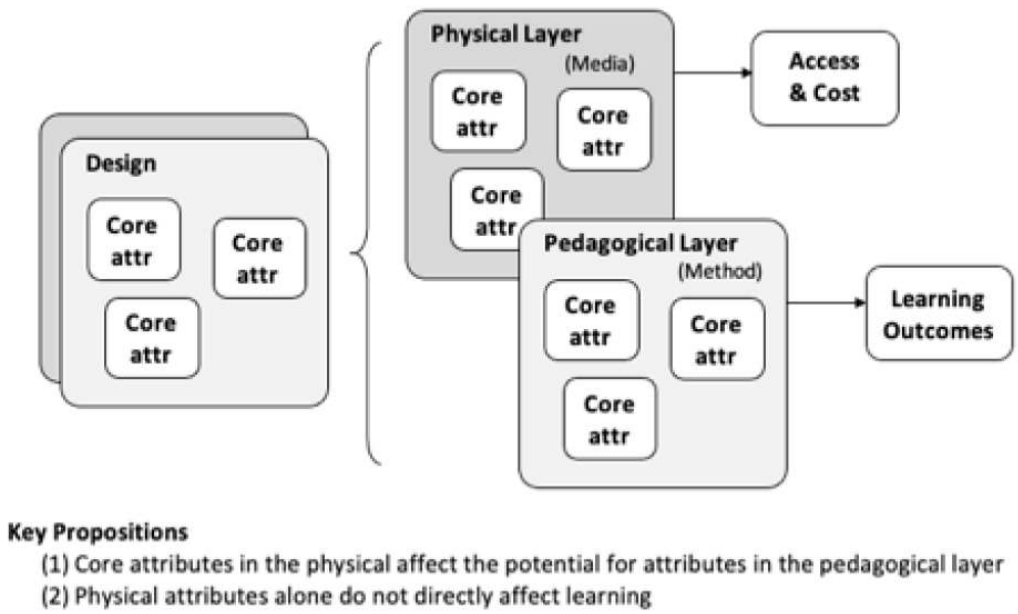

Figure 7.1.1: *A Visual Representation of Two Design Layers From Graham, et al. (2014).*

Allman and Leary (2020) studied the process and identified a set of core attributes within the pedagogical layer that drive the two design layers' alignment. This set of attributes, so-called pedagogical intent, pivot around the learning event and encompass core components, core methods, and core strategies (see Figure 2). As designers establish pedagogical intent related to a specific learning event, it is easier to recognize technological affordances that may be needed and match them with available technological tools. The alignment is achieved iteratively through purposefully utilizing available technology tools to fulfill the underlying pedagogical intent requirements.

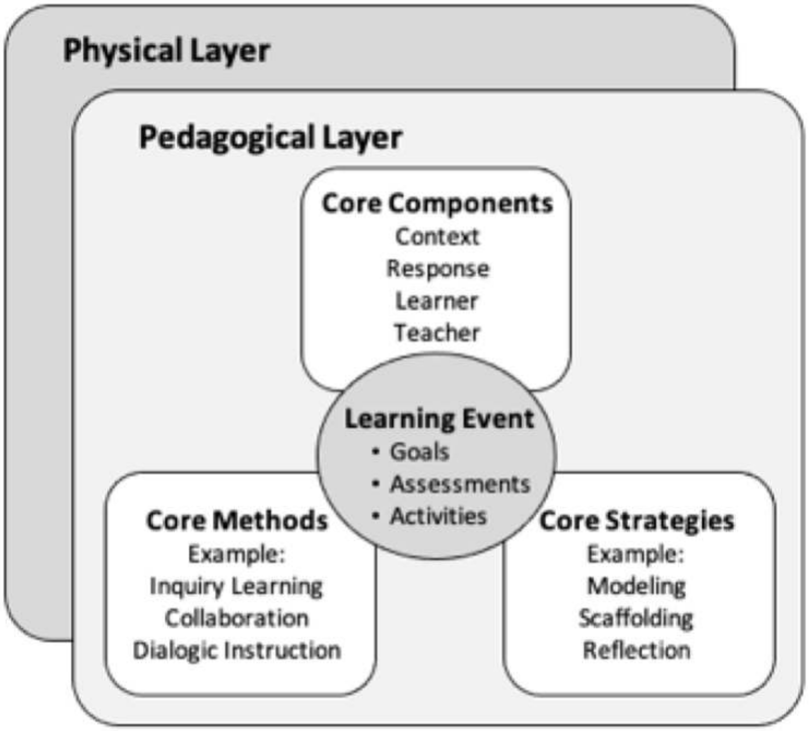

Figure 7.1.2: *Pedagogical Intent—A Set of Core Attributes Within the Pedagogical Design Layer.*

Affordances

The concept of affordances represents what a specific technological tool can do, as well as, "afford" the user, a designer, a teacher, or a learner, to do. Affordances are determined by the properties of the tool but also by the capabilities of the user.

Although the choices of technological resources are important, it is the pedagogical purposes that should drive the form of instructional design solutions. By allowing the function to guide the form through prioritizing pedagogical purposes and aligning pedagogical and physical design layers, we can design more effective technology-mediated learning experiences and use current technologies in innovative ways.

Principle 2: Identify What Students Will Do With the Technology

In the discipline of instructional/educational technology, researchers have developed many different models for describing how teachers can integrate technology into their teaching. Most of these models focus on how teachers utilize technology. See, for example, the following:

- The TPACK model, which focuses on teacher technological pedagogical content knowledge (Koehler and Mishra, 2009);
- The SAMR model, which focuses on how teachers can use technological strategies to substitute, augment, modify, or redefine their current pedagogical practices (Hamilton et al., 2016);
- The RAT model, which similarly categorizes technology decisions according to whether the technology replaces, amplifies, or transforms the teachers' existing teaching practices;
- The LoTI model, which depicted seven levels of technology use by teachers in the classroom (Moersch, 1995).

While these models can be helpful in teacher preparation programs, they perpetuate a teacher-centric approach to technology use, often ignoring the learner's experience.

PICRAT. However, a new model has been proposed that builds off of the common SAMR/RAT approaches, but turns the emphasis away from what the teacher does with the technology and toward how the student utilizes the technology (Kimmons et al., 2020). In this model, called PICRAT, designers still consider how to use technology to replace, amplify, and transform the learning; but in addition, designers consider what the student is doing as part of the activity: is the student's learning passive, active, or creative?

The PICRAT model does not dictate that all good instruction must be transformative or that students must be creative while using the technology. However, it does help teachers and designers to diagnose how often they incorporate activities in each of the squares, and whether they are overusing some strategies to the detriment of others. For example, we often find that designers/teachers overuse technology to replace passive forms of learning (e.g. viewing a lecture, reading a textbook) and PICRAT can stimulate thinking about how to engage students more actively and creatively in their learning with technology.

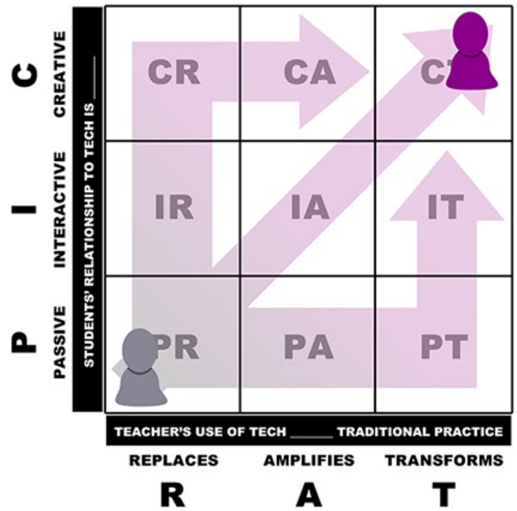

Figure 7.1.3: *PICRAT Model*

PICRAT for Effective Technology Integration in Teaching

Challenges When Designing Learning With Technology

In this chapter, we have mostly proposed technology as a powerful asset for designers as they create effective learning, as long as they first, focus on aligning the technology's affordances with matching pedagogies; and second, focus on the students' experiences with the technology. By maintaining these two foci, technology can have a powerful influence on student learning. However, research has provided several additional cautions. We highlight a few important ones here, but be aware that there are many more, and technology, as would be the case with any tool or strategy, should be applied judiciously after careful learner/needs analysis.

Challenge #1: Technology Can Be Distracting

While technology can enhance learning, it can also easily distract from it. We are all familiar with overworked Powerpoint slides or videos where the core message is lost amid spinning graphics, useless animations, distracting photos, or disconnected audio. Richard Mayer, and his collaborators, have outlined key principles for designing effective educational multimedia in their Cognitive Theory of Multimedia Learning, or CTML (Mayer, 1995). These principles are based on core cognitivist assumptions and theories such as dual coding theory (Paivio, 1990) and information processing limits and activity (West et al., 2013). The core idea behind the theory is that of congruence—or that various media should work together, not at disarray, to solidify interpretation of an idea and the development of appropriate mental schemas. More specifically, Mayer and Moreno (1998) identified 5 key principles for designers:

1. **Multiple Representation Principle:** It is better to present an explanation in words and pictures than solely in words.
2. **Contiguity Principle:** When giving a multimedia explanation, present corresponding words and pictures contiguously rather than separately.
3. **Split-Attention Principle:** When giving a multimedia explanation, present words as auditory narration rather than as visual on-screen text.
4. **Individual Differences Principle:** The foregoing principles are more important for low-knowledge than high-knowledge learners, and for high-spatial rather than low-spatial learners.
5. **Coherence Principle:** When giving a multimedia explanation, use few rather than many extraneous words and pictures.

The research on CTML is quite extensive with a great deal of applicability to designers, and you are encouraged to continue your learning in this area by seeking out recent publications on this topic.

Challenge #2: Equity

Although technology has the potential to contribute to equity among learners, it is frequently a great source of inequality with regards to access and usage. Technology is typically adopted faster and in more engaging and innovative ways in schools serving affluent communities. Students in low-income schools may have comparable access to computers while at school but their access to computers and reliable internet may be limited at home. Additionally, low-income schools frequently employ technology for routine drills, content delivery, and in teacher-centered ways rather than facilitating access to knowledge and learning further enlarging the digital divide (Reich, 2019; Warschauer et al., 2004).

Effective use of technology can remove barriers to learning. It can make content and materials more accessible, less culturally biased, and less linguistically challenging. Technology can support educators to regularly assess their learners' needs, promptly respond to their progress, and provide tailored support based on those needs. In order for technology to promote a more equitable learning environment, access to computers, tablets or devices and reliable fast internet connection must be ensured both at school and at home. Next, attention needs to be paid to ongoing professional development and instructional coaching to support teachers, particularly to understand how they can influence student equity.

However, change in teacher practice and effective technology integration occurs gradually. In order to create more equitable learning environments and innovative uses of technology in their classrooms, teachers need to see multiple examples and have opportunities to practice in their classrooms. Finally, to promote equity, it is imperative that we see beyond technology integration and recognize the importance of using technology-generated data to better understand where learners are and monitor their progress as well as utilize learner-centered educational approaches to promote authentic and meaningful learning experiences mediated by technology.

Challenge #3: Media Centrism

The field of instructional design evolved in part from a foundation in educational media. Perhaps for this reason, there is sometimes a bias towards overemphasizing technology in our designs. Throughout the history of our field, we see initial, frenzied excitement over a new technology that eventually is born out to be not nearly as disruptive as originally envisioned (e.g. virtual reality, moocs, interactive whiteboards, clickers, etc.).

Gibbons (2018) outlined succinctly a common pattern for new instructional designers, arguing they begin media centric, because "The technology itself holds great attraction for new designers. They often construct their designs in the vocabulary of the medium rather than seeing the medium as a . . . preferably invisible channel for learning interaction" (para. 3). According to Gibbons, designers then evolve to focus on the instructional message, then the instructional strategy, before finally learning to design according to an instructional model. "Model centering encourages the designer to think first in terms of the system and model constructs that lie at the base of subject-matter knowledge. . . . Then to this base of design is added strategy, message, and media constructs" (para 6).

Because of this inherent bias towards technology as the first solution, designers must practice discipline in not choosing the novel technological choice first before fully analyzing its true affordances.

Challenge #4: Time/Cost/Efficiency Tradeoffs

Technology is often expensive to integrate into a learning environment—particularly if it is a new technology and especially if access must be provided for a large number of students to maintain equity. For example, the ability to teach mathematics to young children using virtual manipulatives using proprietary software on expensive tablets may be superior for some learning objectives to plastic, physical manipulatives. However, would the cost of buying and replacing the tablets be worth it? In addition, how much time will it take to train teachers and students on the new software? How much instructional time will it take in the class period to conduct the activity, including charging the devices, organizing them on the media cart, and retrieving them from students afterwards?

In making decisions about integrating technology into learning environments, designers must not only analyze what decisions will help people learn best, but also which decisions are most practical.

Conclusion

It is clear that technology plays a very important role in our discipline, as many academic programs include the word in the title of their department. However, what technology designers use in the learning environments they create is less important than how they use it. In this chapter, two key principles have been outlined for designing effective instruction with technology: First, match the pedagogy to the technology's affordances; and second, focus on what students will do with the technology, more so than the teacher. Four challenges have also been outlined that are common when technoloy is used in design, and some suggestions have been provided for confronting these challenges. Perhaps the most important idea is to remember digital technologies, like theories, processes, and models, are tools—and tools are only as effective as the builder and the blueprints that will utilize the tools.

Application Exercise

Consider a time in your life when you needed to learn something difficult. Some examples might be fractions as a child, learning another language, or learning a new routine at work. First, analyze what your needs were as a learner: what did you need to learn, and what made it challenging? Second, describe what kind of technology could have helped you? What affordances of the technology would have made it useful? Third, pick one of the challenges outlined in this chapter and discuss how an instructional designer could have utilized the technology effectively while minimizing those challenges. For example, how could they have reasonably provided equitable access? Or utilized CTML design principles?

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Designing Instructional Text

Shanali Govender & Tasneem Jaffer

The term "instructional text" has been widely used to describe a wide range of textual objects, from whole texts (such as textbooks, manuals, guides and even narrative, reading scheme texts) to parts of a text. Historically, much of the research on instructional text has been in relation to the linguistic construction of texts (Tarasov et al., 2015) and document design (Misanchuk, 1992). In this chapter, we are going to narrow the focus substantially. This is not a chapter on how to write a didactic text, in other words, how to convey subject-specific information in print texts or online. Instead, this chapter will focus on the often overlooked "instructional text" that supports learning. Drawing on concepts from fields such as applied linguistics, graphic and multimedia design, and diversity studies, we're going to focus our attention on the kind of textual features that work alongside subject-specific content to direct learners' attention and action—instructional text.

What Does Instructional Text Do?

Instructional text is commonly found hiding inside other texts: in classroom conversation, in textbooks and learner guides, in educator-produced material such as worksheets or assignment briefs, and on websites and course sites. We often do not really notice instructional text unless it is badly written and disrupts the flow of the learning. Instructional text can play a number of roles in face-to-face, print, and online learning contexts, including:

- contributing to creating a learning environment,
- outlining the structure of a learning experience,
- directing learners' attention to specific areas,
- directing learners' actions and behaviours, and
- creating links between different parts of a learning experience.

Issitt (2004) noted that when we are constructing instructional text for print media, we should pay careful attention to the placement, construction, and design of these texts, and this is equally true for online and multimodal media, especially in asynchronous formats.

Instructional Text: In the Classroom, in Print, and Online

While most educators pay careful attention to instructional text that conveys subject-specific content, less attention is given to instructional text that supports the learning of content.

In face-to-face spaces, instructional text often happens in direct response to learners' actions. Moving into an online or multimodal context poses some new challenges and affordances for constructing instructional text. Poorly constructed instructional text in online and multimedia forms can be very confusing for learners but well-constructed instructional text can also open the door to a wonderful range of visual and verbal opportunities. So if you are an instructional designer, you need to think intentionally about the different spaces where instruction is needed.

Towards a Theoretical Perspective

The Community of Inquiry (CoI) framework (Figure 1), developed almost 20 years ago, drew together the useful categories of Social Presence, Cognitive Presence, and Teaching Presence to describe the "dynamics of an online educational experience" in light of asynchronous, text-based group discussions (Garrison et al., 2010, p. 6).

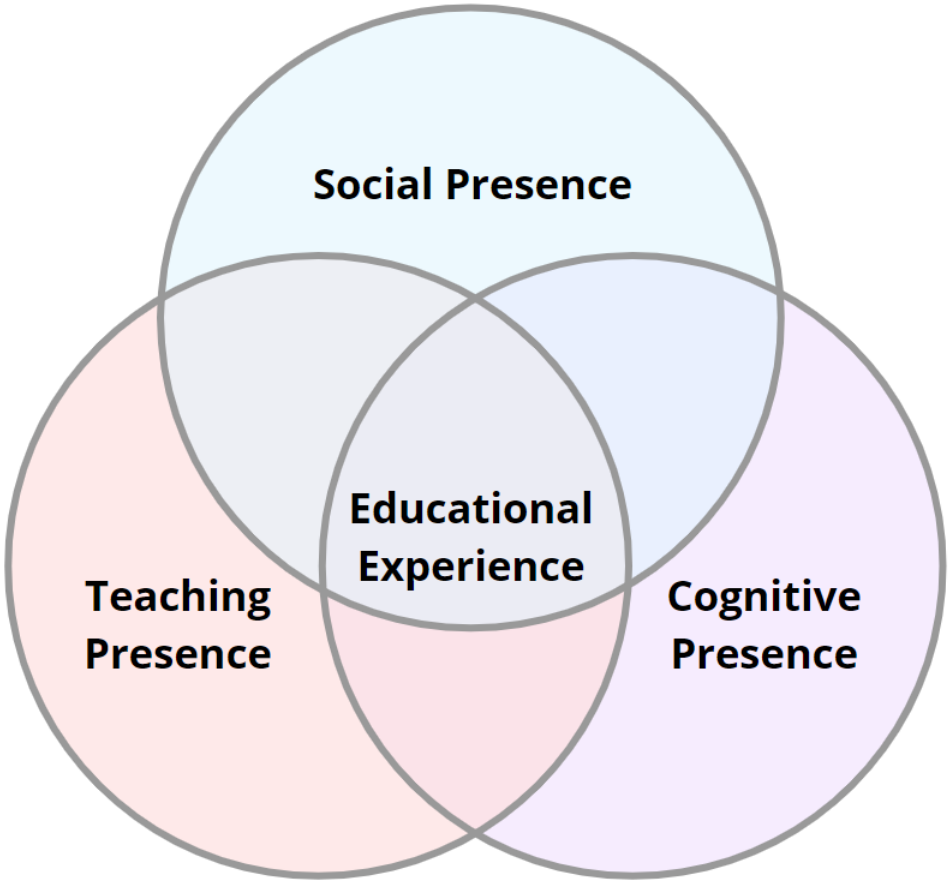

Figure 7.2.1: *Community of Inquiry (CoI) Framework*

This model remains useful today, and can be used to think about instructional text in print media, online text, and multimodal media. While most educators' focus tends to remain resolutely on cognitive presence, attention to social presence and teaching presence when constructing successful instructional text can enhance learner satisfaction and strengthen a sense of community. Social presence in an online learning experience can help participants to "identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop interpersonal relationships by way of projecting their individual personalities" (Garrison, 2009, p. 352). The specific textual choices that an educator makes in constructing instructional text will either support the achievement of this aim or hamper it.

Principles for Constructing Instructional Text

Additional Information

- Slides for Principles for constructing instructional text
- Video for Principles for constructing instructional text

Whether you are constructing instructional text for written, online, multimodal contexts, there are a number of key principles that you will need to bear in mind. These principles come from a wide variety of research fields, including perception studies in psychology, user experience research, multimodal studies, and applied linguistics.

Principle 1: Simplify: Reduce Extraneous Load

Simplifying texts and producing ''easy-to-read texts'', or ''plain language texts'' is another way of thinking about reducing extraneous load to produce texts that align with readers' ability levels (Arfe et al., 2017). Extraneous load or processing refers to any work that a learner might need to do that does not contribute to the learning goal or outcome (Mayer, 2019). Poorly written, excessively complicated instructional text, or instructions that are only issued verbally can contribute to extraneous cognitive load. Instructional text should

- be short and direct

- avoid jargon
- highlight key actions
- be easily “findable”
- hyperlink where appropriate

Principle 2: Personalise: Connect Through Voice and Tone

Research suggests that belonging, achieved in part through affective connection, is a key predictor of learner success (Masika & Jones, 2016; Trujillo & Tanner, 2017). In face-to-face classroom contexts, successful educators instinctively use body language and tone of voice to create connection through conveying emotion. This is particularly true for minority learners (Meeuwisse et al., 2010; Rahman, 2013) and in online learning spaces (Delahunty et al., 2014).

Instructional text, in print, online text, or multimodal texts, often suffers from an absence of emotional connection between the writer and the reader (Issitt, 2004), failing to build belonging in support of learning. Instructional text is, however, an opportunity to connect with learners on levels beyond the purely cognitive, enhancing learning through building connection, belonging and trust (see Figure 2). The use of a human (as opposed to synthesized voice) and to “you” and “I” as opposed to third person pronouns or more formal language are ways of building connections (Ginns et al., 2013).

> Hello all
>
> Thank you so much to everyone who made time to chat this week (and a special thank you to the super kind people who were so accommodating of when I double booked myself!) Christine and I really, really enjoyed meeting each of you individually, and hearing about your projects. I loved hearing all your voices and getting to hear a little about the context in which you work.
>
> **Week 3: Look back**
>
> There were four parts to Week 3:
>
> 1. We continued working on our Learning Designs using Laurillard's Learning Types. Make sure that you've contributed to the *Learning Types and Pedagogic strategies*. Make sure you pop back into section 4.1 and look at the slides that groups have filled in - there are fantastic ideas here!
> 2. In section two, you encountered the concept of affordances and choose the tools your students would need to complete their activities. Your affordance map from this section will go straight into your Learning Design Rationale.
> 3. In section 3, we looked at two theories (Gagne and Salmon) to help us to sequence the order of student activities. Don't forget to go and look at the Slides that have crowd-sourced examples for each of Gagne's Nine Instructional events :-)
> 4. Finally in section 4, you had an opportunity to look at the the Learning Design Plan Brief and Learning Design Plan Rubric.

Figure 7.2.2: *Exemplar Email Showing Tone and Personalising Practices for Instructional Text*

The text, highlighted in yellow above, points to some of the language choices made in an instructional text to build connection and convey emotion. Not everyone will do this in the same ways based on factors such as the personality of the instructor, the age of your learners, and the context in which you work; but for this educator, this is an authentic example of “voice” that seeks to promote connection. In certain contexts, the use of emoticons, gifs, and memes might be an authentic and approachable way to build connection.

The pervasiveness of recording devices in the form of cellphones, cameras, lecture recording, and live video conferencing contribute to educators across the educational sector feeling increasingly under surveillance. In the context from which we are writing, a research-intensive university in South Africa, staff are hyper-aware and often uncomfortable with being recorded. This can result in both teaching and learning interactions and instructional text that is hyper-correct, hyper-formal and devoid of personality and the opportunity for connection.

Consider Multimodal Instructional Text

Instructional texts in multimodal contexts can take advantage of the affordances of video and audio to improve clarity and strengthen connection. In blended contexts, making the instructional text available in both online and face-to-face modes can support learning in a seamless manner.

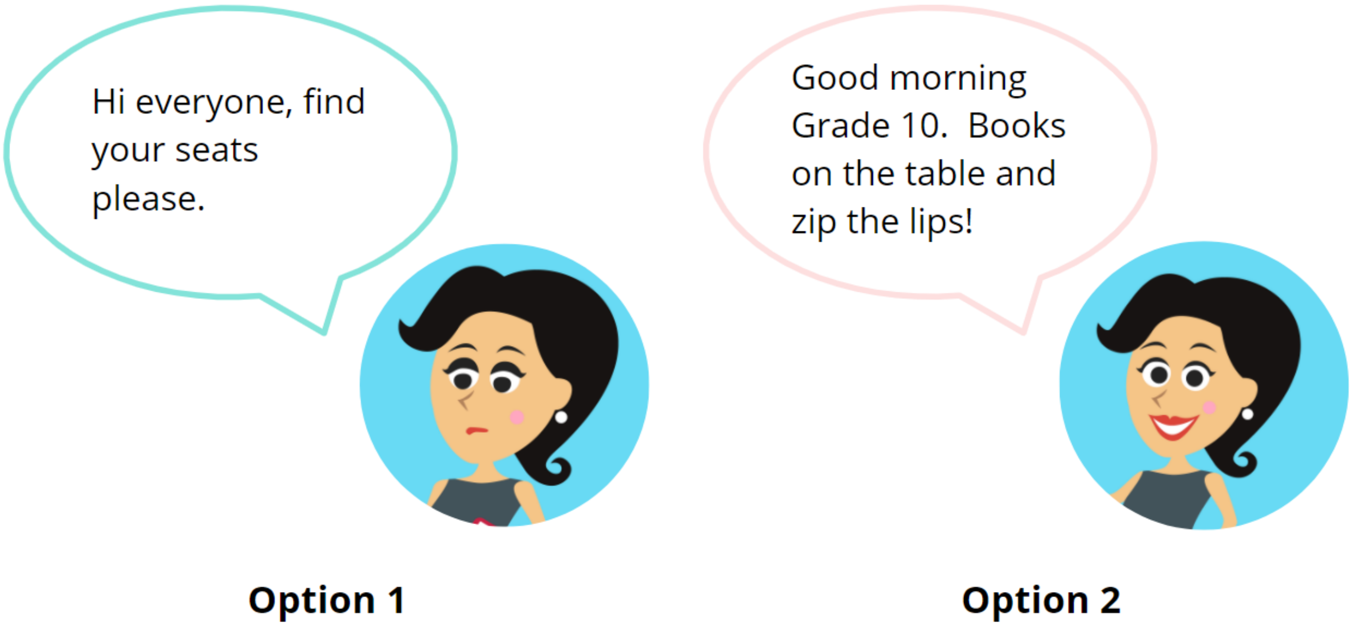

Figure 7.2.3: *Example Showing the Complexity of Conveying Tone in Different Modalities*

Note. Image adapted from macrovector_official - freepik.com

In written text on the page or screen, Option 1 seems much friendlier than Option 2. But what if we were in a live video conference call, and Option 1 was said in a monotone, and Option 2 was said with a cheery smile and a “zip the lips and throw away the key” gesture? The tone changes entirely. The same would be true of an audio recording, video or podcast—formal language, paired with welcoming tone and visuals can have a very different impact than just the text, and of course, text, audio and visuals that work in support of each other would be the most powerful.

Principle 3: Communicate Regularly

The temptation with instructional text is sometimes to write or present long and complex screeds of instructions at the outset of a process. We would encourage you, however, to communicate regularly with learners and to offer instructional text in brief, just-in-time chunks. This is for a number of reasons. Instructional text is most likely to make sense to learners when it is directly related to what a learner needs to do immediately. While it is useful to tell learners at the beginning of the semester how it is that they will submit their final semester project, you really should be prepared to come back in the final weeks of semester and remind them. Instructional text is also a way of building a connection with learners across time. Knowing that a lecturer will email weekly with key submissions, key activities, and a summary of what went well in the previous week is something that learners, particularly in online contexts, value. Instructional communication over time is also an opportunity to acknowledge and encourage learners on an ongoing basis.

Purpose and Placement of Instructional Text

There are many places where you should consider inserting instructional design text. Given the broad role instructional text plays, it is ubiquitous in course design and delivery. There are, however, some typical placements (see Figure 4) of instructional text.

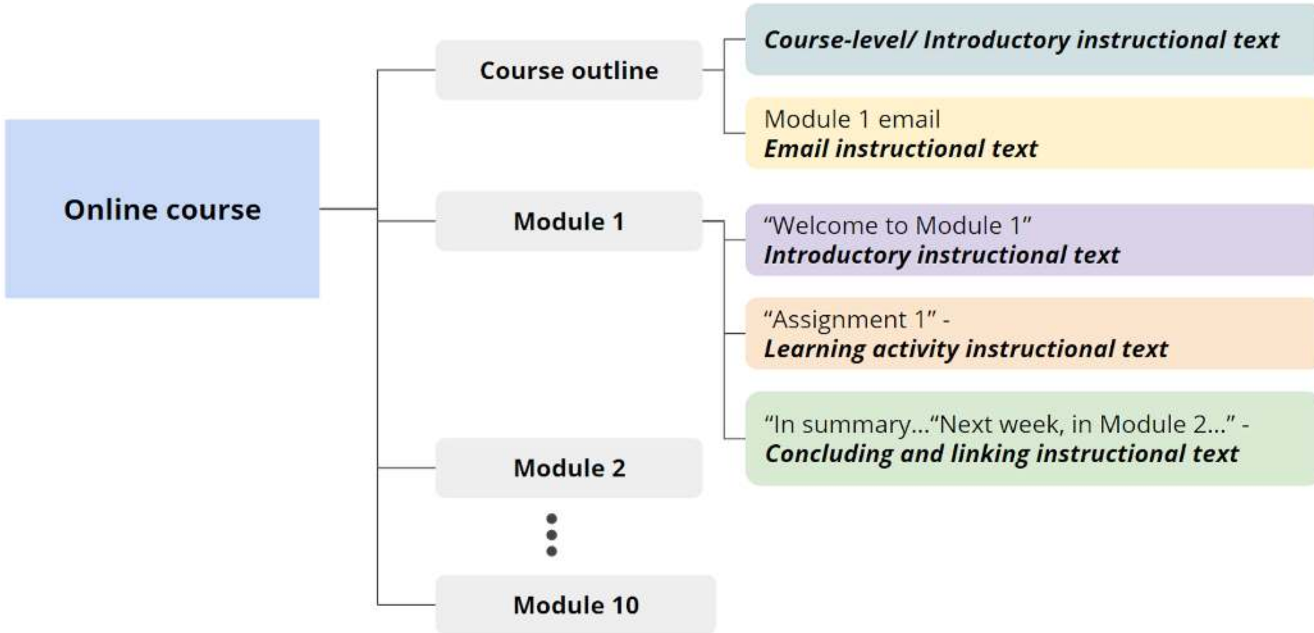

Figure 7.2.4: *Example Structure of an Online Course With Typical Instructional Text Placements*

Introductory, Linking, and Concluding Instructional Texts

Instructional text is often needed at the beginning of a unit or module in a course or textbook. In this location, instructional text will usually outline the shape of the text learning experience ahead of the learner by articulating learning outcomes and identifying key aspects of the learning activities. It might alert the learner to activities such as live sessions, expected time on tasks, or equipment required for that week. Figure 5 is an example of introductory instructional text.

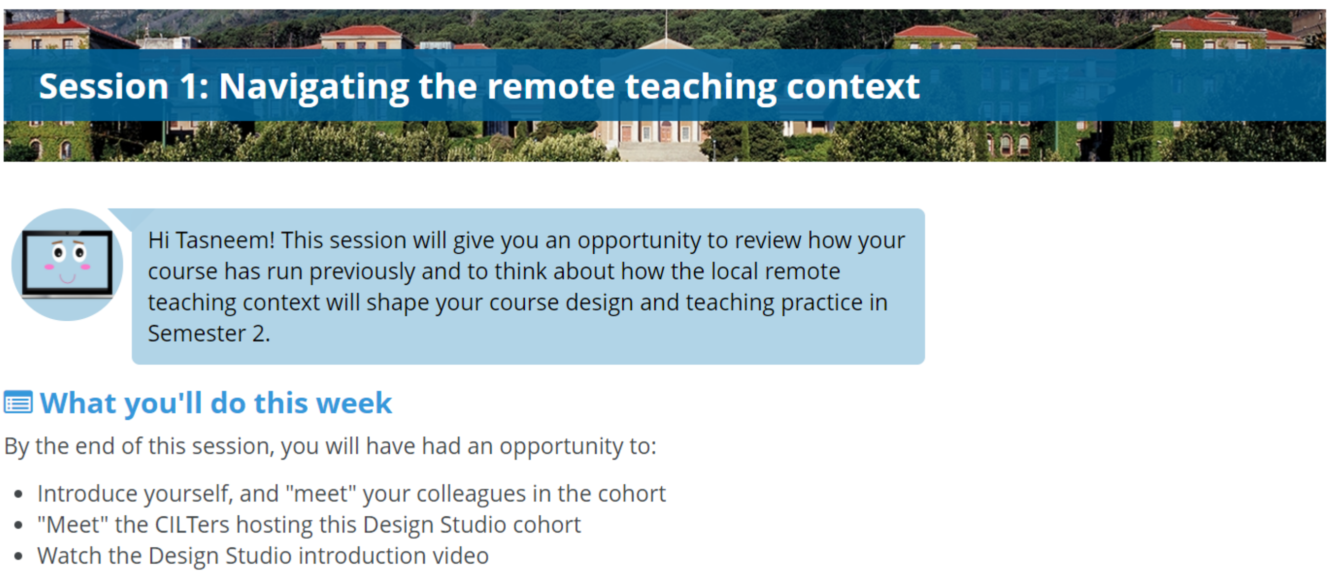

Figure 7.2.5: *Example Showing Introductory Instructional Text*

While the text above performs an introductory function, similar texts can perform linking functions between sections of text or activities, and to conclude learning "chunks."

Instructional Text to Support Navigation

Both print learning texts and online learning spaces have their own rules and norms. As an educator, you may be very aware that bold text or italicized text requires particular attention, or that text in a particular shade of blue with an underline is likely to be hyperlinked. However, the norms of texts and online spaces are not always immediately apparent to all learners, who may need some assistance navigating either the text or the space. Further, learners are almost always enrolled in multiple courses, each with its own structure, rules and norms. Figure 6 provides an example of instructional text with a navigation purpose.

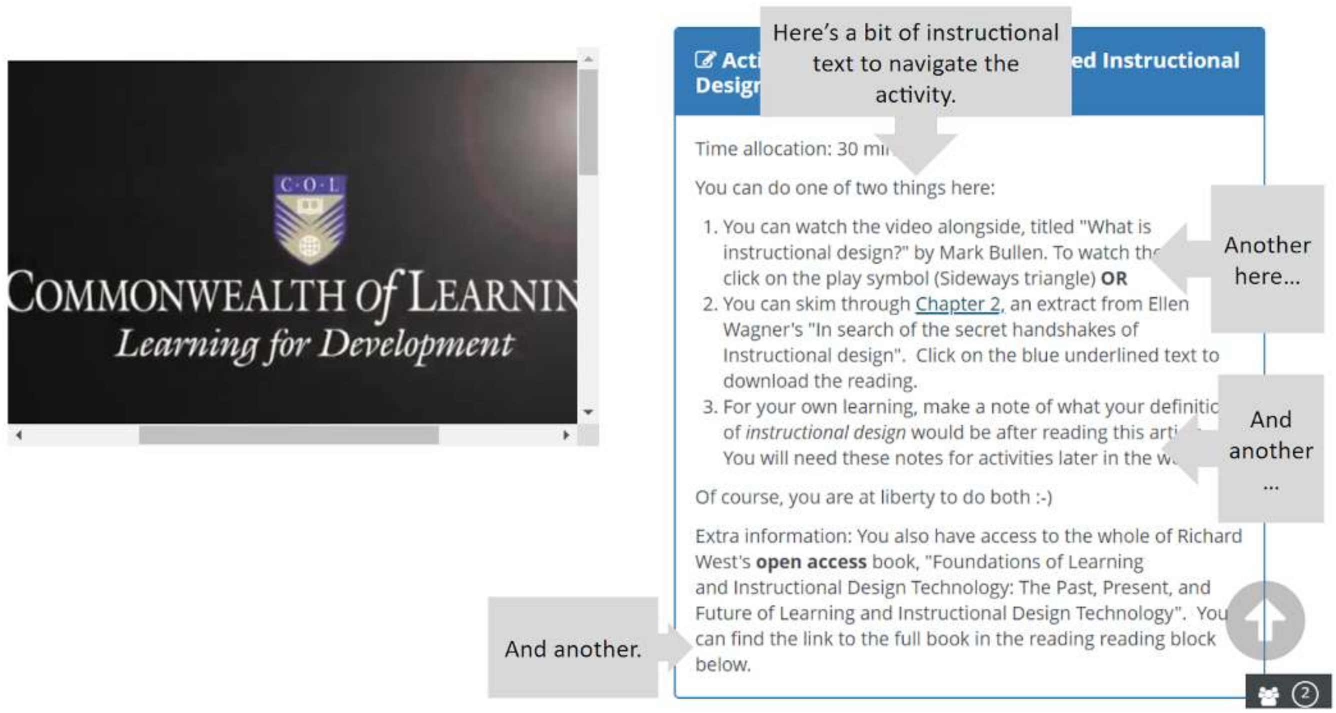

Figure 7.2.6: *Example Showing Navigation Techniques in a Learning Activity*

Being explicit about the structure, rules, and norms of your course can improve the learner experience by reducing extraneous cognitive load. That is, because of the way the content is presented, learners may have to do excessive analyzing that is not necessary to achieve the learning outcomes of the course (Mayer, 2019). It is our responsibility as instructors to limit this load, allowing learners to focus their attention and efforts on what we really want them to learn.

Learning Activity Instructional Text

If you research older articles, you will often come across instructional text articles that refer to writing the instructions of an assignment or manual for print. Each assignment or assessment created for learners contains instruction—sometimes the instruction is minimal if it is an open-ended question or more intensive if it is a step-by-tutorial. Depending on the level of the learners, the level of instruction used for assessments may differ. Figure 7 is the instruction for a small activity on learner personas.

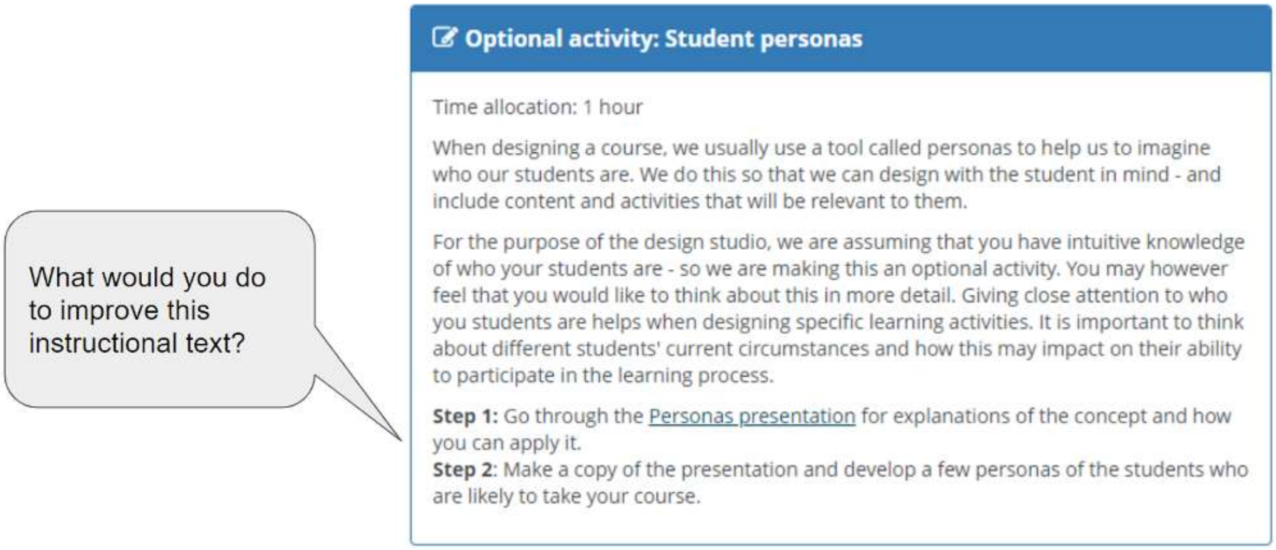

Figure 7.2.7: *Example Showing Instructional Text in a Learning Activity*

Email as Instructional Text

In an online setting, course announcements or emails are often used by the instructor to communicate with learners on a regular basis (see Figure 8). This type of instruction typically includes, but is not limited to reminders, deadlines, changes in course information, and feedback on assessment. While other forms of instruction may be pre-planned, emails are done with a short turnaround time and therefore contextual to what is currently happening in the class. If we, as instructors, are communicating sensitive or not-so-great information about learner grades, we want to pay particular attention to our tone. It is the little things that contribute to a successful email—like the usage of greetings.

Figure 8

Example of an Instructional Text in an Email

Example:

Hello everyone

We don't have any new work/input at the moment, so I hope you are all catching your breath and writing happily!

In this week's live session, we focused on the first two sections of the Learning Design Rationale. We talked about trigger problems in relation to the introduction and started to think about the "Thinking like a designer" section. We tried two short activities to get everyone to think about the goal of both these two sections.

Seema had a great question about how to use the feedback in the blogs. Do not use this feedback to rewrite your blogs—it's totally unnecessary. The blogs are, however, actually key parts of your LDR, so use this feedback to improve your final LDR.

Next week, we are using our two live sessions to continue strengthening the LDRs

- Monday (4:30pm) - Context section (Saadiq)
- Wednesday (3pm) - Design and Develop sections (Sandiso, Widad)

Thanks to our volunteers for next week—we will have some examples to think about our work in relation to!

Also, check out the Commons tool in the left-hand menu! It's a great place for leaving messages or sharing questions and resources.

Stay strong!
Shanali

Visual Design of Instructional Text

While the content of the instructional text is central to its purpose of guiding the learner, there are many other factors that contribute to its success. An example is focusing on accessibility in the instructional text's visual design. When designing instructional text, we need to think about how it caters to the learner’s experience from a visual perspective, which affects the learner’s ability to find information (Lonsdale, 2016). These visual guidelines draw on the work of Hartley (1981), Universal Design for Learning (UDL), and the field of User Experience (UX) to name a few. Regardless of a physical or digital medium, these guidelines are important considerations for the design of your instructional text. Good instructional text will not always be noticeable to the learner, but poor instructional text or the absence of instructional text will be evident. When designing instructional text there are a few key areas that need to be considered.

Headings

Headings improve the learner's ability to scan and navigate the content. At any point, a learner should know where they came from, where they are, and where they are going. Headings signal the topic, and in many cases give you an idea of whether the information under the heading will be relevant. Before lesson planning, it is a good idea to sit down and plan the structure including the headings and subheadings for one unit or lesson. This allows you to mimic the heading structure for future lessons, creating a consistent learning experience. For optimum accessibility, here you want to make use of the heading styles provided by Word, Google Docs, or any text editor.

Numbering

Numbering aids in sequencing and organizing information. Furthermore, it is particularly valuable for referencing purposes (Hartley, 1981). Where possible, numbering is encouraged, as it provides opportunities to reference by number in announcements, emails, assignments, and other parts of the course (see Figure 9; e.g., "Please have a look at section 2.2 detailing how to use an empathy map.") If the course content changes regularly, you may want to be cautious about the upkeep of a numbering system. Numbering also provides learners with an easy reference method when emailing an instructor with queries.

Figure 9

Example Showing Content Structure Using Headings and Numbering

1. Introduction to Online Learning Design 1.1 What is online learning design? 1.2 Knowing your context 2. Understanding your learners 2.1 Personas 2.2 Empathy maps

Bullets

Break up large chunks of text into smaller numbered or bulleted lists. For example, if there are five key points for a topic, it might be a good idea to outline this using bulleted lists (see Figure 10).

Figure 10

Example Showing a Before and After of Converting a Chunk of Text to a Bulleted List

Tips for filming your online lectures Example: Large chunk of text (Before) Script writing is an essential part of preparing to film your lecture for an online course. Here are five key tips you need to think about when filming. If writing a verbatim script, use short sentences, short paragraphs and simple syntax. Be clear and concise: aim to convey maximum information using minimum words. Check that your script flows, that you are explaining the links between paragraphs or sections. Storytelling is a useful device to keep learners engaged—try to mimic this in your videos. Don't use abbreviations in the spoken form—e.g., say the United States instead of the US, University of Cape Town instead of UCT.
Example: Bulleted list (After) Script writing is an essential part of preparing to film your lecture for an online course. Here are five key tips you need to think about when filming: • Use short sentences, short paragraphs and simple syntax. • Be clear and concise: aim to convey maximum information using minimum words. • Check that your script flows, that you are explaining the links between paragraphs or sections. • Use storytelling in your videos to keep learners engaged. • Don't use abbreviations in the spoken form—e.g., say the United States instead of the US, University of Cape Town instead of UCT.

Spacing

Designers talk about "white space"—which is the space around text and images like in this textbook. Golombisky and Hagen (2013) phrase it really well "Too much space, and visuals and type get lost or don't talk to each other. Not enough space and they start to fight with each other"(p. 7). White space is necessary and appropriate when placing text and images, and it contributes to the readability of the instruction. Having white space around the most important information allows it to stand out from the rest of the text. Following the methodology of chunking (see Figure 11), you should break up text into logical chunks which can provide the white space needed to maximize readability (Moran, 2016).

Figure 7.2.11: *Example Showing How Groupings of Text May Appear to a Learner*

Fonts

Font choice can impact the readability of the text. Opt for common, highly readable fonts like Arial, Tahoma, Verdana, or others and avoid decorative fonts that are difficult to read. Some font-families are considered more readable than others, with division among those who prefer sans-serif or serif fonts. A simple web search for the most accessible fonts will give a selection of suitable fonts. Limit text to one or a few select fonts—having too many will be distracting for the reader. Although they may seem boring, they are effective and easy on the eyes. Let's leave the decorative fonts for the kids (see Figure 12).

Figure 7.2.12: *Example Showing How Decorative Fonts May Not Be Easy on the Eye*

Font Size

Depending on the placement of the instructional text, it's important to consider the font size. If important instructions are too small and illegible, they might be overlooked by the reader (see Figure 13).

Figure 13

Example Showing Readability of Different Font Sizes

This is 8px
This is 10px
This is 12px
This 14px
This is 18px

Emphasis Using Text Effects

When communicating important information like deadlines, it is common to **bold**, <u>underline</u>, or *italicize* certain parts of the text to make it stand out to the learner. For example, the bolding on **this part of the sentence** signals that you should focus on it. Here it is important to be consistent in the style of emphasis you are going to be using throughout your course materials in order to not confuse learners.

Colors and Highlighting

If color is used to signal important text, you want a good contrast between the colors used. Poor color contrast may not be readable and particularly affect learners who are color-blind. Using an online contrast checker like WebAIM will determine whether the text is well-contrasted (see Figure 14). As far as possible, color should not be the only way to show emphasis.

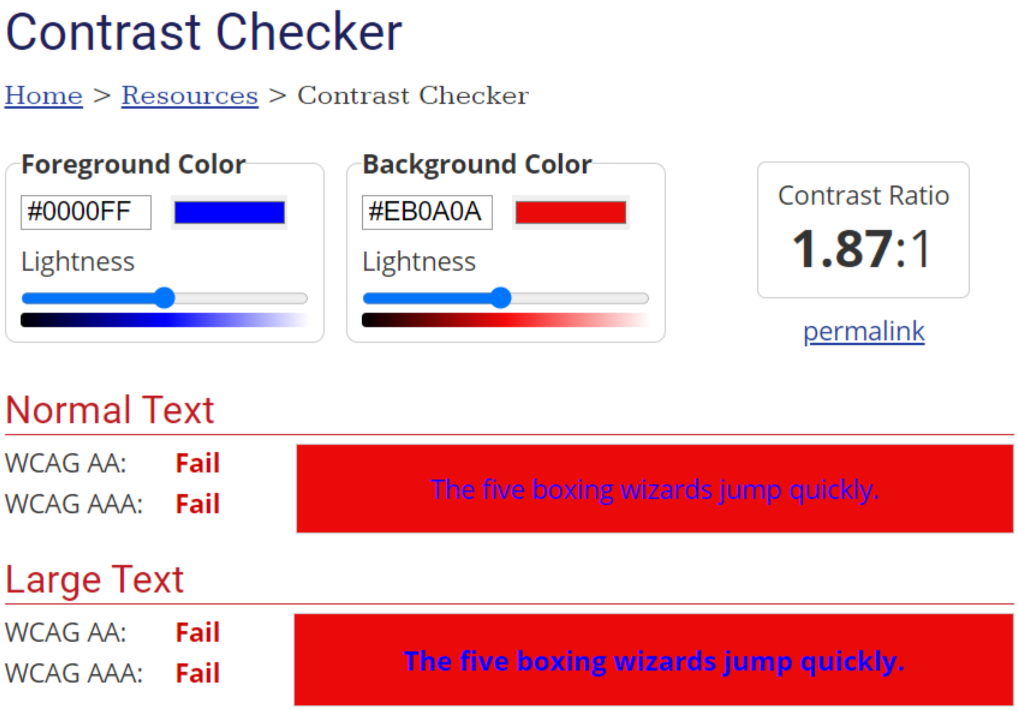

Figure 7.2.14: *Example of a Contrast Checker Showing Inaccessible Color Usage*

Conclusion

In this chapter, we have limited our focus to the kind of instructional text that works between subject-specific material to support learning. While we hope that the principles suggested to you will continue to be useful over a period of time, factors such as mode (face to face, blended, or online) and ever-changing technological and digital contexts, mean that what learners find appealing and supportive will change. We encourage you to pay attention to the role of instructional text in learning, and to take steps to develop your capacity with constructing instructional text by, above all, listening to your learners.

Application Exercises

Exercise 1

Refer to Figure 7: Example showing instructional text in a learning activity. Which principles for constructing instructional text do you see at work in this example? Compare your answers with a peer and see if you missed anything.

Exercise 2:

Here's a version of the email announcement example we used earlier with some creative use of font and colour. Copy this email into a text editor, remove all the formatting and think about font colour, size and spacing to improve the read-ability.

Example:

Hello everyone. We don't have any new work/ input at the moment so I hope you are all catching your breath and writing happily! In this week's live session we focused on the first two sections of the LDR. We talked about trigger problems in relation to the introduction and started to think about the "Thinking like a designer section". We tried two short activities to get everyone to think about the goal of both these two sections. Seema had a great question about how to use the feedback in the blogs. Do not use this feedback to rewrite your blogs - it's totally unnecessary. The blogs are however, actually key parts of your LDR, so use this feedback to improve your final LDR. Next week, we are using our two live sessions to continue strengthening the LDRs - Monday

(4:30pm) - Context section (Saadiq) and Wednesday (3pm) - Design and Develop sections (Sandiso, Widad). Thanks to our volunteers for next week - we will have some examples to think about our work in relation to! Also, check out the Commons tool in the left-hand menu! It's a great place for leaving messages or sharing questions and resources.

Kind regards

Shanali

Exercise 3:

Find an existing example of instructional text. This could be something you have written previously or an example from a textbook or online course. Using what you have learned in this chapter about principles for constructing and designing instructional text, edit the example you have found. Share your edits with a peer or a friend for feedback.

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7.3: Audio And Video Production For Instructional Design Professionals

Audio and Video Production for Instructional Design Professionals

Marshall G. Jones & Lisa Harris

Practicing instructional design professionals use digital audio and video in learning materials for a variety of reasons including content presentation, feedback, and assessment. Some audio and video materials used for purposes like feedback and assessment may have a narrow audience and may not require high production value (i.e. the editing needed to make audio and video materials professional and polished). For those uses, you simply record and share.

Depending on the resources of a project, instructional designers may create these materials themselves or work with media production professionals. Because modern smartphones have access to basic media production tools, it is possible for anybody to capture and edit audio and video. This is an acceptable solution for materials with a narrow audience or materials that will not be shared widely. However, media that is included in professional learning materials needs to have a polished and professional look and feel.

This chapter will provide an overview of audio and video tools that instructional designers can use to capture, edit, and share professional learning materials with limited resources. In addition, terms and issues associated with audio and video production will be introduced. This introductory knowledge will help guide you as you seek to enhance your skills and will also help you communicate effectively with media production professionals during your career.

Lossless and Lossy Media

Audio and video files are commonly referred to as *media files*. There will be other media files that you work with as an instructional design professional, but these are the foundations of most media production projects.

Because so much of the work we do is shared digitally on the Internet, working with any type of media is a compromise between the highest quality and the smallest file size. Which is why you need to learn how to compress uncompressed media files. We sometimes refer to uncompressed media as *lossless* and compressed media as *lossy*.

A lossless file is uncompressed and is at the highest digital quality. “Lossy” media has lost some of the original quality. This means that it has been exported to a file size and type that can be used and shared easily. An exported file is a compromise between file size and quality. Lossless media is media captured in its highest quality. This allows us to edit in the highest quality available and then export it in the most appropriate format. Audio and video examples are included below.

Audio

The most common lossless audio file you will work with is a .wav file (Waveform Audio Format. Pronounced *wave*). There are others, but .wav files are the most commonly used. (See https://edtechbooks.org/-Coyb for a list). A .wav file is uncompressed and at its highest quality. After the audio is recorded, it is edited for length, clarity, and production quality and exported to a lossy compressed format. The most common compressed audio file is an .mp3 file. The sound quality of a .wav file is higher in quality and preferred by professional musicians and audio engineers. However, a .wav file can be as much as ten times larger than an .mp3 file. Given the file size difference, instructional designers often use .mp3 files as a compromise between file size and quality.

Video

The quality of the video recorded is determined by the camera used. Video quality is referred to as video resolution and measured by pixel dimensions. See Table 1 for common types of video resolution from lowest quality to highest quality.

Table 1

Common Video Resolutions

Video Resolution	Abbreviation(s)	Pixel Dimensions
Standard Definition	SD	720x480
High Definition	HD	1280x720 (Also written as 720p)
Full High Definition	Full HD	1920x1080 (Also written as 1080p)
Ultra High Definition or 4K	Ultra HD or 4K	3840x2160

Note. See https://edtechbooks.org/-CgI and https://edtechbooks.org/-CgI for more details.

The quality of the camera determines the highest quality of the video available to you. As of the writing of this chapter, newer smartphones record in HD and Full HD, though some newer phones do allow for 4K recordings. Professional video cameras, and many consumer level cameras, will record in 4K. Once the video is edited for length, content, and production values, the final resolution can be determined when the video is exported and saved to a lossy file type to share, typically an .mp4 file.

How to Compromise Between Quality and File Size

This will depend on several factors such as:

- how you will deliver the materials,
- the content of the materials, and
- where you will be using the materials.

For example, if you were recording music and wanted to distribute it on a compact disc, you would want to export your audio file in a .wav format. You would want the highest quality so that the nuances of the music could be enjoyed by the listener. If you are recording a podcast, lecture, or some other type of voice file and your plan is to distribute that through a learning management system or some other internet-based option, an .mp3 file is preferred. An .mp3 file has levels of audio quality, or fidelity, which are measured by the bitrate. The lower the bitrate, the lower the quality or fidelity to the original recording. A bitrate of 96 would be a lower quality .mp3 while a bitrate of 320 would be the highest quality. The bitrate is chosen when the audio file is exported. For more information on bitrate, see https://edtechbooks.org/-Zavu.

When exporting video, it also depends on what you plan to do with the video. If you are broadcasting the video through a television network or streaming service, you would likely want to export in 4k or Full HD (1080p). If you are distributing your video through an online streaming service such as YouTube or Vimeo, you could likely use a lower resolution HD file. Your choice of resolution will depend on the content of the video. If you were creating a highly technical video that requires significant granular detail, such as repairing a piece of equipment, or performing surgery, you would want a higher resolution, likely 4K (Ultra HD) or Full HD (1080p). If you were recording a lecture or a narrated PowerPoint presentation a lower resolution such as HD (720p) would be fine. It would depend on the content and how you are distributing it. It is unlikely that you would ever export in Standard Definition (SD). That is the resolution that was common to many video cassette recorders. We include it here as you may see it if you are including older recorded materials in a project.

Recording and Editing Digital Audio

Before you can compress your audio as an .mp3 file, you must capture, or record the audio. On the face of it, recording audio is relatively straightforward, assuming you have a recorder:

1. Press the record button.
2. Talk.
3. Press the stop button.
4. Export it as an .mp3 file.

Recording high quality audio is more difficult. Where you record is an issue to consider. Field recording, such as interviews in offices, classrooms, or outside areas are different from recording in a single stationary place, like a studio. This chapter primarily covers the fundamentals of audio recording in a stationary space with limited resources.

Additional Resources

If you are interested in field recording, Michael Helms' podcast and website are helpful resources (https://michaelthesoundguy.com).

To record professional sounding audio, you have to think about a number of factors such as what microphone you are using, how close you are to your microphone, where you are recording, and how to edit your audio before you export it and share it. We will cover each in turn.

Microphone Quality

For professional sounding audio, you need a better microphone than the one in your computer or your smartphone. You also need a microphone that records in stereo. Mono (also known as monaural or monophonic) audio plays in a single channel. Stereo plays in two channels, left and right. Put more simply, mono audio plays in only one ear of your headphones. Stereo plays in both. Space limits our discussion of every type of microphone, and there are many such as dynamic and ribbon microphones. For more information on dynamic and ribbon microphones, see: https://edtechbooks.org/-SHa. If you have access to recording engineers and their studio, they will have professional microphones available. We are focusing our chapter on a versatile microphone for instructional designers, the condenser microphone.

Condenser microphones have electronics inside of them to help provide a better-quality recording. They typically connect directly to your computer through a USB port. They provide for greater *fidelity in sound*, which means the microphone can provide a recording that is very close to the original performance. If you listen to live music and a recording of the same performance, you will hear things differently. Your ears will pick up sounds at a live performance that even the best microphone cannot capture. Better microphones will provide recordings as close as possible to the original. So higher fidelity means better quality. And better microphones produce higher fidelity.

Condenser microphones capture a wide range of frequencies well. They make the low tones richer and the high tones sound crisp without sounding "tinny." Condenser microphones can be very expensive. You can pay thousands of dollars for a condenser microphone, and if you were a recording engineer working with symphonies or studio musicians, you would. However, for the type of recording most instructional design professionals do—mostly voice recordings for .mp3 files or voice overs for video—you need a good microphone, not a great one. There are many to choose from and an internet search for comparisons will yield many. What you choose will likely depend on your budget.

The "Snowball" microphone by Blue is an example of a compromise between cost and quality. It is an example of a good, but not great, microphone. This USB microphone provides good sound quality at a reasonable price and is a good addition to your instructional designer tool kit. It is available at many retailers or from the website directly. Our inclusion of the Snowball microphone is used as an example only and should not be considered a commercial endorsement.

Figure 7.3.1: *Blue Snowball Condenser Microphone*

Note. Visit https://edtechbooks.org/-qFv for more information.

Distance from Your Microphone

The closer you are to your microphone, the better the sound quality. How close depends on the microphone, so it is best to experiment until you get to know your microphone better, but think two–six inches away as being close.

Your microphone will record every sound in the room. When you record, think about air conditioners, fans, and other ambient noises. Also, think about air. The air between you and your microphone is recorded as dead air. If there is a lot of air between you and your microphone, you will get a hissing noise when you turn up the volume. While the microphone can and will pick up all of the sounds, the mic will pick up sounds closer to the microphone more clearly. Which is why you want to be close to the microphone. However, if you get too close to a microphone you may “pop the mic”. Popping the mic is the term used to describe the noise that you hear when hard consonants like *p*, *t*, *d*, etc. are used close to the microphone. The microphone may pick these sounds up and produce an annoying popping sound on a recording. To lessen mic popping, use a pop filter. These devices provide a mesh like fabric that rests between you and the microphone and help diffuse the sound of the hard consonants.

Figure 7.3.2: *Blue Snowball Mic with Pop Filter*

Note. Source: https://edtechbooks.org/-FzAV

Pop filters are relatively inexpensive. Because a person sits close to a pop filter when speaking, they are likely to spread aerosols as they speak. We recommend you treat them as personal items.

Room Size

The best place to record audio is in a recording studio. Recording studios have *baffling*, soft material on the walls and ceilings, to lessen echo in the room. If you do not have access to a recording studio, consider the size of your room. Large rooms may produce more echo. Small rooms will produce less. The less echo in a recording the better.

The larger the room, the greater the problems for recording. Your microphone will pick up ambient noises like your air conditioner, but it will also pick up the echoes of the room. Rooms with a lot of tile and glass and tile (think kitchens and bathrooms in your home) allow the sound to "bounce" off the hard surfaces. Audio recording in large rooms produces audio that may sound thin and produce unwanted echoes.

When possible, use a small room with carpets, drapes, and other fabrics to help absorb excess sound. You can also create a better environment with boxes to contain the microphone and soft materials to surround it. In the image below, the person has placed their microphone in a box with foam to absorb excess sound. You could also achieve this effect with a box and any kind of fabric like towels or small pillows. Notice that the microphone is close to the foam in the box. This will help keep sound on the other side of the microphone from being recorded as well and helps eliminate dead air.

Figure 7.3.3: *Creating a Better Recording Environment*

Note. See https://edtechbooks.org/-Vod for more information.

Audio Software

To create a professional sounding recording, you need multitrack software to edit audio. A finished audio file is a number of tracks, or layers of audio, edited together for quality and clarity. Each track is a type of audio. One track might be your voice, and another track your background music (see Figure 4). Audio software allows you to *mix* your audio. Mixing audio means that you adjust levels of each track to make your voice loud enough and your background music soft enough to blend well together.

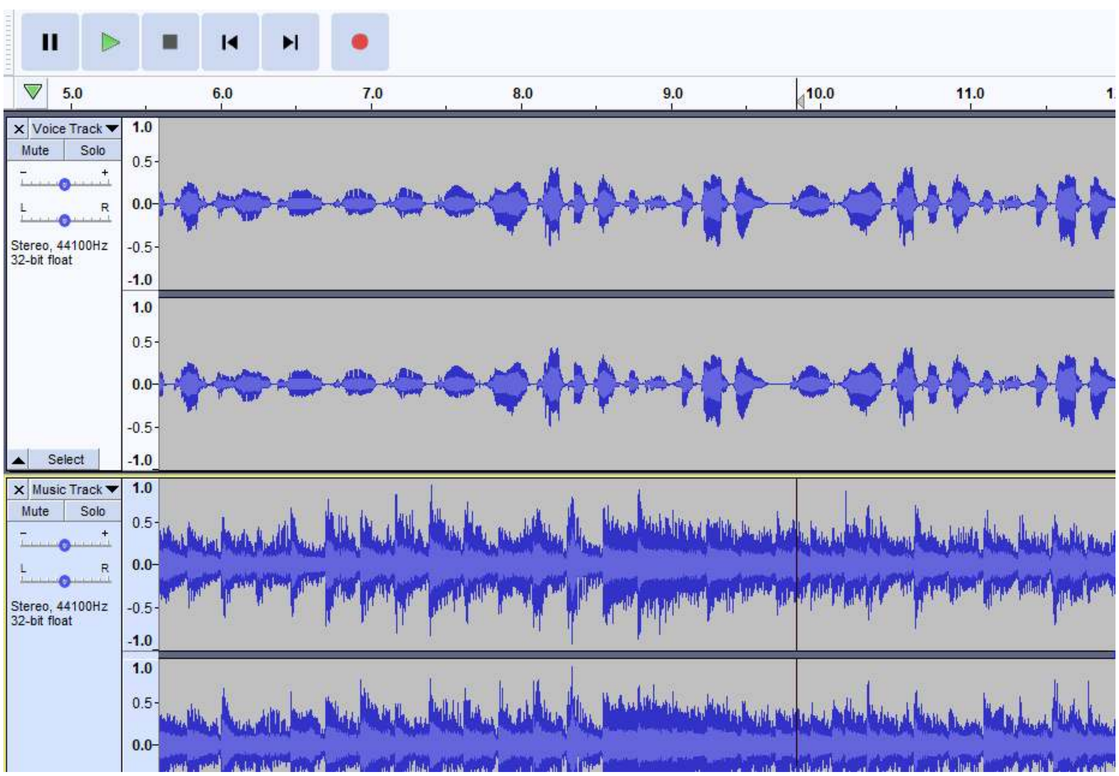

Figure 7.3.4: *Multiple Audio Tracks*

Note. The top track is a voice track and the bottom track is a background music track.

There are many professional options available, but Audacity is a free, open source tool that we recommend. It is available for both Mac and PC computers. Below are a set of tutorials that will help you get started with *Audacity* (version 2.3.2) and audio editing.

1. Audacity: An Introduction
   A brief tutorial demonstrating the user interface and basic functions of *Audacity* audio software.
2. Audacity: Adding Background Music To Your Project
   How to add background music to your podcast using *Audacity*. The video covers importing a music file and how to use "fade in" and "fade out" to make the final version sound more polished.
3. Audacity: The Effects Menu
   This short tutorial introduces the Effects menu in *Audacity* and demonstrates how to apply a change in pitch effect.
4. Audacity: The Time Shift Tool
   This tutorial introduces the Time Shift Tool in *Audacity*. Use the Time Shift Tool to move an audio track horizontally on your timeline.
5. Audacity: Exporting Audio as an. Mp3 File
   This brief tutorial demonstrates how to export your *Audacity* project as an mp3 file so it can be shared with others. This is the stage of the production process when you would choose the bitrate for an .mp3 file.

Digital Video

Most people have a better-than-average video camera in their pocket or bag. Modern smartphones contain impressive cameras and can record quality video. Because everybody can create video easily now, we think of video as being easy. On the face of it, digital video is easy. Sound and lighting are hard.

Video and Expectations

Without the resources of professional videographers and filmmakers, you should not expect to make videos that will look like the ones you see on television or in the movies. Those videos require resources including multiple cameras, multiple camera angles, good field recording equipment, professional lighting kits, sophisticated video editing software, personnel, and more. However, depending on the needs of your learners and the type of content you need to create, it is possible to make compelling and professional looking videos with limited resources. What follows are some resources to help you produce video with limited resources. Experience producing video yourself will help you work with professional video production teams during your career.

Video Terminology

Below is an alphabetical list of terms used in capturing, editing, and sharing videos that you are likely to encounter. While this is far from a complete list, some knowledge of these terms will help you both produce your own video and work with professional video producers.

Table 2

Video Terminology

Aspect Ratio	The relationship between the width and height of your video. It is expressed numerically such as 4:3 and 16:9.
Boom Mics	High quality microphones that can attach to your camera to allow better sound while you are shooting video.
B Roll	Supplemental background footage. This is stock footage that is used while voice over audio plays. For example, if there is a news report about vaping, you will often see video clips of random people not associated with the story vaping. Those clips are B Roll footage.
Clip	A piece of video. You can take one long video clip and split it to make multiple small clips. You can take multiple small clips and order them to create a final product.
Compression	The amount of data in a video file. Smaller files have higher compression rates. High-definition video has lower compression rates.
Credits	Information at the end of a video detailing information about the creator of the video, actors, or other important information about the video.
Dissolve	An editing term. A transition between two elements in your video. You might dissolve between two video clips, or between a clip and a title.
Export	“Saving” your video in a format that can be shared with others or uploaded to a video sharing site, typically an MP4 file.
Fade	An editing term. It is the transition between a visual and a black screen. As in “Fade to Black”.
Filters	An editing term. Color Corrections that can be made to a video clip. Much like filters you might add to an image in image editing software.
Preview Window	The area of the screen in a video editor that lets you see the movie in part or in entirety within the software as you edit the video.
Project Library	An area in your editing software that contains all of the video clips, still images, and audio files you have imported to use in your video.
Timeline/Storyboard	In video editing software, the area of the screen that contains clips that you have moved from the library for editing and inclusion in your project. The timeline/storyboard is typically found at the bottom of the screen.
Scrub	An editing term. To fast forward or rewind a video or audio clip on the Timeline/Storyboard.
Shot List	A list of all of the shots, or video you need to collect, that you will need in your project.
Split	An editing term. To cut a single video clip into two separate clips. You would do this to isolate the video you want to remove by splitting it before and after the video you want to remove and then deleting the piece in the middle. You would split a clip to insert something before or after the clip, such as a title, still image, or another video clip.
Titles	Text that appears on a solid color or an image that helps mark the beginning of the video or provides a section break descriptor for the video.
Trim	An editing term. To remove content from the beginning or the end of a video clip. Trimming does not allow you to remove video from the middle of a clip. To do that, you would need to split the clip.
Tripod	A three-legged stand used to hold a camera still during filming.

Note. A more complete collection of terms is available from Vimeo.

Video Cameras

Professional video cameras used by professional videographers are more expensive and sophisticated than consumer level cameras. Nevertheless, quality video can be captured with consumer level cameras. For example, most modern Digital Single Lens Reflex (DSLR) cameras are capable of shooting Full High Definition video. Many mirrorless cameras are capable of shooting in 4K or Ultra High Definition video. If you are recording a speaker, you would likely need an external microphone, such as a boom microphone, for your live audio. However, if you are able to use voice over audio, the information on audio recording in this chapter would help you create your audio track.

Smartphones are capable of shooting high quality video. As with DSLRs and Mirrorless Cameras, you will need an external microphone to record live audio. When shooting with a smartphone, always orient the camera in landscape mode (see Figure 5). Recording video with a smartphone in portrait mode will produce black bars on either side of the video when you edit (see Figure 6).

Camera technology changes rapidly. While 4K video is the current highest resolution commonly available, 8K video technology is available as of the writing of this chapter. If you are considering purchasing video equipment, it is best to research current standards before you purchase. The website, digitaltrends.com, has buying guides that are a good place to begin your search.

Figure 7.3.5: *Still Frame of Smart Phone Video Shot in Landscape Mode*

Figure 7.3.6: *Still Frame of Smart Phone Video Shot in Portrait Mode*

Video Editing Tools

Once the video is recorded, you will want to edit the video for quality and clarity. To edit the video you need to import the video into a video editor. Much like word processors let you edit the length, quality, and appearance of text, video editors do the same for video. Video editors range from the basic and introductory, such as the free *Windows Video App* available in Windows 10 and *iMovie* available on Apple computers, to the professional level tools *Adobe Premiere* and *Final Cut Pro*. As you might imagine, professional video tools are more sophisticated, more complicated to use, provide better final products, and are expensive. *Windows Video App* and *iMovie* are included in your system software and require no additional purchase.

If you have never used a video editor, *Windows Video App*, available in Windows 10, and *iMovie*, available on Apple computers, are excellent places to start. Tutorials for both are widely available online, but we offer these introductory tutorials on the *Windows Video App*. For non Windows users, these videos can also introduce you to the basic interface of video editing software and some of the tools and features common to all video editing software applications.

Windows Video App Interface

This short video is an introduction to not only the *Windows Video App* interface, but also to what video editors look like. You will see examples of the *Project Library*, the *Storyboard/Timeline*, and the *Preview Window*.

Introduction to Editing

This short video provides an introduction on editing video with the *Windows Video App*. While the tutorial is specific to the *Windows Video App*, the terms and techniques are mirrored in most video editors.

Editing and Special Effects

This short video provides more editing options and demonstrates how to use special effects in the *Windows Video App.*

There are free open source video editing tools available as well. Shotcut and OpenShot are cross platform video editors with sophisticated features rivaling those of paid professional video editing software.

Screencasts

Screencasts are recordings of the action displayed on a computer or mobile device screen. They are often used as tutorials to demonstrate how to use a particular function of a piece of software. The cursor is often highlighted by a halo of color so that it is easy for a viewer to track the cursor's movement on the screen. The person demonstrating the task on screen typically narrates these videos in real time. Screencasts may or may not include a thumbnail video image of the speaker overlaid on the screencast. The videos used to demonstrate the audio editing software above are examples of screencasts. Screencasting video can be uploaded into video editing software and used as a clip in a longer video or edited for clarity and quality.

Screencasting Software

There are multiple options for screencasting software, including free and paid versions.

Camtasia

Camtasia offers a suite of video capturing and editing tools. It is available for a free trial but does require a paid account for the most sophisticated features.

Loom

Loom is advertised as a video communication tool, but its functions include screencasting.

Screencastify

Screencastify is popular with users because of its integration of screencasts with Google products.

Screencast-o-matic

Screencast-o-matic has a free and paid version. The paid version removes the watermark, extends your recording time, and offers video editing tools. The free version is quite robust.

Video and Your Computer

Video is memory intensive and, depending on your computer's processor and memory, may tax your computer quickly. You should save early and often. At times, your video editing software will start to do things that you know it is not supposed to do. For example, you may insert a title and it will show up in the wrong place. This is a memory management issue. Quitting and restarting the application will clear the working memory and the software should work properly. It may be necessary to do this multiple times when editing.

Tips for Creating Video

It is possible for instructional designers and developers to create good, effective learning materials with limited video resources. For example, adding titles and credits to a screencast will help give it a more polished and professional look. Editing out unwanted pieces of a video will help focus the learner. When creating video with limited tools, there are some basic things to remember.

Length

For videos produced with limited resources, typically the shorter the better. For example, instead of creating one long video that demonstrates the five functions of the *Audacity* audio editing software, five shorter videos were created. This allows learners to watch what they need without rewinding and fast forwarding. If you are recording an hour-long lecture, break that lecture up into shorter videos. This allows the learner to watch pieces when they have time. It can seem overwhelming to sit down to watch an hour-long lecture. If these shorter videos are labeled well when placed in a learning management system, it also allows the learner to locate and rewatch only the parts they feel they need remediation on.

Special Effects

Use them judiciously. Use them sparingly. When people first use video editing software and realize how easy it is to use special effects and transitions, it can be tempting to overuse them. We advise people new to video editing to make a video early that uses every wipe, fade, and explosion they can find and get it out of their system. After that, use them only when they make sense in context of the content.

Lighting

When shooting video with limited resources, shoot in places that provide as much indirect natural light as possible. Look for rooms with windows on multiple walls. Notice the direction the light is coming from as it may cast shadows on subjects. Avoid filming in front of windows to avoid backlights making your subject appear as a shadow. If professional lighting is not available, look for lamps that you can place on either side of your subject to balance the light and avoid shadows.

Audio

Capturing live audio will sound better in a smaller space. If you are recording in a large room, use an external microphone like a lapel microphone or boom microphone to capture your audio. Unless you have professional level skills and equipment, do not record your audio source separately from your video source. Synching the audio with the video can be difficult for users with limited resources and may result in the person's lips not matching their words. When possible, use voice-over narration and the recommendations presented in the audio section of this chapter for the best quality.

B Roll Footage

When added carefully and paying attention to the needs of your content, high quality B Roll footage can dramatically improve the look and professionalism of your video project. The websites pexels.com and pixabay.com provide free high quality B Roll footage that you can use in your projects.

Conclusion

With free and open source software and some reasonably priced pieces of equipment, it is possible for instructional design professionals to create quality audio and video learning materials with limited resources. The tools, resources, and tips provided here are a starting point for you to begin work with audio and video. Once you have worked with entry-level skills you will be able to expand upon those during your career as an instructional design professional.

Using Visual and Graphic Elements While Designing Instructional Activities

Justin Sentz

The time and expense of creating and obtaining visual/graphic elements, or pictures, for use within instruction is not insignificant. Then why use visual or graphic elements during instruction at all? The use of pictures during the design of instructional activities has been shown to have a significant impact with regard to both increased learner motivation and improved learning outcomes (Carney & Levin, 2002). Pictures and graphics can serve to convey information to the learner directly or facilitate the learner's understanding of related textual information within the instruction. Different types of visual and graphic materials are particularly suited for specific functions during instruction, and there are well-established design considerations for their use within instructional activities to increase their effectiveness. The use of pictures and graphics plays an important role in helping to manage the intrinsic cognitive load and reducing the extraneous cognitive load experienced by learners, who are then able to devote mental resources to learning the material within the instruction (Sweller et al., 2019).

The Role of Visual Messages in the Communication of Information

In order to be intentional about the use of visual and graphic elements during the design of instruction, it is important to first consider some of the fundamental concepts related to the role of visual messages within the communication of information more generally. What exactly is a picture, and what purpose does it serve? Knowlton (1966) proposed that visuals, or pictures, could be categorized according to their purpose or function within instruction-realistic, logical, or analogical. Realistic pictures look like the objects they refer to in the real world outside of the instruction. If the intention is to communicate a concrete example of the concept being presented, then a realistic picture is a good option for doing so. Logical pictures, on the other hand, provide a visual depiction of the structure of a concept being presented. If the purpose is to communicate an understanding of the organization of territories within a country or how electricity flows through a circuit, then a logical picture such as a map or diagram would be effective. Finally, an analogical picture depicts relationships among complex concepts through the use of concrete visual elements that are more familiar to the person. When there is a need to compare a particular phenomenon to something a learner is more likely to encounter in everyday life, then an analogical picture is a helpful option for communicating that information.

Using Visual or Graphic Elements to Increase the Effectiveness of Instruction

Taking into consideration the role of visual messages in the process of communicating information, it is important to think about ways in which visual and graphic elements can be used to increase the effectiveness of instructional materials. Peeck (1993) has suggested that the effectiveness of pictures within instruction is dependent upon the manner in which they cause the learner to process the information contained within the visual elements provided. This, in turn, is a product of both the characteristics of the learners themselves and the graphic materials used within the design. For example, visual elements can be a powerful means of showing spatial relationships or positioning of objects that are being presented within the instruction. These types of visuals can be placed before a section of text when learners are expected to draw upon prior knowledge of the information. They may also be placed in-line with the text when learners are unfamiliar with the spatial relationships and will benefit from a picture that shows relative positioning of the objects being discussed. Depending on the complexity of the material relative to the expertise level of the learner, pictures may also serve to illustrate abstract concepts that are presented textually within the instruction. Learners can use these visual elements to supplement their comprehension of the material through these representations or confirm their understanding of the text by reviewing the graphics and pictures provided. Yet another element of effectively using visual and graphic elements within instruction is the potential to motivate learners to pay particular attention to specific material and process information from the text more deeply. A learner may prefer to clarify or reinforce their understanding of textual information through visual elements, which can in turn help with the encoding and subsequent retrieval of that information at a later time.

Types of Visual Elements and Their Functions Within Instruction

While pictures and other visual elements can be extremely effective for learner motivation and comprehension, specific types of visual elements are more effective than others based on their function relative to the ways in which they relate to the instruction.

Levin et al. (1987) categorize pictures into five general types according to those functions-representation, organization, interpretation, transformation, and decoration. One of the most common types of pictures used in instruction is representational, which illustrates the textual information being presented for the purpose of reinforcement (see Figure 1). When the purpose of using a picture is to present a concrete visual representation of information contained in the instruction, a representational picture is often the way to go.

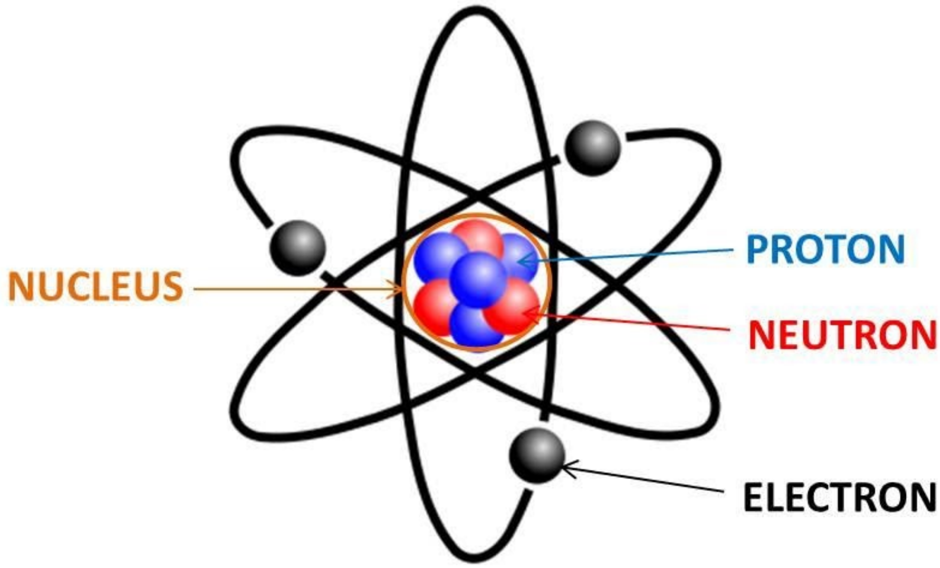

Figure 7.4.1: *A Representational Picture Illustrating the Components of an Atom*

Note. Retrieved from http://www.whoinventedfirst.com/who-discovered-the-atom/

Another type of visual element is organizational, which shows relationships between different parts presented in the text (see Figure 2). These can serve the purpose of illustrating a series of steps in a procedure or provide a large set of data through graphics such as diagrams or charts.

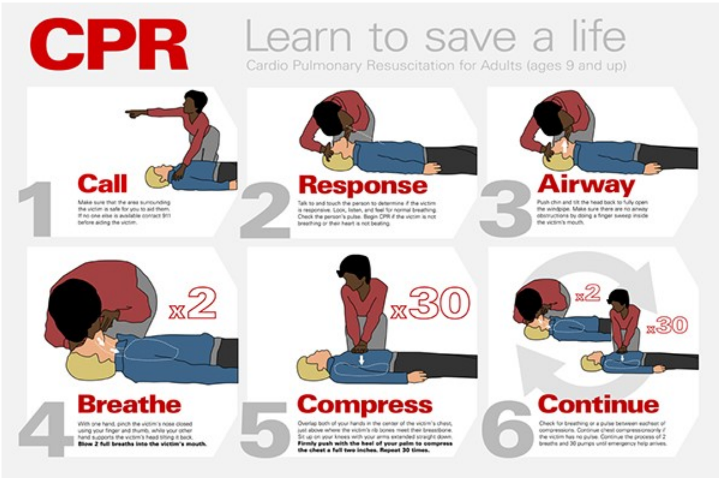

Figure 7.4.2: *An Organizational Picture Illustrating the Steps for Performing CPR*

Note. Retrieved from https://www.behance.net/gallery/3164...hart-Re-design

An interpretational picture is a third type of visual element that is often used when the intent is to clarify complex information provided within the text (see Figure 3). Much like Knowlton's (1966) idea of analogical pictures, these visual analogies can be used to ground more abstract concepts in visual elements that are easier for the learner to comprehend.

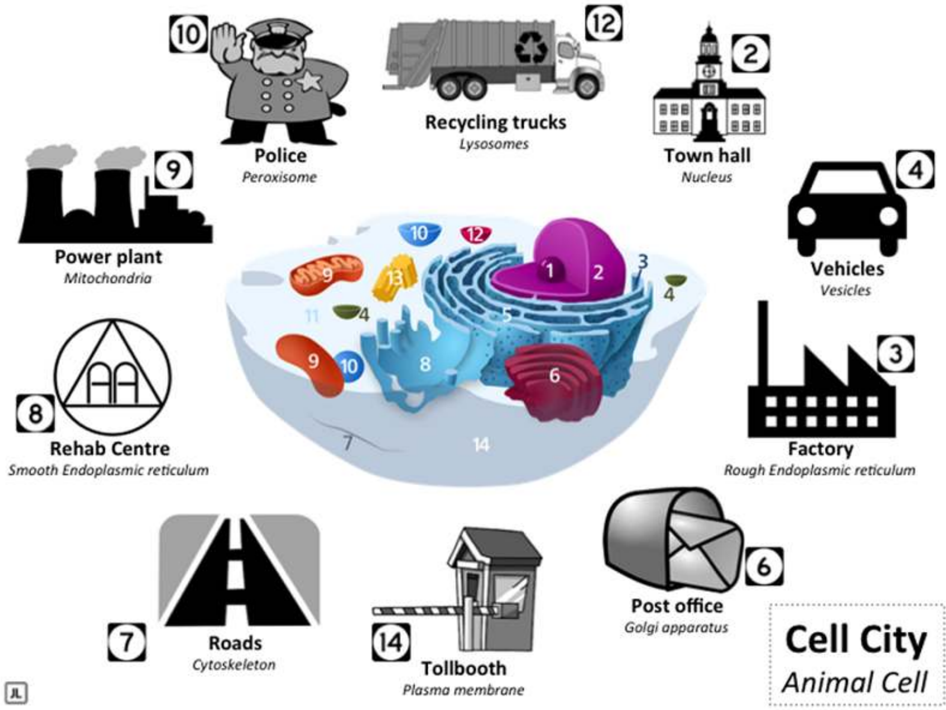

Figure 7.4.3: *An Interpretational Picture Presenting the Structures in an Animal Cell as Buildings in a City*

Note. Retrieved from https://www.up.ac.za/teaching-and-le...llular-biology

Yet another type of graphic element that is somewhat infrequently used is the transformational picture, which provides a mnemonic that facilitates retrieval of information from memory at a later time (see Figure 4). If the intent of the visual element is to help the learner memorize information through the association of a related picture, then the creation of a transformational picture may be worth the time and effort to design.

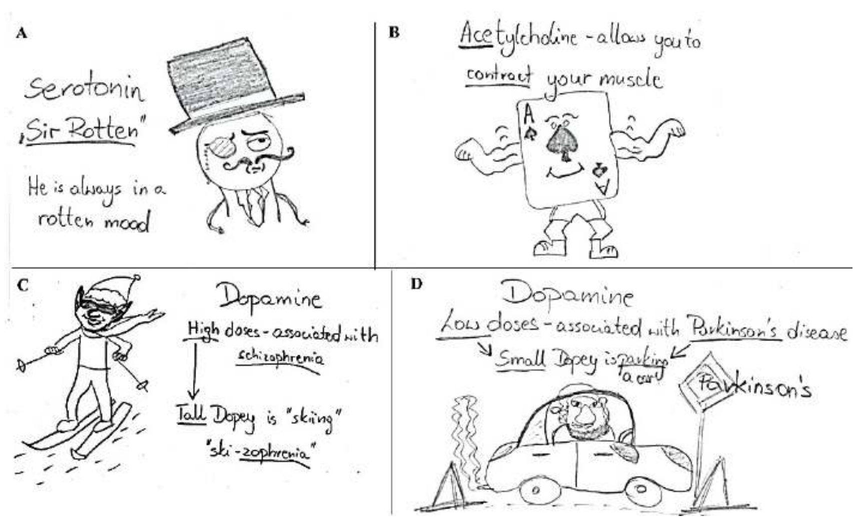

Figure 7.4.4: *A Transformational Picture Using Mnemonics for the Actions of Neurotransmitters*

Note. Retrieved from shorturl.at/hluJ7

A final type of visual element that is used within instruction but has no empirical support for its impact on learning is the decorative picture, which serves to break up textual information or provide "eye candy" for the learner (see Figure 5). While it is sometimes argued that decorative images may motivate learners, their use is not directly tied to improved learning outcomes and are thus generally discouraged.

Figure 7.4.5: *A Decorative Picture of a Mountain*

Note. "Mountain" by barnyz is licensed under CC BY-NC-ND 2.0

Strategies for Structuring Visual or Graphic Elements to Facilitate Processing

We can see that visual and graphic elements have the potential to increase the effectiveness of instruction, and specific types of visual elements are more appropriate based on their intended function within the instruction. However, it is also important to note that the manner in which visual and graphic elements are structured have a significant impact on the manner in which they are processed by learners. Sweller et al. (2019) describe cognitive load as the mental effort required by learning tasks that impact the learner's ability to both process new information and store it within long-term memory. They propose a set of strategies for structuring visual and graphic information to help manage the intrinsic load associated with the material itself and the extraneous cognitive load that is introduced by the instructional techniques employed:

- Integrate textual and graphic information into one element in order to eliminate the effect of splitting the learner's attention. This could be accomplished by taking a list of procedural steps and overlaying them on a diagram to show where each step should be performed.
- Eliminate multiple stand-alone sources of textual and graphical information in order to reduce the mental effort needed to deal with redundant information. If a visual or graphic element can fully communicate a concept without additional textual information, then it should be used on its own.
- Present concepts before adding context by giving the learner increasingly realistic visual elements during the instruction. By starting with low-fidelity visual elements and building toward high-fidelity elements, the learner is able to gain an understanding of the concepts rather than being distracted by contextual details.
- Gradually present information to learners through visual and graphic elements. Through the use of this simple-to-complex strategy, the learner will be able to avoid getting overloaded by too much information before processing the required information.
- Strategies to reduce cognitive load tend to have a reverse effect on learners with greater levels of expertise, and thus need to be adjusted accordingly. An example of this would be if the instruction will be used with expert learners who are familiar with a

procedural diagram, the textual instructions could be removed from the graphic element and replaced with numbers for each step.

Finding and Creating Visual and Graphic Elements

Locating or creating visual and graphic elements to enhance instructional activities according to the principles discussed in this chapter may seem like a daunting task, but there are a number of resources available to make the process manageable. If you would like to find visual elements that have already been created by someone else, a number of sites online have collections of images that can be used without having to pay for their use. A few of these sites include:

- Creative Commons image search
- Unsplash
- Pixabay
- StockSnap.io
- Pexels

In addition to these individual sites, you can also use the Google Image Search in order to identify visual elements that have usage rights allowing you to employ them in your instruction without infringing on the copyrights of the owner. Watch this video to learn how this is done:

Google Image Search and the Usage Rights Filter Tutorial

If you are unable to locate existing visual or graphic elements for use in your instruction or have specific requirements in mind, you can always create them yourself in a number of different ways. First, you can take photos with a smartphone or digital camera and download these onto your computer for incorporation into your materials. Second, you could create the visual element by hand with a line drawing that communicates the desired information and scan that image into your computer using a digital scanner or printer. Finally, you can create visual elements in software packages such as Adobe Photoshop or through the SmartArt feature in Microsoft Word or PowerPoint and export them for use in your instruction. Google Drawings is a free, web-based alternative to these types of software that can be used to create charts, maps, or diagrams and download them as PNG or JPEG files without a great deal of design experience. Watch this video to see the basic use of this tool:

Introduction to Google Drawing

Conclusion

Employing the use of visual and graphic elements during the instructional design process is not simply a matter of finding or creating a set of pictures that are somehow related to the textual information in the instruction. Research has shown that visual elements have the potential to increase motivation and foster improved learning outcomes, but only when the appropriate role of visual messages in the communication of information is taken into account. Specific types of visual elements can be used to serve a particular function in the instruction based on the manner in which information is presented, such as showing spatial relationships or illustrating abstract concepts within the text. In addition, following basic strategies for structuring visual and graphic information can facilitate learner processing through the management or elimination of the cognitive load experienced by the learner. In the end, the creation and curation of visual/graphic elements for instructional activities will be well worth the time and effort invested when the purpose of using those elements is aligned with the objectives of the overall instruction.

Application Exercises

1. Using an existing unit of instruction or one that you are in the process of creating, explain how you would use visual or graphic elements to increase the effectiveness of the instruction by doing the following:
    1. Showing spatial relationships or the relative positioning of objects
    2. Illustrating abstract concepts that are presented in the text
    3. Motivating learners to pay particular attention to specific material in the text
2. Using pre-existing instruction or materials you have created, explain how visual elements are used (or could be used) to serve each of the following functions:
    1. Representation
    2. Organization
    3. Interpretation
    4. Transformation
3. Within a unit of instruction that employs visual and graphic elements, explain how at least three of the five strategies for structuring visual elements outlined in this chapter could be used to reduce cognitive load and facilitate processing for the learner.

Additional Readings and Resources

Check out these resources for additional information on the topic of using visual and graphic elements while designing instructional activities:

- 233 Tips on Graphics and Visual Design [PDF eBook]
- Instructional Design and Visual Design: The Pillars of Great eLearning
- 10 Types of Visual Content You Should Use to Increase Learner Engagement
- Accessible U: Instructional Graphics

- Do Learners Understand Your Instructional Graphics? [Podcast]

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Levin, J. R., Anglin, G. J., & Carney, R. N. (1987). On empirically validating functions of pictures in prose. In D. M. Willows & H. A. Houghton (Eds.), The Psychology of Illustration: I. Basic Research (pp. 51-85). New York: Springer.

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Sweller, J., van Merriënboer, J. J. G., & Paas, F. (2019). Cognitive architecture and instructional design: 20 years later. Educational Psychology Review, 31(2), 261-292.

7.5: Simulations And Games

Simulations and Games

Jeff Batt

Simulations present the learner with real world scenarios and allow them to explore the scenario in a "safe" environment. A basic pattern for this is to (a) present or show the desired end result; (b) allow students to safely try the result out; (c) then evaluate if the student is able to complete the task; (d) and allow them to play around with the concepts in an engaging way to deepen their learning. Let's call these: present, try, evaluate, and play.

Present: Presenting starts by showing the learner how to perform a certain action. This could be by simply showing them a video or having them click through a series of slides or steps to see how to accomplish a task.

Try: Trying happens as the learner is placed in an environment that is reminiscent of the real-world environment, but this environment has been simplified, altered to minimize or eliminate risks, or has been otherwise modified to draw out the material to be learned. This is what we mean when we say a simulation is a "safe environment." For instance, in a simulated Information Technology environment, the learner can't cause a system to crash or accidentally send out secure user data as they try things out. You do want the simualted environment to be recognizable when compared to the real-world scenario, however, so that learners get an authentic experience and can transfer what they learned back into the real environment.

Evaluate: After learners have seen the desired outcome and tried it in a safe environment, you want to evaluate them: can they do it in an environment with no extra help and with real consequences? Evaluation helps both solidify lessons learned as well as providing the teacher/instructional designer insight into whether the learner can perform the task or not.

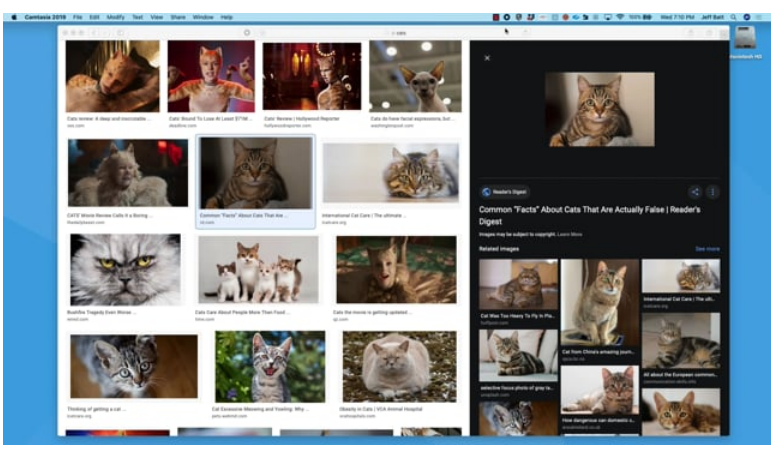
Play: Simulations and games allow for exploration; learners don't have to just proceed through the instructional material in a linear way. And even fun, exciting games can be educational; they create engagement that helps students learn the concepts in a different manner through their simulated play. Games can even create a desire for the student to "try again" to see if they can get a higher score or if they can master a concept. Gaming, then, could be a useful technique to help solidify the concepts being taught.

Keeping these four principles in mind, let's consider how they could be applied in some common scenarios.

Simulation—Watch

One form of an instructional simulation asks learners to watch a procedure or skill. One of the more common forms these simulations can take is the software simulation. A software simulation is essentially showing someone how to do some action on a computer by recording your screen. In Video 1 you can see an example of how to create a Watch simulation using the screen recording tool Camtasia.

Video 1: How to Create a Watch Simulation

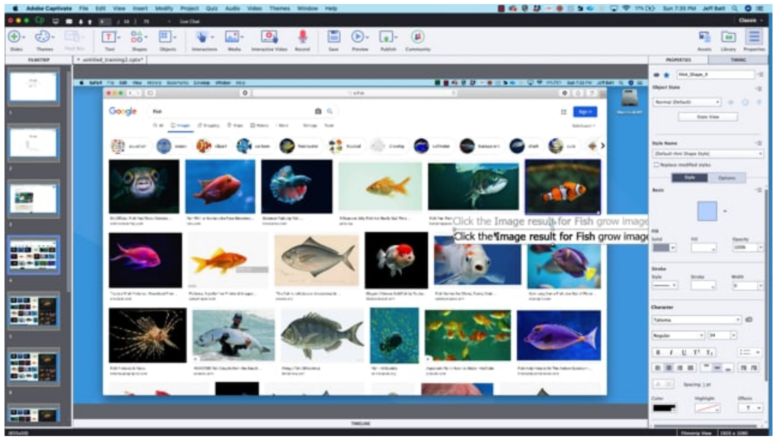


Watch on Vimeo

Simulation—Try

The next kind of simulation is one that allows students to try a skill or procedure themselves. This allows the learner to engage with the content and practice it in a safe environment. There are various applications that can be used for creating a Try simulation; in Video 2 you can see an example of how to create a Try simulation using the tool Captivate.

Video 2: How to Create a Try Simulation



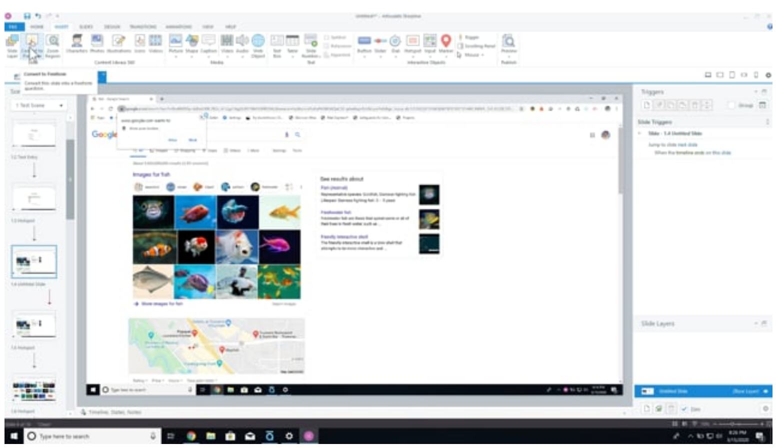
Watch on Vimeo

One last tip: when you create Try simulations, consider including ways that the student could possibly fail. Failing is part of learning; it can help the learner see what happens if they select various alternatives, as well as help them consider how they can recover from their mistakes.

Simulation—Evaluate

After the learner has watched a procedure and tried it out for themselves, you may need to ensure they know how to perform certain tasks. This is where the role of Evaluate simulations come into play. Evaluate simulations help both you and the learner judge if they are able to perform a task they have just learned. The most helpful evaluation simulations are ones that allow the user to fail and learn from their mistakes. The key here is to try to make the simulations as close to the real environment as possible. Video 3 shows you how to get started doing this.

Video 3: An Example of How to Create an Evaluate Simulation



Watch on Vimeo

Simulation—Play

The last type of simulation allows students to play with ideas or concepts associated with the instructional environment. Playing helps learners work with the knowledge they have gained in different, engaging ways. The goal is to help them take what they learn and apply it in novel ways so they are able to master it better. Let's walk through some important parts of a game.

There are key factors that go into creating a learning game which enables this simulated play. I don't think anyone expects you to create a World of Warcraft type game, but there are some parts you can use to make the game stand out in an engaging and fun way for the learner. Some important considerations for Play simulations include: Theme, Progression, and Challenge. Consider each of these principles using the extended example below.

Theme

A theme is a unifying core to your game that helps express its purpose, and bring a sense of harmony between that purpose and the tone, visuals, audio, video, text, and other elements you create. To immerse learners into the game, introduce a theme as soon as possible, perhaps expressed by using a clever or unique logo. This helps the learner know they are exiting the standard instructional format and entering a gamifed environment.

Review this Jeopardy-style game. Notice how a theme is introduced when the learner first begins the game, as are initially presented with a large logo that provides clues about what they will be doing.

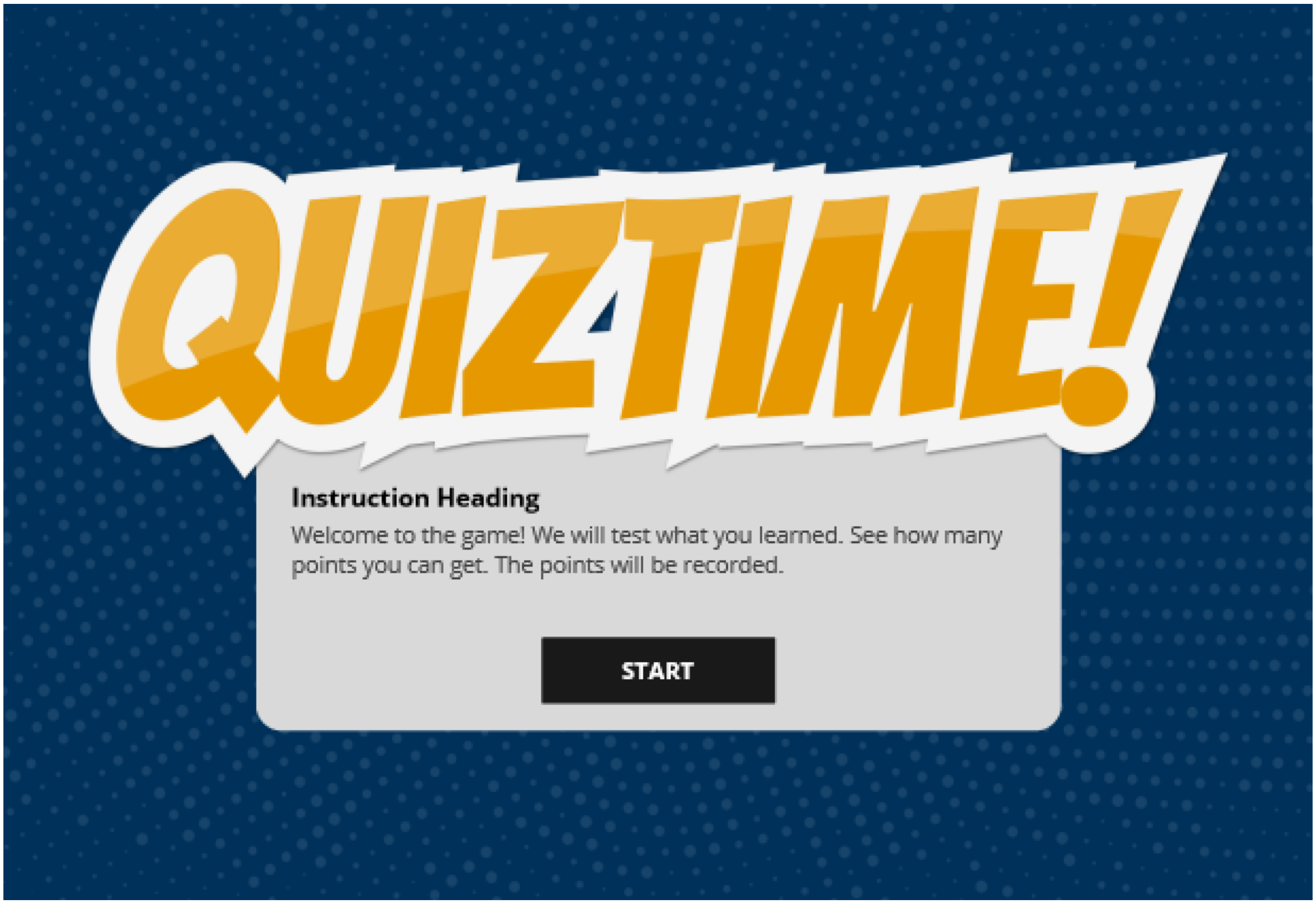


Figure 7.5.1: *Initial Logo of a Game*

Providing a theme has a couple of results. It sets the tone of the game through the logo and visuals that complement the logo. And the theme can help you tell the "story" of the game, or provide cues to the learners about how they should interact with the environment.

Progression

Progression is how learners move from the beginning to the end of your game, and how they navigate through the steps in between. Progression is a principle you could use in different ways. In the case of our Jeopardy game, the tool to manage progression is the game board.

Figure 7.5.2: *Progression Screen*

As the learner moves throughout the game, they clearly see where they have been along with what levels or cards were successful or unsuccessful.

Figure 7.5.4: *Progression Screen Reflecting Progress*

This type of progression tool is also helpful for the learner if they try the game again. They can use the progression board to gauge how they are doing each time they play.

Challenge

Challenges are how you present instructional content and allow learners to interact with that content. In our game, when the learner chooses options on our the progression board, they begin an individual challenge. These challenges can come in many different forms with varying levels of challenge between the tasks. One way to challenge the learner is through a standard question.

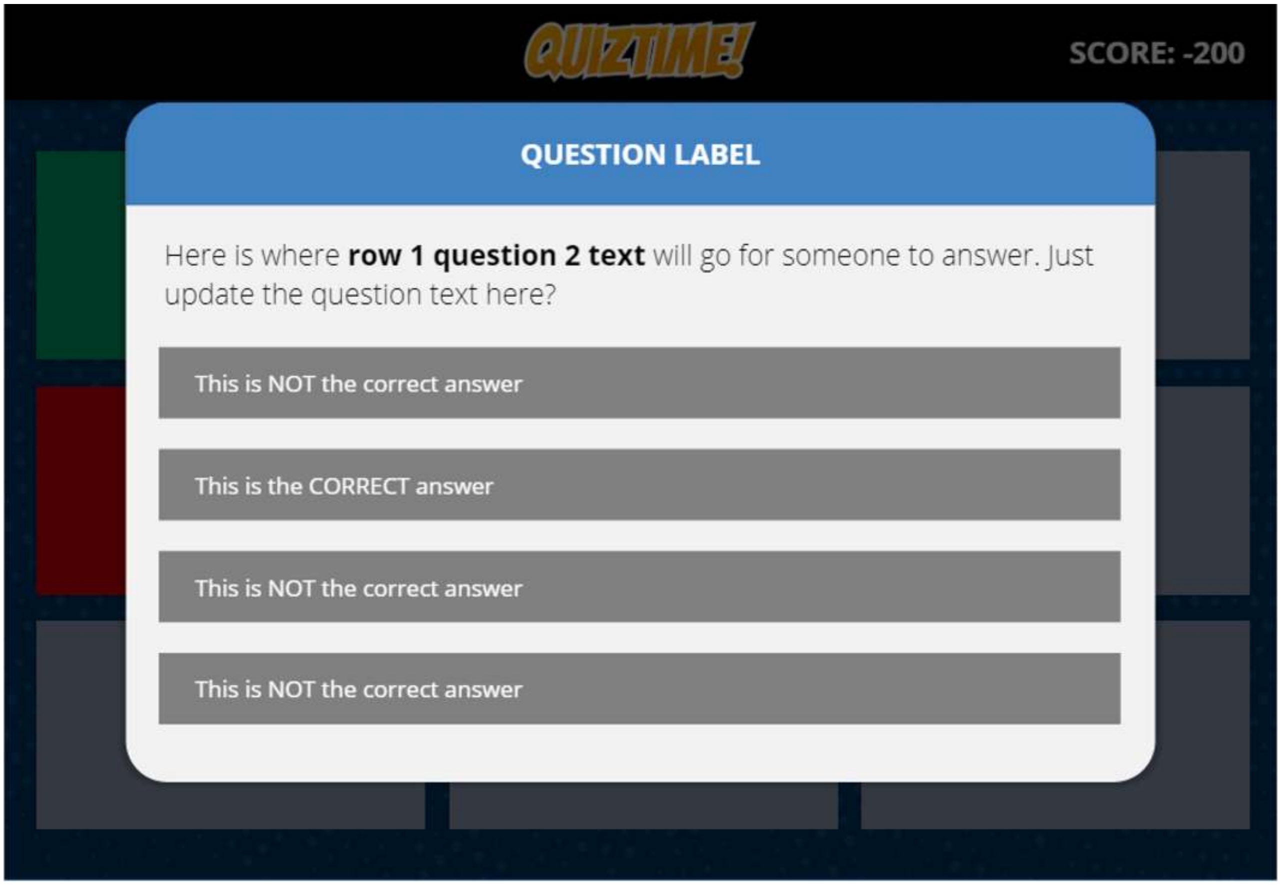


Figure 7.5.4: *Standard Question*

If the learner gets the answer incorrect, they will see some kind of visual indication, and perhaps some feedback.

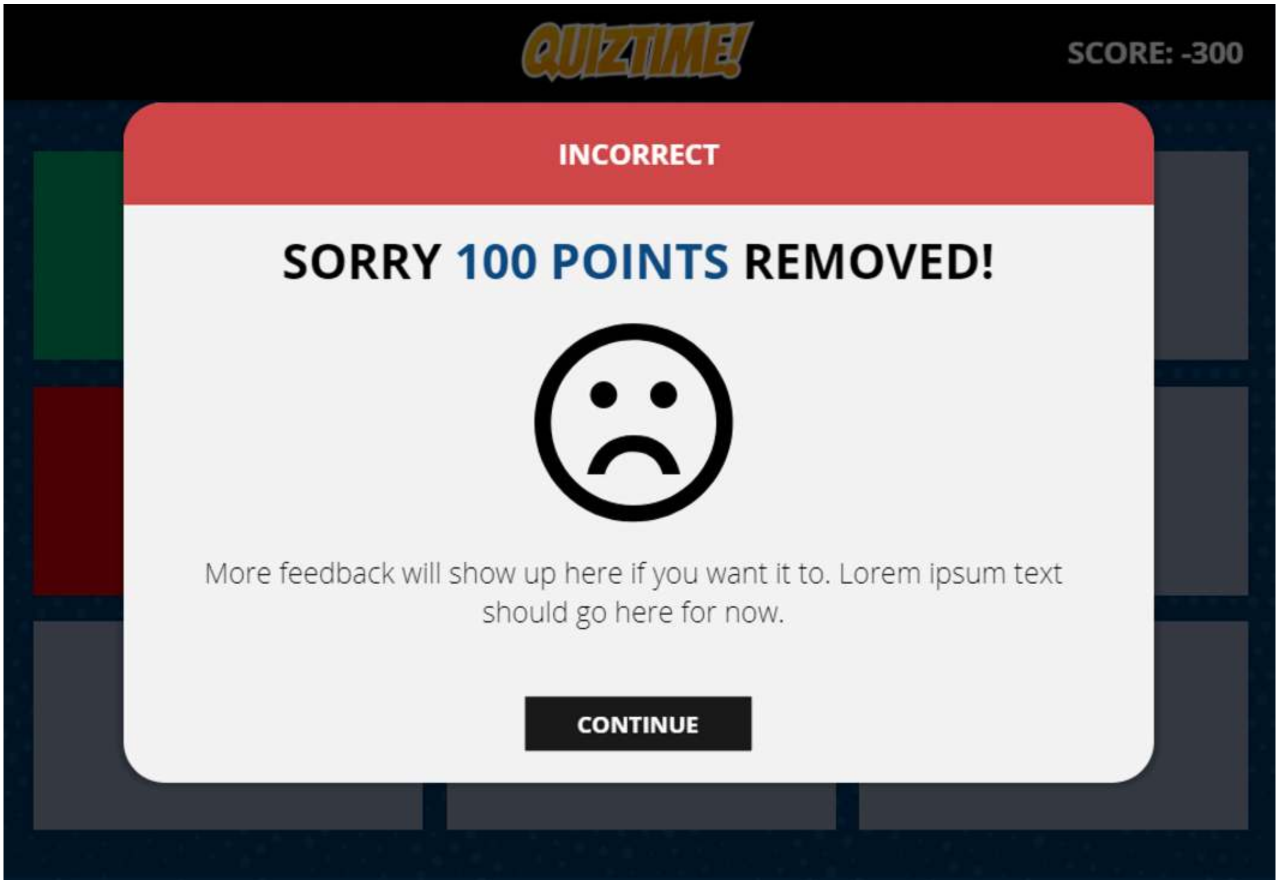


Figure 7.5.5: *Feedback on Incorrect Answer*

If the learner gets the question correct, they will see correct feedback.

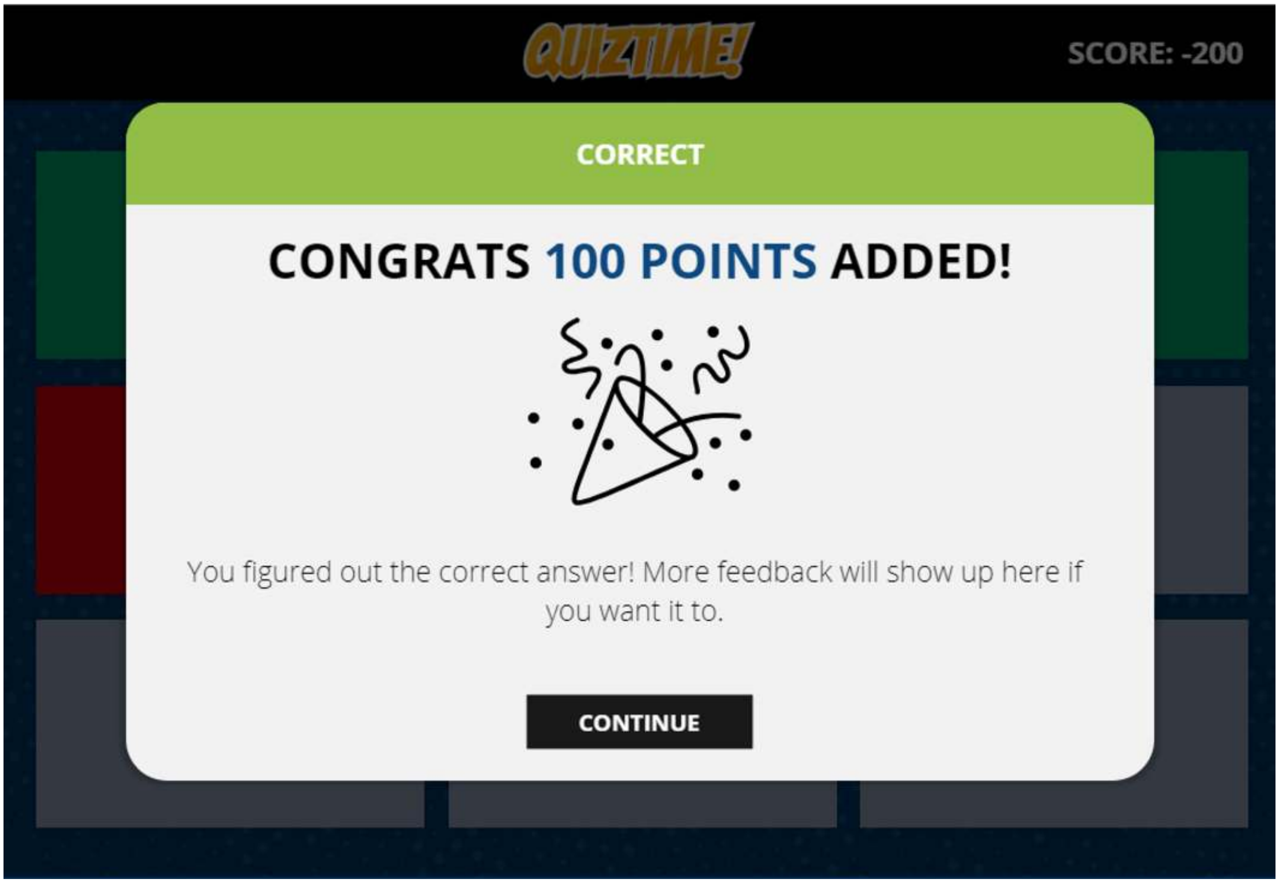


Figure 7.5.6: *Feedback on Correct Answer*

But you can present challenges in ways other than through questions. You can also add some more ambitious aspects into each challenge, like having them try a procedure or a skill.

Also, since this is a game, you might want to have an overall score that is visible to the learner. When the learner gets the challenge correct, the score increases. To make it even more challenging, points could be taken away when the learner does not answer correctly. You could also add a timer or other sense of urgency for students to complete the game.

Managing Interactions in Simulations and Games

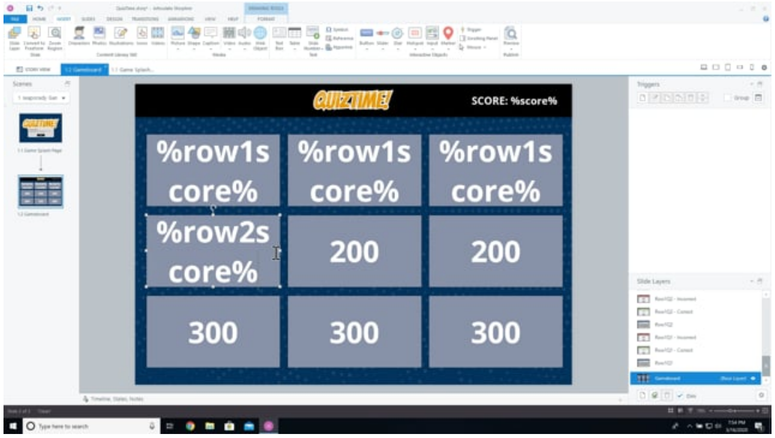
Simulations and games require you to manage interactions that students have with the program, such as when you have to pass information from one screen to another based on how students respond to a question. Three common ways of managing interactions you should know about are Variables, Triggers, and Conditions.

Variables

Variables are storage locations. They hold information that can change or be updated later. The most common type of variable for a game is the Number variable which will store a number value. This is perfect for scoring or being able to calculate end results in a final interaction. For instance, if you create a game with a score, you want to create a variable that holds the initial starting value (probably 0), but can then be changed depending on whether learners earn points or have them taken away.

Let’s explore how to create a variable in this video in a common instructional authoring tool.

Video 4: Creating Variables



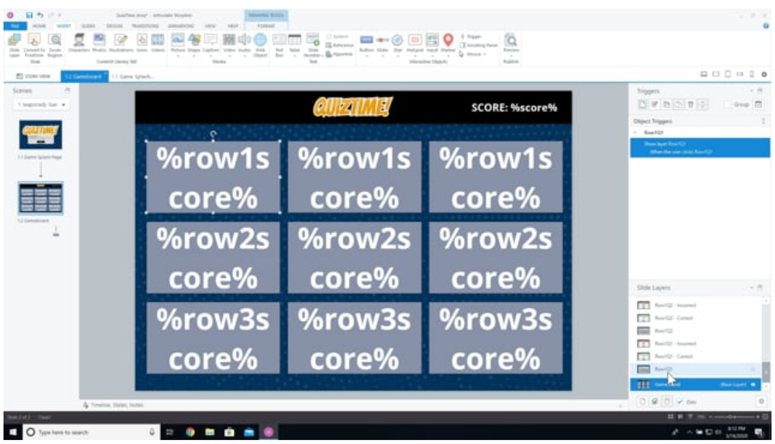
Watch on Vimeo

Triggers

Triggers are events that happen in a simulation. For instance, when a button is clicked, what should happens next? In many instructional authoring tools, you'll use triggers to show and hide different elements based on how learners interact with a page.

You have a lot of flexibility with triggers, and the key to adding different types of interactive play is to try out different types of triggers. Instead of only using standard questions in a game, for example, you can use drag and drop, timed elements, and more. This creates the interaction and intensity of simulated play.

Video 5: Using Triggers



Watch on Vimeo

One key to using triggers is deciding when the trigger will happen. This is done under the "when" part of the triggers. Figure 7 provides a list of instances when a trigger can fire.

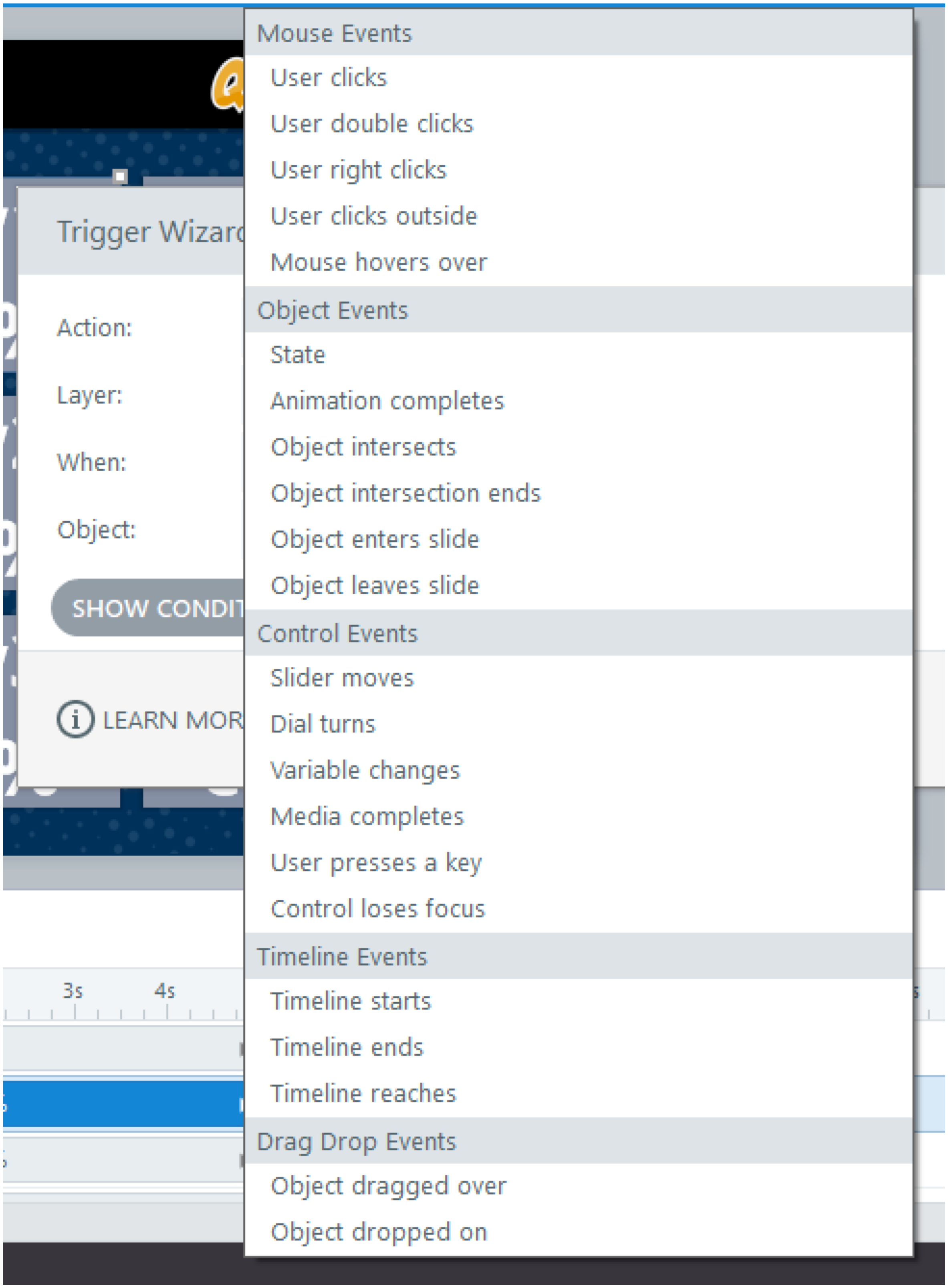


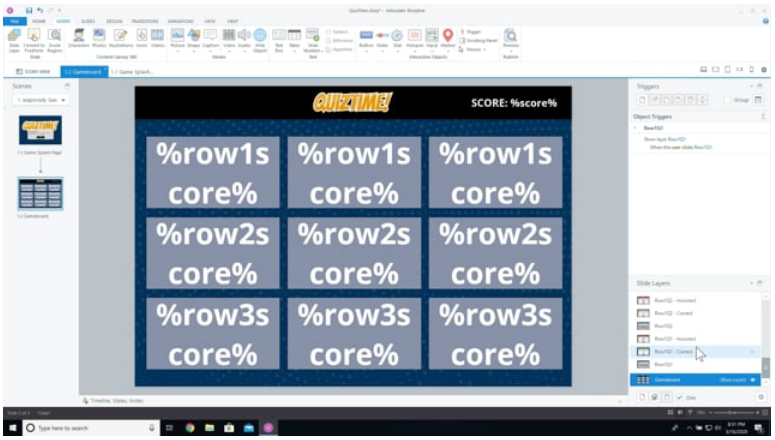
Figure 7.5.7: *Trigger Selection Screen*

Conditions

Triggers are great, but there may be times you only want the trigger to happen if a certain condition is true. Consider the following statement: "If you're happy and you know it, clap your hands."

This is a simple statement, but it reflects so much of what a condition is. It starts with the key word if. Meaning, we only want this condition to happen if certain conditions are true, and the conditions are, "if you are happy and you know it." We are checking for two conditions, then running the action if the condition is true.

Video 6: Understanding Conditions



Watch on Vimeo

Most of the time you will use conditions when you are checking a variable value. So, with the Variable option selected, find the variable you are checking for and select the value. It will then ask you to select an operator. Let's use the score variable and check if it is greater than or equal to 100.

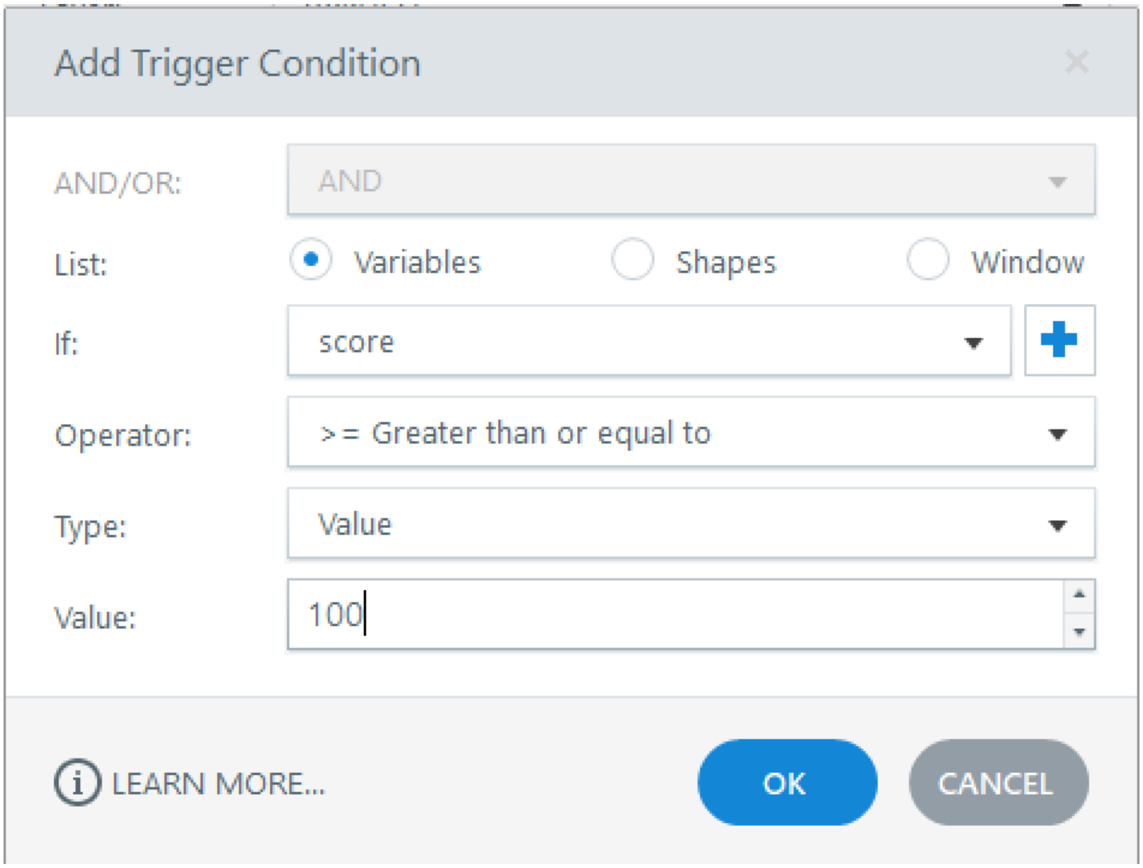


Figure 7.5.8: *Trigger Condition Screen*

Now this trigger will only run if the value is 100 or greater. This is a great way for you to only have triggers run if a condition is met.

Conclusion

The goal of instruction is to help the learner first understand and then be able to apply what they are learning in safe and controlled environment. Simulations and games are great tools for doing this, allowing learners to test the new concepts before entering the real world, practice mastery through fun and engaging games, and try scenarios in an environment that allows them to fail and learn from their mistakes.

7.6: Designing Informal Learning Environments

Designing Informal Learning Environments

Seth A. Martinez & Justin N. Whiting

For the past 30 years, the prevailing 70-20-10 industry model of employee development postulates that 70 percent of individual learning and growth occurs through relevant but challenging experiences, 20 percent through relationships and social interactions, and only 10 percent through formal learning activities (Center for Creative Leadership, 2020; Watkins et al., 2014). What, then, is the implication for learning design given these trends? To assist in taking advantage of such patterns, this chapter is dedicated to the design of informal learning environments.

Defining Formal and Informal Learning

Have you ever sat outside at night and gazed up at the stars? Perhaps you have done this with a child as you talk about constellations. Now imagine you pick up a smartphone with an augmented reality app that can provide instant information and feedback on the stars that you see. Without stepping foot in a classroom or reading a textbook, personalized and on-demand informal learning has occurred. This scenario of real-time information and feedback not connected with any formal setting is one example of informal learning.

According to TrainingIndustry.com, formal learning refers to "a type of learning program in which the goals and objectives are defined by the training department, instructional designer, and/or instructor." Informal learning can be defined as the pursuit of any knowledge, skill, or understanding that occurs outside a formal or non-formal learning event, such as a classroom, training facility, or eLearning course (Dirksen, 2015). Informal learning includes family discussions at home, Googling a topic on the Internet, seeking advice from a colleague, visits to museums, and other everyday experiences (Livingstone, 1999; Bell, 2009). Informal learning has shown to be effective across many contexts (Allen, 2004; Bell, 2009; Miller et al., 2008), especially in work environments (Carliner 2012). Examples in the workplace include "brown bag" learning, like Talks at Google; the Boeing Leadership Center, which devotes an entire portion of the learning path to an open-ended, unstructured mentoring program; and GE's Crotenville training, which is famous for the shadowing and rotation program that was created precisely to take advantage of the informal learning that occurs between a novice and an expert.

In trying to delineate formal and informal learning, it may also be helpful to consider the formality of instruction on a scale. Sefton-Green (2004) stated that informal learning is used quite loosely to describe many kinds of learning that occur outside of schools or other formal settings. Rather than pointing to a specific definition for informal learning, he proposed that learning environments be evaluated on a scale from informal to formal on two criteria: (1) organization of the curricula and (2) the setting, as seen in Figure 1.

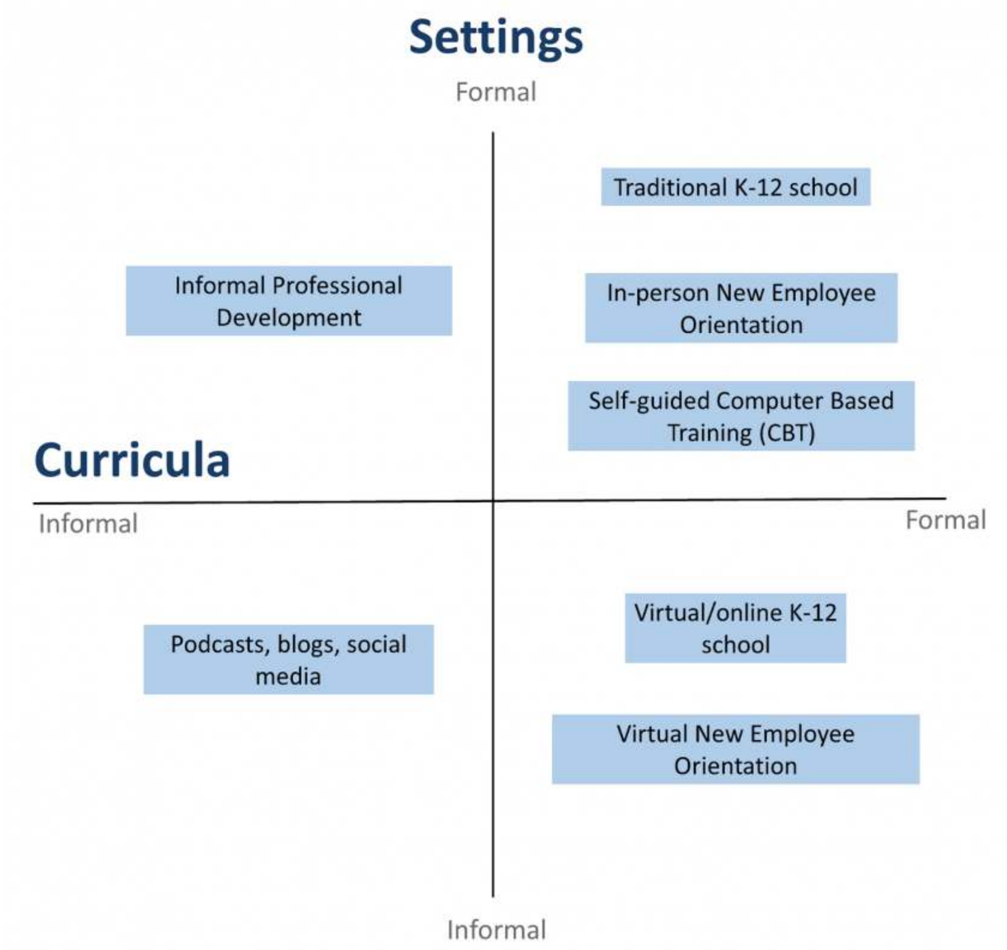


Figure 7.6.1: *Evaluating Learning Environments*

If we use this as a guide to identify informal learning spaces, we can determine not only if a learning environment is formal or informal, but we can see where it might sit on this spectrum. For example, schools have traditionally been highly formal on both the setting and the curricula. But recent growth of online/virtual schools may still be formal and highly structured in terms of the curricula, while the setting may be in someone's own home and on their own time schedule. Similarly, workplaces are using more informal newsletters, podcasts, wikis, or informal professional development, rather than formal, in-person training meetings, or assigned computer-based training.

Designing for Informal Learning

With informal learning now defined, the focus of this chapter shifts to four principles that are effective guides to consider when designing environments conducive to informal learning.

Principle 1: Provide Learners a Choice in Their Learning

Instructional designers should deeply consider how learners are going to interact with content. For teachers and professors developing a syllabus, allowing the learner a choice in their learning experience can have a direct link to intrinsic motivation (Cordova & Lepper, 1996). Consider providing several options for a midterm assignment and allow the learner to decide which assignment looks most relevant to them. Or, rather than assign a topic for a project, allow the learner to submit a proposal of a topic of personal interest.

In a corporate setting, developers can provide a list of possible related topics, and only require mastery of one. Consider curating a library of resources in various media such as video, image, text, audio (podcast), self-guided modules, and then allow learners to decide how to gain mastery of the topic. Even in instances where there is a more strict set of regulations (e.g. compliance) that must be covered, there are options to allow the learner some control over their learning. For example, consider presenting the content not in a linear way, where the learner proceeds from topic A to topic Z, but instead allow them to choose the order of topics they may want to go through first. Instead of a bulleted list or outline in a computer module, consider a more visual layout where they can choose the order from a group of topics.

Museums have long been an excellent example of providing learners with a choice in their learning experience. While museums may provide courses, scripted tours, and other formal learning experiences, for many, museums are open spaces that encourage exploration and even learning through failure (Simpson et al., 2019). Museum educators carefully plan out displays, flow of the rooms, and many other factors to create fun and engaging environments. Learners in a museum choose where they go, how long they interact with a specific exhibit or section, and generally do not have many constraints.

Principle 2: Design for Collaboration, Idea Sharing, and Peer Interaction

While teamwork, collaboration, and group projects are all components of formal learning, informal learning is also well suited to benefit from social interaction. Albert Bandura argued that “most human behavior is learned observationally through modeling: from observing others, one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action” (p. 22, 1977). Further, Lev Vygotsky maintained that social learning consists of learning through social interaction (1978).

When more specific knowledge is needed by an individual, a personalized informal experience in the form of coaching or mentoring will allow a novice to learn directly from an expert. A learning experience that centers on group work and peer interaction will invite informal learning to take place as individuals pose questions to and receive answers from their teammates and colleagues. To do this, consider assigning group tasks or projects, or posing problems that require multiple individuals to complete. A technique to take advantage of the unscheduled nature of informal social learning is to design a wiki or forum system that leverages the knowledge of the community in a socially constructed manner. Lastly, an emerging trend in informal learning is *microlearning*—small learning units such as text phrases, photos, or audio snippets—and its associated affordances for instructional designers (Giurgiu, 2017). For the specific principles of microlearning design, see Zhang and West (2020).

Principle 3: Leverage the Benefits of Constructionism and Project-Based Learning

Constructionism and project-based learning are two additional areas where we can design informal learning opportunities. With constructionism and project-based learning, learners typically become active participants in the experience and learn organically as they work through a challenge. Designers working to implement informal learning principles can include opportunities for exploration and creation. Many businesses have implemented innovation centers or creativity labs where new ideas can be tested and prototyped. For example, Pixar fosters innovation and encourages their employees to develop new skills through their Pixar University. As part of the “university,” employees can sign up for free classes in painting, ballet, or sculpting. Additionally, Lowe’s Home Improvement company has created innovation labs where employees reimagine how to help customers using augmented reality to plan virtual home renovation projects. Allowing learning through experimentation and failure can lead to better quality products and services (see April 2011 issue of Harvard Business Review).

A recent trend in schools, communities, museums, and even healthcare, is the rise of makerspaces. Makerspaces provide a physical space where many forms of constructionist and project-based learning may occur (Peppler et al., 2016). Maker Faires have been promoted and popularized by *Make Magazine* and other organizations around the globe. The effort to overcome constraints can often lead to creativity in these spaces (Stokes, 2005). In a makerspace, learners may be mentored by another individual on how to use a machine such as a 3D printer or laser cutter. Often, small groups may work together to prototype and test ideas.

Principle 4: Leverage the Benefits of Gamification and Playful Competition

Playful competition and gaming are proven mechanisms for increasing learner engagement (Steinkuehler & Squire, 2014). While the principle holds for formal learning, it is particularly effective in designing informal learning environments. Gamification is “a relatively recent term that describes using game thinking and game mechanisms in nongame contexts to engage users (Deterding, 2013)” (Steinkuehler & Squire, 2014, p. 389). The key criteria for an effective gamified design are exploration, immersion, socialization, and competition.

To design for exploration, it is important to design an experience that does not necessarily have a single path toward a solution. This allows the learners to truly discover, explore, make mistakes, and iterate. To design for immersion, it is important that the challenge be such that the only way to solve the problem is with dedicated, focused time, over an extended period. For example, learners can (a) build or produce an artifact from scratch, (b) solve a problem that requires the synthesis and application of multiple concepts simultaneously, (c) give or receive feedback to or from peers or experts where they must refine their work as part of the final solution, or (d) some combination of all three. (Socialization is discussed in Principle 2 above.) To design for competition, it is helpful to consider something that determines one or multiple winners. Challenges with levels, simulations, scoring, badges, and leaderboards are features of competition that you can incorporate into your design.

Designing for Informal Learning at Adobe

In late 2016, the Adobe CTO set forth a new charge: to upskill all software engineers (SWE), of which there were approximately 6,000 globally, in the machine learning (ML) discipline. To accomplish this, an ML Training Program was launched to begin the process of mass upskilling. After one year, an initial cohort of 1,000 individuals had completed the five-month e-learning courses, bringing with them many lessons learned. One consistent point of feedback across multiple stakeholders was that an opportunity for more in-person, hands-on learning was needed compared to the one-hour-per-week classroom sessions that had been available for the participants over the five months. In this instance, the challenge loomed large to introduce a more intensive in-person, hands-on experience to 1,000 people who were scattered across the globe.

To address the feedback, the training team designed and implemented a bootcamp model that incorporated a project-based competition in the form of a hackathon for the second cohort of 1,000. The bootcamps would be three consecutive days each. Over those three days, the team would spend three-fourths of one day delivering company-specific material related to the company's AI/ML platform. The remaining two and one-fourth days for the learners would be spent in the hackathon competition, thus allowing for the immersive and dedicated time-on-task.

To start each hackathon, the training team provided the basic rules and constraints. Bootcamp attendees would divide into small teams of two to six people, organized by their shared ML interests. To gamify the hackathon, each team was asked to prepare a brief "Venture Capital Pitch" to present the ML feature they each worked on over the two or more days. There were four categories that would be awarded winners: most interesting feature, most likely to become an actual Adobe product feature, most whimsical, and best overall feature. During the course of the entire hackathon, a small number of ML experts would roam the large room and answer any questions a team may have.

By creating this environment, the learners spent two or more days laboring to develop their ML feature. The ID team observed that the competition fueled their natural interest by increasing the participants' drive to ask project-relevant questions and to consume publicly available ML content on the internet. Numerous teams arrived hours before the days started and stayed hours past the day's allotted block of time. Participants would extend what they had learned from the e-Learning courses by scouring publicly available websites to find help for their unique scenarios. Some would watch brief tutorials and, if relevant, immediately teach their teammates what they learned; other teams would divide and test out open-source code and, once successful, exclaim "I got it, it worked!" for the others on the team to know they need not search further.

This pattern repeated itself constantly over the approximately two days. Ultimately, the hackathon experience fostered an environment in which participants would seek out anything and everything to assist them in overcoming an obstacle and therefore advance the ML feature they were designing in hopes of building a competitive feature for the competition. In the end, knowing (and hearing) the effort put forth by all teams, the participants reported taking great pleasure in listening to the presentations and viewing the demos of each team's ML solution developed over the hackathon.

Reflection

Table 1 below lists several informal learning activities with their associated strengths and limitations. The application exercise that follows Table 1 will assist in your thinking of when and how to apply the informal learning design principles discussed in this chapter.

Table 1

Strengths and Limitations of Informal Learning Activities

Learning Activity/Tool	Description	Strengths	Limitations
Project- or problem-based scenarios	Projects/problems allow learners to appropriately struggle through arriving at a solution. The struggle area is essentially the zone of proximal development, where informal learning occurs.	• Can address multiple learning objectives with a single problem scenario • Can be accomplished in small groups, thus alleviating the need for a high number of experts to provide guidance or help	• Cost: potentially very expensive to execute • Time: potentially very time-consuming to design, execute, and evaluate
Coaching or mentoring programs	An example of social learning, where a novice can learn directly from someone more expert. The cycle of practicing/trying, receiving feedback, and trying again is strongly supported by an expert who serves as a guide.	• Close proximity to relevant expertise • Feedback that is very specific, timely, and personalized • Often 1:1	• Time: often difficult to design a program that requires so much time of someone senior in experience • Challenging to find one (let alone many) individuals with seniority willing to participate
Job aids, wikis, tutorials, or internal forums	A strong collection of relevant resources is generally superior to formal instruction. In contrast to formal instruction, these resources require little cost, take little time to design and produce, and are extremely tactical in nature.	• Cost: minimal • Speed: utility is all that matters, so they can be created quickly • Crowd-sourced information is often highly actionable	• Potential lack of monitoring/governance • Because utility is most important, they can sometimes be poorly designed visually
Communities of practice, learning networks, or external forums	A community of practice is designed for, and by, the interested participants themselves.	• Cost: typically free or inexpensive • Typically more broadly applicable than information in an internal forum • Maintenance & governance	• Can be overly general (i.e., not applicable enough)
Exhibits, museums, or performances	Exhibits and museums are open spaces that encourage exploration and even learning through failure. At a performance, an individual learns through observation.	• Exhibits and displays can be highly engaging • Socializing with other attendees/participants is common, thus inviting the social component of informal learning • Observational learning is also very effective (Bandura, 2003)	• Cost: entry can be potentially quite expensive • Time: to maximize learning at a performance or museum often requires multiple hours, minimum.

Application Exercise

For your reflection:

1. What is the relative amount of information intended to be taught?
   1. If it is a considerable amount, consider a formal learning approach.
   2. If it is a small amount, formal learning could simply be excessive. Consider a simpler solution like a wiki or job-aid that would require much less time/cost to create.
2. What needs to be learned? Is it explicit or tacit?
   1. If it is explicit information (i.e., codified or written down), then consider formal instruction.
   2. If it is tacit information (i.e., not codified or recorded), consider leveraging an informal learning environment.
3. How complex is the material?
   1. If it is highly complex, consider formal instruction.
   2. If it is not highly complex, consider leveraging a social learning component, where participants must work together or share knowledge to achieve a common goal.
4. How much/often is the content subject to change?
   1. If it is not often, consider formal instruction. Taking the time, cost, and effort to design a formal experience is justified when it will have a long shelf-life.
   2. If the content will change fairly often (or more), then consider an informal learning design which, by definition, embraces a changing landscape and seeks up-to-date, accurate information—regardless of the source.

Conclusion

The evidence is clear that often, learners gain knowledge predominantly outside of formal settings. As a result, instructional and learning experience designers should be intentional about taking advantage of the affordances of informal learning. To that end, as you follow the four design principles shared above, you will be able to design informal learning experiences that take advantage of the natural interests and curiosity of your learners.

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The Design of Holistic Learning Environments

Jason K. McDonald

One of the factors that makes a design compelling is when it has a sense of harmony and completeness. When we experience the design, it does not feel like a collection of individual parts that just happen to be together. Instead, they "fit" together. In fact, we likely do not stop to consider the discrete components making up the design at all. But if we do notice the individual parts, we typically can sense how each belongs. There is a sense of balance and resonance that emerges from the precise configuration we experience. We see the design as a whole, meant to be experienced as a whole. And in the best cases, the sense of completeness and balance somehow extends into us—we feel more complete and more in balance because we have encountered something as complete and in balance as this design. Nelson and Stolterman (2012), in their book, *The Design Way: Intentional Change in an Unpredictable World*, call this type of experience holistic design. In this chapter, I consider some of the conditions that lead to holistic designs, along with what these conditions could mean in the context of instructional design.

Figure 1 presents a diagram from *The Design Way* that highlights the major conditions of holistic design. Discussion of the entire diagram is more complex than we need to consider here, but if you are interested in the topic, I encourage you to review Nelson and Stolterman's complete treatment in their book (Nelson & Stolterman, 2012, pp. 93–102).

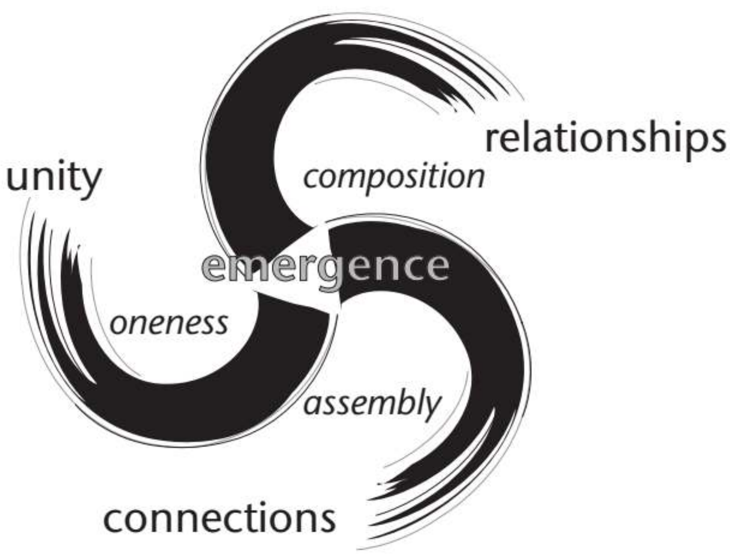

Figure 7.7.1: *Dimensions of Emergent Wholes*

Note. Reprinted from Nelson, H. G., & Stolterman, E. (2012). *The design way: Intentional change in an unpredictable world* (2nd ed.). The MIT Press, p. 94. Used by permission; all rights reserved.

The diagram illustrates how we can design objects or services in a way that transcends the individual parts from which they are assembled to create something holistic. As Nelson and Stolterman put it, we rely on "those unifying forces that cause things to stand together . . . thus forming meaning for individuals who are part of the whole or served by the whole" (p. 94). When something is holistic, it has properties that cannot be predicted when we examine each of the pieces individually. But that does not mean the individual parts are not important. Quite the opposite, in fact. Each component contributes something to the overall sense of the whole and is necessary to achieve the effect of the whole. Removing or changing the pieces, then, could lead to a design with a completely different effect.

Holism is not often addressed in instructional design. Perhaps the closest we come is when we consider the graphic design of our instruction. In this case we do frequently consider what effect the visual components of our instruction are having, and if they are contributing to an overall pleasing visual sense. (For tips on how to create a pleasing visual design, see the articles The Building Blocks of Visual Design or 10 Basic Principles of Graphic Design). Holism is important to consider in other aspects of instruction as well. Yet despite its importance, holistic design can also be difficult to talk about explicitly. The effects it has are subtle. But using Nelson and Stolterman (2012) as our guide, let's explore some ways that the instruction you design can inspire a sense of holistic completeness.

Connection

First, consider the effects of the connections between individual elements in your design. There is an analogy here to connections between physical objects: when joining together two pieces of wood, we connect them with a nail or a screw. When joining together pieces of metal, we connect them with a weld. We can also consider more sophisticated methods of connecting when we include the idea of an intermediary fastener. Nails and screws are a direct connector between two pieces of wood, and the result is a rigid link. But we could connect our wood using an intermediary: a hinge. We screw the hinge into adjacent pieces of wood and the result is a connection between the wood that is more flexible. When building an object, then, we need to consider what materials we are working with, and this will help us decide what kinds of connections we can make. Then we consider what we want the connection between the elements to be, and this will help us further choose an appropriate link to achieve our objective. A holistic design will choose connections that are both appropriate for the material being used as well as the type of connection that is desired.

There are at least two applications of this analogy to instructional design. The first is between different elements of an instructional product that students experience. What types of connections are possible between the different pages of an online educational activity, for instance? Or between elements on the same page? Or between different units of the same course? The types of connections that are possible will be partly a function of the material the designer is working with (images, text, web pages, etc.), and partly a function of the effect the designer wants to have (the student can choose between these three pages; or the student must go to this page, etc.). Attentive designers will consider the connections between these elements as much as a carpenter will consider the connection between wood beams supporting the structure they are creating.

Another type of connection instructional designers can consider is between the different layers of their instruction. Gibbons (2013) proposed that all instructional products or learning systems are composed of different layers that perform different functions in a design. For example, one of the layers is the representations that students experience (what they see, hear, touch, etc.). Another layer is the controls that students use to input information back into the instruction (typing into a text box, submitting a form, or answering a teacher's question). There must be some kind of connection between these layers for the instruction to have its effect. If instructional designers pay attention to the effects they want each layer to have, they can find connections between the layers they can intentionally design to help lead to that effect. Similar to connections between individual elements, designers should both pay attention to the material each layer is made of (physical or conceptual) as well as the type of connections that are appropriate for the intended effect.

Application Exercise

Find an example of an instructional product or service (perhaps an online training module, a face-to-face classroom lesson, or a museum-type experience). Ask yourself:

- What are the individual elements of which the product is composed? (e.g. different pages in the module; different activities in the lesson)
- What is connecting those elements together?
- Why do you think they were connected in that way?
- Can you imagine alternative ways of connecting these elements?

Relationships

The second condition of holistic design is the relationships between elements in a design. Relationships are similar to the idea of connection, since every relationship connects different entities in some way. So everything just described about connections applies to relationships as well. But relationship implies more than the fact that elements are connected. The idea of relationship implies there is a structure to the connection, one that suggests an effect that transcends what the individual elements provide on their own. When two (or more) things are in relationship with each other, we can see that they belong together. Returning to our previous example of making something out of wood, we can easily nail together wood of any shape or size. But a relationship between different pieces of wood implies that we have done more. We also consider how our joint between the pieces fits together harmoniously. We might cut one board so it fits into an existing grove in the other. Or we apply stain or paint so the coloring of the wood produces a pleasing effect when placed next to each other. We can also consider the relationship of what we build with something larger than itself. For instance, when we ask whether a chair fits in a room, we usually aren't talking about if we can actually squeeze it into the space. Rather, what we usually mean is does the chair feel like it belongs? Is the relationship between the chair and the rest of the furniture harmonious? Or does it feel like the chair came from a different family than everything else in the room?

Parrish (2005) described some ways that instructional designers can pay attention to the relationship between elements in their designs. He encouraged designers to pay attention to the "rhythms of instructional activities" in their products, to find "methods for creating dynamic tension and revealing unity within content sequences," or to develop "strategies that provide memorable closure to learning experiences" (p. 17). In each of these cases, elements in an instructional product would not only be connected in some way, but the structure of that connection would produce an aesthetic effect. This effect transcends the actual material being interacted with in a way that communicates messages that often cannot be spoken (e.g. why a subject matters, what is beautiful about it, or how might I [the student] be changed by it).

Application Exercise

Using the example you found earlier, try identifying the relationships between elements in the instruction. Ask:

- What are the structures of the connections identified in this instruction?
- What kind of effects do those relational structures suggest?
- Can you imagine alternative relationships that can connect these elements?

Unity

The last factor to consider is unity, or the overall effect the connections and relationships have in a complete design. In considering unity we should first recognize that there will always be connections and relationships between design elements. If designers do not consider them intentionally (leaving them to chance), people will look for some kind of connection, and there is no guarantee the designer will be happy with what they find. When designers do not intentionally plan for unity between connections/relationships, often this leads to the design being experienced as disjointed. People may not be able to identify what about it is dissatisfying, but they will sense something about it that is harsh or jarring. But worse is when the connections and relationships that people find generate a sense of dissonance or incongruity, an active sense that these elements do not belong together. And more than being slightly displeased with the design, people actively dislike it, again often without knowing exactly why.

But if connections and relationships are intentionally considered, they can generate an overall, unifying effect that is pleasing and pleasurable to experience. People feel comfortable with these types of design. Wilson (2013) described this as "how elements hang together" for the person experiencing it, "and support [them having] a coherent experience" (p. 40). The word coherent is the key. Unity is a result of everything in the design seeming to belong, to be in its proper place, and be in that place for a proper reason. Let's assume we designed and built a beautiful, ornate chair, with intricate patterns in the legs and a soft, luxurious fabric on the back and seat. If we place the chair in an elementary school cafeteria, it will stick out. Any sense of unity in the room (assuming there was one before!) would be lost. But if we place our chair in a university library, perhaps in a special collections reading room, it could contribute to a sense of unity that people experience in the room as being a place of learning.

How does unity apply in instructional design? Parrish (2009) described it as the designer's care for experiences that are "infused with meaning, and felt as coherent and complete" (p. 511). While there might be multiple ways to do this, Parrish proposed that designers can pursue unity by intentionally considering connections and relationships between instructional elements that (a) create distinct beginnings, middles, and endings for the instruction; (b) set students in the role of being the protagonist of their own learning; (c) set a theme for the instruction through the choice of learning activities; and (d) create a context that immerses students in the instructional situation.

Application Exercise

Using the same example as before, consider the sense of unity you experience with the instruction. Ask:

- Do the connections and relationships in the instruction contribute towards an overall effect?
- How would you characterize this effect?

- Is there any evidence to suggest this effect was intentionally considered by designers? Or did they seem to leave it to chance?
- What might you change about the instruction to generate a stronger sense of unity?

Conclusion

Nelson and Stolterman (2012) concluded that a holistic design creates emergent qualities, or qualities that cannot be experienced when only considering the individual elements that are connected together in intentionally considered relationships of unity. They also stated these emergent qualities have "significance" for the people using a design. They mean something to people, and "embody [some] essence of human potential more fully" (p. 101). This seems to be sufficient justification for considering holistic design as part of the instructional design process. Instructional design is about helping people learn, or, in other words, unlocking some aspect of their human potential. And it is more than the educational content and instructional strategies that do this. To create designs that are truly remarkable and uncover at least some aspects of human potential, people need to experience instruction with emergent, holistic qualities. These are generated as designers consider the connections between individual elements of their instruction, form those connections into structured relationships, and align both into a unified whole that can produce an aesthetic, transcendent effect.

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7.8: Measuring Student Learning

Measuring Student Learning

Lisa Harris & Marshall G. Jones

Measuring student learning is critical in the teaching and learning processes and can serve many purposes. Instructors can use assessment results to plan future instruction, adapt current instruction, communicate levels of understanding to students, and examine the overall effectiveness of instruction and course design. The measurement of student learning can take place before, during, or after instruction. Before lessons are even developed, instructors need to know what students already know and can do related to the content. There is no point in wasting time teaching something students already know, or in starting at a level that is so advanced students don't have the prerequisite knowledge necessary to be successful. To that end, the learner analysis in instructional design could be considered a type of assessment. Giving a pre-assessment, also called diagnostic assessment, can provide instructors with this valuable information. Measuring student learning during instruction, a formative assessment, provides instructors with important information about how students are progressing towards the learning objectives while there is still time to adjust instruction. Instructor may ask questions such as:

- Are students getting it?
- Are they confused about something that needs to be retaught?
- Is it time to move on with new material?

Finally, measuring student learning at the end of instruction, a summative assessment, provides information about the degree to which students mastered the learning objectives.

This chapter outlines practical strategies instructional designers can use to develop high-quality assessments to measure student learning. Best practices are the same for constructing diagnostic, formative, and summative assessments. Links to additional tools and resources are also provided.

Constructing High-Quality Assessments

High-quality assessments are those that lead to valid, reliable and fair assessment results. Validity refers to the trustworthiness of the assessment results. For instance, if a student gets 80% of test items correct, does that mean they understand 80% of the material taught? Does the assessment measure what it purports to measure, or is the final score polluted by other factors? For example, consider a test that assesses mathematical ability and is made up of word problems. When taken by an English language learner or by an emerging reader, does the test assess math, reading, or a combination of both? The reliability of an assessment refers to the consistency of the measure. Multiple-choice test items, when properly constructed, are highly reliable. There should be only one correct answer and it is easy to grade. Essay items or performance assessments, on the other hand, are more subjective to grade. Finally, the extent to which an assessment is fair is a characteristic of a high-quality assessment. Fairness is the degree to which an assessment provides all learners an equal opportunity to learn and demonstrate achievement. While some aspects of validity and reliability can be measured through statistical analysis, it is uncommon that such complex measurement procedures are used for typical classroom assessments. Attending to best practices in assessment alignment and test item and assessment construction helps instructional designers increase the validity, reliability, and fairness of assessment instruments.

Assessment Alignment

One of the most important concepts in assessment is alignment. It is critical that assessments and assessment items are aligned with goals and objectives. It is impossible to determine the extent to which learners have met course or workshop goals and objectives if their knowledge and skills have not been assessed. Assessment alignment tables and test blueprints are two tools instructional designers can use to align assessments and assessment items with learning objectives.

Learning Taxonomies and Learning Objectives

Learning taxonomies assists instructional designers in constructing both learning objectives and assessment items. Bloom's Revised Taxonomy and Webb's Depth of Knowledge (DOK) are two frameworks commonly used by educators to categorize the academic rigor of an assessment as a whole or individual assessment items. To increase the content validity of an assessment, the complexity of the individual test questions should align with the level of knowledge or skill specified in the learning goal. If a learning objective states that a student compares and contrasts information, it is not appropriate for test items to simply ask students to recall information. Likewise, if the learning goal states that students will be able to synthesize information, a paper-and-pencil test will likely not be a sufficient measure of that skill.

Bloom's Revised Taxonomy divides learning into three domains: cognitive, affective, and psychomotor (Anderson et al., 2001). This chapter focuses on the cognitive domain which consists of six levels that vary in complexity. The three lower levels (remembering, understanding, and applying) are referred to as lower order thinking skills also called LOTS. The top three (analyzing, evaluating, and creating) are referred to as higher order thinking skills, or HOTS. Lists of verbs associated with each of these levels are readily available on the web and are very instrumental in helping instructional designers write measurable learning objectives and test questions that go beyond recalling definitions. (For an example, see: https://edtechbooks.org/-EZbp.)

Similar to Bloom, Webb divides levels of knowledge into increasingly complex categories. These include recall and reproduction, skills and concepts, strategic thinking, and extended thinking (Webb, 1999). Student tasks range from a student being able to recall facts to synthesizing information from a variety of sources. A description of tasks at each level can be found online at https://edtechbooks.org/-bVW. These descriptions can help instructional designers design assessment tasks that range in complexity.

Assessment Alignment Tables

Regardless of the assessment method, instructional designers can ensure that learning goals, objectives, and assessments align by creating an alignment table. In the example below, course goals, student learning outcomes, and assessments are aligned in a table. This example is from a college level course on teaching with technology for pre-service teachers. This table indicates there is at least one learning objective aligned with each course goal and at least one assessment method aligned with each objective. If you find that a particular learning objective isn't being assessed, you can go back and develop an assessment to measure the learner's progress. A link to an Assessment Alignment Table Template is provided at the end of this chapter in the Additional Resources list.

Table 1

Example Assessment Alignment Table

Course Goal	Student Learning Objective (SLO)	Assessment(s)
Plan and implement meaningful learning opportunities that engage learners in the appropriate use of technology to meet learning outcomes.	SLO1. Develop a technology integrated activity plan that meets the needs of diverse learners (e.g. ELL, at-risk, gifted, learners with learning disabilities).	Technology Integration Portfolio
	SLO2. Explain how and why to use technology to meets the needs of diverse learners (e.g. ELL, at-risk, gifted, students with learning disabilities).	Technology Integration Portfolio Midterm
Use technology to implement Universal Design for Learning.	SLO3. Describe the elements of UDL included in the technology integrated activity.	Technology Integration Portfolio
Model and require safe, legal, ethical, and appropriate use of digital information and technology.	SLO4. Describe legal, ethical, cultural, and societal issues related to technology.	Midterm Final

Table of Specifications

In addition to creating an alignment table for all assessments in the entire course, instructional designers can also create a table of specifications, or test blueprint, to align individual test items to course objectives. A table of specifications aligns the learning objective, all items on a single test, and the level of knowledge being assessed. This is evidence of content validity. This also helps the instructional designer see if the test includes items related to all the learning goals, and if the assessment items are written to elicit knowledge at the appropriate level of complexity. If you find that you have too many questions about one topic or not enough about another, or that you are only asking lower level questions when the learning objective is focused on higher order thinking skills, the test can be edited accordingly. The figure below shows a test blueprint for a 12-item test about assessment. Each number represents the question number on the test. A link to a Table of Specifications Template is provided at the end of this chapter in the Additional Resources list.

Table 2

Sample Test Blueprint for a 12 Item Test

Learning objective	Level of Knowledge	
	Lower Order	Higher Order
Analyze learning objectives in terms of format, specificity, reasonableness, and alignment.	1, 2	8, 12
Explain the importance of alignment when designing lessons and assessments.	3, 5	10
Compare and contrast reliability and validity of classroom assessment	4, 6, 7	11, 9

Assessment Formats

Common assessment formats include multiple-choice and essay questions, observation, oral-questioning, and performance-based assessments. This chapter focuses on paper-and-pencil tests and performance assessments. Best practices in constructing each are described below. These guidelines help increase the validity, reliability, and fairness of assessments.

Multiple-Choice Best Practice Guidelines

Multiple-choice items are very easy to grade (assuming there is only one correct answer) but very difficult to write. Coming up with plausible distractors, or the incorrect responses, is the hardest part. If some answer choices aren't plausible (ones that are meant to be funny, for example), the probability that a student will be able to guess the correct answer increases. It is also difficult, but not impossible, to write multiple-choice questions that assess higher-order thinking skills. Tips for constructing multiple-choice test questions that assess HOTS are provided below.

1. All answer choices should be similar in length and grammatically correct in relation to the item stem.
2. Avoid "all of the above", and "none of the above" answer choices.
3. Avoid confusing combinations of answer choices such as "A and B"; "B and C"; "A, B and C but not D".
4. Avoid negatively stated stems. If you must use them, bold the negative word to make it what you are asking clearer to the learner.
5. Avoid overlapping answer choices. (This most commonly occurs with number choices.)
6. The item stem should make sense on its own and not contain any extraneous information.
7. Don't include any clues in the item stem that would give the answer away.
8. Don't include too many answer choices. Typically, multiple choice questions contain four options.
9. Ensure the correct answer is the best answer.
10. Randomize the order of the correct answers.

Table 3

Examples of Poor and Improved Items

Poor Item	Improved Item	Explanation
If a boy is swimming two miles an hour down a river that is polluted and contains no fish and the river is flowing at the rate of three miles per hour in the same direction as the boy is swimming, how far will the boy travel in two hours? a. four miles b. six miles c. ten miles d. twelve miles	A boy is swimming two miles per hour down a river relative to the water. The water is flowing at the rate of three miles per hour. How far will the boy travel in two hours? a. four miles b. six miles c. ten miles d. twelve miles	The poor item contains extraneous information and a confusing sentence structure. In the improved item, the extraneous information was removed. In addition, the prompt was broken up into several sentences and the actual question stands on its own.
Which one of the following is not a safe driving practice on icy roads? a. accelerating slowly b. jamming on the brakes c. holding the wheel firmly d. slowing down gradually	All of the following are safe driving practices on icy roads <u>EXCEPT</u> a. accelerating slowly. b. jamming on the brakes. c. holding the wheel firmly. d. slowing down gradually.	When reading the poor item, a test taker may not recognize that they are being asked to pick a non-example of a safe driving practice. In the improved item, the word "except" is in all caps and underlined to call attention to what is being asked.
In most commercial publishing of a book, galley proofs are most often used __________ . 1. page proofs precede galley proofs for minor editing. 2. to help isolate minor defects prior to printing of page proofs. 3. they can be useful for major editing or rewriting. 4. publishers decide whether book is worth publishing.	In publishing a book, galley proofs are most often used to 1. aid in minor editing after page proofs. 2. isolate minor defects prior to page proofs. 3. assist in major editing or rewriting. 4. validate menus on large ships.	In the poor item, each answer choice is not grammatically correct in relation to the item stem. Often, a test taker can pick out the correct answer choice because it is the only one that is grammatically correct and not because they actually knew the answer. In the improved item, the item stem and answer choices have been edited so that they are all grammatically correct.

Tips for Writing Higher Order Thinking Multiple-Choice Questions

Tip 1: Use scenarios or provide examples that are new to learners. This allows you to ask learners to do more than simply recognize the correct answer. (Note that this can be problematic if you are assessing struggling readers or ESL learners. Know your audience!)

Tip 2: Develop multiple-choice questions around a stimulus you provide such as a map, graph, diagram, or reading passage. These are called interpretive exercises. Interpretive exercises include a set of data or information and a series of multiple-choice questions having answers that are dependent upon the information given.

Best Practice Guidelines for Writing Essay Items

Essay questions are a good way to assess deep understanding and reasoning skills. Students can provide more in-depth answers in essay questions. Essay questions are also much easier to write than multiple-choice items. They are, however, harder to grade. Below are best practice guidelines for constructing and grading essay items and some real-world examples.

- Select the most important content in the workshop or unit to assess with essay times. Using essay items limits the amount of content you can cover on any one test because they take more time for a learner to answer. If one topic is less important than another, consider only asking multiple-choice questions about it.

- Write the prompt to focus learners on the key ideas they should address in their response. For example, tell learners how many reasons should they give, or how many examples should they provide. Stating directly what you want means that the learner doesn't have to try to interpret how much is enough.
- Break multi-faceted questions up into individual items. If the question is very long, make it more than one essay question on the test. This helps focus both the test taker and the grader.
- Include scoring criteria with the prompt and assign appropriate point values. If you want someone to provide three reasons why the Renaissance began in Italy, decide how many points each reason should count and make that clear to the learner. It is very difficult to objectively grade an essay question worth 10 or 20 points without first determining the grading criteria.
- Only include essay items that require higher-order thinking. Essay questions are too time consuming to grade. If it can be assessed with a multiple-choice question instead, don't waste valuable time reading essay answers.
- Avoid allowing learners to select which essay items they answer. This keeps learner scores comparable. If learners can choose which essay questions to answer, the test is not assessing the same thing for all students.

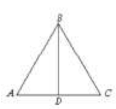
Note: Essay items can also be assessed with rubrics. See Performance Assessments and Rubric Development for more information on how to construct a rubric.

Essay Item Examples

Below are examples of high- and low-quality essay items. Note that the high quality examples include explicit instructions about what needs to be included in the answer. In addition, how the points will be allocated is clear. The low quality essay items are both very broad in scope. A test taker could easily answer the question without touching on any of the topics the instructor wanted them to include in their answer. In addition, it isn't clear to the test taker or the instructor how the points are allocated. This can lead to inconsistencies in grading.

High-Quality Examples

1. Proof 1: Given ABC is equilateral, and BD is the angle bisector of angle ABC. Prove that the measure of angle ADB and angle CDB is equal to 90 degrees. Provide the statement and reason for each step using the two-column proof format. (1/2 point for each correct statement and 1/2 point for each correct reason given. 8 total points.)



2. Compare and contrast large-scale assessment and classroom assessment on the dimensions of frequency and nature of feedback. (2 points frequency, 2 points feedback. 4 total points)

Low-Quality Examples

1. Explain weather and climate. (20 points)
2. Describe the three principles of Universal Design for Learning. Do you believe they should be used to guide instruction? Why or why not? (10 points)

Best Practice Guidelines in Developing Performance-Based Assessments

Performance-based assessment allows learners to apply knowledge and skills in authentic situations. Performance-based assessment results in the creation of a performance or a product. Performance examples include public speaking, inventing something to solve a problem, putting on a play, or playing in a basketball game. Public service announcements, digital videos, and infographics created by learners are examples of products. Consider the following guidelines when constructing performance assessments:

1. Design a task that applies to real-world situations. The more authentic a performance-based assessment can be the more meaningful it will be to the learner, although access to resources and time will certainly impose project limitations. For example, writing a paper on gardening, designing a garden, and creating a garden are all examples of performance tasks with varying degrees of authenticity.
2. Develop a task description that includes the following:

1. Purpose/learning objectives. Why are the learners completing this task? Write the learning objectives in learner friendly language.
2. Clear directions. Break down the task into its component parts. Don't assume learners know how to jump immediately into creating the final performance or product.
3. Perimeters and constraints. How much time do the learners have to complete the project? What resources are they allowed to use? Is it a group or individual project? Who are they allowed to ask for help?
4. Assessment criteria. How will the performance or product be graded? This is discussed in more detail below in the Rubrics section.

3. Develop any job aides learners will need in order to complete the task. Do you need to teach any additional skills such as how to locate articles in a database, how to measure volume, or how to use a particular piece of software?
4. If at all possible, provide learners with an example.

Rubrics

As discussed earlier in the chapter, reliability is related to scoring consistency. One way to help ensure scoring consistency is to use rubrics for grading subjective assessment items, including essay questions and performance assessments. Rubrics focus the attention of a grader on what is most important about the assignment. Rubrics include topics or elements and descriptions of levels of performance. This provides a roadmap for how to assess an assignment that is more subjective than a multiple-choice question. Without a rubric, it is easy for a grader to grade for one thing for the first 10 papers and grade for something else the last 10 papers. This occurs when an instructor has a lot of papers to grade, grading takes place over several days, and if more than one instructor is grading the same assignment. Providing a rubric up front is also beneficial to the student. They communicate to the student from the beginning what is important, on what to focus, and where to spend time and energy.

There are three types of rubrics: holistic, analytic, and single-point. This section will focus on analytic rubrics, because they allow instructors to assess the component parts of the performance assessment individually and provide the clearest grading criteria. Several additional resources about the different types of rubrics are provided below.

An analytic rubric consists of criteria, levels of performance, and descriptors.

Rubric

Levels

Criteria

Descriptors

	Exceeds Expectations	Meets Expectations	Below Expectations
Accuracy of information	Product includes accurate references to the **UDL Principles and Guidelines.** 3 points	Product includes accurate references to the **UDL Principles or Guidelines** only. 2.5- 2 points	Product includes **inaccurate references** to the UDL Principles and/ or Guidelines. < 2 points
Depth of Knowledge	Product shows use of **complex thinking** about what Universal Design for Learning is and why it is important for teaching and learning. Explanation/ justification is clear and includes multiple and varied facets of UDL. 3 points	Product shows **application** of UDL concepts and why it is important for teaching and learning. Explanation/ justification may lack clarity. Justification includes multiple and varied facets of UDL. 2.5- 2 points	Product shows **a basic knowledge** of UDL Or Information about UDL is inaccurate. Or Justification does not include multiple or varied facets of UDL. < 2 points
UDL Examples	Product includes concrete examples of UDL Principles and Guidelines. 3 points	Product includes concrete examples of UDL Principles only. 2.5- 2 points	Product does not includes concrete examples of UDL Principles or Guidelines. Or Examples may be general. < 2 points

Figure 7.8.1: *Example of an Analytic Rubric*

Best Practice Guidelines for Creating Rubrics

1. Determine the criteria. Criteria can be written as a learning objective or category. Criteria should be measurable, important to the performance task, and taught. For example, creativity is often assessed in performance-based assessments. If creativity was not explicitly taught, it shouldn't be measured.
2. Determine the weight of each criteria. Will they all be worth the same amount of points or will some count for more than others?
3. Determine the number of performance levels. How many levels of the rating scale will be delineated on the rubric? Will they be numbers such as 4, 3, 2, 1 or descriptive such as developing, meets expectations, and exceeds expectations. Typically, analytic rubrics contain three to five performance levels.
4. Write descriptors for each of the performance levels. This is the hardest part! Descriptors should address the quality of the product. It is okay to count project elements for some of your criteria (i.e. number of references, number of graphs), but not for all of them. See examples of quality and numerical descriptors below.

Numerical Descriptors vs Quality Descriptors Example

Table 4

Numerical Descriptors in an Annotated Bibliography Rubric

	4	3	2	1
Quality / Reliability of Sources	All sources cited are reliable and trustworthy.	At least 80% of sources cited are reliable and trustworthy.	At least 50% of sources are reliable and trustworthy.	Less than 50% of sources cited are reliable and trustworthy.
	5 points	4-3 points	2 points	0-1 point

Table 5

Quality Descriptors in a Technology Lesson Plan Rubric

	Exceeds Expectations (A)	Meets Expectations (B to C)	Below Expectations (C- and below)
Teacher candidate develops a learner-centered, technology-integrated activity that promotes creativity, collaboration, or communication, and results in a learner-created product.	Activity promotes significant learner engagement through creativity, collaboration, and communication. Actively includes opportunity for learner to create a product.	Activity promotes creatively, collaboration, or communication and focuses on learner engagement with technology. Actively includes opportunity for learner to create a product.	Activity focuses on teacher-use of technology but lacks opportunities for learner engagement and/or product creation
	5 points	2-4 points	1 point

Note also that the rubric element directly above is written as a learning objective rather than simply a category.

Conclusion

Aligning test items and performance assessments to learning objectives, using best practice guidelines to create assessments, and using rubrics to grade complex tasks, are strategies instructional designers can use to develop high-quality assessments. High-quality assessments provide instructors with accurate information regarding the extent to which learners met the learning objectives, a critical component of the teaching and learning process. Accurate assessment results help instructional designers plan future instruction, adapt current instruction, communicate levels of understanding to students, and examine the overall effectiveness of instruction and course design.

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CHAPTER OVERVIEW

8: Design Relationships

8.1: Working With Stakeholders And Clients

Working With Stakeholders and Clients

Lee Tran, Kathy Sindt, Rudy Rico, & Benjamin Kohntopp

Throughout your experiences as an instructional designer, you may form many different relationships with your colleagues. However, one of your most important relationships will be the one you have with your stakeholders or clients. It is important to recognize that the relationship with your stakeholders or clients is not solely based on transaction, but is also one of collaboration. In any instructional development process, there will be many different roles that each collaborator plays, as each brings a different set of expertise.

Remember, as an instructional designer, the communication style you choose to use will involve feedback from both parties. Your stakeholders or clients are looking to you for guidance in instructional design and content delivery. However, part of your work will be reliant on the content that your stakeholders or clients are giving you.

As instructional designers, we want to build trust with those we work with to better collaborate and deliver an end-product that meets the goals of a project. By building a stakeholder or client relationship, we can better understand who our target audience is, the project needs, and what our learning outcomes are.

For example, let's say you received a set of instructional materials on how to make toast. The instructional material provided may be simple to follow, but there may be details missing needed for you to start your work, such as knowing if your target audience has access to a toaster. This detail would be important in your design to ensure that learners have access to all of the materials needed to successfully complete the course. As we continue this chapter, think about what kind of details you would need to start a course development and write them down.

Throughout this chapter, we will be looking at different aspects of the client relationship, including the process, guidance and communication, scope of work, collaborative workspaces, challenges, ethical concerns, and reviewing content.

The Process

Every instructional design project should follow an instructional design model. The most familiar model is the ADDIE model. This model includes the following components: Analyze, Design, Develop, Implement, and Evaluate (Kurt, 2017).

Another popular model and the one we use at Colorado Community Colleges Online (CCCOnline) is the backward design model (Wiggins and McTighe, 1998). In this model, the focus is on the result of the instruction, while also asking what the students should be able to understand and do after the instruction has been provided. All instruction, learning activities, and assessments direct the students toward achieving the result.

Whether you are following the ADDIE model, the backward design model, or another process to design your instruction, it is important that your stakeholders understand your process and the reasons you are using that process. It's also important to be sure your stakeholders know what you expect of them as part of the process. Getting buy-in on your process at the start will eliminate problems later. If the stakeholders understand what you expect, and the reasons for the expectations, they are better equipped to follow your procedures and processes.

There are different ways to ensure your stakeholders understand your process. One excellent option is to have initial meetings with all the stakeholders where you provide the stakeholders with information about the process and your expectations of each of them.

At CCCOnline, all of our stakeholders are required to take an orientation course that describes our processes and expectations. Once all stakeholders have completed the orientation, an initial vision meeting is held to discuss the scope of the project, to clarify the expectations from the stakeholder perspective, and to establish the duties and roles of all members of the team. After the vision meeting is completed, a kickoff meeting is held a couple of weeks later to review and finalize the project outline and scope, to set the timeline for the project, including deliverable due dates, review dates, and the final project deliverable due dates. The kickoff meeting is the beginning of the design phase of the project.

Guidance and Communication

Setting Communication Standards

As you work with your clients in your course development, you will want to ensure there is a standard of communication in place. A communication standard may include preferred methods of communication, frequency, and availability. By setting communication standards, you and your client can follow the expectations of each party in the development and promote a steady workflow. Remember that even though you are the instructional designer, your client is very much your partner throughout the development to ensure content validity and that the end product meets the needs of the target audience.

Becoming a Learning Coach

Your client will be looking at you for guidance in your expertise in instructional design. This expertise makes you what we will be calling a Learning Coach. A client may be an expert in their particular field, but may not have the same expertise with learning theories and applications to deliver their content to a mass audience. By understanding your role as not only the instructional designer, but as a Learning Coach to your clients, you are there to help guide your clients in their instruction development journey. Some clients may come to you with anxieties or questions like, "How do we engage the audience within different learning environments?" or "How do we measure the appropriate outcomes?". Your coaching is meant to put your client at ease. As you coach your client through their concerns, you may notice your client becoming more confident in what your instructional product will be and in turn providing content that is better suited for the learning environment. This mutual understanding can ensure success.

Flexibility

Always remember that your client is human. Much like you, certain circumstances in their lives may affect the delivery of content. We want to ensure that the proper expectations are set in place, but also be flexible enough to understand that certain circumstances may get in the way. By being flexible and empathetic, you ensure that neither you nor your clients lose motivation or energy throughout the development process.

Scope of Work

When beginning work on an instructional design project, it is important to ensure that all the stakeholders agree on the scope of work (SOW) for the project. The project scope determines the goals/objectives, deliverables, and deadlines of the project.

At the start of any project, define the goals and objectives so you understand what the stakeholders are expecting. We have included some templates that can aid in defining your goals and setting the scope of your project. These include a PreMeeting and vision Meeting Guide, a Vision Scope Template, a Kickoff Call script, and a Course Map (outline of the project).

In addition to the goals and objectives, determine what deliverables you will provide as part of the project. Will you be creating a large, full-scale curriculum project, with multiple courses, or are you developing a single course? You need to know what kinds of media you will be developing. Are you expected to create video or interactive content, or will you be developing more static content? If you are developing any multimedia, be sure to determine the length/amount of this content before beginning. The more multimedia and interactive content you will be developing, the more resources your project will take. You need to be in agreement with your stakeholders on all aspects related to the scope of the work before the start of the project.

Finally, you need to determine the timeline of the project. Decide upfront when each deliverable is due, how long the stakeholders have to review the content, and how long you will need to make any revisions requested by the stakeholders. Agreement on these issues avoids conflict later in the process.

In addition to having the scope clearly defined at the start of the project, it is important that you and the stakeholders have clearly defined expectations of all members of the team. Are the stakeholders expected to write content? Are they expected to review content, and if so, at what stages of the project? Some stakeholders may only be directly involved at the beginning and end of a design project, while others may be involved during the entire process. Be sure that each stakeholder, including you, understands the expectations of them during the development process.

A major reason for clearly defining the scope of the work and your expectations of the stakeholders is to help eliminate scope creep. Scope creep occurs when a part of the project takes longer or more work than originally determined. This usually happens when one of the stakeholders expects or asks for additional work beyond the original agreement or statement of work. The best way to avoid scope creep is to have clearly defined and agreed upon scope and expectations before the project starts.

Setting up a Collaborative Workspace

In this section, we will focus on collaborating with your design team and setting up a workspace that allows each member to contribute. Depending on your situation, a collaborative workspace can include both physical and virtual spaces. Setting up a collaborative workspace is key to ensuring that all stakeholders can contribute during the design process and questions about content can be addressed before developing course materials.

The first step to consider when setting up a collaborative workspace is the types of materials that will be delivered. If the instructor or subject matter expert you are working with is delivering large files, such as MP4 video files or large text files, then a cloud-based file hosting service like Dropbox, Microsoft's One Drive, or Google's G Drive may be a solution. File hosting services allow the user to upload large files and share the uploaded content with members in your organization.

Once you agree on a file hosting service, set up a folder, and share the folder with the stakeholders who will be delivering content. Make sure you provide the right type of access so that the stakeholders have permission to edit and add content.

In addition to setting up a file-sharing collaborative workspace, you should set a schedule for delivering content, and schedule regular meetings to check in with your stakeholders. Having a regular meeting scheduled can help prevent any communication issues or identify issues that come up as content is delivered.

Collaboration Tools

Tools for Meeting With Stakeholders

Web conferencing software – ex. Zoom, Skype

Tools for Project Planning

Spreadsheets, Shared Calendars – ex. MS Excel, Google Calendar

Tools for Content Delivery

Cloud-based services – ex. Dropbox, MS One Drive

Depending on your institution, a face-to-face meeting can be held at the start of the project and then transition to online meetings or conference calls. Meeting with all your stakeholders face-to-face at the beginning of course development can help determine which members of the development team are essential to future meetings and which content to assign for development to each member.

Challenges

Communication with stakeholders, as stated in our section on setting up a collaboration space, is key to ensuring completion of the course development on deadline. One common issue that occurs when developing online courses is lack of communication leading to confusion on how content is delivered, when content is to be delivered, and how content is reviewed for quality. For example, while working on a teacher education course last summer, I encountered an issue with the subject matter expert's schedule. At the initial meeting, the subject matter expert indicated she was familiar with the content from previously teaching the course and would have no issues making the content updates. However, the subject matter expert also indicated during the meeting that she would be on vacation abroad and would not be able to deliver content until after she returned. Since the subject matter expert indicated she was familiar with the content as an instructor, I recommended that she complete an initial review and submission of new content for the course's first two modules prior to going on vacation. Knowing that the subject matter expert would be unavailable during the first phase of development prompted me to update the content delivery schedule. Therefore, setting up expectations early on is essential to catching possible scheduling conflicts and avoiding confusion later in the content delivery stage of course development.

To avoid communication issues, also speak with your stakeholders regularly. We emphasize "speak," because long emails can lead to more confusion. Email communication is good for quick updates, but long emails chains can be more time consuming than simply talking on the phone for 5 minutes to clarify an issue. Therefore, set up a regular meeting time each week and check in with your stakeholders often by phone or web conference. After all the stakeholders are comfortable with the development process, you can hold meetings less frequently, but at the beginning stages of development avoid going more than a week between meetings.

Not communicating expectations early on with all of your stakeholders can lead to missed deadlines and content delivery falling behind schedule. Therefore, make deadlines clear and use a project plan to keep track of all the major milestones during the content delivery phase. If a deadline is missed, communicate with your stakeholders immediately and identify the issue that caused the delay. However, sometimes the stakeholder in charge of delivering the content may have fallen behind and need additional support to create the content. Courses that incorporate Open Educational Resources (OER) may be more challenging to develop content for and, therefore, may require more time. This is due to the "open" nature of OER content. While there are many free resources available to educators, not all OER content is high quality, or accessible.

Technical issues may also prevent the delivery of content; checking with your stakeholders when they miss deadlines can help identify if it is a technology issue or a content issue. Depending on the file-sharing system you selected, there may be issues updating content in the online workspace, and you may need to coach your stakeholders as to how to properly upload and share content with the design team.

When content is not delivered, and several deadlines are missed, set up a meeting with the key stakeholders, and develop a plan to get content delivery back on schedule. For this reason, it is often a good idea to set up a buffer between the end of content delivery and the start of the course launch. I typically set an early content delivery date of about 3 weeks before content is due for review.

Ethical Concerns

On some days during your course development cycle, you may feel like teacher dealing with a student. You know that the student is very skilled, but at times they may need your guidance. This is especially true when it comes to Ethical Concerns that might arise during the course development process. While a subject matter expert (SME) is exactly that, an expert in their chosen subject, they aren't expected to know everything. This means that, regardless of the type of development (OER or otherwise), your subject matter expert will be looking for outside sources to supplement their material.

Plagiarism

Although some might think of plagiarism as a concern reserved for students, it is a reality for the individuals creating the courses as well. Any time a subject matter expert looks for material, they run the risk of plagiarizing content. In most environments, this is very problematic. Many places will take ownership of a SME's work upon its completion; therefore, having plagiarized or stolen content can cause problems for that institution or place of business. Here a few strategies you can use when working with your SME:

1. When the content first comes in, be sure to read it thoroughly. Reading your content is the simplest way to tell if a SME has been plagiarizing. You should have a feeling for how a SME writes by now, from emails to course maps, so if anything in their content seems suspect to you, it might be time to raise a red flag and ask them about it, especially if they are missing citations for their material.
2. If you're able, run the content through a plagiarism checker, such as Turnitin, Quetext, or Prepostseo (those last two are free). Keep in mind that while the plagiarism checker will give you a better idea of where an SME's content came from, it doesn't necessarily mean plagiarism has taken place.
3. As you read over the content and suspect plagiarism in a particular passage, highlight it, and paste the suspected content into a Google search. Believe it or not, the search results that come back may be bolded portions of a website where the content is from. If it is, you need to discuss this with your SME.

Catching plagiarism early is vital. SMEs may not be aware that what they're doing is plagiarism and may continue to do it throughout the process. It might be helpful to discuss Creative Commons licenses with them to elucidate what they can and cannot do. Reading through a basic overview of the licenses (https://edtechbooks.org/-JMt) might save you from future issues.

Conflict

Unfortunately, sometimes, conflicts between you and your SME arise. Remember that during development, communication is key. More often than not, SMEs are happy to dispense their knowledge, but they also must be heard. They are not a tool to be used and discarded. Keep this in mind to save your developments from falling apart. Here is one example:

During the development of a course, the SME, who was writing an entire OER eBook, decided that she wanted links to the eBook placed in every page of the course so students could readily access it everywhere. While I immediately disagreed with her, I allowed her to finish her reasoning. Once she concluded, I explained that from a design perspective, this could cause confusion for students, regardless of her good intentions. I told her I appreciated her input and told her that if she disagreed, we could have a meeting involving the dean (her boss) and we could talk things out with him. She decided to do so, we talked it out and we came to an agreement: the links to the eBook would be placed in only the most relevant and useful places. We both walked away from the conflict satisfied with our agreement.

Reviewing the Content

Quality Assurance

We all want our students to have the best quality courses. One of the most important components of a course development comes during the quality assurance (QA) check. Whether you as the ID do it alone or you're lucky to have someone there to help you with it, quality assurance is paramount. CCCOnline implements QA via a two-fold approach: we have a designated QA person checking the course throughout the entirety of the build. When the content first comes in, they go over all the essential components thoroughly and write feedback and recommendations. Then, once the course is in place in the LMS, they review it again. Throughout the entire process, the QA person is viewing the course as a student would and ensuring everything makes sense. As Instructional Designers, we should never forget the end user: our students.

Approval

Not only should a QA person sign off on the content, but the SME and the program leader(s) should also have a say in approving the content. Essentially, when the content is in, and before it is placed in the LMS all parties should have their voices heard:

1. The QA person should be viewing the course from the student's perspective, giving valuable insight that might go unnoticed otherwise.
2. The SME and program leader(s) should have the best understanding of the content and should, therefore, ensure the course aligns with all objectives and hits all of its necessary deliverables.
3. As the ID, you must do some of both: ensure the content aligns with the outcomes that have been set and ensure the course will make sense from a student perspective.

Conclusion

In this chapter we discussed some strategies for collaborating with various stakeholders during a course development and provided some recommendations for solving some common issues instructional designers encounter during the collaboration phase. As the instructional designer, having a well-developed project plan, that includes deadlines for content delivery and dates for meetings with stakeholders, is essential for a successful course development. Therefore, when developing your project plan remember some of the issues we presented here and the types of challenges your stakeholders may encounter during content delivery. What can you do as the instructional designer to help your stakeholders meet the deadlines? Consider the following:

1. What type of content are your stakeholders expected to deliver?
2. When is the course expected to launch? Consider potential time constraints for stakeholders.
3. How much time will the quality assurance process take?
4. Will stakeholders be asked to review content on multiple occasions? How will reviews and feedback be managed?

Templates

- Kickoff Call Script
- Pre-Meeting and Vision Meeting Guide
- Vision Scope Template
- Course Map (.xlsx)

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8.2: Leading Project Teams

Leading Project Teams

Ashley Smith

My palms were sweaty. The conference room was warm. Seated directly across the table was the Vice President of Asset Protection of Walmart US. The company had flown me from Idaho to Bentonville, Arkansas, for this moment, my first big break, and my chance to make a name for myself. I was leading a team tasked with developing a curriculum that would be implemented everywhere in the United States, and I was ready—ready to spring into action and dazzle the high-level executives with my instructional design prowess.

Finally, the VP turned to me and asked, “When do you think we can roll this out?” I gave an estimate, but that wasn’t what I thought was the most crucial part of my presentation. Then came the follow-up question. “Do you have a breakdown of who will pay for what?” I did not. Reality smacked me square across my overly confident face. I was not there to present a proposal for my innovative, custom-designed, and beautifully-built curriculum. I mean, yes, I was, but that was only a small part of my role. As this development progressed, it became more evident that the senior leadership was more concerned about milestones and deadlines than my knowledge of ADDIE. I was not only an instructional designer; I was the project manager, the bottom line. It was my responsibility to handle timelines, budgets, and all the not-so-fun, not-so-creative details that would enable my team to pull off this massive project and produce an excellent product.

When I left the corporate world behind and started to design curriculum for higher education, my project management skills were invaluable. As you join the world of instructional designers, you will often find yourself in the role of a project manager. Over the years, I have learned, leading project teams is an essential skill for an instructional designer to master. It is something to embrace and not fear.

Basics of Project Management

From the *Project Management Body of Knowledge Guide* (PMBOK Guide), a project is “a temporary endeavor undertaken to create a unique product, service, or result” (Project Management Institute, 4). The keyword in the definition of project is *temporary*. The permanent, everyday production of products and services is called operations. Project management is “the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements” (Project Management Institute, 10).

Now let’s explore several basic concepts of Project Management: Project Phases, Project Constraints, Project Management Triangle, and Ethics of Working with Teams.

Project Phases

The textbook, *Project Management for Instructional Designers*, describes four typical lifecycle phases of a project: Initiation, Planning, Execution, and Closeout (or Closing) (see Figure 1).

Arrows showing the four phases of project management (initiation, planning, execution, and closeout).

Figure 8.2.1: *Four Phases of Project Management*

The Initiation phase encompasses all the assignments and actions that need to occur before project planning. The Initiation phase starts “with the assignment of the project manager and ends when the project team has sufficient information to begin developing a detailed schedule and budget” (Wiley et al., p. 3.1). The Planning phase centers on developing “an understanding of how the project will be executed and a plan for acquiring the resources needed to execute it” (Wiley et al., p. 3.1). The Execution phase emphasizes “the major activities needed to accomplish the work of the project” (Wiley et al., p. 3.1). The Closeout (or Closing) phase signifies the last stage of a project and where “project staff is transferred off the project, project documents are archived, and the final few items or punch list is completed” (Wiley et al., p. 3.1). I would recommend exploring more about each of these phases in this textbook, Project Management for Instructional Designers.

Additional Videos

- 4 Phases of the Project Life Cycle
- The Typical Phases in Project Management

Project Constraints

Scope

With every project, we must consider scope. The definition of project scope is "what tasks the project team is expected to accomplish and, just as importantly, what is not part of the project" (Wiley et al, p. 7.2).

Every project, being temporary in nature, has a beginning and ending. As the project manager, you need a clear vision of where the project needs to go. To help understand this concept, we will explore the second habit of *7 Habits of Highly Effective People*, "Begin with the end in mind." Stephen Covey (2013) states,

"'Begin with the end in mind' is based on the principle that all things are created twice. There's a mental or first creation, and a physical or second creation, to all things. Take the construction of a home, for example. You create it in every detail before you ever hammer the first nail into place. You try to get a very clear sense of what kind of house you want…

The carpenter's rule is 'measure twice, cut once.' You have to make sure that the blueprint, the first creation, is really what you want, that you've thought everything through. Then you put it into bricks and mortar. Each day you go to the construction shed and pull out the blueprint to get marching orders for the day. You begin with the end in mind" (p. 95).

Like the construction of a house, you need to plan and create a "blueprint" for your project before work can begin. After you understand the project, you will need to articulate this vision to your team. Your team will never have a better understanding of the project scope than you. As the project manager, if you are unclear about the project's expectations, your team will also be unclear on them. This path leads to scope creep.

Dangers of Scope Creep

Scope creep happens anytime the project's requirements change after you start the project. This creep is a subtle phenomenon. Threats to time and cost loom as you allow small changes to occur based on last-minute suggestions. These change requests are often coupled with the rationale that, "We are already adjusting the curriculum anyway." Or "It's only one small change." One small change can have an enormous impact on the project. In many cases, as the project manager, you will underestimate the full effect of the change. You never want to find yourself in the position where you overpromise and underdeliver. Scope creep will make you unable to fill your commitments and leave your stakeholders disappointed.

Cost

As a project manager, you have an essential role to manage budgets and cost. You will need know your budgetary constraints and work to minimize costs. As illustrated in my Walmart example, knowing your budget and costs are of crucial consideration and interest to your stakeholders.

Time

Your stakeholders also want to know whether the project is on schedule. Stakeholders' satisfaction is often tied to project performance expectations. You need to know the timeframe you have to accomplish the project. You will need to estimate how long every stage of the project will take and find the project's critical path.

Rapid prototyping reduces time and cost in a project. (Rapid prototyping was explored in earlier chapters.) By prototyping, you and your stakeholders can make decisions that will save time and money. This process results in higher overall quality and allows you to influence the decision-making process along the way. Prototyping enables you to make the best use of our next concept, the project management triangle.

Project Management Triangle

A common adage about project management is, "You can have it good, fast, or cheap. Pick two." This statement derives from the concept called the "project management triangle," or sometimes referred to as the "iron triangle." There are several variations of the triangle. One of the most common variations is the constraints of cost, time, and scope make the sides of the triangle with the center representing quality (see Figure 2).

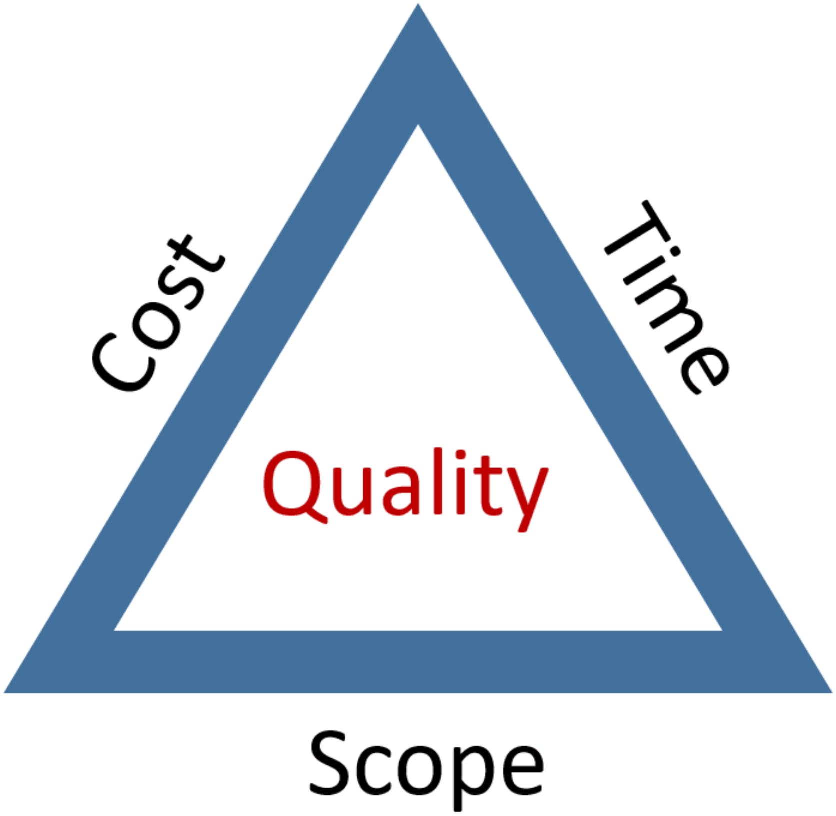

Figure 8.2.2: *Project Management Triangle*

Let's say you are creating a training course, and you want it to be done quickly (time constraint) and at a low cost (cost constraint.) It becomes evident that the scope needs to be limited (scope constraint). You will not be able to add a lot of extras to the course (e-learning or VR experience). If you try to do all three, the quality of the course will suffer. If the clients want the VR experience, then the costs will rise. There are always tradeoffs for every adjustment made to a project because you cannot improve all three constraints simultaneously. As the project manager, it is critical to understand the consequences of every decision made and how it affects other decisions.

Application Exercises

- Create a chart that explains what happens at each phase of the project management lifecycle.
- How can effectively managing project constraints (scope, time, and cost) help a project to be successful and prevent scope creep?

Working With Teams

Besides knowing the constraints, understanding the different teams that you will be working with on a project is imperative. There are several different types of teams that you may work with on any project. In this chapter, we will only highlight a few of those teams.

Figure 8.2.3: *Relationship Between Different Teams on a Project*

Working With Your Team

Whether you were given your team or you selected your team, your leadership will determine the team effectiveness and ultimately the success of the project. Your ability to manage and inspire people will be one of the most critical factors to the success of the project. You will need to assess what skills you will need for the project and match them with your team members.

As you identify strengths and skills of your team members, you need to allow people to play off their strengths. In the book, *Strengths Finder 2.0*, Gallup scientists "discovered that people have several times more potential for growth when they invest energy to developing their strengths instead of correcting their deficiencies" (Rath, 2007, p. i). I have found when people are leveraging their strengths, they are happier and more productive.

Working With SME

A subject-matter expert (SME) can be a blessing and a curse at the same time. A SME offers much-needed content knowledge; however, the project can quickly become off schedule if the SME is unavailable or unable to meet critical deadlines. Developing a relationship with an SME is explored more in the chapter called, "Working With Stakeholders and Clients." Maintaining healthy relationships with key stakeholders, like the SME, will dramatically impact the project.

Working With the Delivery Team (Instructors, Faculty, Trainers, etc.)

As an instructional designer, rarely are you the one delivering or teaching the curriculum. Because of that, it is critical to keep the instructor/trainer in mind with the design of the materials, and how will it be implemented by the delivery team. With the excellent materials your team created, you will want the instructor training performed at the same high level. It may be necessary for you to work with your organization's delivery arm to ensure that the Train the Trainer (T3) sessions or teacher education programs happen according to plan. With this coordination, a successful implementation will allow the participants to experience the curriculum the way you design it. To explore more about implementation, read the chapter in this textbook titled, "Implementation and Instructional Design."

Working With the Stakeholders and Clients

Your underlying goal of the project is to deliver what your stakeholders and clients want. To effectively do that, you need to answer these questions: what is the goal and how will success be assessed? You need to know the goal and design in the assessment.

When I created my first workshop for Walmart, I built it solely around the content given to me by the subject matter experts. I created beautiful workbooks and presentations. I even had the chance to attend the workshop as the material was delivered. At the end of the workshop, all the participants were ready to change the world because of my class. I thought to myself, "#LearningWasAchieved." A few weeks later, I was asked by a senior leader what type of return on investment (ROI) metrics I had and how well did the workshop achieve the outcomes? After scrambling to pull information together about the success of the class, I was only able to generate a pitiful report. I realized the failure was not in the workshop, but that I was unprepared to report on its success. From this experience, I learned the importance of backward design. In backward design, you start with the learning outcomes or goals, create assessments to measure those outcomes, and then create the content that will enable the learners to complete the assessments successfully.

The next time I developed a class, I started the conversation by asking questions such as: "What do we want to measure?" and "What do the students need to know?" I did this questioning on the front side of the project. I designed in key outcome metrics with how they would be assessed in the curriculum. This time, I had the reports prepared, showing ROI. Of all the leadership and management skills I have learned, the ability to show value (ROI) to my stakeholders has had the greatest impact on my professional success as a designer. Another chapter, "Working With Stakeholders and Clients," reviews more on these interactions.

Effective Strategies in Leading a Team

Figure 4 shows the strategies to use to help you successfully lead your team through a project.

Figure 8.2.4: *Effective Strategies in Leading a Team*

Clarifying Roles and Responsibilities

Define the roles of your team. You need to understand who is ultimately responsible. Hyman G. Rickover, the "Father of the Nuclear Navy," led a team to build the world's first nuclear-powered submarine, the USS Nautilus. He had a deep understanding of responsibility. He said, "Responsibility is a unique concept... You may share it with others, but your portion is not diminished. You may delegate it, but it is still with you... If responsibility is rightfully yours, no evasion, or ignorance or passing the blame can shift the burden to someone else. Unless you can point your finger at the man who is responsible when something goes wrong, then you have never had anyone really responsible." (United States Congress, 1965, p. 87). Although you may have delegated tasks, the shared successes and failures of your project are yours to bear.

Additional Videos

- Key Project Team Roles

Streamlining Workflow

Find bottlenecks. As a leader, you can't fully delegate responsibility away for a project. So, if tasks aren't happening, you need to ask, "Why?" You will need to find solutions. In the book, *The Goal: A Process of Ongoing Improvement*, the main character receives a critical insight from one of his professors, "What you have learned is that the capacity of the [project] is equal to the capacity of its bottlenecks" (Goldratt, 1992, p. 158). This capacity of any given bottleneck on your team or as part of your project affects the amount of work accomplished during a particular timeframe.

The speed of the project will depend on the number of bottlenecks. It would be best if you gave time and attention to improving those bottlenecks each day. The priority has to be what problems your team is having and helping them solve the issues quickly. These problems or bottlenecks will determine whether you will meet your deadline.

Communicating Effectively

Don't keep your people in the dark. As the project manager, you will need to develop strong communication channels with your team and stakeholders. B.G. Zulch discovered that "The single most significant factor affecting the success of a project is the communication ability of the project manager. If it seems true that everything rises and falls on communication and leadership, it stands to reason that leadership communication ability is the foundational skill that must be attained for a project manager to be effective…Communication is so important to project success that it has been referred to as the lifeblood of a project…" (2014, p. 1001).

Don't allow blind spots to develop. The responsibility of communication does not rest solely on the project manager. The entire team needs to be communicating regularly with updates on progress. Without regular updates, blind spots will occur.

Have regular meetings with your team. Many meetings are considered boring and a waste of time because the leader conducting the meeting does not know how to have a productive meeting. From the book, *Death by Meeting*, Lencioni (2004) asserts two ideas for more productive meetings. First, meetings need more drama. The meetings need to be centered around conflict by addressing difficult questions. Let your people be passionate about what they do. Second, meetings need contextual structure. Not every meeting is the same type. Have the right kind of meeting that addresses your needs from a daily check-in to a monthly strategic meeting.

Additional Videos

- Improving Your Project Management Communication
- How to Run Team Meetings

Creating a Feedback Culture

Foster a culture of offering and receiving feedback. Feedback creates accountability. In the book, *The Oz Principle*, Connors et al. (2004) state, "You can gain great insight from frequent, regular, and ongoing feedback from other people. Although it can cause a great deal of pain and embarrassment at times, honest input helps create the accurate picture of reality that lies at the core of accountability" (p. 81). With any project, you need people to be accountable for their assigned tasks. With this loop of giving and receiving feedback, you, as the manager, can see the status of each part of the project. When you see epic failures with projects, many times, the lack of feedback is the underlying reason for it.

Additional Videos

- Managing Teams & Giving Feedback – Project Management

Be in the Details

Spend the majority of your time in the details of the project. Admiral Rickover, the manager who led the team to build the world's first nuclear-powered submarine, drove this point home by stating, "The man in charge must concern himself with details. If he does not consider them important, neither will his subordinates. Yet 'the devil is in the details.' It is hard and monotonous to pay attention to seemingly minor matters. In my work, I probably spend about ninety-nine percent of my time on what others may call petty details. Most managers would rather focus on lofty policy matters. But when the details are ignored, the project fails. No infusion of policy or lofty ideals can then correct the situation" (Rickover, 1982). Success is through the execution of small tasks.

Managing Conflicts

Have crucial conversations. Anytime you are dealing with people under time and money constraints, you are going to have conflict. As a project manager, you will be required to have crucial conversations. From the book, *Crucial Conversations*, Patterson et al. (2002) define a crucial conversation as "a discussion between two or more people where stakes are high, opinions vary, and emotions run strong" (p. 3). When leading a crucial conversation, it is imperative to stay focused on the facts and issues. Prepare ahead of time so you can stay calm and not be distracted by strong feelings and emotional appeals. A leader who approaches these difficult conversations in a non-emotional way serves his people more effectively. You can create a safe environment for a crucial conversation by validating the other person's position. Patterson et al. (2002) recommend the STATE method to manage conflict. The STATE method is an acronym of the tools you can use: Share your facts, Tell your story, Ask for others' paths, Talk tentatively (or speaking gently and respectfully), and Encourage testing (or invite others to talk) (p. 124).

Additional Videos

- Conflict Management – Key Concepts in Project Management

Application Exercises

- Identify the type of support you will need to give for each of the different teams with which you are interacting.
- Which strategies do you feel are the most important and how would you apply those strategies to your situation?

Conclusion

In this chapter, we discussed that although you may be an instructional designer, you might often find yourself in the project manager role. We explored the four phases of the project management lifecycle: initiation, planning, execution, and closeout. We also studied how the project management triangle showed how the three constraints of scope, time, and cost can impact quality of a project. We reviewed the different teams you will work with on a project and provided effective strategies in leading a team.

Even if project management is new to you, becoming an effective project manager can be learned. As you master those skills, you will find yourself leading effective teams. A well-managed project will cause a positive outlook for everyone from your team down to the stakeholders and clients. Your finely-tuned project management skills will lead you to future success.

Resources

- Project Management for Instructional Designers Textbook (PM4ID)
- Project Management Institute – pmi.org
- A Guide to the Project Management Body of Knowledge (PMBOK® Guide)

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8.3: Implementation And Instructional Design

Implementation and Instructional Design

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Editor's Note

This is a remixed version of an earlier chapter on implementation in instructional design that can be found at the ADDIE Explained website, and is printed here under the same license as the original.

Instruction is designed to be used. This seemingly obvious statement carries a rather significant implication: the work of an instructional designer should not end upon the final development of the product, but must include considerations for when, where, and how the instruction will be used by real learners in actual situations. This work is called implementation. It requires planning and attention to detail—the same as found throughout the rest of the instructional design process, in fact—to complete successfully. Without implementing an instructional design, all the design work would, in large measure, be wasted.

Implementation is a frequently-skipped step of the instructional design process, however. Designers are often (understandably) ready for their next exciting assignment, and often the client or other stakeholders want to be the primary actors during implementation. The organization the designer works for may also not consider it within their scope to assign instructional designers to help in the implementation phase.

But even when someone else has the actual responsibility to implement an instructional design, the designer can (and should) still be involved, at least in some fashion. Often he or she will have information that no one else has about the design (what certain components are meant for, or how certain features behave), and that information is crucial to ensure it can be implemented successfully. Few people know the entire project as well as the designer does, and this expertise should be drawn upon during the implementation process.

The purpose of this chapter is to introduce considerations that need to be made during the implementation phase of the instructional design process. To organize our discussion we rely on the five stages of introducing a new design as described by Everett M. Rogers (2003). Additionally, it is imperative that instructional designers (or other change agents like teachers or stakeholders) are aware of how people typically use products or services as they are being implemented. So we also describe how adopters of new products or services commonly move through Rogers's stages.

Adopting New Designs

Gibbons (2013) described the importance of implementation as follows:

Implementation is a period of intense and important change. In addition, it is a period of high-stakes decisions that affect the judgment of continued use of your product. Your product is not only making its first impression on people during implementation, but it is gathering either support or censure from those most likely to determine its viability—students, instructors, and administrators. A careful implementation plan can help your product to be introduced with the best possible chances of success (p. 410).

Similarly, Rogers (2003) suggested that, "the perceived newness of an innovation, and the uncertainty associated with this newness, is a distinctive aspect of innovation decision making" (p.161). As a result of this "uncertainty," understanding the design adoption process can help designers plan an instructional design implementation to maximize the chances it can have its intended effect with learners. To help instructional designers create a complete implementation plan, we recommend considering the phases of innovation adoption as a framework for creating their implementation plans (see Figure 1). The five stages in Rogers's model that will be discussed in this chapter are:

- Knowledge
- Persuasion
- Decision
- Use
- Confirmation

Note that the stage when people actually use the new material is stage four of this model! This should be evidence of how important it is to consider many factors that affect how someone will successfully use an instructional design, and encourage designers to not just complete the project and walk away.

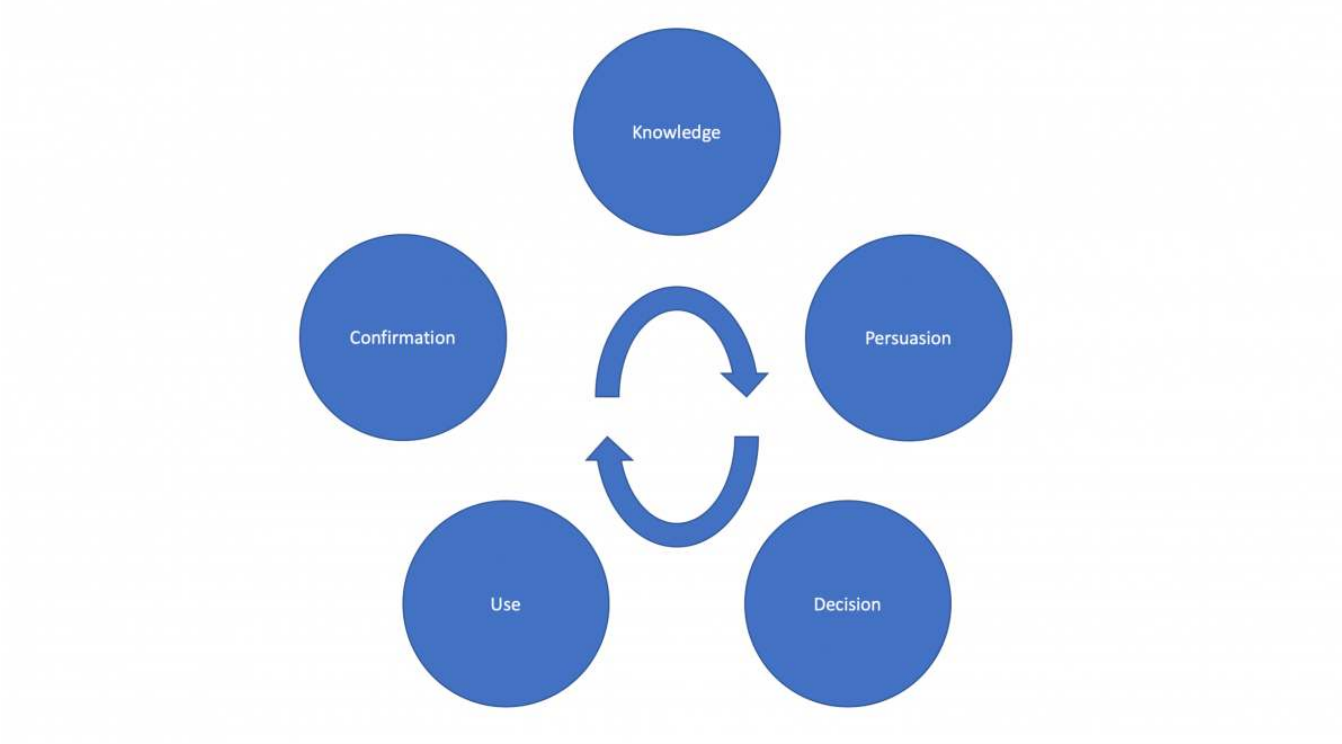

Figure 8.3.1: *The Stages of Roger's Implementation Model*

Knowledge

The expectation within the knowledge stage is that the adopter becomes aware of the design to be implemented, and determines if a need for adopting (or implementing) the design is actually present. In the context of instructional design, this could mean the designer prepares (or helps prepare) material that is useful to decision-makers about why they should use the instruction. This could take the form of an information sheet, or be more sophisticated like a full marketing campaign. It can also be directed to the students themselves, or others who might be the primary adopter of the design who will then introduce it to students (like a teacher or a school district).

Persuasion

The persuasion stage occurs when the adopter begins to decide if they find the new design acceptable. During this process, the adopter "actively seeks information about the new idea, decides what messages he or she regards as credible, and decides how he or she interprets the information that is received" (Rogers, 2003). It is through this process that an adopter begins to decide if the design will be accepted. Instructional designers can facilitate the persuasion stage at the same time they provide knowledge about it. Why is it compelling? How does it fulfill real needs? What can be said about it that adopters will feel emotionally attracted to? (Do more than just provide the facts!) Like before, persuasion can be directed to both the student or other decision-makers.

Decision

The decision stage includes the adopter actively participating in tests that will assist them in determining if the design will be adopted or rejected. It is important to note that this process can justifiably lead to either of these results: adoption or rejection. If the design is adopted, it is evidence that it is seen as a solution to the problem or issue the adopter initially defined. If the design is rejected, it can be classified as either active or passive rejection. According to Rogers (2003), active rejection consists of considering adoption of an innovation and then actively deciding not to adopt it. Passive rejection is when no identifiable decision is made, but due to inaction the innovation is effectively rejected. Instructional designers can help with the decision phase by making it as easy as possible for students or decision-makers to try out the instruction before committing to it. Can the designer be on-site for a test of the materials? Can they demonstrate to students or decision-makers what it actually looks like when the instruction is being used? Can they give away a component for free that people can test?

Use

The next stage in this model is the actual usage of the new design. Using a new product is generally not a one-time endeavor. New design usage is generally considered a long-term process. While the definition of "long-term" can be ambiguous and is heavily determined by the context, it is important to know the use of a new innovation within instructional design is usually not simply "plug and play." There is generally a period of continued education and professional development associated with the adoption. The instructional designer might provide getting started materials so people begin using the materials successfully, or technical support to make sure problems can be solved as soon as they are apparent. They might have to train the person leading the instruction, or at the very least show students how to use all of the features found in the instruction.

As the design is implemented, it is likely that an event referred to as re-invention may occur. Re-invention is defined in this context "as the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation" (Rogers, 2003, p. 180). It is important to note that re-invention is not necessarily a negative, as it can lead to improved results. For instance, an instructional designer may have intended that students complete an online module individually, but as it begins to be used throughout a company, the employees start to gather together in groups and complete the assignments together. Even though the designer did not intend for this kind of use, evaluations could show that it is more effective—students learn more and have deeper insights as they work together. An implication of this is that designers should make their designs flexible, so they don't break down during re-invention. They should also watch for re-invention because it might give them ideas for how they can design better in the future.

Confirmation

Confirmation occurs as the adopter evaluates the decision to adopt and implement the design. Are they satisfied with what they chose? During this stage it is possible that the design will be subsequently discontinued. The evaluation can be based on many measures: learner performance, ease of use, satisfaction, cost to maintain, etc. If discontinuance occurs, it is often a result of some kind of dissonance, or the gap adopters experience between what they expected to happen and what actually happened. It is important, then, for continued use of the design, that the instructional designer seeks methods to reduce or eliminate dissonance. Some methods to achieve reduction of elimination include helping adopters understand how to incorporate the design into their existing practices, continued support and training, and fixing problems the adopter may be experiencing with the instruction that interfere with its ability to achieve its intended outcomes.

Application Exercise

Consider an instructional design project you are either currently involved in, or one you are familiar with. Write a brief implementation plan for this project that uses all five of Rogers's implementation phases.

Prepare a brief presentation about this implementation plan, as if you were assigned to explain to your client why each phase is important to successfully implement the project.

Attributes of Designs That Lead to Successful Implementation

In addition to the innovation-decision process, it is important for the instructional designer to consider factors in the design itself that contribute to rates of adoption. Rogers (2003) identified five such attributes: relative advantage, compatibility, complexity, trialability and observability.

Relative Advantage

The concept of relative advantage refers to whether the design is actually an improvement over the current product or service the adopter has been using. If the adopter perceives that the design's value does not exceed that of the current product used, the design is much less desirable and unlikely to be adopted. In contrast, a design that is determined to be of greater value is more likely to be adopted. Instructional designers should be considering the relative advantage of their instruction throughout the design process. How is what they are designing better than the status quo?

Compatibility

Compatibility is in reference to how well the design aligns with other aspects of the adopter's life and circumstances. This could include the adopter's professional, pedagogical, and sociocultural ideologies. Conflict with any of these schemas, whether directly impacting the design's actual use, could threaten adoption. As indicated by Rogers (2003), "any new idea is evaluated in comparison to existing practice. Thus compatibility is, not surprisingly, related to the rate of adoption of an innovation" (p. 249). Through careful attention to the adopter's (students or other decision-makers) beliefs, interests, needs, and concerns throughout the design process, designers can help prepare their instruction so it is more compatible with what adopters expect and need.

Complexity

Complexity is how difficult it is to comprehend, incorporate, and actually use the design. While complexity does not impact the rate of adoption to the same degree as relative advantage and compatibility, the complexity of a design can negatively impact how likely it is for adopters to use (or want to use) it. If a design is perceived to be too difficult to incorporate or use, it is less likely to be adopted in the first place or more likely to be discontinued if it is adopted. Good evaluation and testing of prototypes throughout the instructional design process can help minimize the complexity of their instruction. Designers, in fact, can consider how they can specifically test prototypes to help minimize complexity (such as through a usability test).

Trialability

Trialability refers to how readily a design can be tested or used with a limited commitment. For example, software is often introduced in stages, or "betas." These stages of progressively more complete versions of a product permit its testing on a limited basis. Such testing permits users to identify issues and helps increase adoption. Trialability has a positive impact on the rate of adoption for early adopters, but is less impactful on the rate of adoption for later adopters (Rogers, 2003). As is hopefully clear, the trialability of instruction is closely associated with the decision phase described above. Designers should prepare for the trialability of their instruction as early as possible in their design process. High fidelity prototypes might be an easy and low-cost way of doing this.

Observability

Observability refers to "the degree to which the results of an innovation are visible to others" (Rogers, 2003, p. 16). Designs that are more difficult to observe or difficult to explain and operationalize are less likely to be adopted. This can be especially difficult for instructional designers because so much of the learning process is invisible or hard to observe. It helps to make sure the learning goals of the instruction are as measurable and observable as possible. Regularly reporting the results of assessments of student learning can also help. While important, however, observability is the least impactful of the attributes Rogers identified.

Application Exercise

You are an instructional designer implementing a new computer-based learning tool in a K-12 classroom. The teacher is not technologically savvy and is hesitant to use this new tool. Explain what steps might be taken to support the teacher and mitigate their concerns.

Considering Rogers' five attributes that impact the rate of adoption of innovations, please explain how these attributes would affect implementation decisions that you, as an instructional designer, would make, for this teacher.

Conclusion

In this chapter, we discussed the implementation phase of the instructional design process. We described important factors of implementation using the five stages of the diffusion of innovations: knowledge, persuasion, decision, implementation, and confirmation. We also reviewed characteristics of a design itself that can impact rates of implementation: relative advantage, compatibility, complexity, trialability and observability.

Implementation is a phase instructional designers should begin planning for at the beginning of their project. By carefully reviewing the material we provide here, designers—and those they support—will be able to ensure the instruction they create is actually used by those it is intended for so the desired changes that led to its creation can be brought about.

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Glossary

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