Foundations of Learning and Instructional Design Technology

Historical Roots & Current Trends

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What Is This Thing Called Instructional Design?

Ellen D. Wagner

Design | Instructional Design | Learning Design

In this chapter, Wagner discusses the challenge of how to define the field.

Editor's Note

The following is an excerpt from Ellen Wagner's article entitled "In Search of the Secret Handshakes of Instructional Design," published in the Journal of Applied Instructional Design. The title for this chapter comes from a portion of Wagner's essay to better represent the portion of her article that is republished here.

Wagner, E. (2011). Essay: In search of the secret handshakes of ID. *The Journal of Applied Instructional Design, 1*(1), 33–37.

Practitioners and scholars working in the professions clustered near the intersection of learning and technology have struggled to clearly and precisely define our practice for a long time—almost as long as technologies have been used to facilitate the creation, production, distribution, delivery and management of education and training experiences.

As a professional group, instructional designers—IDs—often bemoan the fact that it is hard to tell "civilians" what it is that we actually do for a living. Ironically this inability to clearly describe our work is one of the "secret handshakes" that unites us in our quest to better define our professional identity.

One of my favorite examples of this definitional challenge was described in a recent blog post by Cammy Bean, vice-president of learning for Kineo, a multinational elearning production company:

> *You're at a playground and you start talking to the mom sitting on the bench next to you. Eventually, she asks you what you do for work. What do you say? Are you met with comprehension or blank stares? This was me yesterday:*
>
> *Playground Mom: So, what do you do?*
>
> *Me: I'm an instructional designer. I create eLearning.*
>
> *Playground Mom: [blank stare]*

> *Playground Mom: [weak smile]*
>
> *Me: I create training for companies that's delivered on the computer….*
>
> *Playground Mom: weak nod…"Oh, I see."*
>
> *I see that she really doesn't see and I just don't have the energy to go further. I'm sort of distracted by the naked boy who just ran by (not mine). We move on.*
>
> *Is it me? Is it the rest of the world?*
> *http://cammybean.kineo.com/2009/05/describing-whatyou-do-instructional.html*

AECT has actively supported work on the definitions of big overarching constructs that offer people working at the intersections of learning and technology with a sense of identity, purpose and direction. Lowenthal and Wilson (2007) have noted that AECT has offered definitions in 1963, 1972, 1977, 1994, and 2008 to serve as a conceptual foundation for theory and practice guiding "The Field." But they wryly observe that our definitional boundaries can be a bit fluid. For example, after years of describing what we do as "educational technology," Seels and Richey (1994) made a case for using the term "instructional technology" as the foundational, definitional descriptor. Januszewski and Molenda (2008) returned us to the term "educational technology" as being broader and more inclusive. All seemed to agree that the terms educational technology and instructional technology are often used interchangeably. In discussing these implications for academic programs, Persichitte (2008) suggested that labels—at least the label of educational technology or instructional technology—do not seem to matter very much. And yet, I wonder—without precision—do we not contribute to the confusion about what it is that people like us actually do?

And what about this thing we do called instructional design? That seems to be an even harder domain to adequately define and describe. A definition of instructional design offered by the University of Michigan (Berger and Kaw, 1996) named instructional design as one of two components (the other being instructional development) that together constitute the domain of instructional technology. Instructional design was then further described in the following four ways:

Instructional Design-as-Process: Instructional Design is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of a delivery system to meet those needs. It includes development of instructional materials and activities; and tryout and evaluation of all instruction and learner activities.

Instructional Design-as-Discipline: Instructional Design is that branch of knowledge concerned with research and theory about instructional strategies and the process for developing and implementing those strategies.

Instructional Design-as-Science: Instructional design is the science of creating detailed specifications for the development, implementation, evaluation, and maintenance of situations that facilitate the learning of both large and small units of subject matter at all levels of complexity.

Instructional Design as Reality: Instructional design can start at any point in the design process. Often a glimmer of an idea is developed to give the core of an instruction situation. By the time the entire process is done the designer looks back and she or he checks to see that all parts of the "science" have been taken into account. Then the entire process is written up as if it occurred in a systematic fashion. http://www.umich.edu/~ed626/define.html

Ten years later, Reiser & Dempsey (2007) defined instructional design as a "systematic process that is employed to develop education and training programs in a consistent and reliable fashion" (pg. 11). They noted that instructional technology is creative and active, a system of interrelated elements that depend on one another to be most effective. They suggested that instructional design is dynamic and cybernetic, meaning that the elements can be changed and communicate or work together easily. They posited that characteristics of interdependent, synergistic, dynamic, and outcome, is self-correcting and empirical, and is a collaborative effort. They concluded that instructional design includes the steps of analysis, design, development, implementation, and evaluation of the instructional design.

Continue reading Wagner's essay on JAID's website.

2023 AECT Definition

On October 19, 2023, the AECT Board of Directors approved an updated definition for the field as follows, "Educational technology is the ethical study and application of theory, research, and practices to advance knowledge, improve learning and performance, and empower learners through strategic design, management, implementation, and evaluation of learning experiences and environments using appropriate processes and resources."

Note that many use educational technology and instructional design interchangeably, and while this AECT definition specifically refers to educational technology, it describes it as a process and practice of designing learning interventions.

Application Exercises

- Write a brief description of a real-world example of instructional design as a process, a discipline, a science, and/or a reality.
- Think of a time you were involved in the instructional design either as a teacher or learner. How did you work through each of these pieces? 1. Centers on the learner 2. oriented on central goal 3. includes meaningful performance & measurable outcome 4. self-correcting and empirical 5. collaborative

[Ellen D. Wagner]

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A Short History of the Learning Sciences

Victor Lee

It is inevitable that someone studying learning and instructional design and technology (LIDT) will come across the term Learning Sciences. Yet, for many, that moniker is fundamentally ambiguous and misunderstood, and questions abound about this thing called Learning Sciences. Are there multiple learning sciences or is there one dedicated and official field referred to with the plural of Learning Sciences? Is one supposed to capitalize both words when writing about it? Is it essentially classic educational psychology with a new name? Does it involve things beyond the mental phenomenon of learning? Is it actually a science? Are there points of convergence, divergence, or redundant overlap with other fields, including those that would be seen in the field of instructional design and technology? Are those who call themselves learning scientists best seen as friends, rivals, or innocuous others to those who consider themselves instructional designers? There are so many questions. There are also many answers. And a lack of a one-to-one correspondence between questions and answers has persisted in the roughly 30 years (see Figure 1) since the term began to see heavy use (assuming we are concerned with the capitalized L and capitalized S version, which will be the default for this chapter).

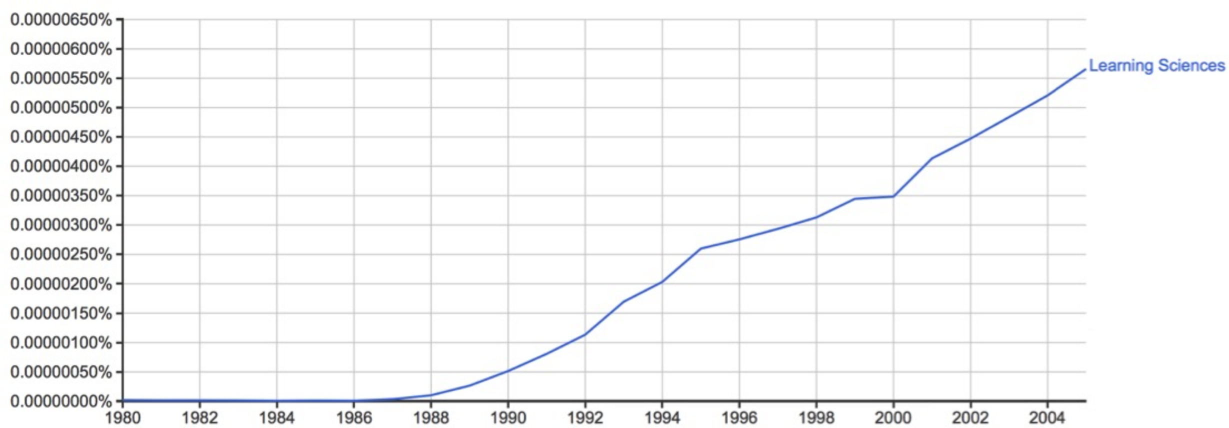

Figure 1. Use of the term Learning Sciences as depicted in Google's Ngram viewer. A major continuous increase appears to occur around 1990.

No article, book, nor chapter has been written that gives authoritative and definitive answers to these questions. The current chapter is no exception. Others have made noteworthy efforts, including contributors to a special issue of Educational Technology (Hoadley, 2004; Kolodner, 2004), those who have edited handbooks of the Learning Sciences (Fischer, Hmelo-Silver, Goldman, & Reimann, in press; Sawyer, 2006), and those who have prepared edited volumes that gather and publish firsthand reports from a number of seminal learning scientists (Evans, Packer, & Sawyer, 2016). In a sense, all of the above are snapshots of a still-unfolding history, and I recommend them all for the interested reader. This chapter exists as an effort to crudely present Learning Sciences to the LIDT community as it exists at this point in time from one point of view. The current point of view is presumably legitimized because the author of this chapter has the words Learning Sciences on his diploma and serves professionally for Learning Sciences conferences, journals, and academic societies. As the author, I do lead with the caveat that some of what I have to say here is an approximation

To Understand, We Must Look Backwards

There seems to be consensus that Learning Sciences is a relatively young,[1] interdisciplinary academic field. (The word learning is obviously important.) Yet the same could be said for other fields, including many that are more prominently known as LIDT fields. In addition, many seemingly related questions and problems touching on teaching, learning, and technology are addressed by both Learning Sciences and LIDT fields. Yet some people will adamantly maintain that the fields are, at their core, fundamentally different bodies who do different things. Others will argue that those differences are inconsequential and that, functionally, they are the same. So in response to these differing views, I suggest we consider the similarities between Learning Sciences and other LIDT fields as analogous to convergent evolution in evolutionary biology—the process by which dolphins and sharks evolved similar traits but were preceded by different genetic histories. There is certainly much overlap in what each field does and the spaces each inhabits, but the histories leading up to each are markedly different. Those histories matter, because they formed the skeletons for the bodies that exist today and help us understand why there may be some underlying differences coupled with functional similarities.

Cognitive and Artificial Intelligence Roots

If Figure 1 is any indication, the recent history of Learning Sciences goes back about 30 years, and it can be traced to some important locations and events[2]: namely, the first International Conference of the Learning Sciences (ICLS), which took place in 1991 and was connected to the Artificial Intelligence in Education (AIED) community. No formal society nor publication venue for Learning Sciences existed at that time. The first ICLS was hosted in Evanston, Illinois, in the United States, home of what was then the Institute for the Learning Sciences and the first degree program in Learning Sciences, at Northwestern University. The year 1991 was also when the first issue of the Journal of the Learning Sciences was published.

The connection to the AIED community is central to the historic identity of Learning Sciences. In the 1980s, cognitive science had emerged as an interdisciplinary field that, along with segments of computer science, was concerned with the workings of the human mind. The so-called “cognitive revolution” led to interdisciplinary work among researchers to build new models of human knowledge. The models would enable advances in the development of artificial intelligence technologies, meaning that problem solving, text comprehension, and natural language processing figured prominently. The concern in the artificial intelligence community was on the workings of the human mind, not immediately on issues of training or education. The deep theoretical commitments were to knowledge representations (rather than to human behaviors) and how computers could be used to model knowledge and cognitive processes.

Of course, as work in the years leading up to the first ICLS progressed in how to model and talk about (human) cognition, many had also become interested in using these new understandings to support learning and training. Intelligent tutoring systems gained prominence and became an important strand of work in Learning Sciences. That work continues to this day, with much of the work having ties historically to institutions like Carnegie Mellon University and the University of Pittsburgh. These tutoring systems were informed by research on expertise and expert-novice differences along with studies of self-explanation, worked examples, and human tutoring. Many of those who did original work in those areas still remain in Pittsburgh, but their students, colleagues, postdoctoral fellows, and others have since established their own careers in other institutions.

Marvin Minsky

Another locus of work on artificial intelligence was at the Massachusetts Institute of Technology, home to the Artificial Intelligence Laboratory (now known as the Computer Science and Artificial Intelligence Laboratory [CSAIL]) founded by the late Marvin Minsky. Also at MIT was Seymour Papert, who was named co-director of the AI Lab. Papert was a mathematician who contributed significantly to early AI research with Minsky. Papert saw early on the tremendous power of computers and their potential for learning and knowledge construction and became a passionate advocate for learning through computation, expressed largely through his theory of constructionism (Papert, 1980) and in the creation of the Logo programming language with Wallace Feurzig. Papert's research program migrated away from classical AI research and more toward issues of epistemology and learning. His efforts later led to the creation of the MIT Media Lab. A number of scholars trained with him, and the ideas and technologies generated at the Media Lab would spread with students who went on to positions at other institutions. As a result, constructionism, computational thinking, and Papert's sense of "powerful ideas" continue to be major strands of Learning Sciences to this day.

Papert was not the only one interested in how people learned to do computer programming.[3] Relatedly, programming was a concern for the Pittsburgh tutoring systems and also for others involved in the field, such as Elliot Soloway, who was initially at Yale before later relocating to University of Michigan. Others influential in the field were asking questions about what cognitive benefits result from learning to program. One such person was Roy Pea, who had been doing work in new educational technology and media with Jan Hawkins at the Bank Street College in New York. In Cambridge, educational technology endeavors informed by recent cognitive science were being pursued at places like Bolt, Beranek, and Newman (BBN) by the likes of John Seely Brown and Allan Collins, among other talented social scientists and technologists. These early scholars represented a part of the new educational media and computer programming sphere of research and development.

Text comprehension was another important area of initial research in artificial intelligence, with research on text and reading taking pace in numerous places, including Yale, University of Illinois, and Vanderbilt to name a few. There are numerous scholars of major influence who were involved at these different institutions, and any effort on my part to name them all would certainly fail to be exhaustive. A few to note, however, include Roger Schank, who relocated from Yale to Northwestern University, established the Institute for the Learning Sciences, and amassed faculty who would subsequently establish what has become the oldest academic program in the field; Janet Kolodner, who studied case-at University of Illinois, who then moved with her husband, Joseph Campione, to University of California, Berkeley. Schank and Bransford, with their respective teams at their institutions, were developing new ways to integrate narrative story structures into technology-enhanced learning environments based on the discoveries that were being made in text-comprehension and related cognition research. Brown, with her student Annemarie Palincsar (who moved on to University of Michigan), worked on extending seminal work on reciprocal teaching (Palincsar & Brown, 1984) to support improvement in text comprehension in actual real-world classroom contexts. The desire to use the new tools and techniques that were being developed from this cognitive research in actual learning settings rather than laboratories had been growing at all the aforementioned locations and led to the development of a methodological staple in Learning Sciences research: design-based research (Brown, 1992; Collins, 1992), to be elaborated upon more below.

Thus far, what one should be able to see from this gloss of Learning Sciences history is the major areas of research. For instance, cognitive science and artificial intelligence figured prominently. Understanding how to best model knowledge and understanding in complex domains continued to be a major strand of research. New technological media and a focus on children expressing and exploring new ideas through computer programming played prominently. There were also inclinations to look at story structure as it related to human memory in order to improve the design of tools and technologies for learning. Finally, there was a desire to take all these discoveries and findings and try to get them to work in actual learning settings rather than laboratories. These were not unified positions but rather all core areas of research and interest in the group that was coming together to establish the field of Learning Sciences. With that list in mind, and knowing that academic conference keynote lectures are usually given to high-profile or aspirational figures in the field, we have some context for the following list of invited keynote addresses at the first ICLS in 1991.

- Cognition and Technology Group at Vanderbilt—Designing Environments that Invite Thinking and Innovation
- Allan Collins—Design Issues for Interactive Learning Environments
- Andrea diSessa—Computational Media as a Foundation for New Learning Cultures
- James Greeno—Environments for Situated Conceptual Learning
- Marlene Scardamalia—An Architecture for the Social Construction of Knowledge
- Elliot Soloway—“Fermat’s Last Theorem? I Learned About It on Star Trek”

In that list, we can see the Vanderbilt group represented along with Collins and Soloway. Andrea diSessa, a prominent and frequently cited scholar in Learning Sciences (Lee, Yuan, Ye, & Recker, 2016) and in other fields, had completed his PhD at MIT in physics and worked closely with Seymour Papert. diSessa’s areas of research included students learning to program and how physics is learned. His academic career is largely associated with the institution where he spent most of his time as a professor: the University of California, Berkeley. Other important scholars at this point were Greeno and Scardamalia, who will be covered in the sections below.

Sociocultural Critiques and Situative Perspectives

Cognitive science and artificial intelligence were major influences in Learning Sciences, but contemporary work in the field is not exclusively intelligent tutoring systems, research on students’ mental models, or how people learn to program or use new digital media. A major, if not primary, strand of Learning Sciences research is based on a sociocultural perspective on learning. At times, this maintains an ongoing tension with the cognitive- and AI-oriented perspectives, and active dialogue continues (diSessa, Levin, & Brown, 2016).

John Seely Brown, mentioned previously as being a key figure in the New England area, was later brought to the West Coast to work for Xerox PARC (Palo Alto Research Center) and head the new Institute for Research on Learning (IRL). Part of the activities of the IRL team at PARC involved studying how to support learning, including in the photocopying business (Brown & Duguid, 1991). Importantly, the Bay Area location positioned PARC near the University of California, Berkeley, where scholars like Alan Schoenfeld, Peter Pirolli, Marcia Linn, Ann Brown, Andrea diSessa, and James Greeno had all been hired into a new program focusing on education in mathematics, science, and technology.

practice was very different from how mathematics understanding was conceptualized by the cognitive psychologists (e.g., Lave, Murtaugh, & de la Rocha, 1984). Additionally, Lave and Wenger published a seminal monograph, Situated Learning (1991), summarizing several cases of learning as it took place in actual communities of practice. The learning involved much more than knowledge acquisition and instead was better modeled as changes from peripheral to central participation in a community. Adequately encapsulating the extensive work of Lave, Wenger, and colleagues is well beyond what can be done in a chapter. However, they earned the attention of Greeno (Greeno & Nokes-Malach, 2016) and others by suggesting that entirely different units of analysis were necessary for people to study learning. These perspectives were largely cultural and social in nature, taking talk and interaction and material artifacts as they were taken up in practice as critical. At the time, there were also groundbreaking works published, such as the translation of Lev Vygotsky's work (1978), Barbara Rogoff's studies of real-world apprenticeship (Rogoff, 1990), and Edwin Hutchins's bold proposal that AI approaches to cognitive science were being far too restrictive in recognizing and understanding cognition as it happened "in the wild" (Hutchins, 1995).

These ideas had a great deal of influence on the emerging community of learning scientists, and the close proximity of the scholars and their ideas led to major public debates about how learning could best be understood (Anderson, Reder, & Simon, 1996; Greeno, 1997). The establishment and acceptance of cultural-historical activity theory and the work of Michael Cole (an institutional colleague of Hutchins) and Yrjo Engestrom also figured prominently as CHAT found a place in education and other scholarly communities. Also influential was James Wertsch, an anthropologically oriented, cultural historical educational scholar.

In essence, a critique of mainstream cognitive science and an alternative perspective had emerged and attracted a contingent. Graduate programs and major research centers formed, and still the networks of scholars that existed continued to dialogue with one another and produce trainees who would later continue developing the newly created field of Learning Sciences. Those individuals would shape the scholarly agenda and produce theoretical innovations for how learning was conceptualized that were different from what had been dominant in previous academic discourse.

Much of contemporary Learning Sciences research has extended these ideas. Rather than focusing on knowledge, many learning scientists focus on social practices, whether they be scientific or mathematical practices, classroom practices, or informal practices. Identity as a socially constructed and continually mediated construct has become a major concern. Seeking continuities between cultures (with cultures not necessarily being geographical nor ethnic in nature) and discovering how to design activities, tools, or routines that are taken up by a culture or give greater understanding of how cultures operate remain ongoing quests. Other concerns include historicity, marginalization of communities, cultural assets rather than cultural deficits, equity, social justice, and social and material influences on spaces that are intended to support learning.

Helping people learn and using new technologies remain important themes, but rather than focusing on computers solely as tutoring systems or spaces where simulations of complex phenomena can be run, current learning sciences technologies with a sociocultural bent allow for youth to collect data about their cities and critically examine equity and opportunity; to become community documentarians and journalists so that local history is valued and conserved in line with the individual interests of participating youth; to build custom technologies of students' own design that better the circumstances of their peers, homes, and communities; and to obtain records of everyday family or museum or after-school activities that have embedded within them germs of rich literary, mathematical, historical, or scientific thought. Current technologies also act as data- and knowledge-sharing tools that help make invisible practices and routines in schools more visible to teachers and other educators.

Computer-supported Collaborative Learning

In the early days of Learning Sciences, cognitive and sociocultural perspectives figured prominently, in addition to the opportunity to look at and modify intact educational systems rather than relegating research to strictly the laboratory. The relationships being built and dialogues taking place were critically important, as was the proximity of research with what got spotlighted as internally sanctioned Learning Sciences research. The community that participated in the first ICLS that began to feel a rift was the Computer Supported Collaborative Learning (CSCL) community. Many, but not all, scholars in this area were located in Europe.

CSCL, like the rest of the Learning Sciences community, was also seriously interested in cognition, new technologies, and social contexts of learning. However, if there were some distinguishing features of the CSCL community, the focus on technology-mediated group cognition figured prominently. Several topics were important for looking at how people learned together online in designed spaces. Examining conceptual change as it became a reciprocal and negotiated process between multiple parties using a technology was also part of this group emphasis. Scripting that informed implicit expectations for how students would interact and move through collaborative learning activities became a major focus. Online knowledge building environments with asynchronous participation and online discourse were also a big focus of CSCL. Ideas about collaborative learning from Naomi Miyake (Chukyo University, then University of Tokyo, Japan), Jeremy Roschelle (SRI International, USA), Stephanie Teasley (SRI International, now at University of Michigan, USA), Claire O'Malley (University of Nottingham, UK), Frank Fischer (Ludwig-Maximilian University of Munich, Germany), Pierre Dillenbourg (University of Geneva and later at École Polytechnique Fédérale de Lausanne, Switzerland), Paul Kirschner (Open University, Netherlands), Gerry Stahl (Drexel University, USA), Marlene Scardamalia and Carl Bereiter (Ontario Institute for Studies in Education, Canada), and Timothy Koschmann (Southern Illinois University, USA) were formative.[4] Sometimes classrooms were the focus, but other learning settings, such as surgical rooms or online forums, became important research sites as well.

CSCL became a distinct enough strand of research that its own workshop was held in 1992 and then its own conference in 1995. Analyses of networks of collaboration and conference topics appear in Kienle and Wessner (2006). There were scholars who consistently appeared at both ICLS and CSCL conferences. Activity in one conference was in no way mutually exclusive from activity in the other. However, there were eventually contingents that were more drawn to one community over the other. Ultimately, given deep overlaps and crossover between CSCL and ICLS, a formal society that oversaw both conference series, the International Society of the Learning Sciences (ISLS), was established in 2002. Many of the aforementioned CSCL scholars were elected president of that society as the years proceeded, and many early graduate students who participated in the formation of these communities and the Learning Sciences field, who went on to become established scholars themselves, were elected as well. In 2006, the International Journal of Computer-Supported Collaborative Learning was established as a leading publication venue, with Gerry Stahl as founding editor. This was officially sponsored by the ISLS, as was the society's other flagship journal that had been operating since 1991, Journal of the Learning Sciences, with Janet Kolodner as the founding editor.

- **Professional Organizations**
  - International Society of the Learning Sciences
  - American Educational Research Association SIGs Learning Sciences and Advanced Technologies for Learning
- **Conference Venues**
  - International Conference of the Learning Sciences
  - Computer-Supported Collaborative Learning
- **Academic Journals**
  - Journal of the Learning Sciences
  - International Journal of Computer-Supported Collaborative Learning
- **Academic Programs and Online Resources**
  - Network of Academic Programs in the Learning Sciences (NAPLeS)

Design-based Research

As an interdisciplinary field with a mix of cognitive, computational, sociocultural, and anthropological traditions all in dialogue, the methodological palette began with and maintained a great deal of diversity. Controlled experiments, think-aloud protocols, interview studies, field work, and computational modeling all appear in Learning Sciences research along with other methods and methodological approaches. However, Learning Sciences strongly associates itself also with the articulation of design-based research as a methodology.

The nature of design-based research has been described in many places elsewhere (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; The Design-Based Research Collective, 2003; Sandoval & Bell, 2004), and new innovations to support that paradigm have been developed in the over two and a half decades since it was first introduced in academic publication (e.g., Sandoval, 2013). The simplest articulation of design-based research is that it involves researchers working with real educational settings and introducing new tools, practices, or activities that embody a set of assumptions that exist based on prior research.

For example, one might know from the existing literature that metacognitive support can improve learning outcomes during laboratory text-comprehension tasks. Rather than accept that as a given and hope that this finding gets translated on its own into classroom practice, the aspiring design-based researcher may then design and develop a new software tool that helps students continually monitor their own understanding and reflect on their own progress when reading science texts at school. The researcher would then test it informally to make sure it is usable and make arrangements with a local school to have some of their English classes use it. Upon bringing it into a school classroom, they discover that the metacognitive supports are actually confusing and counterproductive in the classroom because so much depends on whether students find the topic engaging and whether the teacher can orchestrate a classroom activity to split instructional time such that students begin by using the tool, participate in a reflective discussion with the teacher, and then return to the tool. The design-based researcher may discover that, unlike the 15-minute sessions reported in the existing literature when metacognitive training was done in the lab, a week is actually required to smoothly implement the tool in the classroom. The teachers need some help noticing what student comments to build upon in the reflection discussions. Texts need to be modified to immediately connect more to topics students already know.

In this experience, a well-meaning researcher attempted to take the best of what was known from prior research and ended up taking participants on a much more complicated journey than intended. That journey began to reveal how metacognitive activity works in a real education setting, how software tools should be designed and used in school settings, and what sorts of things classroom teachers need to do with the software to make it maximally effective. To classroom.

That cycle is a very general summary of how design-based research unfolds. The researcher may have varying levels of involvement in the educational setting, where they may provide some initial professional development or training to a facilitator and then watch what unfolds later or where they may directly lead the classroom activities by their self. Design-based research can be a solo endeavor or a major team one. The benefit of this type of research is that it puts theoretical assertions (e.g., metacognitive supports improve text comprehension) in harm's way by allowing for the complexity of the real world to be introduced. This helps to refine (or even establish) stronger theory that speaks to complexities of how learning works in different systems. The intact unit could be a single student, a single classroom, a group of teachers, multiple classrooms, multiple grade bands in a school, a museum exhibit, a museum floor, an after-school program, a university course, or an online course. The outcomes of design-based research are articulated especially nicely by Edelson (2002), who argues that design-based research ultimately produces new knowledge about domain theories, design frameworks, and design methodologies. diSessa and Cobb (2004) have also suggested that design-based research can be the locus for new theoretical constructs to emerge.

As design-based research has matured, some have pushed to broaden its scope to speak to larger educational systems. Rather than working with individual students or classrooms, design-based implementation research (DBIR) promotes partnership with educational institutions such as entire schools or school districts (Penuel, Fishman, Cheng, & Sabelli, 2014). Related design-based approaches also appear as improvement science (Lewis, 2015) and in research-practice partnerships (Coburn & Penuel, 2016). As of late, these have been receiving more attention. Optimistically, we could see this as the desire of funding agencies and academic communities to scale important findings from the past decades of design-based research and to understand what enables new and powerful tools and activities to support learning and impact more learners.

As such, it is common for design-based research to appear in Learning Sciences research, whether in a single study or across a multi-year research program that may involve dozens of researchers and multiple academic institutions working in partnership with educational systems. Again, even though design-based research is prominent, effective and successful learning scientists need not claim design involvement in order to be considered as meaningfully contributing to the field. It does help, however, to be aware of the methodological approach, its history, warrants for arguments made through design-based research, and the kinds of knowledge that the field develops from design-based studies. It is also important to consider that design-based research has broadened in its appeal such that other fields are participating in design-based research without having prior historical ties to the Learning Sciences.

Learning Sciences and LIDT Fields

To summarize, Learning Sciences has a history that gives it its unique character. That history is tied to cognitive science and artificial intelligence, to new forms of educational media, to sociocultural and situative critiques and studies of learning, to group cognition as it involves multiple learners and technology mediation, and to an appreciation for what design can do in service of advancing academic knowledge. At its surface, this looks much like what LIDT fields also care about and also pursue. In broad strokes, that is true. However, the histories of Learning Sciences and LIDT fields have differences, and those origins ripple unintentionally in terms of what conferences and what journals are favored. The argument has been made that LIDT and Learning Sciences have much to gain from more cross talk, and that is likely true. However, that cross talk has not always happened (Kirby, Hoadley, & Carr-Chellman, 2005), and perceptions remain that fundamental barriers exist that discourage such cross talk. In some cases, strong academic departments have split because faculty in them felt that LIDT and Learning Sciences were incompatible.

However, there have since been deliberate efforts to close perceived rifts. For example, Pennsylvania State University made a deliberate effort to hire individuals trained in Learning Sciences (Chris Hoadley, Brian K. Smith) into their already strong LIDT-oriented department, and that promoted dialogue and relationship building, although the LS-oriented faculty the University of Georgia Learning and Performance Systems Laboratory (Daniel Hickey and Kenneth Hay) took positions in a new Learning Sciences program established at Indiana University. The push for more relationship building is now there.

The future of the relationship between LIDT and Learning Sciences organizations and programs is ultimately up to those who are currently training as students in those fields. As someone who has been operating in both spaces, although I was explicitly trained in one, I understand many barriers are actually illusory. There are different foci and theoretical commitments and expectations in each field, but both communities deeply care about learning and how we can build knowledge to improve the tools, practices, and environments that support it. To gain traction in the other field, people simply start by reserving judgment and then reading the other field's core literatures. They start conversations with individuals who are connected to the other field and initiate collaborations. They get excited about ideas that other parties are also currently thinking about, and they have dialogue. In fact, that's the simplified version of how Learning Sciences began. It could be the beginning of the history for a new multidisciplinary field in the future as well.

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Footnotes

1. Compared to, say, Philosophy, Mathematics, or History ↩
2. The prehistory of Learning Sciences is presented quite compellingly by Pea (2016) and Schank (2016). ↩
3. A true Papert perspective would likely not privilege computer programming so much as rich and generative representational media embedded in contexts that allow the exploration, construction, and sharing of powerful ideas. ↩
4. Of course, there were far more highly influential CSCL scholars than are in this list, and many were also participating in ICLS primarily. ↩

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LIDT Timeline

Jennifer Ramsey

1905–1953

1954–1969

1970–1984

1985–2003

2004–2009

2010–2022

Jennifer Ramsey

Access it online or download it at https://edtechbooks.org/foundations_of_learn/lidt_timeline.

Programmed Instruction

Instructional Design | Instructional Design History | programmed instruction

Editor's Note

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Programmed instruction (PI) was devised to make the teaching-learning process more humane by making it more effective and customized to individual differences. B.F. Skinner's original prescription, although it met with some success, had serious limitations. Later innovators improved upon the original notion by incorporating more human interaction, social reinforcers and other forms of feedback, larger and more flexible chunks of instruction, and more attention to learner appeal. Although PI itself has receded from the spotlight, technologies derived from PI, such as programmed tutoring, Direct Instruction, and Personalized System of Instruction have compiled an impressive track record of success when compared to so-called conventional instruction. They paved the way for computer-based instruction and distance learning. The success of the PI movement can be attributed largely to the commitment of its proponents to relentless, objective measurement of effectiveness.

Origins of the Programmed Instruction Movement

During the first half of the 20th century, research and theory in American psychology tended to revolve around the perspective of behaviorism, and Thorndike's (1911) theorems—the law of recency, the law of effect, and the law of exercise—remained at the center of discussion for decades. In the 1920s Sidney Pressey, a psychology professor at Ohio State University, invented a mechanical device based on a typewriter drum, designed primarily to automate testing of simple informational material (1926). As he experimented with the device he realized that it could also provide control over drill-and-practice exercises, teaching as well as testing. In explaining why his device was successful he explicitly drew upon Thorndike's laws of recency, effect, and exercise as theoretical rationales (Pressey, 1927). Unfortunately, despite the fact that Pressey continued to develop successful self-teaching devices, including punchboards, that had all the qualities of later "teaching machines," his efforts were essentially a dead end in terms of a lasting effect on education. However, Pressey lived and worked long enough to participate in the discussions surrounding the new generation of teaching machines that came along in the 1950s.

The movement that had a more enduring impact on education and training was animated by a reframing of Thorndike's behaviorist principles under the label of radical behaviorism. This school of thought proposed a more rigorous definition of the law of effect, adopting the term *reinforcer* to refer to any event that increases the frequency of a preceding proponent of radical behaviorism, B.F. Skinner, demonstrated that by manipulating these three variables experimenters could elicit quite complex new behaviors from laboratory animals (Ferster & Skinner, 1957).

Skinner's Invention of Programmed Instruction

Skinner was led to apply the principles of operant conditioning to academic tasks by a personal experience with one of his own children. As reported by his older daughter, Julie:

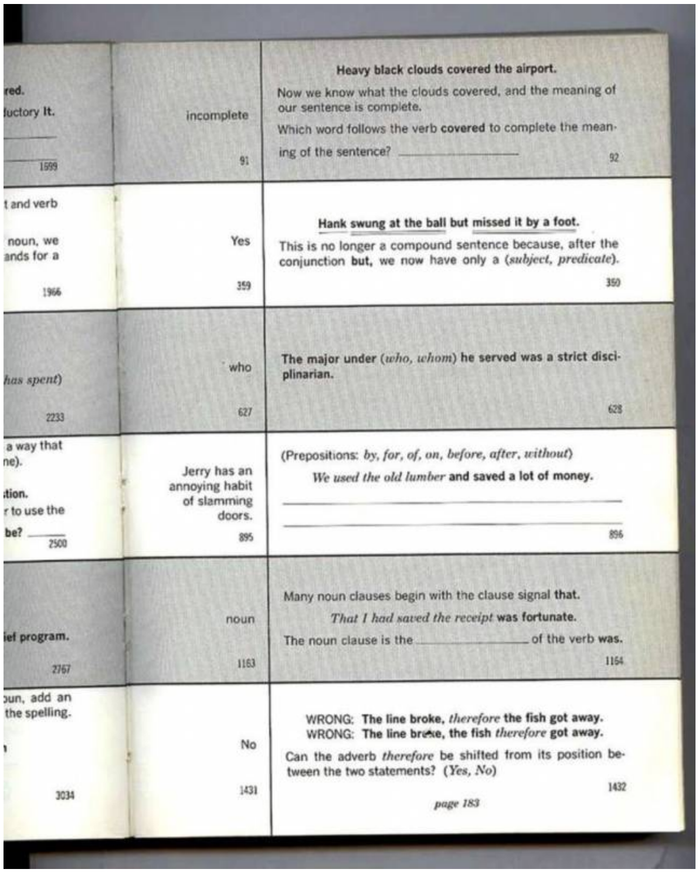
> *When the younger [daughter, Deborah] was in fourth grade, on November 11, 1953, Skinner attended her math class for Father's Day. The visit altered his life. As he sat at the back of that typical fourth grade math class, what he saw suddenly hit him with the force of an inspiration. As he put it, 'through no fault of her own the teacher was violating almost everything we knew about the learning process. '(Vargas, n.d.)*

Having analyzed the deficiencies of group-based traditional instruction, Skinner (1954) proceeded to develop a mechanical device (shown in Figure 1) that could overcome the limitations of lock-step group presentation, replacing it with individually guided study in which the contingencies of reinforcement could be carefully controlled. In Skinner's new format the content was arranged in small steps, or frames, of information. These steps lead the learner from the simple to the complex in a carefully ordered sequence, and, most importantly, at each step the learner is required to make a response—to write or select an answer. The program then judges whether the response is correct. The theory dictated that the learner should then receive some sort of reinforcer if the response were correct. In Skinner's method, the reinforcer took the form of "knowledge of correct response," that is, telling the learner the right answer or confirming that they got the right answer. The main purpose of the mechanical elements of the system was to ensure that users could not peek ahead at the correct answers. The next step in the sequence could only take place after a response was written inside a little window frame and a lever pulled to cover the learner's response with a transparent cover while revealing the correct answer. The device, referred to by others as a *teaching machine*, soon gained national attention and attracted a following of eager software authors.

Figure 1. A teaching machine of the Skinner type. Used with permission of AECT, successor to DAVI.

Further Development of Programmed Instruction

The instructional format used in teaching machines became known as programmed instruction (PI), and this new technology became a popular subject of educational research and development by the late 1950s. Within a few years developers were dispensing with the elaborate mechanical apparatus, instead relying on users (rightly or wrongly) to discipline themselves and refrain from peeking ahead at the correct answer. Thus PI lessons could be published in book publishers rushed to produce books in programmed format. They offered programmed books that appealed to mass audiences, such as *Goren's Easy Steps to Winning Bridge* (1963) by the famous bridge master Charles Goren, and those that aimed at the school market, such as *English 2600* (Blumenthal, 1961), which taught the fundamentals of grammar in a step-by-step linear program, illustrated in Figure 2.



red. luctory **It.** 1599	incomplete 91	**Heavy black clouds covered the airport.** Now we know what the clouds covered, and the meaning of our sentence is complete. Which word follows the verb **covered** to complete the meaning of the sentence? ______ 92
t and verb noun, we ands for a 1966	Yes 359	**Hank swung at the ball but missed it by a foot.** This is no longer a compound sentence because, after the conjunction **but,** we now have only a (*subject, predicate*). 360
has spent) 2233	who 627	**The major under (*who, whom*) he served was a strict disciplinarian.** 628
a way that ne). tion. r to use the be? ______ 2500	Jerry has an annoying habit of slamming doors. 895	(Prepositions: *by, for, of, on, before, after, without*) *We used the old lumber* **and saved a lot of money.** ______ ______ 896
ief program. 2767	noun 1163	Many noun clauses begin with the clause signal **that.** *That I had saved the receipt* **was fortunate.** The noun clause is the ______ of the verb **was.** 1164
oun, add an the spelling. 3034	No 1431	WRONG: **The line broke, *therefore* the fish got away.** WRONG: **The line broke, the fish *therefore* got away.** Can the adverb *therefore* be shifted from its position between the two statements? (*Yes, No*) 1432

page 183

Figure 2. Example of page layout of a linear programmed instruction book: English 3200 by Joseph Blumenthal, New York: Harcourt Brace & World, 1962.

Linear vs. Intrinsic Programming

The original programs devised by B.F. Skinner and his followers led users through a pre-specified sequence of small steps. Shortly after Skinner's invention, Norman Crowder introduced a variation that was not founded on any particular theory of learning, but only on practicality. It featured a more flexible programmed lesson structure that allowed learners to skip ahead through material that was easy for them or to branch off to remedial frames when they had difficulty. Crowder (1962) labeled his method *intrinsic programming*, but it was quickly dubbed *branching programming* because a schematic outline of the program resembled a tree trunk (the prime path) with multiple branches (the remedial sequences). Skinner's method was thereafter known as *linear programming*. The two approaches are contrasted in Figure 3.

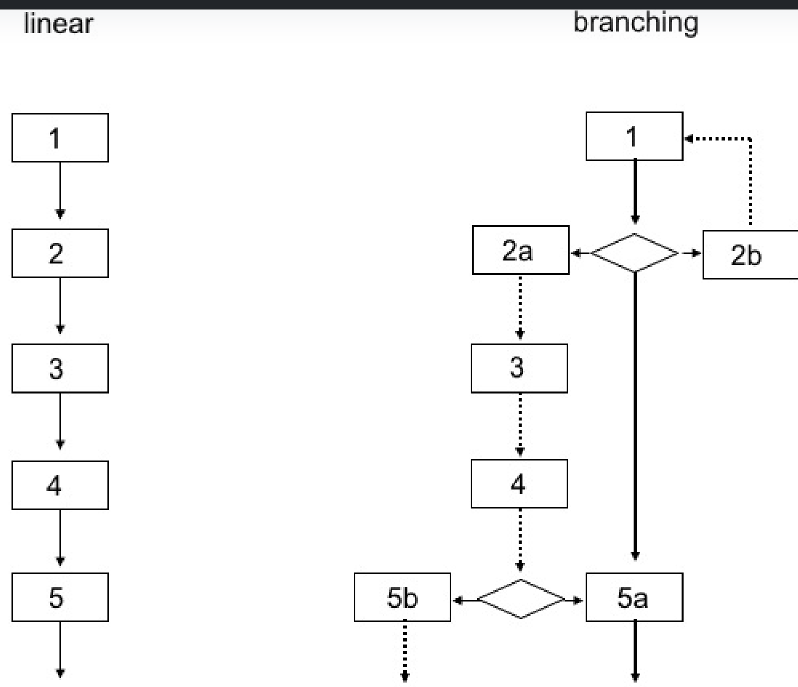


Figure 3. Comparison of the organization of a linear vs. branching programmed text. © Michael Molenda. Used with permission.

Initially, Crowder's programs were incorporated into the *AutoTutor*, a desktop teaching machine which used his branching technique to tailor the lesson to the responses of the learner. The original *AutoTutor*, released in the early 1960s, provided individualized instruction long before general-purpose desktop computers were feasible. But Crowder also joined the rush to convert programs to book form. His *TutorText* series became one of the best-known series of programmed materials. In the print format, readers encountered multiple-choice questions and each alternative answer led to a different "next page" in the book.

Pi in Formal Education

PI was first employed in formal education in the college courses taught by Skinner and his colleagues in the late 1950s. Experiments in schools began with teaching spelling to second- and third-graders in 1957 and teaching mathematics in high schools in 1959 (Saettler, 1990, p. 297). Large-scale school implementation projects were conducted in the early 1960s in Denver and Long Island, NY. The major lesson learned in these experiments was that although the materials themselves were effective, PI could not make a substantial impact on the efficiency or effectiveness of schooling without extensive restructuring of classroom routines and school organization. Schools then, as now, were resistant to systemic restructuring (Saettler, 1990, pp. 297-302).

The Programmed Instruction Boom

Authors and publishers unleashed a flood of programmed materials both in linear and branching formats. Between the early 1960s and 1966, new titles proliferated at an accelerating rate as publishers vied with each other for market dominance. Figure 4 illustrates this boom, showing the growth curve of programmed materials in the United Kingdom, which was paralleled in the U.S. As with other technological innovations, the upward slope did not continue indefinitely. After 1966 the publication of new titles declined rather rapidly and then leveled off. Although there is little fanfare today,

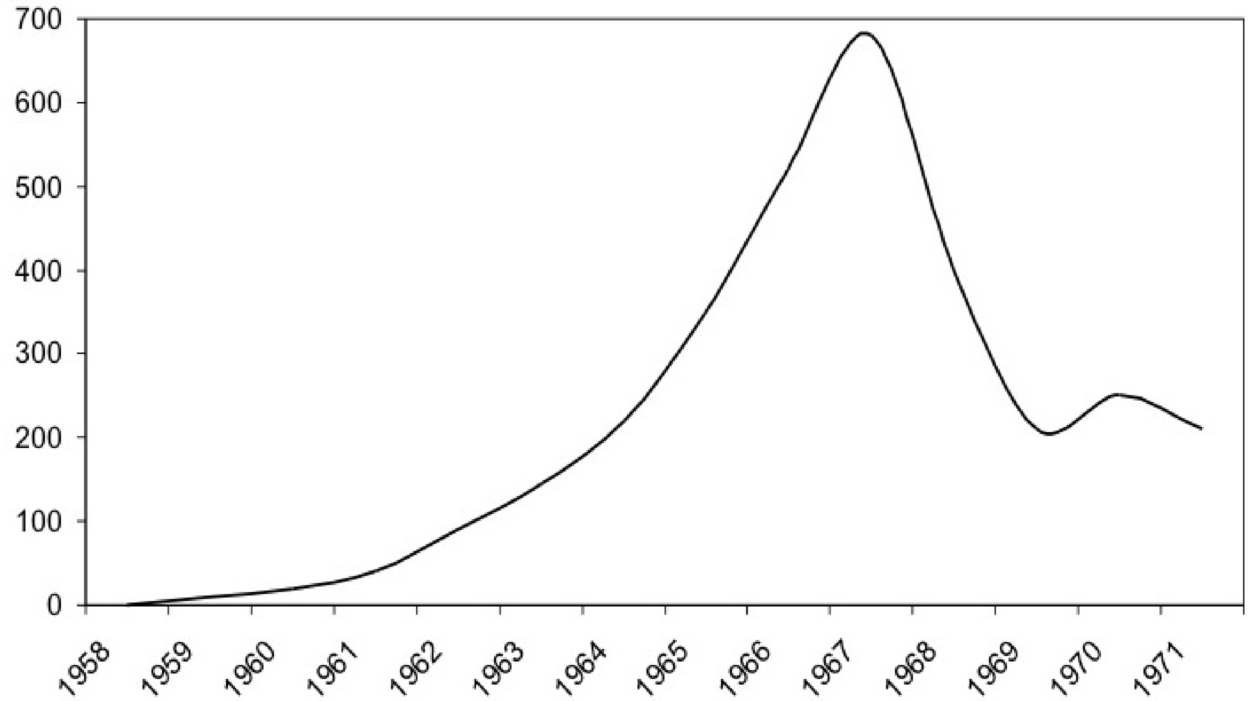


Figure 4. Number of programmed instruction titles available in the market each year in the United Kingdom. Adapted from Figure 1 in Hamer, J.W., Howe, A. & Romiszowski, A.J. (1972). Used with permission of SEDA, successor to APLET.

Striving for Effectiveness

One of the major tenets of PI was that learners should practice mainly correct responses, so that they could experience frequent reinforcement. The only way of assuring this was to test and revise each program during development. In fact, *developmental testing* was a mandatory specification for materials destined for the military training market. The US Air Force required that "at least 90% of the target population will achieve 90% of the objectives" (Harris, p. 142). This was known as the 90/90 criterion and was widely accepted as the standard benchmark of effectiveness. One of the consequences of this practice was to promote the flowering of a systematic procedure for designing, testing, and revising programmed materials, a precursor to later instructional design models.

Another consequence was to encourage an empirical, data-based approach to instruction, since each PI development project was similar to a controlled experiment. The professional literature of the 1960s carried hundreds of reports on testing of PI programs and comparisons of programmed treatments with other sorts of treatments. One of the first casualties of this research was Skinner's set of specifications. Small steps did not prove to be essential, nor linear sequencing…as demonstrated by Crowder's branching method. The immediacy of reinforcement did not prove to be critical for a great many types of learning tasks. Indeed, the efficacy of "knowledge of results" as a reinforcer did not stand up under scrutiny. In retrospect, it was predictable that "knowledge of correct response" would not work as a universal reinforcer. Researchers (and lay people) already knew that different people respond to different reinforcers at different times. When a person is satiated with ice cream, ice cream is no longer reinforcing. The same is true of being told the correct answer. At some point curiosity is satiated. Researchers rediscovered that there are no universal reinforcers.

Interestingly, even though the individual hypotheses making up PI did not prove to be robust, experiments comparing PI to so-called *conventional instruction* (a construct that needs to be critically deconstructed in its own right!) tended to simply received more time and effort in its preparation and delivery. Second, users are often attracted to the novelty of any new treatment—at least until the novelty wears off. Finally, the PI treatments not only had more time and attention, they were designed through a rigorously thought-out, systematic process, which included not only precise specification of objectives but also testing, revision, and re-testing. Indeed, it was the realization that the *design process* was the valuable part of programmed instruction that led to the emergence of systematic instructional design as a powerful tool (Markle, 1967).

Programmed Instruction in Davi

It was not inevitable that PI would become a factor in the field then known as audiovisual (AV) communications, represented by AECT's predecessor, the Department of Audio-Visual Instruction (DAVI), a unit of the National Education Association. In the late 1950s and early 1960s DAVI was enjoying a growth spurt stimulated, first, by the mushrooming of new schools in the post-World War II expansion period and, second, by the largest ever federal infusion of money into public education, the National Defense Education Act (NDEA) of 1958. Schools and colleges, like the rest of American society, lived under the shadow of the Cold War, and the feeling of a life-or-death struggle with the Soviet Union was palpable. With the Soviet launch of Sputnik I in 1957, America confronted the prospect of a dangerous technological inferiority. Education—especially in mathematics, science, and engineering—became an urgent priority.

The DAVI community benefited from the reinvigorated march to expand and improve education through the NDEA. *New educational media* became the hot topic of ramped-up research and development activity as well as the beneficiary of enhanced school-equipment budgets. Attendance at DAVI conventions zoomed from the hundreds to the thousands as school AV administrators, many newly assigned, flocked to see and buy the new hardware and software exhibited there: film, slide and filmstrip, phonograph and audio tape, opaque and overhead projection, radio, and television (Godfrey, 1967).

The 1959 DAVI convention program was primarily devoted to these audiovisual media. It had a single research paper devoted to PI, "Teaching Machines and Self-Instructional Materials: Recent Developments and Research Issues," but by 1960 there were several sessions devoted to PI, including a major one entitled "Programmed Instructional Materials for Use in Teaching Machines" (Sugar & Brown, n.d.). This title gives a clue to the connection between AV administrators and PI: mechanical devices were initially used to deliver the programmed lessons. When schools and colleges acquired teaching machines someone had to take care of them. Who was more suited to this task than the AV coordinator who already took care of film, filmstrip, slide, and overhead projectors? The focus on hardware is indicated by the name that marked this new special interest group at the next several DAVI conventions: the Teaching Machine Group.

DAVI's commitment to this new phenomenon was signaled by the publication of a collection of key documents on PI (Lumsdaine & Glaser) in 1960, and then a follow-up compilation of later research and commentary in 1965 (Glaser). Attention at the annual DAVI convention grew; by the late 1960s the convention offered about a dozen sessions a year on PI, representing about a one-tenth share of the stage. The conversation was still predominantly about AV media, but PI had a visible, sustained presence. PI was even more visible in scholarly circles, as indicated by Torkelson's (1977) analysis of the contents of *AV Communication Review*, which showed that between 1963 and 1967 the topics of teaching machines and programmed instruction represented a plurality of all articles published in that journal.

DAVI was not the only, or even the primary professional association interested in PI. When Air Force experiments in 1961 demonstrated the dramatic time and cost advantages of PI (efficiency as well as effectiveness) military trainers and university researchers quickly formed an informal interest group, which by 1962 became a national organization, the National Society for Programmed Instruction (NSPI). The organization grew to encompass over 10,000 members in the U.S., Canada, and forty other countries. As the interests of members also grew and evolved to include all sorts of technological interventions for improved human performance, the name, too, evolved to its current form, International Society for Performance Improvement (ISPI).

Gradually, throughout the 1960s the central focus of the field was shifting from the production and use of AV materials to designing and utilizing interactive self-instructional systems. B.F. Skinner coined the term *technology of teaching* in 1968 to describe PI as an application of the science of learning to the practical task of instruction. Other authors used the term *educational technology*; an early example being *Educational technology: Readings in programmed instruction* (DeCecco, 1964). This idea supported the notion promoted by James D. Finn (1965) that *instructional technology* could be viewed as *a way of thinking* about instruction, not just a conglomeration of devices. Thereafter, more and more educators and trainers came to accept *soft* technology, the "application of scientific thinking" as well as *hard* technology, the various communications media. And when the time came to reconsider the name of the association in the late 1960s, one of the names offered to the membership for vote combined elements of both. The vote in June 1970 showed a three-to-one preference for the hybrid name, Association for Educational Communications and Technology (AECT).

Other Soft Technologies Derived From Programmed Instruction

Over the decades since Sidney Pressey's and B.F. Skinner's bold innovations in self-instruction, many other concerned educators have tried their hands at improving upon the format initially incorporated into teaching machines. Obviously, computer-assisted instruction was heavily influenced by PI. In addition, a number of other technological spin-offs from PI have gone on to chart a record of success in improving the effectiveness of education. Three will be examined in some detail—programmed tutoring, Direct Instruction, and Personalized System of Instruction.

Programmed Tutoring

A psychology professor at Indiana University, Douglas Ellson, had a life-long consuming interest in improving the teaching-learning process. He examined PI very closely, detected its weaknesses, and in 1960 developed a new approach to address those weaknesses (Ellson, Barber, Engle & Kampwerth, 1965). Programmed tutoring (PT) puts the learner together with a tutor who has been trained to follow a structured pattern for guiding the tutee. Like PI, students work at their own pace and they are constantly active—reading, solving problems, or working through other types of materials. The tutor watches and listens. When the tutee struggles to complete a step, the tutor gives hints, taking the learner back to something he already knows, then helps him to move forward again. Thus, learners are usually generating their own answers. And instead of receiving "knowledge of correct response" as reinforcement, they receive *social* reinforcers from the tutor—praise, encouragement, sympathy, or at least some attention.

Of course, giving every student a tutor is a labor-intensive proposition, but Ellson solved this problem by using *peers*as tutors—students of the same age or a little older, a role they proved able to play after a little training in how to follow the specified procedures. Not only did tutors serve as "free manpower," but research showed that it was a win-win situation because tutors showed learning gains even greater than the tutees'! By going through the material repeatedly and teaching it to someone else, they strengthened their own grasp of the material.

During the early 1980s PT gained credibility due to its track record in comparison studies (Cohen, J.A. Kulik & C. C. Kulik, 1982). It was recognized by the U.S. Department of Education as one of the half-dozen most successful innovations and it was widely disseminated (although not as widely as it deserves, as with many of the other soft technologies that have been developed over the years).

Direct Instruction

Direct Instruction (DI) was actually not derived explicitly from programmed instruction. Its originator, Siegfried "Zig" Engelmann was an advertising executive with a degree in philosophy. He developed DI as a way to help disadvantaged children succeed academically. He was an eager experimenter, and, through trial, he worked out an instructional framework that produced rapid learning gains. It consists of fast-paced, scripted, teacher-directed lessons with teacher

- overt practice—students respond to teacher cues in unison
- social reinforcers—teacher attention, praise, and encouragement
- ongoing feedback and correction from the teacher
- lessons developed through extensive testing and revision.

DI has been extensively used and tested since the 1960s. A large-scale comparison of twenty different instructional models implemented with at-risk children showed DI to be the most effective in terms of basic skills, cognitive skills, and self-concept (Watkins, 1988). More recently it has been found to be one of three comprehensive school reform models "to have clearly established, across varying contexts and varying study designs, that their effects are relatively robust and … can be expected to improve students' test scores" (Borman, Hewes, Overman & Brown, 2002, p. 37).

Personalized System of Instruction

Fred Keller devised the Personalized System of Instruction (PSI) or "Keller Plan" in 1963 for the introductory psychology course at a new university in Brasilia. He was seeking a course structure that would maximize students' success and satisfaction. He and his collaborators were inspired by Skinner's programmed course at Harvard and Ferster's at the Institute for Behavioral Research (Keller, 1974). In PSI, all the content material of a course is divided into sequential units (such as textbook chapters or specially created modules). These units are used independently by learners, progressing at their own pace. At the end of a unit, learners take a competency test and immediately afterward they receive feedback from a proctor with any coaching needed to correct mistakes. This procedure prevents ignorance from accumulating so that students to fall further and further behind if they miss a key point (Keller, 1968). During the period it was being tested at many colleges and universities, the 1960s and 1970s, PSI was found to be the most instructionally powerful innovation evaluated up to that time (J.A. Kulik, C. C. Kulik & Cohen, 1979; Keller, 1977). Although "pure PSI" courses are not common nowadays, the mastery-based, resource-centered, self-paced approach has been incorporated into many face-to-face courses in schools, universities, and corporate training centers…and it set the pattern for what was to become "distance education."

Conclusion

The programmed instruction movement was born as a radical reconstruction of the traditional procedures for teaching. It aimed to free learners (and teachers!) from the misery of the lock-step group lecture method. The innovators who followed were similarly motivated to expand human freedom and dignity by giving learners more customized programs of instruction in a humane, caring context with frequent one-to-one contact. They developed methods of instruction that were amenable to objective examination, testing, and revision. They viewed caring instruction as synonymous with effective instruction. In the words of Zig Engelmann:

My goal for years has been to do things that are productive and that help make life better for kids, particularly at-risk kids. I don't consider myself a kinderphile…. For me it's more an ethical obligation. Certainly kids are enchanting, but they also have a future, and their future will be a lot brighter if they have choices. We can empower them with the capacity to choose between being an engineer, a musician, an accountant, or a vagrant through instruction (Engelmann, n.d.).

They welcomed empirical testing of their products and demanded it of others. Instruction that was wasting students' time or grinding down their enthusiasm was simply malpractice. Their legacy lives on, mainly in corporate and military training, where efficiency and effectiveness matter because savings in learning time and learning cost have direct bearing on the well-being of the organization. As public purse strings tighten, the day may come when learning time and learning costs are subjected to close accountability in public school and university education also.

1. Think about Programmed Instruction, Programmed Tutoring, Direct Instruction, and Personalized System of Instruction. What type of instruction would you prefer to receive? What type would you prefer to give?
2. What aspects of Skinner's programmed instruction are still used in instructional design today?

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Is Programmed Instruction Still Relevant Today?

Hack Education is a collection of essays by Audrey Watters that discuss the fascination in our field and society with automizing teaching and learning, from Skinner's teaching machines to modern day MOOCs.

Can you think of any other examples of the principles of Programmed Instruction still being discussed today?

Please complete this short survey to provide feedback on this chapter:
http://bit.ly/ProgrammedInstruction

Edgar Dale and the Cone of Experience

Dale's Cone of Experience | Experiential Learning | Instructional Design History

Editor's Note

The following chapter was based on the following article, previously published in *Educational Technology*.

Lee, S. J., & Reeves, T. C. (2007). Edgar Dale: A significant contributor to the field of educational technology. *Educational Technology, 47*(6), 56.

How can teachers use audiovisual materials to promote learning that persists? How can audiovisual materials enable students to enjoy learning through vicarious experience? These were two of the many important research and development questions addressed by an extraordinary educational technology pioneer, Edgar Dale. Although he is perhaps best remembered today for his often misinterpreted "Cone of Experience," Dale made significant contributions in many areas as evidenced by just a few of the titles of the many books he wrote during his long lifespan (1900-1988), including: *How to Appreciate Motion Pictures* (1933), *Teaching with Motion Pictures* (1937), *How to Read a Newspaper* (1941), *Audiovisual Methods in Teaching* (1946, 1954, 1969), *Techniques of Teaching Vocabulary*(1971), *Building a Learning Environment* (1972), *The Living Word Vocabulary: The Words We Know* (1976), and *The Educator's Quotebook* (1984).

Background

Born in 1900 at the dawn of a new millennium, Edgar Dale's work continues to influence educational technologists in the 21st Century. Dale grew up on a North Dakota farm, and according to Wagner (1970), he retained the no-nonsense thinking habits and strong work ethic of his Scandinavian forebears throughout his illustrious career. While working on the family farm and later as a teacher in a small rural school, Dale earned both his Bachelors and Masters degrees from the University of North Dakota partially through correspondence courses.

In 1929, he completed a Ph.D. at the University of Chicago, and then joined the Eastman Kodak Company where he collaborated on some of the earliest studies of learning from film. Interestingly, although many of these early studies were experimental ones designed to compare learning from film with other media, Dale later expressed distain for such studies. According to De Vaney and Butler (1996):

> *When Dale was asked why he did not do experimental research in which a scholar attempted to prove over and over that students learn from radio or film, he replied: "It always bothers me, because anybody knows that we learn from these things (media). There's no issue about that. . . . Well I suppose in any field, to be respectable you have to do a certain kind of research. (p. 17)*

as President of the Division of Visual Instruction (DVI) of the National Education Association (NEA) from 1937-38, the professional association that is now known as the Association for Educational Communications and Technology (AECT).

Influences

Although he traced his ideas back as far as Pestalozzi (1746 – 1827), who pioneered the concept of learning through activity, and Froebel (1782 – 1852), who first promoted the principle that children have unique needs and capabilities, Edgar Dale's work was most heavily influenced by John Dewey (1859-1952). Dewey stressed the importance of the continuity of learning experiences from schools into the real world and argued for a greater focus on higher order outcomes and meaningful learning.

In his first edition of *Audiovisual Methods in Teaching* (1946), Dale expanded Dewey's concept of the continuity of learning through experience by developing the "Cone of Experience" which relates a concrete to abstract continuum to audiovisual media options (Seels, 1997). Dale (1969) regarded the Cone as a "visual analogy" (p. 108) to show the progression of learning experiences from the concrete to the abstract (see Figure 1) rather than as a prescription for instruction with media. In the last edition of *Audiovisual Methods in Teaching* (1969), Dale integrated Bruner's (1966) three modes of learning into the Cone by categorizing learning experiences into three modes: enactive (i.e., learning by doing), iconic (i.e., learning through observation), and symbolic experience (i.e., learning through abstraction).

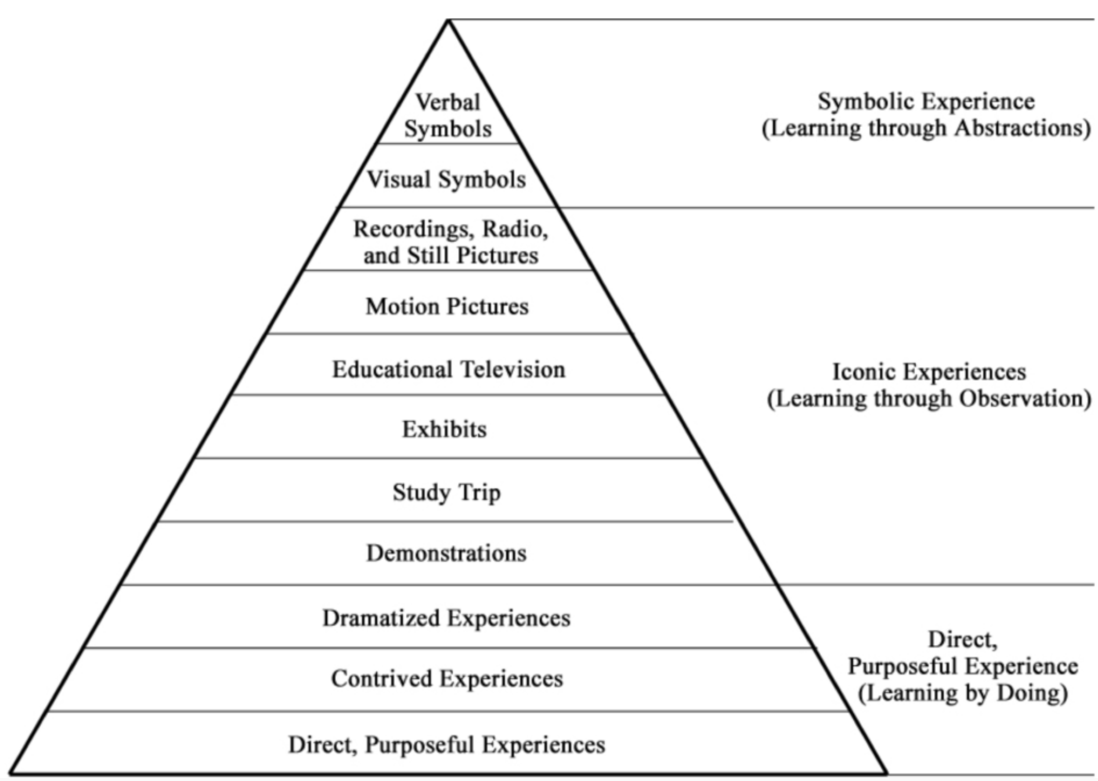

Figure 1. Dale's Cone of Experience.

bottom of the Cone represented “purposeful experience that is seen, handled, tasted, touched, felt, and smelled” (Dale, 1954, p. 42). By contrast, at the top of the Cone, verbal symbols (i.e., words) and messages are highly abstract. They do not have physical resemblance to the objects or ideas. As Dale (1969) wrote, “The word *horse* as we write it does not look like a horse or sound like a horse or feel like a horse” (p. 127).

Dale (1969) explained that the broad base of the cone illustrated the importance of direct experience for effective communication and learning. Especially for young children, real and concrete experiences are necessary to provide the foundation of their permanent learning. The historical importance of Dale’s Cone rests in its attempt to relate media to psychological theory (Seels, 1997) and the Cone has shaped various sets of media selection guidelines ever since. For example, influenced by Dale, Briggs (1972) delineated general principles for media selection according to the age of learners, the type of learners, and the type of task.

Current Application

Dale’s Cone of Experience continues to influence instructional designers today in both theory and practice. For example, Baukal, Auburn, and Ausburn built upon Dale’s ideas in developing their [Multimedia Cone of Abstraction](http://files.eric.ed.gov/fulltext/EJ1101723.pdf), available at http://files.eric.ed.gov/fulltext/EJ1101723.pdf.

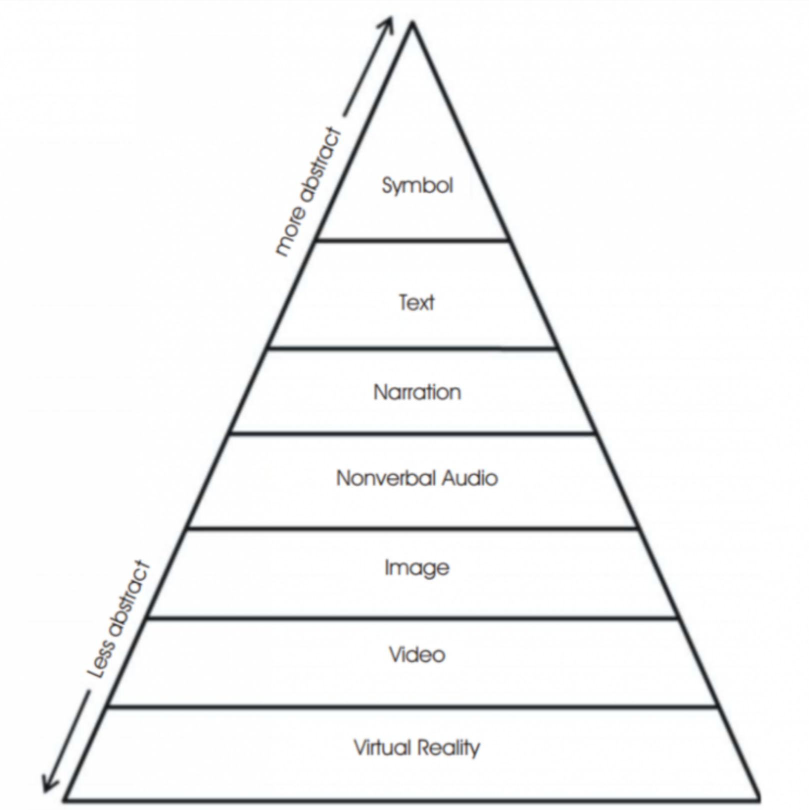

Figure 3. Proposed Multimedia Cone of Abstraction

Multimedia Cone of Abstraction

percent of what they read, 20 percent of what they hear, 30 percent of what they see, 50 percent of what they hear and see, 70 percent of what they say, and 90 percent of what they both say and do. Even though Dale did not mention the relationship between the level of the Cone and a learner's level of recall, many practitioners mistakenly believe that the bogus "Remembering Cone" was Dale's work. A Google search reveals an astonishing number of attributions of the "Bogus Cone" to Edgar Dale. Molenda (2003) concludes that the so-called empirical evidence for the "Remembering Cone" appears to have been fabricated by petroleum industry trainers in the 1960s.

In addition to this confusion, the implications of Dale's Cone have been misunderstood or misapplied. For example, Dale's Cone has been used to maintain that more realistic and direct experience is always better. However, Dale (1969) demurred, writing that, "Too much reliance on concrete experience may actually obstruct the process of meaningful generalization" (p. 130). Also, Dale noted that providing realistic learning experiences may not be efficient in terms of cost, time, and efforts. Instead, Dale suggested that teachers should balance combinations of concrete and abstract learning experiences.

Further Reading

For a thorough analysis of the prevalence of the "Remembering Cone" myth in instructional design, along with analysis tracing the history of this myth and the evidence against it, see the final issue in 2014 of Educational Technology, which presented a special issue on the topic.

Application Exercises

While learning by doing (direct, purposeful experience) may be better than learning through abstraction (symbolic experience), explain why you think Dale (1969) felt that "Too much reliance on concrete experience may actually obstruct the process of meaningful generalization."

Experiential Learning Environments

In another book *Can You Give The Public What It Wants* (1967), Dale reiterated Dewey's influence on his ideas by writing: "As I return to *Democracy and Education* [published by Dewey in 1916] I always find a new idea that I had not seen or adequately grasped before" (p. 186). Dale (1969) described learning as a "fourfold organic process" (p. 42) which consisted of needs, experiences, incorporation of the experiences, and the use of them. To promote permanent learning, Dale asserted that teachers should help students identify their *needs* for learning and set clearly defined learning goals related to their needs. A learning *experience* must be personally meaningful with respect to students' backgrounds and developmental stages and the nature of the experience should be logically arranged to help students *incorporate* new knowledge with what they already have. Later, students should have opportunities to *practice and try out* their new knowledge in real life as well as in learning contexts. Dale (1972) wrote:

> *To experience an event is to live through it, to participate in it, to incorporate it, and to continue to use it. To experience is to test, to try out. It means to be a concerned participant, not a half-attentive observer. (p. 4)*

Thus, effective learning environments should be filled with rich and memorable experiences where students can see, hear, taste, touch, and try. Dale (1969) articulated the characteristics of rich experiences. In a rich experience:

- students have emotionally rewarding experiences that will motivate them for learning throughout their lives,
- students have chances to practice their past experiences and combine them to create new experiences,
- students have a sense of personal achievement, and
- students can develop their own dynamic experiences.

In Dale's perspective (1972), most students in schools did not learn how to think, discover, and solve real problems. Rather, students were forced to memorize facts and knowledge in most schools, and as a result, any knowledge they acquired was inert in their real lives. For this reason, he argued that we should have revolutionary approaches to improve the quality of educational learning environments. To build learning environments infused with rich experiences, Dale argued for the development of new materials and methods of instruction. Dale promoted the potential of audiovisual materials, believing that they could provide vivid and memorable experiences and extend them regardless of the limitations of time and space. Dale (1969) argued:

> *Thus, through the skillful use of radio, audio recording, television, video recording, painting, line drawing, motion picture, photograph, model, exhibit, poster, we can bring the world to the classroom. We can make the past come alive either by reconstructing it or by using records of the past. (p. 23)*

Dale believed that audiovisual materials could help students learn from others' first-hand experience, or *vicarious*experience. Dale (1967) claimed, "Audiovisual materials furnish one especially effective way to extend the range of our vicarious experience" (p. 23). Dale concluded that audiovisual materials could provide a concrete basis for learning concepts, heighten students' motivation, encourage active participation, give needed reinforcement, widen student experiences and improve the effectiveness of other materials.

Although as noted above, Dale (1969) did not advocate comparative media studies, he did recommend evaluating combinations of media and instructional materials in actual learning environments. Amazingly, Dale anticipated the direction of media research as if he had been privy to the Great Media Debate between Clark (1994) and Kozma (1994). Dale (1969) provided an analogy:

> *As we think about freight cars and their contents we can and do distinguish them. But the vehicle and its contents are closely linked. The gondola car is linked with coal: we do not haul oil in it. The piggy-back conveyances for transporting automobiles are not used to transport wheat. In all communicating of messages, therefore, we must consider the kind of vehicle used to transport them, realizing that medium-message characteristics will influence what can be "sent" to a receiver. (p. 133)*

Dale recommended that researchers should look at the effects of combinations of media in the environment where they will be used rather than the testing of a single, isolated medium in the laboratory. By conducting research in real classrooms, the varied combinations of possible factors such as attributes of audiovisual materials, how to use and administer them, learners' characteristics, and learning environments could be examined because learning occurs through dynamic interaction among the learner, the context, and the media. Although the experimental methods of educational and psychological research were focused on testing the tenets of behaviorism and pitting one media against another throughout most of his career, Dale was prescient in his recognition that the complexities of learning render most such studies fruitless.

Final Remarks

Dale was much more than a scholar isolated in the ivory towers of academe. As described by Wagner (1970), "He actively fought for better schools, academic freedom, civil rights, and other causes long before these became popular issues" (p. 94). Dale also anticipated the still-neglected importance of media education by promoting in the 1930s the then radical notion that teachers should help their students to understand the effects of media on them, their parents, and society, and to learn how to critically evaluate the contents of the radio, newspapers, and films. Dale was a socially

Application Exercises

- Think about your most memorable learning experience. How was it (or how was it not) a "rich experience" as defined by Dale?
- Dale felt that a rich experience would be "emotionally rewarding" and "motivate [learners] for learning throughout their lives." Describe an experience you have had that was emotionally rewarding and motivated you to continue learning throughout your life.
- Why does Dale suggest teachers balance their time providing concrete and abstract teaching opportunities?

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Please complete this short survey to provide feedback on this chapter: http://bit.ly/ConeExperience

Memory

Rose Spielman, William Jenkins, & Marilyn Lovett

This chapter describes the basic functions of memory and three stages of memory storage. It provides an overview of procedural and declarative memory and semantic and episodic memory, and provides implications for designers.

Editor's Notes

The following is excerpted from an OpenStax book produced by Rice University. It can be downloaded for free at https://openstax.org/details/books/psychology-2e

Spielman, R. M., Jenkins, W. J., & Lovett, M. D. (2020). How memory functions. In *Psychology 2e*. Retrieved from https://openstax.org/details/books/psychology-2e

How Memory Functions

Learning Objectives

By the end of this section, you will be able to:

- Discuss the three basic functions of memory
- Describe the three stages of memory storage
- Describe and distinguish between procedural and declarative memory and semantic and episodic memory

Memory is an information processing system; therefore, we often compare it to a computer. Memory is the set of processes used to encode, store, and retrieve information over different periods of time (Figure 1).

Figure 1. Encoding involves the input of information into the memory system. Storage is the retention of the encoded information. Retrieval, or getting the information out of memory and back into awareness, is the third function. Image available in original Openstax chapter.

Encoding

We get information into our brains through a process called **encoding**, which is the input of information into the memory system. Once we receive sensory information from the environment, our brains label or code it. We organize the information with other similar information and connect new concepts to existing concepts. Encoding information occurs through automatic processing and effortful processing.

If someone asks you what you ate for lunch today, more than likely you could recall this information quite easily. This is known as **automatic processing**, or the encoding of details like time, space, frequency, and the meaning of words. Automatic processing is usually done without any conscious awareness. Recalling the last time you studied for a test is another example of automatic processing. But what about the actual test material you studied? It probably required a lot of work and attention on your part in order to encode that information. This is known as **effortful processing** (Figure 2).

Figure 2. When you first learn new skills such as driving a car, you have to put forth effort and attention to encode information about how to start a car, how to brake, how to handle a turn, and so on. Once you know how to drive, you can encode additional information about this skill automatically. (credit: Robert Couse-Baker)

What are the most effective ways to ensure that important memories are well encoded? Even a simple sentence is easier to recall when it is meaningful (Anderson, 1984). Read the following sentences (Bransford & McCarrell, 1974), then look away and count backwards from 30 by threes to zero, and then try to write down the sentences (no peeking back at this page!).

2. The voyage wasn't delayed because the bottle shattered.
3. The haystack was important because the cloth ripped.

How well did you do? By themselves, the statements that you wrote down were most likely confusing and difficult for you to recall. Now, try writing them again, using the following prompts: bagpipe, ship christening, and parachutist. Next count backwards from 40 by fours, then check yourself to see how well you recalled the sentences this time. You can see that the sentences are now much more memorable because each of the sentences was placed in context. Material is far better encoded when you make it meaningful.

There are three types of encoding. The encoding of words and their meaning is known as **semantic encoding**. It was first demonstrated by William Bousfield (1935) in an experiment in which he asked people to memorize words. The 60 words were actually divided into 4 categories of meaning, although the participants did not know this because the words were randomly presented. When they were asked to remember the words, they tended to recall them in categories, showing that they paid attention to the meanings of the words as they learned them.

Visual encoding is the encoding of images, and **acoustic encoding** is the encoding of sounds, words in particular. To see how visual encoding works, read over this list of words: *car, level, dog, truth, book, value*. If you were asked later to recall the words from this list, which ones do you think you'd most likely remember? You would probably have an easier time recalling the words *car, dog, and book*, and a more difficult time recalling the words *level, truth, and value.* Why is this? Because you can recall images (mental pictures) more easily than words alone. When you read the words car, dog, and book you created images of these things in your mind. These are concrete, high-imagery words. On the other hand, abstract words like level, truth, and value are low-imagery words. High-imagery words are encoded both visually and semantically (Paivio, 1986), thus building a stronger memory.

Now let's turn our attention to acoustic encoding. You are driving in your car and a song comes on the radio that you haven't heard in at least 10 years, but you sing along, recalling every word. In the United States, children often learn the alphabet through song, and they learn the number of days in each month through rhyme: "Thirty days hath September, / April, June, and November; / All the rest have thirty-one, / Save February, with twenty-eight days clear, / And twenty-nine each leap year." These lessons are easy to remember because of acoustic encoding. We encode the sounds the words make. This is one of the reasons why much of what we teach young children is done through song, rhyme, and rhythm.

Which of the three types of encoding do you think would give you the best memory of verbal information? Some years ago, psychologists Fergus Craik and Endel Tulving (1975) conducted a series of experiments to find out. Participants were given words along with questions about them. The questions required the participants to process the words at one of the three levels. The visual processing questions included such things as asking the participants about the font of the letters. The acoustic processing questions asked the participants about the sound or rhyming of the words, and the semantic processing questions asked the participants about the meaning of the words. After participants were presented with the words and questions, they were given an unexpected recall or recognition task.

Words that had been encoded semantically were better remembered than those encoded visually or acoustically. Semantic encoding involves a deeper level of processing than the shallower visual or acoustic encoding. Craik and Tulving concluded that we process verbal information best through semantic encoding, especially if we apply what is called the self-reference effect. The **self-reference effect** is the tendency for an individual to have better memory for information that relates to oneself in comparison to material that has less personal relevance (Rogers, Kuiper, & Kirker, 1977). Could semantic encoding be beneficial to you as you attempt to memorize the concepts in this chapter?

Storage

Once the information has been encoded, we have to somehow retain it. Our brains take the encoded information and place it in storage. **Storage** is the creation of a permanent record of information.

Richard Shiffrin (1968). Their model of human memory (Figure 3), called Atkinson and Shiffrin's model, is based on the belief that we process memories in the same way that a computer processes information.

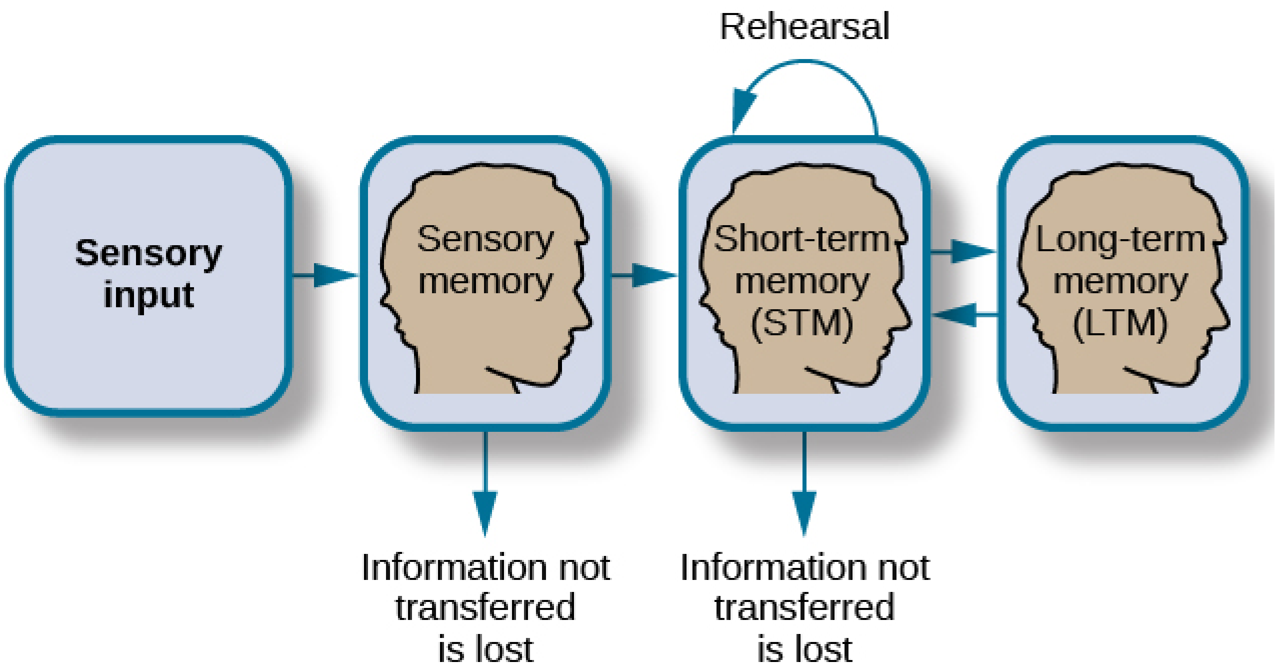

Figure 3. According to the Atkinson-Shiffrin model of memory, information passes through three distinct stages in order for it to be stored in long-term memory. Image available in original Openstax chapter.

Atkinson and Shiffrin's model is not the only model of memory. Baddeley and Hitch (1974) proposed a working memory model in which short-term memory has different forms. In their model, storing memories in short- term memory is like opening different files on a computer and adding information. The working memory files hold a limited amount of information. The type of short-term memory (or computer file) depends on the type of information received. There are memories in visual-spatial form, as well as memories of spoken or written material, and they are stored in three short-term systems: a visuospatial sketchpad, an episodic buffer (Baddeley, 2000), and a phonological loop. According to Baddeley and Hitch, a central executive part of memory supervises or controls the flow of information to and from the three short-term systems, and the central executive is responsible for moving information into long-term memory.

Sensory Memory

In the Atkinson-Shiffrin model, stimuli from the environment are processed first in **sensory memory**: storage of brief sensory events, such as sights, sounds, and tastes. It is very brief storage—up to a couple of seconds. We are constantly bombarded with sensory information. We cannot absorb all of it, or even most of it. And most of it has no impact on our lives. For example, what was your professor wearing the last class period? As long as the professor was dressed appropriately, it does not really matter what she was wearing. Sensory information about sights, sounds, smells, and even textures, which we do not view as valuable information, we discard. If we view something as valuable, the information will move into our short-term memory system.

Short-Term Memory

Short-term memory (STM) is a temporary storage system that processes incoming sensory memory. The terms short-term and working memory are sometimes used interchangeably, but they are not exactly the same. Short-term memory is more accurately described as a component of working memory. Short-term memory takes information from sensory memory and sometimes connects that memory to something already in long-term memory. Short-term memory storage lasts 15 to 30 seconds. Think of it as the information you have displayed on your computer screen, such as a document,

Rehearsal moves information from short-term memory to long-term memory. Active rehearsal is a way of attending to information to move it from short-term to long-term memory. During active rehearsal, you repeat (practice) the information to be remembered. If you repeat it enough, it may be moved into long-term memory. For example, this type of active rehearsal is the way many children learn their ABCs by singing the alphabet song. Alternatively, elaborative rehearsal is the act of linking new information you are trying to learn to existing information that you already know. For example, if you meet someone at a party and your phone is dead but you want to remember his phone number, which starts with area code 203, you might remember that your uncle Abdul lives in Connecticut and has a 203 area code. This way, when you try to remember the phone number of your new prospective friend, you will easily remember the area code. Craik and Lockhart (1972) proposed the levels of processing hypothesis that states the deeper you think about something, the better you remember it.

You may find yourself asking, “How much information can our memory handle at once?” To explore the capacity and duration of your short-term memory, have a partner read the strings of random numbers (Figure 4) out loud to you, beginning each string by saying, “Ready?” and ending each by saying, “Recall,” at which point you should try to write down the string of numbers from memory.

9754 68259 913825 5316842 86951372 719384273
6419 67148 648327 5963827 51739826 163875942

Figure 4. Work through this series of numbers using the recall exercise explained above to determine the longest string of digits that you can store. Image available in original Openstax chapter.

Note the longest string at which you got the series correct. For most people, the capacity will probably be close to 7 plus or minus 2. In 1956, George Miller reviewed most of the research on the capacity of short-term memory and found that people can retain between 5 and 9 items, so he reported the capacity of short-term memory was the "magic number" 7 plus or minus 2. However, more contemporary research has found working memory capacity is 4 plus or minus 1 (Cowan, 2010). Generally, recall is somewhat better for random numbers than for random letters (Jacobs, 1887) and also often slightly better for information we hear (acoustic encoding) rather than information we see (visual encoding) (Anderson, 1969).

Memory trace decay and interference are two factors that affect short-term memory retention. Peterson and Peterson (1959) investigated short-term memory using the three letter sequences called trigrams (e.g., CLS) that had to be recalled after various time intervals between 3 and 18 seconds. Participants remembered about 80% of the trigrams after a 3-second delay, but only 10% after a delay of 18 seconds, which caused them to conclude that short-term memory decayed in 18 seconds. During decay, the memory trace becomes less activated over time, and the information is forgotten. However, Keppel and Underwood (1962) examined only the first trials of the trigram task and found that proactive interference also affected short-term memory retention. During proactive interference, previously learned information interferes with the ability to learn new information. Both memory trace decay and proactive interference affect short-term memory. Once the information reaches long-term memory, it has to be consolidated at both the synaptic level, which takes a few hours, and into the memory system, which can take weeks or longer.

Long-term Memory

Long-term memory (LTM) is the continuous storage of information. Unlike short-term memory, long-term memory storage capacity is believed to be unlimited. It encompasses all the things you can remember that happened more than just a few minutes ago. One cannot really consider long-term memory without thinking about the way it is organized. Really quickly, what is the first word that comes to mind when you hear “peanut butter”? Did you think of jelly? If you did, you probably have associated peanut butter and jelly in your mind. It is generally accepted that memories are organized in semantic (or associative) networks (Collins & Loftus, 1975). A semantic network consists of concepts, and as you arrangement, concepts are believed to be arranged hierarchically in the mind (Anderson & Reder, 1999; Johnson & Mervis, 1997, 1998; Palmer, Jones, Hennessy, Unze, & Pick, 1989; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976; Tanaka & Taylor, 1991). Related concepts are linked, and the strength of the link depends on how often two concepts have been associated.

Semantic networks differ depending on personal experiences. Importantly for memory, activating any part of a semantic network also activates the concepts linked to that part to a lesser degree. The process is known as spreading activation (Collins & Loftus, 1975). If one part of a network is activated, it is easier to access the associated concepts because they are already partially activated. When you remember or recall something, you activate a concept, and the related concepts are more easily remembered because they are partially activated. However, the activations do not spread in just one direction. When you remember something, you usually have several routes to get the information you are trying to access, and the more links you have to a concept, the better your chances of remembering.

There are two types of long-term memory: *explicit and implicit* (Figure 5). Understanding the difference between explicit memory and implicit memory is important because aging, particular types of brain trauma, and certain disorders can impact explicit and implicit memory in different ways. **Explicit memories** are those we consciously try to remember, recall, and report. For example, if you are studying for your chemistry exam, the material you are learning will be part of your explicit memory. In keeping with the computer analogy, some information in your long-term memory would be like the information you have saved on the hard drive. It is not there on your desktop (your short-term memory), but most of the time you can pull up this information when you want it. Not all long-term memories are strong memories, and some memories can only be recalled using prompts. For example, you might easily recall a fact, such as the capital of the United States, but you might struggle to recall the name of the restaurant at which you had dinner when you visited a nearby city last summer. A prompt, such as that the restaurant was named after its owner, might help you recall the name of the restaurant. Explicit memory is sometimes referred to as declarative memory, because it can be put into words. Explicit memory is divided into episodic memory and semantic memory.

Learn More

View this video that explains short-term and long-term memory (https://www.youtube.com/watch?v=TUoJc0NPajQ) to learn more about how memories are stored and retrieved.

Episodic memory is information about events we have personally experienced (i.e., an episode). For instance, the memory of your last birthday is an episodic memory. Usually, episodic memory is reported as a story. The concept of episodic memory was first proposed about in the 1970s (Tulving, 1972). Since then, Tulving and others have reformulated the theory, and currently scientists believe that episodic memory is memory about happenings in particular places at particular times—the what, where, and when of an event (Tulving, 2002). It involves recollection of visual imagery as well as the feeling of familiarity (Hassabis & Maguire, 2007). **Semantic memory** is knowledge about words, concepts, and language-based knowledge and facts. Semantic memory is typically reported as facts. Semantic means having to do with language and knowledge about language. For example, answers to the following questions like “what is the definition of psychology” and “who was the first African American president of the United States” are stored in your semantic memory.

Implicit memories are long-term memories that are not part of our consciousness. Although implicit memories are learned outside of our awareness and cannot be consciously recalled, implicit memory is demonstrated in the performance of some task (Roediger, 1990; Schacter, 1987). Implicit memory has been studied with cognitive demand tasks, such as performance on artificial grammars (Reber, 1976), word memory (Jacoby, 1983; Jacoby & Witherspoon, background, and you are not aware of their influence. Implicit memories can influence observable behaviors as well as cognitive tasks. In either case, you usually cannot put the memory into words that adequately describe the task. There are several types of implicit memories, including procedural, priming, and emotional conditioning.

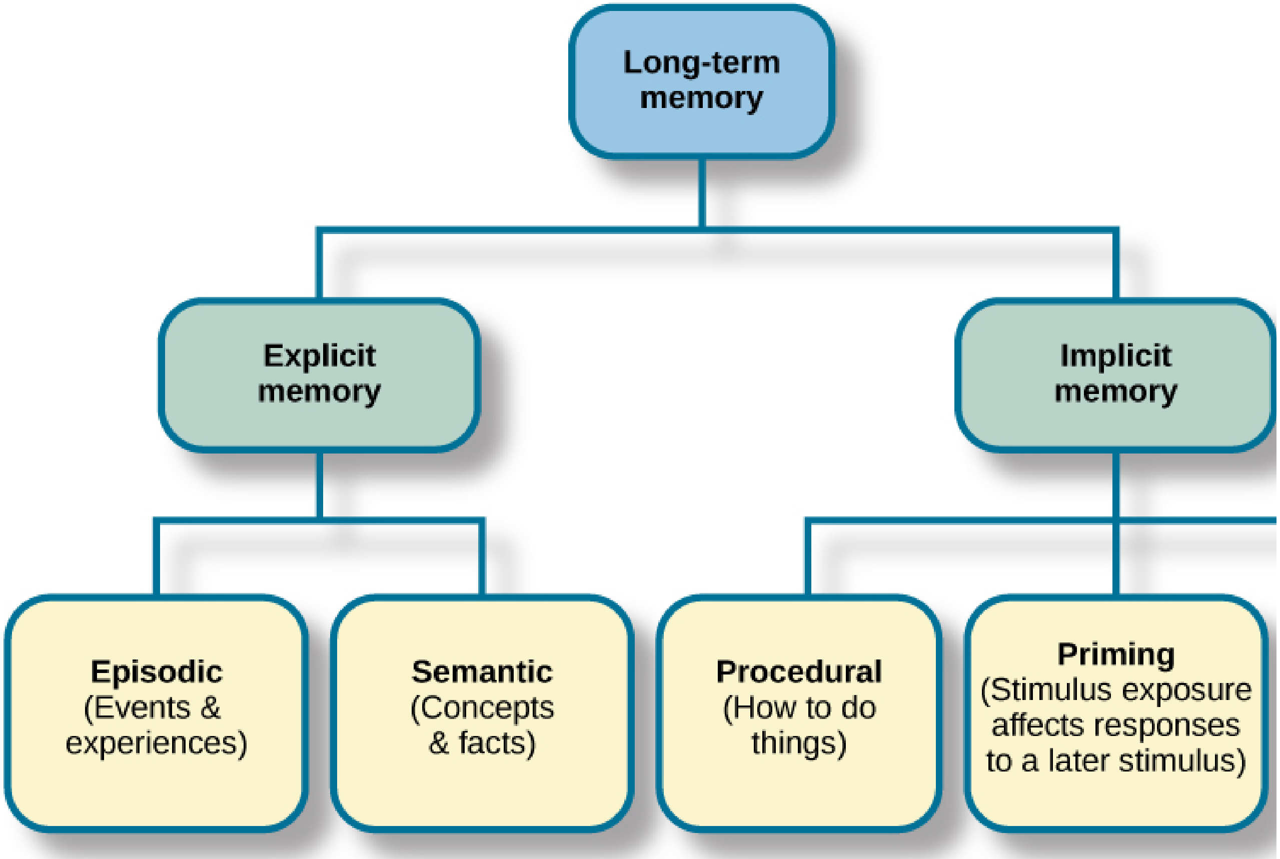

Figure 5. There are two components of long-term memory: explicit and implicit. Explicit memory includes episodic and semantic memory. Implicit memory includes procedural memory and things learned through conditioning. Image available in original Openstax chapter.

Implicit **procedural memory** is often studied using observable behaviors (Adams, 1957; Lacey & Smith, 1954; Lazarus & McCleary, 1951). Implicit procedural memory stores information about the way to do something, and it is the memory for skilled actions, such as brushing your teeth, riding a bicycle, or driving a car. You were probably not that good at riding a bicycle or driving a car the first time you tried, but you were much better after doing those things for a year. Your improved bicycle riding was due to learning balancing abilities. You likely thought about staying upright in the beginning, but now you just do it. Moreover, you probably are good at staying balanced, but cannot tell someone the exact way you do it. Similarly, when you first learned to drive, you probably thought about a lot of things that you just do now without much thought. When you first learned to do these tasks, someone may have told you how to do them, but everything you learned since those instructions that you cannot readily explain to someone else as the way to do it is implicit memory.

Implicit priming is another type of implicit memory (Schacter, 1992). During priming exposure to a stimulus affects the response to a later stimulus. Stimuli can vary and may include words, pictures, and other stimuli to elicit a response or increase recognition. For instance, some people really enjoy picnics. They love going into nature, spreading a blanket on the ground, and eating a delicious meal. Now, unscramble the following letters to make a word.

What word did you come up with? Chances are good that it was "plate."

Had you read, “Some people really enjoy growing flowers. They love going outside to their garden, fertilizing their plants, and watering their flowers,” you probably would have come up with the word "petal" instead of plate.

Do you recall the earlier discussion of semantic networks? The reason people are more likely to come up with “plate” after reading about a picnic is that plate is associated (linked) with picnic. Plate was primed by activating the semantic network. Similarly, “petal” is linked to flower and is primed by flower. Priming is also the reason you probably said jelly in response to peanut butter.

Implicit emotional conditioning is the type of memory involved in classically conditioned emotion responses (Olson & Fazio, 2001). These emotional relationships cannot be reported or recalled but can be associated with different stimuli. For example, specific smells can cause specific emotional responses for some people. If there is a smell that makes you feel positive and nostalgic, and you don't know where that response comes from, it is an implicit emotional response. Similarly, most people have a song that causes a specific emotional response. That song's effect could be an implicit emotional memory (Yang, Xu, Du, Shi, & Fang, 2011).

Can You Remember Everything You Ever Did or Said? Episodic memories are also called autobiographical memories. Let's quickly test your autobiographical memory. What were you wearing exactly five years ago today? What did you eat for lunch on April 10, 2009? You probably find it difficult, if not impossible, to answer these questions. Can you remember every event you have experienced over the course of your life—meals, conversations, clothing choices, weather conditions, and so on? Most likely none of us could even come close to answering these questions; however, American actress Marilu Henner, best known for the television show Taxi, can remember. She has an amazing and highly superior autobiographical memory (Figure 6).

Figure 6. Marilu Henner's super autobiographical memory is known as hyperthymesia. (credit: Mark Richardson)

Very few people can recall events in this way; right now, fewer than 20 have been identified as having this ability, and only a few have been studied (Parker, Cahill & McGaugh 2006). And although hyperthymesia normally appears in adolescence, two children in the United States appear to have memories from well before their tenth birthdays.

Retrieval

So you have worked hard to encode (via effortful processing) and store some important information for your upcoming final exam. How do you get that information back out of storage when you need it? The act of getting information out of memory storage and back into conscious awareness is known as **retrieval**. This would be similar to finding and opening a paper you had previously saved on your computer's hard drive. Now it's back on your desktop, and you can work with it again. Our ability to retrieve information from long-term memory is vital to our everyday functioning. You must be able to retrieve information from memory in order to do everything from knowing how to brush your hair and teeth, to driving to work, to knowing how to perform your job once you get there.

There are three ways you can retrieve information out of your long-term memory storage system: recall, recognition, and relearning. **Recall** is what we most often think about when we talk about memory retrieval: it means you can access information without cues. For example, you would use recall for an essay test. **Recognition** happens when you identify information that you have previously learned after encountering it again. It involves a process of comparison. When you take a multiple-choice test, you are relying on recognition to help you choose the correct answer. Here is another example. Let's say you graduated from high school 10 years ago, and you have returned to your hometown for your 10-

The third form of retrieval is **relearning**, and it's just what it sounds like. It involves learning information that you previously learned. Whitney took Spanish in high school, but after high school she did not have the opportunity to speak Spanish. Whitney is now 31, and her company has offered her an opportunity to work in their Mexico City office. In order to prepare herself, she enrolls in a Spanish course at the local community center. She's surprised at how quickly she's able to pick up the language after not speaking it for 13 years; this is an example of relearning.

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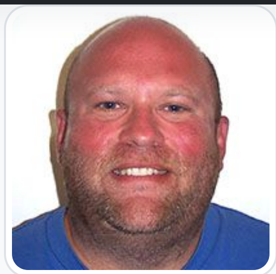

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Intelligence

Rose Spielman, William Jenkins, & Marilyn Lovett

Editor's Note

The following is excerpted from an Openstax book produced by Rice University. Download at https://openstax.org/details/books/psychology-2e.

Spielman, R. M., Jenkins, W. J., & Lovett, M. D. (2020). What are intelligence and creativity? In *Psychology 2e*. Retrieved from https://openstax.org/details/books/psychology-2e

What are Intelligence and Creativity?

Learning Objectives

By the end of this section, you will be able to:

- Define intelligence
- Explain the triarchic theory of intelligence
- Identify the difference between intelligence theories
- Explain emotional intelligence
- Define creativity

A four-and-a-half-year-old boy sits at the kitchen table with his father, who is reading a new story aloud to him. He turns the page to continue reading, but before he can begin, the boy says, “Wait, Daddy!” He points to the words on the new page and reads aloud, “Go, Pig! Go!” The father stops and looks at his son. “Can you read that?” he asks. “Yes, Daddy!” And he points to the words and reads again, “Go, Pig! Go!”

This father was not actively teaching his son to read, even though the child constantly asked questions about letters, words, and symbols that they saw everywhere: in the car, in the store, on the television. The dad wondered about what else his son might understand and decided to try an experiment. Grabbing a sheet of blank paper, he wrote several simple words in a list: mom, dad, dog, bird, bed, truck, car, tree. He put the list down in front of the boy and asked him to read the words. “Dad, dog, bird, bed, truck, car, tree,” he read, slowing down to carefully pronounce bird and truck. Then, “Did I do it, Daddy?” “You sure did! That is very good.” The father gave his little boy a warm hug and continued reading constitutes intelligence and how it can be measured.

Classifying Intelligence

What exactly is intelligence? The way that researchers have defined the concept of intelligence has been modified many times since the birth of psychology. British psychologist Charles Spearman believed intelligence consisted of one general factor, called *g*, which could be measured and compared among individuals. Spearman focused on the commonalities among various intellectual abilities and de-emphasized what made each unique. Long before modern psychology developed, however, ancient philosophers, such as Aristotle, held a similar view (Cianciolo & Sternberg, 2004).

Others psychologists believe that instead of a single factor, intelligence is a collection of distinct abilities. In the 1940s, Raymond Cattell proposed a theory of intelligence that divided general intelligence into two components: crystallized intelligence and fluid intelligence (Cattell, 1963). **Crystallized intelligence** is characterized as acquired knowledge and the ability to retrieve it. When you learn, remember, and recall information, you are using crystallized intelligence. You use crystallized intelligence all the time in your coursework by demonstrating that you have mastered the information covered in the course. **Fluid intelligence** encompasses the ability to see complex relationships and solve problems. Navigating your way home after being detoured onto an unfamiliar route because of road construction would draw upon your fluid intelligence. Fluid intelligence helps you tackle complex, abstract challenges in your daily life, whereas crystallized intelligence helps you overcome concrete, straightforward problems (Cattell, 1963).

Other theorists and psychologists believe that intelligence should be defined in more practical terms. For example, what types of behaviors help you get ahead in life? Which skills promote success? Think about this for a moment. Being able to recite all 45 presidents of the United States in order is an excellent party trick, but will knowing this make you a better person?

Robert Sternberg developed another theory of intelligence, which he titled the **triarchic theory of intelligence** because it sees intelligence as comprised of three parts (Sternberg, 1988): practical, creative, and analytical intelligence (Figure 1).

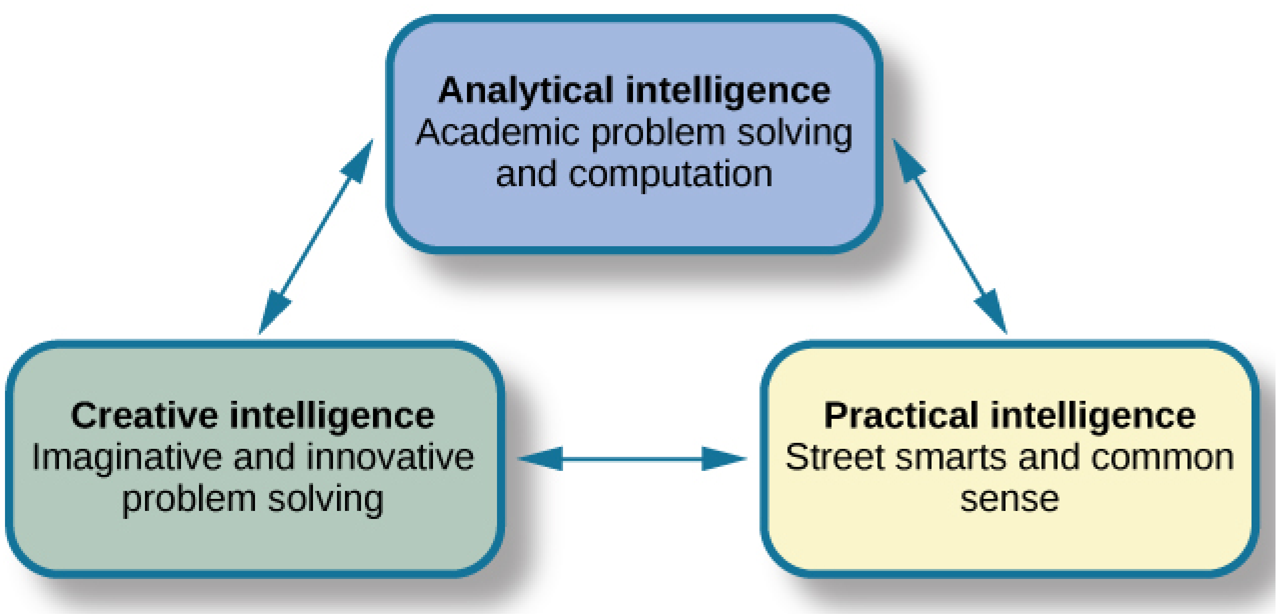

Figure 1. Sternberg's theory identifies three types of intelligence: practical, creative, and analytical. Image available in original Openstax chapter.

Practical intelligence, as proposed by Sternberg, is sometimes compared to "street smarts." Being practical means you find solutions that work in your everyday life by applying knowledge based on your experiences. This type of intelligence

Analytical intelligence is closely aligned with academic problem solving and computations. Sternberg says that analytical intelligence is demonstrated by an ability to analyze, evaluate, judge, compare, and contrast. When reading a classic novel for literature class, for example, it is usually necessary to compare the motives of the main characters of the book or analyze the historical context of the story. In a science course such as anatomy, you must study the processes by which the body uses various minerals in different human systems. In developing an understanding of this topic, you are using analytical intelligence. When solving a challenging math problem, you would apply analytical intelligence to analyze different aspects of the problem and then solve it section by section.

Creative intelligence is marked by inventing or imagining a solution to a problem or situation. Creativity in this realm can include finding a novel solution to an unexpected problem or producing a beautiful work of art or a well-developed short story. Imagine for a moment that you are camping in the woods with some friends and realize that you've forgotten your camp coffee pot. The person in your group who figures out a way to successfully brew coffee for everyone would be credited as having higher creative intelligence.

Multiple Intelligences Theory was developed by Howard Gardner, a Harvard psychologist and former student of Erik Erikson. In Gardner's theory, each person possesses at least eight intelligences. The eight intelligences are linguistic intelligence, logical-mathematical intelligence, musical intelligence, bodily kinesthetic intelligence, spatial intelligence, interpersonal intelligence, intrapersonal intelligence, and naturalistic intelligence. Among cognitive psychologists, Gardner's theory has been heavily criticized for lacking empirical evidence. However, educators continue to study and use Gardner's theory, with some colleges even discussing how they integrate Gardner's theory into their classrooms. Gottfredson describes one possible reason for the continued use of Gardner's theory: " . . . that there are multiple independent intelligences, suggesting that everyone can be smart in some way. This is, understandably, a very attractive idea in democratic societies" (2004).

Gardner's inter- and intrapersonal intelligences are often combined into a single type: emotional intelligence. **Emotional intelligence** encompasses the ability to understand the emotions of yourself and others, show empathy, understand social relationships and cues, and regulate your own emotions and respond in culturally appropriate ways (Parker, Saklofske, & Stough, 2009). People with high emotional intelligence typically have well-developed social skills. Some researchers, including Daniel Goleman, the author of *Emotional Intelligence: Why It Can Matter More than IQ*, argue that emotional intelligence is a better predictor of success than traditional intelligence (Goleman, 1995). However, emotional intelligence has been widely debated, with researchers pointing out inconsistencies in how it is defined and described, as well as questioning results of studies on a subject that is difficult to measure and study empirically (Locke, 2005; Mayer, Salovey, & Caruso, 2004)

The most comprehensive theory of intelligence to date is the Cattell-Horn-Carroll (CHC) theory of cognitive abilities (Schneider & McGrew, 2018). In this theory, abilities are related and arranged in a hierarchy with general abilities at the top, broad abilities in the middle, and narrow (specific) abilities at the bottom. The narrow abilities are the only ones that can be directly measured; however, they are integrated within the other abilities. At the general level is general intelligence. Next, the broad level consists of general abilities such as fluid reasoning, short-term memory, and processing speed. Finally, as the hierarchy continues, the narrow level includes specific forms of cognitive abilities. For example, short-term memory would further break down into memory span and working memory capacity.

Intelligence can also have different meanings and values in different cultures. If you live on a small island, where most people get their food by fishing from boats, it would be important to know how to fish and how to repair a boat. If you were an exceptional angler, your peers would probably consider you intelligent. If you were also skilled at repairing boats, your intelligence might be known across the whole island. Think about your own family's culture. What values are important for Latinx families? Italian families? In Irish families, hospitality and telling an entertaining story are marks of the culture. If you are a skilled storyteller, other members of Irish culture are likely to consider you intelligent.

of that culture exemplifies your **cultural intelligence**, sometimes referred to as cultural competence.

Learn More

Watch this video to learn more (http://openstax.org/l/theoryintel).

Creativity

Creativity is the ability to generate, create, or discover new ideas, solutions, and possibilities. Very creative people often have intense knowledge about something, work on it for years, look at novel solutions, seek out the advice and help of other experts, and take risks. Although creativity is often associated with the arts, it is actually a vital form of intelligence that drives people in many disciplines to discover something new. Creativity can be found in every area of life, from the way you decorate your residence to a new way of understanding how a cell works.

Creativity is often connected to a person's ability to engage in **divergent thinking**. Divergent thinking can be described as thinking "outside the box;" it allows an individual to arrive at unique, multiple solutions to a given problem. In contrast, **convergent thinking** describes the ability to provide a correct or well-established answer or solution to a problem (Cropley, 2006; Gilford, 1967).

Think About It!

Creativity

Dr. Tom Steitz, former Sterling Professor of Biochemistry and Biophysics at Yale University, spent his career looking at the structure and specific aspects of RNA molecules and how their interactions could help produce antibiotics and ward off diseases. As a result of his lifetime of work, he won the Nobel Prize in Chemistry in 2009. He wrote, "Looking back over the development and progress of my career in science, I am reminded how vitally important good mentorship is in the early stages of one's career development and constant face-to-face conversations, debate and discussions with colleagues at all stages of research. Outstanding discoveries, insights and developments do not happen in a vacuum" (Steitz, 2010, para. 39). Based on Steitz's comment, it becomes clear that someone's creativity, although an individual strength, benefits from interactions with others. Think of a time when your creativity was sparked by a conversation with a friend or classmate. How did that person influence you and what problem did you solve using creativity?

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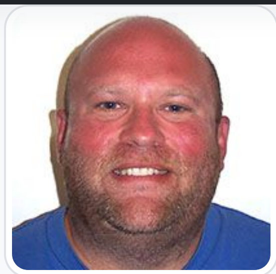

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Behaviorism, Cognitivism, Constructivism

Comparing Critical Features From an Instructional Design Perspective

Peggy A. Ertmer & Timothy Newby

Editor's Note

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The need for a bridge between basic learning research and educational practice has long been discussed. To ensure a strong connection between these two areas, Dewey (cited in Reigeluth, 1983) called for the creation and development of a "linking science"; Tyler (1978) a "middleman position"; and Lynch (1945) for employing an "engineering analogy" as an aid for translating theory into practice. In each case, the respective author highlighted the information and potential contributions of available learning theories, the pressing problems faced by those dealing with practical learning issues, and a general lack of using the former to facilitate solutions for the latter. The value of such a bridging function would be its ability to translate relevant aspects of the learning theories into optimal instructional actions. As described by Reigeluth (1983, p. 5), the field of Instructional Design performs this role.

Instructional designers have been charged with "translating principles of learning and instruction into specifications for instructional materials and activities" (Smith & Ragan, 1993, p. 12). To achieve this goal, two sets of skills and knowledge are needed. First, the designer must understand the position of the practitioner. In this regard, the following questions would be relevant: What are the situational and contextual constraints of the application? What is the degree of individual differences among the learners? What form of solutions will or will not be accepted by the learners as well as by those actually teaching the materials? The designer must have the ability to diagnose and analyze practical learning problems. Just as a doctor cannot prescribe an effective remedy without a proper diagnosis, the instructional designer cannot properly recommend an effective prescriptive solution without an accurate analysis of the instructional problem.

In addition to understanding and analyzing the problem, a second core of knowledge and skills is needed to "bridge" or "link" application with research–that of understanding the potential sources of solutions (i.e., the theories of human learning). Through this understanding, a proper prescriptive solution can be matched with a given diagnosed problem.

Why this emphasis on learning theory and research? First, learning theories are a source of verified instructional strategies, tactics, and techniques. Knowledge of a variety of such strategies is critical when attempting to select an effective prescription for overcoming a given instructional problem. Second, learning theories provide the foundation for intelligent and reasoned strategy selection. Designers must have an adequate repertoire of strategies available, and possess the knowledge of when and why to employ each. This knowledge depends on the designer's ability to match the demands of the task with an instructional strategy that helps the learner. Third, integration of the selected strategy within the instructional context is of critical importance. Learning theories and research often provide information about relationships among instructional components and the design of instruction, indicating how specific techniques/strategies might best fit within a given context and with specific learners (Keller, 1979). Finally, the ultimate role of a theory is to allow for reliable prediction (Richey, 1986). Effective solutions to practical instructional problems are often constrained by limited time and resources. It is paramount that those strategies selected and implemented have the highest chance for success. As suggested by Warries (1990), a selection based on strong research is much more reliable than one based on "instructional phenomena."

The task of translating learning theory into practical applications would be greatly simplified if the learning process were relatively simple and straightforward. Unfortunately, this is not the case. Learning is a complex process that has generated numerous interpretations and theories of how it is effectively accomplished. Of these many theories, which should receive the attention of the instructional designer? Is it better to choose one theory when designing instruction or to draw ideas from different theories? This article presents three distinct perspectives of the learning process (behavioral, cognitive, and constructivist) and although each has many unique features, it is our belief that each still describes the same phenomena (learning). In selecting the theory whose associated instructional strategies offers the optimal means for achieving desired outcomes, the degree of cognitive processing required of the learner by the specific task appears to be a critical factor. Therefore, as emphasized by Snelbecker (1983), individuals addressing practical learning problems cannot afford the "luxury of restricting themselves to only one theoretical position… [They] are urged to examine each of the basic science theories which have been developed by psychologists in the study of learning and to select those principles and conceptions which seem to be of value for one's particular educational situation' (p. 8).

If knowledge of the various learning theories is so important for instructional designers, to what degree are they emphasized and promoted? As reported by Johnson (1992), less than two percent of the courses offered in university curricula in the general area of educational technology emphasize "theory" as one of their key concepts. It appears that the real benefits of theoretical knowledge are, at present, not being realized. This article is an attempt to "fill in some of the gaps" that may exist in our knowledge of modern learning theories. The main intent is to provide designers with some familiarity with three relevant positions on learning (behavioral, cognitive, and constructivist) which should provide a more structured foundation for planning and conducting instructional design activities. The idea is that if we understand some of the deep principles of the theories of learning, we can extrapolate to the particulars as needed. As Bruner (1971) states, "You don't need to encounter everything in nature in order to know nature" (p. 18). A basic understanding of the learning theories can provide you with a "canny strategy whereby you could know a great deal about a lot of things while keeping very little in mind" (p. 18).

It is expected that after reading this article, instructional designers and educational practitioners should be better informed "consumers"of the strategies suggested by each viewpoint. The concise information presented here can serve as an initial base of knowledge for making important decisions regarding instructional objectives and strategies.

Learning Defined

Learning has been defined in numerous ways by many different theorists, researchers and educational practitioners. Although universal agreement on any single definition is nonexistent, many definitions employ common elements. The experience" (p. 2).

Undoubtedly, some learning theorists will disagree on the definition of learning presented here. However, it is not the definition itself that separates a given theory from the rest. The major differences among theories lie more in interpretation than they do in definition. These differences revolve around a number of key issues that ultimately delineate the instructional prescriptions that flow from each theoretical perspective. Schunk (1991) lists five definitive questions that serve to distinguish each learning theory from the others:

1. How does learning occur?
2. Which factors influence learning?
3. What is the role of memory?
4. How does transfer occur? and
5. What types of learning are best explained by the theory?

Expanding on this original list, we have included two additional questions important to the instructional designer:

6. What basic assumptions/principles of this theory are relevant to instructional design? and
7. How should instruction be structured to facilitate learning?

In this article, each of these questions is answered from three distinct viewpoints: behaviorism, cognitivism, and constructivism. Although learning theories typically are divided into two categories–behavioral and cognitive–a third category, constructive, is added here because of its recent emphasis in the instructional design literature (e.g., Bednar, Cunningham, Duffy, & Perry, 1991; Duffy & Jonassen, 1991; Jonassen, 1991b; Winn, 1991). In many ways these viewpoints overlap; yet they are distinctive enough to be treated as separate approaches to understanding and describing learning. These three particular positions were chosen because of their importance, both historically and currently, to the field of instructional design. It is hoped that the answers to the first five questions will provide the reader with a basic understanding of how these viewpoints differ. The answers to the last two questions will translate these differences into practical suggestions and recommendations for the application of these principles in the design of instruction.

These seven questions provide the basis for the article's structure. For each of the three theoretical positions, the questions are addressed and an example is given to illustrate the application of that perspective. It is expected that this approach will enable the reader to compare and contrast the different viewpoints on each of the seven issues.

As is common in any attempt to compare and contrast similar products, processes, or ideas, differences are emphasized in order to make distinctions clear. This is not to suggest that there are no similarities among these viewpoints or that there are no overlapping features. In fact, different learning theories will often prescribe the same instructional methods for the same situations (only with different terminology and possibly with different intentions). This article outlines the major differences between the three positions in an attempt to facilitate comparison. It is our hope that the reader will gain greater insight into what each viewpoint offers in terms of the design and presentation of materials, as well as the types of learning activities that might be prescribed.

Historical Foundations

Current learning theories have roots that extend far into the past. The problems with which today's theorists and researchers grapple and struggle are not new but simply variations on a timeless theme: Where does knowledge come from and how do people come to know? Two opposing positions on the origins of knowledge-empiricism and rationalism have existed for centuries and are still evident, to varying degrees, in the learning theories of today. A brief description of these views is included here as a background for comparing the "modern" learning viewpoints of behaviorism, cognitivism, and constructivism.

environment. Beginning with Aristotle (384-322 B.C.), empiricists have espoused the view that knowledge is derived from sensory impressions. Those impressions, when associated contiguously in time and/or space, can be hooked together to form complex ideas. For example, the complex idea of a tree, as illustrated by Hulse, Egeth, and Deese (1980), can be built from the less complex ideas of branches and leaves, which in turn are built from the ideas of wood and fiber, which are built from basic sensations such as greenness, woody odor, and so forth. From this perspective, critical instructional design issues focus on how to manipulate the environment in order to improve and ensure the occurrence of proper associations.

Rationalism is the view that knowledge derives from reason without the aid of the senses (Schunk, 1991). This fundamental belief in the distinction between mind and matter originated with Plato (c. 427-347 B.C.), and is reflected in the viewpoint that humans learn by recalling or "discovering" what already exists in the mind. For example, the direct experience with a tree during one's lifetime simply serves to reveal that which is already in the mind. The "real" nature of the tree (greenness, woodiness, and other characteristics) becomes known, not through the experience, but through a reflection on one's idea about the given instance of a tree. Although later rationalists differed on some of Plato's other ideas, the central belief remained the same: that knowledge arises through the mind. From this perspective, instructional design issues focus on how best to structure new information in order to facilitate (1) the learners' encoding of this new information, as well as (2) the recalling of that which is already known.

The empiricist, or associationist, mindset provided the framework for many learning theories during the first half of this century, and it was against this background that behaviorism became the leading psychological viewpoint (Schunk, 1991). Because behaviorism was dominant when instructional theory was initiated (around 1950), the instructional design (ID) technology that arose alongside it was naturally influenced by many of its basic assumptions and characteristics. Since ID has its roots in behavioral theory, it seems appropriate that we turn our attention to behaviorism first.

Behaviorism

How Does Learning Occur?

Behaviorism equates learning with changes in either the form or frequency of observable performance. Learning is accomplished when a proper response is demonstrated following the presentation of a specific environmental stimulus. For example, when presented with a math flashcard showing the equation "2 + 4 = ?" the learner replies with the answer of "6." The equation is the stimulus and the proper answer is the associated response. The key elements are the stimulus, the response, and the association between the two. Of primary concern is how the association between the stimulus and response is made, strengthened, and maintained.

Behaviorism focuses on the importance of the consequences of those performances and contends that responses that are followed by reinforcement are more likely to recur in the future. No attempt is made to determine the structure of a student's knowledge nor to assess which mental processes it is necessary for them to use (Winn, 1990). The learner is characterized as being reactive to conditions in the environment as opposed to taking an active role in discovering the environment.

Which Factors Influence Learning?

Although both learner and environmental factors are considered important by behaviorists, environmental conditions receive the greatest emphasis. Behaviorists assess the learners to determine at what point to begin instruction as well as to determine which reinforcers are most effective for a particular student. The most critical factor, however, is the arrangement of stimuli and consequences within the environment.

Memory, as commonly defined by the layman, is not typically addressed by behaviorists. Although the acquisition of “habits” is discussed, little attention is given as to how these habits are stored or recalled for future use. Forgetting is attributed to the “nonuse” of a response over time. The use of periodic practice or review serves to maintain a learner’s readiness to respond (Schunk, 1991).

How Does Transfer Occur?

Transfer refers to the application of learned knowledge in new ways or situations, as well as to how prior learning affects new learning. In behavioral learning theories, transfer is a result of generalization. Situations involving identical or similar features allow behaviors to transfer across common elements. For example, the student who has learned to recognize and classify elm trees demonstrates transfer when (s)he classifies maple trees using the same process. The similarities between the elm and maple trees allow the learner to apply the previous elm tree classification learning experience to the maple tree classification task.

What Types of Learning Are Best Explained by This Position?

Behaviorists attempt to prescribe strategies that are most useful for building and strengthening stimulus-response associations (Winn, 1990), including the use of instructional cues, practice, and reinforcement. These prescriptions have generally been proven reliable and effective in facilitating learning that involves discriminations (recalling facts), generalizations (defining and illustrating concepts), associations (applying explanations), and chaining (automatically performing a specified procedure). However, it is generally agreed that behavioral principles cannot adequately explain the acquisition of higher level skills or those that require a greater depth of processing (e.g., language development, problem solving, inference generating, critical thinking) (Schunk, 1991).

What Basic Assumptions/principles of This Theory Are Relevant to Instructional Design?

Many of the basic assumptions and characteristics of behaviorism are embedded in current instructional design practices. Behaviorism was used as the basis for designing many of the early audio-visual materials and gave rise to many related teaching strategies, such as Skinner’s teaching machines and programmed texts. More recent examples include principles utilized within computer-assisted instruction (CAI) and mastery learning.

Specific assumptions or principles that have direct relevance to instructional design include the following (possible current ID applications are listed in italics and brackets following the listed principle):

1. An emphasis on producing observable and measurable outcomes in students [behavioral objectives, task analysis, criterion-referenced assessment]
2. Pre-assessment of students to determine where instruction should begin [learner analysis]
3. Emphasis on mastering early steps before progressing to more complex levels of performance [sequencing of instructional presentation, mastery learning]
4. Use of reinforcement to impact performance [tangible rewards, informative feedback]
5. Use of cues, shaping and practice to ensure a strong stimulus-response association [simple to complex sequencing of practice, use of prompts]

How Should Instruction Be Structured?

The goal of instruction for the behaviorist is to elicit the desired response from the learner who is presented with a target stimulus. To accomplish this, the learner must know how to execute the proper response, as well as the conditions under which that response should be made. Therefore, instruction is structured around the presentation of the target stimulus and the provision of opportunities for the learner to practice making the proper response. To facilitate the linking of stimulus-response pairs, instruction frequently uses cues (to initially prompt the delivery of the response) and reinforcement (to strengthen correct responding in the presence of the target stimulus).

eliciting power but which will be expected to elicit the responses in the "natural" (performance) setting; and (3) arrange environmental conditions so that students can make the correct responses in the presence of those target stimuli and receive reinforcement for those responses (Gropper, 1987).

For example, a newly-hired manager of human resources may be expected to organize a meeting agenda according to the company's specific format. The target stimulus (the verbal command "to format a meeting agenda") does not initially elicit the correct response nor does the new manager have the capability to make the correct response. However, with the repeated presentation of cues (e.g., completed templates of past agendas, blank templates arranged in standard format) paired with the verbal command stimulus, the manager begins to make the appropriate responses. Although the initial responses may not be in the final proper form, repeated practice and reinforcement shape the response until it is correctly executed. Finally, learning is demonstrated when, upon the command to format a meeting agenda, the manager reliably organizes the agenda according to company standards and does so without the use of previous examples or models.

Cognitivism

In the late 1950's, learning theory began to make a shift away from the use of behavioral models to an approach that relied on learning theories and models from the cognitive sciences. Psychologists and educators began to de-emphasize a concern with overt, observable behavior and stressed instead more complex cognitive processes such as thinking, problem solving, language, concept formation and information processing (Snelbecker, 1983). Within the past decade, a number of authors in the field of instructional design have openly and consciously rejected many of ID's traditional behavioristic assumptions in favor of a new set of psychological assumptions about learning drawn from the cognitive sciences. Whether viewed as an open revolution or simply a gradual evolutionary process, there seems to be the general acknowledgment that cognitive theory has moved to the forefront of current learning theories (Bednar et al., 1991). This shift from a behavioral orientation (where the emphasis is on promoting a student's overt performance by the manipulation of stimulus material) to a cognitive orientation (where the emphasis is on promoting mental processing) has created a similar shift from procedures for manipulating the materials to be presented by an instructional system to procedures for directing student processing and interaction with the instructional design system (Merrill, Kowalis, & Wilson, 1981).

How Does Learning Occur?

Cognitive theories stress the acquisition of knowledge and internal mental structures and, as such, are closer to the rationalist end of the epistemology continuum (Bower & Hilgard, 1981). Learning is equated with discrete changes between states of knowledge rather than with changes in the probability of response. Cognitive theories focus on the conceptualization of students' learning processes and address the issues of how information is received, organized, stored, and retrieved by the mind. Learning is concerned not so much with what learners do but with what they know and how they come to acquire it (Jonassen, 1991b). Knowledge acquisition is described as a mental activity that entails internal coding and structuring by the learner. The learner is viewed as a very active participant in the learning process.

Which Factors Influence Learning?

Cognitivism, like behaviorism, emphasizes the role that environmental conditions play in facilitating learning. Instructional explanations, demonstrations, illustrative examples and matched non-examples are all considered to be instrumental in guiding student learning. Similarly, emphasis is placed on the role of practice with corrective feedback. Up to this point, little difference can be detected between these two theories. However, the "active" nature of the learner is perceived quite differently. The cognitive approach focuses on the mental activities of the learner that lead up to a response and acknowledges the processes of mental planning, goal-setting, and organizational strategies (Shuell, 1986). Cognitive theories contend that environmental "cues" and instructional components alone cannot account for all considered to be influential in the learning process (Winne, 1985). The real focus of the cognitive approach is on changing the learner by encouraging him/her to use appropriate learning strategies.

What is the Role of Memory?

As indicated above, memory is given a prominent role in the learning process. Learning results when information is stored in memory in an organized, meaningful manner. Teachers/designers are responsible for assisting learners in organizing that information in some optimal way. Designers use techniques such as advance organizers, analogies, hierarchical relationships, and matrices to help learners relate new information to prior knowledge. Forgetting is the inability to retrieve information from memory because of interference, memory loss, or missing or inadequate cues needed to access information.

How Does Transfer Occur?

According to cognitive theories, transfer is a function of how information is stored in memory (Schunk, 1991). When a learner understands how to apply knowledge in different contexts, then transfer has occurred. Understanding is seen as being composed of a knowledge base in the form of rules, concepts, and discriminations (Duffy & Jonassen, 1991). Prior knowledge is used to establish boundary constraints for identifying the similarities and differences of novel information. Not only must the knowledge itself be stored in memory but the uses of that knowledge as well. Specific instructional or real-world events will trigger particular responses, but the learner must believe that the knowledge is useful in a given situation before he will activate it.

What Types of Learning Are Best Explained by This Position?

Because of the emphasis on mental structures, cognitive theories are usually considered more appropriate for explaining complex forms of learning (reasoning, problem-solving, information-processing) than are those of a more behavioral perspective (Schunk, 1991). However, it is important to indicate at this point that the actual goal of instruction for both of these viewpoints is often the same: to communicate or transfer knowledge to the students in the most efficient, effective manner possible (Bednar et al., 1991). Two techniques used by both camps in achieving this effectiveness and efficiency of knowledge transfer are simplification and standardization. That is, knowledge can be analyzed, decomposed, and simplified into basic building blocks. Knowledge transfer is expedited if irrelevant information is eliminated. For example, trainees attending a workshop on effective management skills would be presented with information that is “sized” and “chunked” in such a way that they can assimilate and/or accommodate the new information as quickly and as easily as possible. Behaviorists would focus on the design of the environment to optimize that transfer, while cognitivists would stress efficient processing strategies.

What Basic Assumptions/principles of This Theory Are Relevant to Instructional Design?

Many of the instructional strategies advocated and utilized by cognitivists are also emphasized by behaviorists, yet usually for different reasons. An obvious commonality is the use of feedback. A behaviorist uses feedback (reinforcement) to modify behavior in the desired direction, while cognitivists make use of feedback (knowledge of results) to guide and support accurate mental connections (Thompson, Simonson, & Hargrave, 1992).

Learner and task analyses are also critical to both cognitivists and behaviorists, but once again, for different reasons. Cognitivists look at the learner to determine his/her predisposition to learning (i.e., How does the learner activate, maintain, and direct his/her learning?) (Thompson et al., 1992). Additionally, cognitivists examine the learner to determine how to design instruction so that it can be readily assimilated (i.e., What are the learner’s existing mental structures?). In contrast, the behaviorists look at learners to determine where the lesson should begin (i.e., At what level are they currently performing successfully?) and which reinforcers should be most effective (i.e., What consequences are most desired by the learner?).

1. Emphasis on the active involvement of the learner in the learning process [learner control, metacognitive training (e.g., self-planning, monitoring, and revising techniques)]
2. Use of hierarchical analyses to identify and illustrate prerequisite relationships [cognitive task analysis procedures]
3. Emphasis on structuring, organizing, and sequencing information to facilitate optimal processing [use of cognitive strategies such as outlining, summaries, synthesizers, advance organizers, etc.]
4. Creation of learning environments that allow and encourage students to make connections with previously learned material [recall of prerequisite skills; use of relevant examples, analogies]

How Should Instruction Be Structured?

Behavioral theories imply that teachers ought to arrange environmental conditions so that students respond properly to presented stimuli. Cognitive theories emphasize making knowledge meaningful and helping learners organize and relate new information to existing knowledge in memory. Instruction must be based on a student's existing mental structures, or schema, to be effective. It should organize information in such a manner that learners are able to connect new information with existing knowledge in some meaningful way. Analogies and metaphors are examples of this type of cognitive strategy. For example, instructional design textbooks frequently draw an analogy between the familiar architect's profession and the unfamiliar instructional design profession to help the novice learner conceptualize, organize and retain the major duties and functions of an instructional designer (e.g. Reigeluth, 1983, p. 7). Other cognitive strategies may include the use of framing, outlining, mnemonics, concept mapping, advance organizers and so forth (West, Farmer, & Wolff, 1991).

Such cognitive emphases imply that major tasks of the teacher/designer include (1) understanding that individuals bring various learning experiences to the learning situation which can impact learning outcomes; (2) determining the most effective manner in which to organize and structure new information to tap the learners' previously acquired knowledge, abilities, and experiences; and (3) arranging practice with feedback so that the new information is effectively and efficiently assimilated and/or accommodated within the learner's cognitive structure (Stepich & Newby, 1988).

Consider the following example of a learning situation utilizing a cognitive approach: A manager in the training department of a large corporation had been asked to teach a new intern to complete a cost-benefit analysis for an upcoming development project. In this case, it is assumed that the intern has no previous experience with cost-benefit analysis in a business setting. However, by relating this new task to highly similar procedures with which the intern has had more experience, the manager can facilitate a smooth and efficient assimilation of this new procedure into memory. These familiar procedures may include the process by which the individual allocates his monthly paycheck, how (s)he makes a buy/no-buy decision regarding the purchase of a luxury item, or even how one's weekend spending activities might be determined and prioritized. The procedures for such activities may not exactly match those of the cost-benefit analysis, but the similarity between the activities allows for the unfamiliar information to be put within a familiar context. Thus processing requirements are reduced and the potential effectiveness of recall cues is increased.

Constructivism

The philosophical assumptions underlying both the behavioral and cognitive theories are primarily objectivistic; that is: the world is real, external to the learner. The goal of instruction is to map the structure of the world onto the learner (Jonassen, 1991b). A number of contemporary cognitive theorists have begun to question this basic objectivistic assumption and are starting to adopt a more constructivist approach to learning and understanding: knowledge "is a function of how the individual creates meaning from his or her own experiences" (p.10). Constructivism is not a totally new approach to learning. Like most other learning theories, constructivism has multiple roots in the philosophical and psychological viewpoints of this century, specifically in the works of Piaget, Bruner, and Goodman (Perkins, 1991). In

How Does Learning Occur?

Constructivism is a theory that equates learning with creating meaning from experience (Bednar et al., 1991). Even though constructivism is considered to be a branch of cognitivism (both conceive of learning as a mental activity), it distinguishes itself from traditional cognitive theories in a number of ways. Most cognitive psychologists think of the mind as a reference tool to the real world; constructivists believe that the mind filters input from the world to produce its own unique reality (Jonassen, 1991a). Like with the rationalists of Plato's time, the mind is believed to be the source of all meaning, yet like the empiricists, individual, direct experiences with the environment are considered critical. Constructivism crosses both categories by emphasizing the interaction between these two variables.

Constructivists do not share with cognitivists and behaviorists the belief that knowledge is mind-independent and can be "mapped" onto a learner. Constructivists do not deny the existence of the real world but contend that what we know of the world stems from our own interpretations of our experiences. Humans create meaning as opposed to acquiring it. Since there are many possible meanings to glean from any experience, we cannot achieve a predetermined, "correct" meaning. Learners do not transfer knowledge from the external world into their memories; rather they build personal interpretations of the world based on individual experiences and interactions. Thus, the internal representation of knowledge is constantly open to change; there is not an objective reality that learners strive to know. Knowledge emerges in contexts within which it is relevant. Therefore, in order to understand the learning which has taken place within an individual, the actual experience must be examined (Bednar et al., 1991).

Which Factors Influence Learning?

Both learner and environmental factors are critical to the constructivist, as it is the specific interaction between these two variables that creates knowledge. Constructivists argue that behavior is situationally determined (Jonassen, 1991a). Just as the learning of new vocabulary words is enhanced by exposure and subsequent interaction with those words in context (as opposed to learning their meanings from a dictionary), likewise it is essential that content knowledge be embedded in the situation in which it is used. Brown, Collins, and Duguid (1989) suggest that situations actually co-produce knowledge (along with cognition) through activity. Every action is viewed as "an interpretation of the current situation based on an entire history of previous interactions" (Clancey, 1986). Just as shades of meanings of given words are constantly changing a learner's "current" understanding of a word, so too will concepts continually evolve with each new use. For this reason, it is critical that learning occur in realistic settings and that the selected learning tasks be relevant to the students' lived experience.

What is the Role of Memory?

The goal of instruction is not to ensure that individuals know particular facts but rather that they elaborate on and interpret information. "Understanding is developed through continued, situated use … and does not crystallize into a categorical definition" that can be called up from memory (Brown et al., 1989, p. 33). As mentioned earlier, a concept will continue to evolve with each new use as new situations, negotiations, and activities recast it in a different, more densely textured form. Therefore, "memory" is always under construction as a cumulative history of interactions. Representations of experiences are not formalized or structured into a single piece of declarative knowledge and then stored in the head. The emphasis is not on retrieving intact knowledge structures, but on providing learners with the means to create novel and situation-specific understandings by "assembling" prior knowledge from diverse sources appropriate to the problem at hand. For example, the knowledge of "design" activities has to be used by a practitioner in too many different ways for them all to be anticipated in advance. Constructivists emphasize the flexible use of pre-existing knowledge rather than the recall of prepackaged schemas (Spiro, Feltovich, Jacobson, & Coulson, 1991). Mental representations developed through task-engagement are likely to increase the efficiency with which subsequent tasks are performed to the extent that parts of the environment remain the same: "Recurring features of the environment may thus afford recurring sequences of actions" (Brown et al., p. 37). Memory is not a context-independent process.

abstract, self-contained concepts or details. To be successful, meaningful, and lasting, learning must include all three of these crucial factors: activity (practice), concept (knowledge), and culture (context) (Brown et al., 1989).

How Does Transfer Occur?

The constructivist position assumes that transfer can be facilitated by involvement in authentic tasks anchored in meaningful contexts. Since understanding is “indexed” by experience (just as word meanings are tied to specific instances of use), the authenticity of the experience becomes critical to the individual’s ability to use ideas (Brown et al., 1989). An essential concept in the constructivist view is that learning always takes place in a context and that the context forms an inexorable link with the knowledge embedded in it (Bednar et al., 1991). Therefore, the goal of instruction is to accurately portray tasks, not to define the structure of learning required to achieve a task. If learning is decontextualized, there is little hope for transfer to occur. One does not learn to use a set of tools simply by following a list of rules. Appropriate and effective use comes from engaging the learner in the actual use of the tools in real-world situations. Thus, the ultimate measure of learning is based on how effective the learner’s knowledge structure is in facilitating thinking and performing in the system in which those tools are used.

What Types of Learning Are Best Explained by This Position?

The constructivist view does not accept the assumption that types of learning can be identified independent of the content and the context of learning (Bednar et al., 1991). Constructivists believe that it is impossible to isolate units of information or divide up knowledge domains according to a hierarchical analysis of relationships. Although the emphasis on performance and instruction has proven effective in teaching basic skills in relatively structured knowledge domains, much of what needs to be learned involves advanced knowledge in ill-structured domains. Jonassen (1991a) has described three stages of knowledge acquisition (introductory, advanced, and expert) and argues that constructive learning environments are most effective for the stage of advanced knowledge acquisition, where initial misconceptions and biases acquired during the introductory stage can be discovered, negotiated, and if necessary, modified and/or removed. Jonassen agrees that introductory knowledge acquisition is better supported by more objectivistic approaches (behavioral and/or cognitive) but suggests a transition to constructivistic approaches as learners acquire more knowledge which provides them with the conceptual power needed to deal with complex and ill-structured problems.

What Basic Assumptions/principles of This Theory Are Relevant to Instructional Design?

The constructivist designer specifies instructional methods and strategies that will assist learners in actively exploring complex topics/environments and that will move them into thinking in a given content area as an expert user of that domain might think. Knowledge is not abstract but is linked to the context under study and to the experiences that the participants bring to the context. As such, learners are encouraged to construct their own understandings and then to validate, through social negotiation, these new perspectives. Content is not prespecified; information from many sources is essential. For example, a typical constructivist’s goal would not be to teach novice ID students straight facts about instructional design, but to prepare students to use ID facts as an instructional designer might use them. As such, performance objectives are not related so much to the content as they are to the processes of construction.

Some of the specific strategies utilized by constructivists include situating tasks in real-world contexts, use of cognitive apprenticeships (modeling and coaching a student toward expert performance), presentation of multiple perspectives (collaborative learning to develop and share alternative views), social negotiation (debate, discussion, evidencegiving), use of examples as real “slices of life,” reflective awareness, and providing considerable guidance on the use of constructive processes.

The following are several specific assumptions or principles from the constructivist position that have direct relevance for the instructional designer (possible ID applications are listed in italics and brackets following the listed principle):

2. An emphasis on learner control and the capability of the learner to manipulate information [actively using what is learned].
3. The need for information to be presented in a variety of different ways [revisiting content at different times, in rearranged contexts, for different purposes, and from different conceptual perspectives].
4. Supporting the use of problem-solving skills that allow learners to go "beyond the information given." [developing pattern-recognition skills, presenting alternative ways of representing problems].
5. Assessment focused on transfer of knowledge and skills [presenting new problems and situations that differ from the conditions of the initial instruction].

How Should Instruction Be Structured?

As one moves along the behaviorist-cognitivist-constructivist continuum, the focus of instruction shifts from teaching to learning, from the passive transfer of facts and routines to the active application of ideas to problems. Both cognitivists and constructivists view the learner as being actively involved in the learning process, yet the constructivists look at the learner as more than just an active processor of information; the learner elaborates upon and interprets the given information (Duffy & Jonassen, 1991). Meaning is created by the learner: learning objectives are not pre-specified nor is instruction predesigned. "The role of instruction in the constructivist view is to show students how to construct knowledge, to promote collaboration with others to show the multiple perspectives that can be brought to bear on a particular problem, and to arrive at self-chosen positions to which they can commit themselves, while realizing the basis of other views with which they may disagree" (Cunningham, 1991, p. 14).

Even though the emphasis is on learner construction, the instructional designer/ teacher's role is still critical (Reigeluth, 1989). Here the tasks of the designer are two-fold: (1) to instruct the student on how to construct meaning, as well as how to effectively monitor, evaluate, and update those constructions; and (2) to align and design experiences for the learner so that authentic, relevant contexts can be experienced.

Although constructivist approaches are used quite frequently in the preparation of lawyers, doctors, architects, and businessmen through the use of apprenticeships and on-the-job training, they are typically not applied in the educational arena (Resnick, 1987). If they were, however, a student placed in the hands of a constructivist would likely be immersed in an "apprenticeship" experience. For example, a novice instructional design student who desires to learn about needs assessment would be placed in a situation that requires such an assessment to be completed. Through the modeling and coaching of experts involved in authentic cases, the novice designer would experience the process embedded in the true context of an actual problem situation. Over time, several additional situations would be experienced by the student, all requiring similar needs assessment abilities. Each experience would serve to build on and adapt that which has been previously experienced and constructed. As the student gained more confidence and experience, (s)he would move into a collaborative phase of learning where discussion becomes crucial. By talking with others (peers, advanced students, professors, and designers), students become better able to articulate their own understandings of the needs assessment process. As they uncover their naive theories, they begin to see such activities in a new light, which guides them towards conceptual reframing (learning). Students gain familiarity with analysis and action in complex situations and consequently begin to expand their horizons: they encounter relevant books, attend conferences and seminars, discuss issues with other students, and use their knowledge to interpret numerous situations around them (not only related to specific design issues). Not only have the learners been involved in different types of learning as they moved from being novices to "budding experts," but the nature of the learning process has changed as well.

General Discussion

It is apparent that students exposed to the three instructional approaches described in the examples above would gain different competencies. This leads instructors/designers to ask two significant questions: Is there a single "best" approach and is one approach more efficient than the others? Given that learning is a complex, drawn-out process that both in nature and diversity, as it progresses (Shuell, 1990). What might be most effective for novice learners encountering a complex body of knowledge for the first time, would not be effective, efficient or stimulating for a learner who is more familiar with the content. Typically, one does not teach facts the same way that concepts or problem-solving are taught; likewise, one teaches differently depending on the proficiency level of the learners involved. Both the instructional strategies employed and the content addressed (in both depth and breadth) would vary based on the level of the learners.

So how does a designer facilitate a proper match between learner, content, and strategies? Consider, first of all, how learners' knowledge changes as they become more familiar with a given content. As people acquire more experience with a given content, they progress along a low-to-high knowledge continuum from 1) being able to recognize and apply the standard rules, facts, and operations of a profession (knowing what), to 2) thinking like a professional to extrapolate from these general rules to particular, problematic cases (knowing how), to 3) developing and testing new forms of understanding and actions when familiar categories and ways of thinking fail (reflection-in-action) (Schon, 1987). In a sense, the points along this continuum mirror the points of the learning theory continuum described earlier. Depending on where the learners "sit" on the continuum in terms of the development of their professional knowledge (knowing what vs. knowing how vs. reflection-in-action), the most appropriate instructional approach for advancing the learners' knowledge at that particular level would be the one advocated by the theory that corresponds to that point on the continuum. That is, a behavioral approach can effectively facilitate mastery of the content of a profession (knowing what); cognitive strategies are useful in teaching problem-solving tactics where defined facts and rules are applied in unfamiliar situations (knowing how); and constructivist strategies are especially suited to dealing with ill-defined problems through reflection-in-action.

A second consideration depends upon the requirements of the task to be learned. Based on the level of cognitive processing required, strategies from different theoretical perspectives may be needed. For example, tasks requiring a low degree of processing (e.g., basic paired associations, discriminations, rote memorization) seem to be facilitated by strategies most frequently associated with a behavioral outlook (e.g., stimulus-response, contiguity of feedback/reinforcement). Tasks requiring an increased level of processing (e.g., classifications, rule or procedural executions) are primarily associated with strategies having a stronger cognitive emphasis (e.g., schematic organization, analogical reasoning, algorithmic problem solving). Tasks demanding high levels of processing (e.g., heuristic problem solving, personal selection and monitoring of cognitive strategies) are frequently best learned with strategies advanced by the constructivist perspective (e.g., situated learning, cognitive apprenticeships, social negotiation).

We believe that the critical question instructional designers must ask is not "Which is the best theory?" but "Which theory is the most effective in fostering mastery of specific tasks by specific learners?" Prior to strategy(ies) selection, consideration must be made of both the learners and the task. An attempt is made in Figure 1 to depict these two continua (learners' level of knowledge and cognitive processing demands) and to illustrate the degree to which strategies offered by each of the theoretical perspectives appear applicable. The figure is useful in demonstrating: (a) that the strategies promoted by the different perspectives overlap in certain instances (i.e., one strategy may be relevant for each of the different perspectives, given the proper amount of prior knowledge and the corresponding amount of cognitive processing), and (b) that strategies are concentrated along different points of the continua due to the unique focus of each of the learning theories. This means that when integrating any strategies into the instructional design process, the nature of the learning task (i.e., the level of cognitive processing required) and the proficiency level of the learners involved must both be considered before selecting one approach over another. Depending on the demands of the task and where the learners are in terms of the content to be delivered/discovered, different strategies based on different theories appear to be necessary. Powerful frameworks for instruction have been developed by designers inspired by each of these perspectives. In fact, successful instructional practices have features that are supported by virtually all three perspectives (e.g., active participation and interaction, practice and feedback).

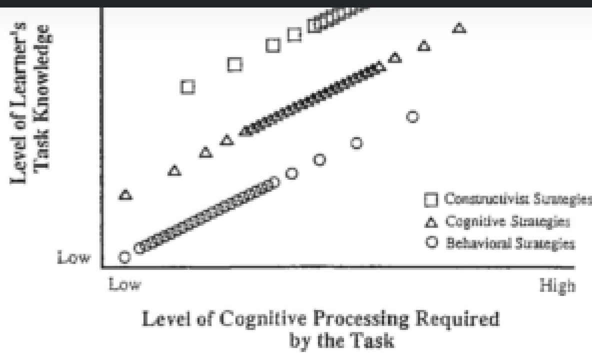

Figure 1. Comparison of the associated instructional strategies of the behavioral, cognitive, and constructivist viewpoints based on the learner's level of task knowledge and the level of cognitive processing required by the task.

For this reason, we have consciously chosen not to advocate one theory over the others, but to stress instead the usefulness of being well versed in each. This is not to suggest that one should work without a theory, but rather that one must be able to intelligently choose, on the basis of information gathered about the learners' present level of competence and the type of learning task, the appropriate methods for achieving optimal instructional outcomes in that situation.

As stated by Smith and Ragan (1993, p. viii): "Reasoned and validated theoretical eclecticism has been a key strength of our field because no single theoretical base provides complete prescriptive principles for the entire design process." Some of the most crucial design tasks involve being able to decide which strategy to use, for what content, for which students, and at what point during the instruction. Knowledge of this sort is an example of conditional knowledge, where "thinking like" a designer becomes a necessary competency. It should be noted however, that to be an eclectic, one must know a lot, not a little, about the theories being combined. A thorough understanding of the learning theories presented above seems to be essential for professional designers who must constantly make decisions for which no design model provides precise rules. Being knowledgeable about each of these theories provides designers with the flexibility needed to be spontaneous and creative when a first attempt doesn't work or when they find themselves limited by time, budget, and/or personnel constraints. The practitioner cannot afford to ignore any theories that might provide practical implications. Given the myriad of potential design situations, the designer's "best" approach may not ever be identical to any previous approach, but will truly "depend upon the context." This type of instructional "cherry-picking" has been termed "systematic eclecticism" and has had a great deal of support in the instructional design literature (Snelbecker, 1989).

In closing, we would like to expand on a quote by P. B. Drucker, (cited in Snelbecker, 1983): "These old controversies have been phonies all along. We need the behaviorist's triad of practice/reinforcement/feedback to enlarge learning and memory. We need purpose, decision, values, understanding–the cognitive categories–lest learning be mere behavioral activities rather than action" (p. 203).

And to this we would add that we also need adaptive learners who are able to function well when optimal conditions do not exist, when situations are unpredictable and task demands change, when the problems are messy and ill-formed and the solutions depend on inventiveness, improvisation, discussion, and social negotiation.

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Additional Reading

An update was published in *Performance Improvement Quarterly* in 2013 by the authors to accompany the 30 year anniversary and republication of the original article. This update adds a strong second part to this article, and you are encouraged to read it here.

Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly*, *26*(2), 43–71.

- How would the instruction be designed differently by a behaviorist, a cognitivist, and a constructivist? Scenario: A high school social study teacher is planning a class on the Vietnam War.
- Describe an example from your life of when you were taught using each method described in this article: behaviorism, cognitivism, and constructivism.
- Based on your reading, would you consider your current instruction style more behavioralist, cognitivist, or constructivist? Elaborate with your specific mindset and examples.

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Sociocultural Perspectives on Learning

Bohdana Allman, Amanda R. Casto, & Drew Polly

Modern sociocultural learning theories stem from the work of Russian psychologist Lev Vygotsky. When examining learning theories, LIDT professionals should consider the role culture, interaction, and collaboration have on quality learning. We propose a set of principles to guide the design of learning experiences. We provide examples of applications and environments that promote deep and meaningful learning.

When examining learning theories, LIDT professionals should consider **sociocultural** perspectives and the role culture, interaction, and collaboration have on quality learning. Modern sociocultural learning theories stem from the work of Russian psychologist Lev Vygotsky. Vygotsky noticed the **dynamic interdependence** of social and individual psychological processes and recognized the role social interactions, language, and culture play in developing higher-order thinking skills. Although Vygotsky's views are considered primarily developmental, they have practical implications for learners of all ages (Kozulin, 1990). Most recently, Vygotsky's and other sociocultural scholars' work have led to new approaches to learning, teaching, and instructional and learning design.

In this chapter, we first review the sociocultural theory's central tenets. We then propose a set of principles informed by sociocultural perspectives to guide the design of learning experiences. We also provide examples of applications and environments that promote deep and meaningful learning.

Sociocultural Perspectives On Learning

Three themes can be identified within Vygotsky's view of sociocultural learning: (a) learning is inherently a social process, (b) psychological tools mediate learning, and (c) learning occurs within the **Zone of Proximal Development** and can be supported by assistance from others.

Learning Is Inherently a Social Process

Proponents of sociocultural theory contend that thinking has social origins and social interactions play a critical role in developing higher-order thinking skills and learning (Vygotsky, 1978). Learners adopt socially shared experiences and acquire strategies and knowledge as they work with others on various tasks (Scott & Palincsar, 2013). While working together toward a common goal, such as solving a problem, learners seek to understand the problem, search for possible solutions, share multiple perspectives, negotiate meaning, and potentially come up with a mutually-satisfying solution. During this process, they gain a deeper understanding of issues related to the problem, including the knowledge of needed facts, theories, processes, and activities associated with the discipline. They use relevant terminology and discourse and practice valuable soft skills and strategies. This type of learning reflects a "transformation of participation in a sociocultural activity" rather than a traditional transmission of discrete cultural knowledge or skills (Matusov, 2015, p. 315).

In addition to learning being social in origin and participatory in character, Vygotsky believed that cognitive development, and learning, in particular, cannot be fully understood without considering the social, cultural, and historical context within which it is embedded (Vygotsky, 1978). Social structures determine people's working nature of individuals and their context has important implications for learning design and research, highlighting the need to focus on the activity rather than on the sequestered individual. As we design and research learning experiences, we need to consider the participants (the learner, peers, the teacher) and their roles, available tools, artifacts to be used and created, as well as the community with its rules (Engeström, 2015).

Psychological Tools Mediate Learning

Another key aspect of sociocultural theory is the role tools play in the learning process. Vygotsky reasoned that social and individual work is mediated by signs or **semiotics**, such as language, systems of counting, conventional signs, works of art, and such (McLeod, 2022). These tools facilitate social and individual functioning. They also support meaning-making and co-construction of knowledge (Vygotsky, 1978).

Appropriation, a process where an individual adopts these socially available psychological tools to assist future independent problem solving, plays a vital role in learning (John-Steiner & Mahn, 1996). Learners do not need to reinvent already existing tools to be able to use them. They only need to be introduced to how a particular tool is used, and then they can apply it across various situations solving new problems (Scott & Palincsar, 2013).

Vygotsky viewed language as the most powerful tool at our disposal, the ultimate collection of symbols that emerge within a culture (Vygotsky, 1986). Language as a form of symbolic mediation assists with two critical roles: (a) communicating with others and (b) facilitating our cognitive development. Using language as a tool for thinking enables us to add meaning to our experiences, organize our thoughts, construct logical meaning, and develop broad and abstract concepts (McLeod, 2022).

Learning Occurs Within the Zone of Proximal Development

The most widely applied Vygotskian sociocultural concept is the **Zone of Proximal Development (ZPD)**, which is “the difference between what a learner can do without help and what he or she can achieve with guidance and encouragement from a skilled partner” (McLeod, 2019). For learning to be most effective, ZPD should be matched with an individual’s developmental level and be slightly beyond their capability. See Figure 1.

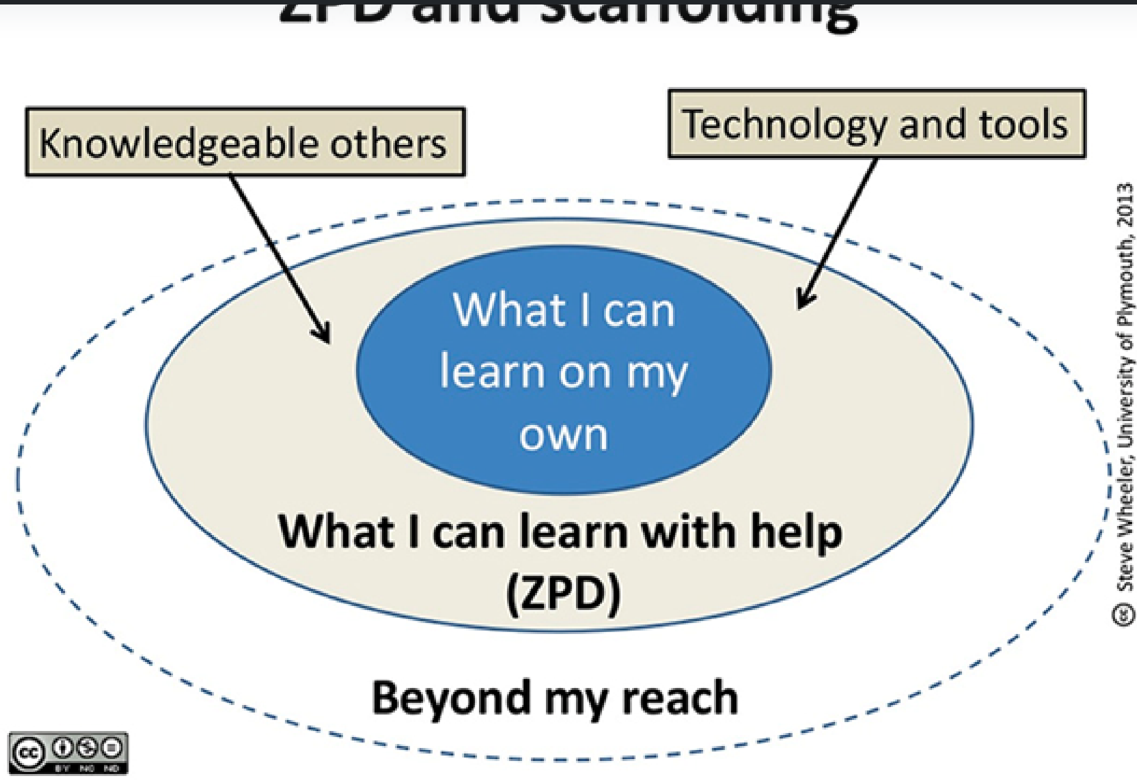


Figure 1. Learning in the Zone of Proximal Development. From "Vygotsky's Sociocultural Theory of Cognitive Development," by S. Mcleod, 2019, SimplyPsychology (https://www.simplypsychology.org/vygotsky.html). CC BY-ND 2013 by Steve Wheeler, University of Plymouth.

In practice, work within the ZPD can be done through productive interactions. Through **guided participation**, learners actively acquire new valuable skills and capabilities as they engage in a meaningful collaborative activity with an assisting, more experienced other (Rogoff, 1990). The notion of instructional **scaffolding** is also related to learning in the ZPD. Scaffolding is any support provided to a learner throughout the learning process to help them complete a task within the ZPD. The types and the extent of support provided are based on performance needs and should be gradually removed as the learner becomes more confident and capable of completing the task independently (Miller, 2011).

Ideas such as ZPD, guided participation, and scaffolding bring to light a fundamentally different view of an instructor who serves as a facilitator of learning rather than a fount of knowledge. Likewise, the learner takes on more responsibilities, such as actively collaborating in the learning process, determining their learning goals, and becoming a resource of knowledge for peers (Grabinger et al., 2007). This shift in roles promotes individualized, differentiated, and learner-centered instruction. When paired with effective **pedagogical** practices, it can become a powerful alternative for reforming current educational systems and creating environments where many different individuals develop a deep understanding of important subjects (Watson & Reigeluth, 2016).

Strengths and Limitations of Sociocultural Theory

The sociocultural theory has several widely recognized strengths. First, it emphasizes any human activity's broader social, cultural, and historical context. It does not view individuals as isolated entities; instead, it provides a richer perspective, focusing on the fluid boundary between self and others. It portrays the dynamic of a learner acquiring knowledge and skills from society and then shaping their environment (Miller, 2011).

Second, the sociocultural theory is sensitive to individual and cross-cultural diversity. In contrast to many other **universalist theories**, sociocultural theory acknowledges differences in individuals within and across cultures.

available (Miller, 2011, p. 198).

Finally, sociocultural theory contributes to our theoretical understanding of cognitive development by integrating the notions of learning and development. The idea of learning driving development rather than learning being determined by the learner's developmental level fundamentally changes our understanding of the learning process and has significant instructional and educational implications (Miller, 2011).

There are also limitations to the sociocultural perspective. The first relates to Vygotsky's premature death, as many of his theories remained incomplete. Additionally, his work was largely unknown until relatively recently for political reasons and issues with translation. The second major limitation is associated with the vagueness of the ZPD theory. For example, the zone varies among individual learners and differs for an individual across different learning domains and time. Additionally, there is no standard metric scale to measure it. Finally, some constructs within the theory may not be as applicable to all cultures as initially thought. For example, since scaffolding heavily depends on verbal instruction, it may not be equally effective in all cultures and for all types of learning (Rogoff, 1990).

Learning Check

(MC) According to Vygotsky's theory of Zone of Proximal Development (ZPD), for learning to be most effective

- [ ] the rigor of a lesson must be matched to a student's IQ score
- [ ] ZPD should be matched with an individual's developmental level and be slightly beyond their capability
- [ ] support should be provided to a learner to help them complete a task outside their ZPD.

(T/F) Learner-centered instruction paired with effective pedagogical practices may lead to learning environments where many different individuals may simultaneously develop a deep understanding of important subjects.

- [ ] True
- [ ] False

(MC) One possible shortcoming of sociocultural perspectives on learning is that it

- [ ] emphasizes the broader social, cultural, and historical context of any human activity
- [ ] promotes the idea that learning is purely determined by the learner's developmental level
- [ ] is an "incomplete" theory that may not be consistent across all cultures or situations

Consider a learning experience that you participated in as a learner. How can you understand this experience based on sociocultural views of learning? For example, how did you learn through interaction with others or through cultural tools? What aspects of the experience were beneficial? How could sociocultural aspects have been applied to improve the learning experience?

Principles to Guide Design of Learning Experiences

The concepts reviewed above emphasize the importance of always considering the learners and their context, orchestrating collaborative learning in communities, providing assistance to support learning, and promoting active participation.

Consider the Learner in Context

Sociocultural theory and related perspectives focus on the learner within their social, cultural, and historical context as an essential part of sound pedagogical solutions that facilitate the development of critical thinking and lifelong learning (Grabinger et al., 2007). Likewise, sociocultural perspectives of instructional design recognize how learners construct their personal meanings of material, with the primary goal of engaging in **authentic context**s that help develop transferable skills and knowledge (Grabinger et al., 2007). To do so, instructional designers must take into account learner diversity and encourage learning in authentic contexts.

Account for Individual and Cross-Cultural Differences

Most instructional design models consider an isolated concept of the learner. However, a strong call has recently been issued for a complete shift in our education and instructional design approaches to reflect our society's changing educational needs (Watson & Reigeluth, 2016). More contemporary design approaches, such as Universal Design for Learning, recognize that every learner is unique and influenced by his or her embedded context. These approaches strive to provide challenging and engaging curricula for diverse learners while designing for the social influences surrounding them.

Another implication based on Vygotskian views of learning is acknowledging individual and cross-cultural differences in learning and development. As instructional designers, we should be more sensitive to diversity in learners and recognize that a large amount of research has been done on white, middle-class individuals associated with Western tradition. The resulting understanding of development and learning often incorrectly assumes universality. Realizing that "ideal thinking and behavior may differ for different cultures" and that "different historical and cultural circumstances may encourage different developmental routes to any given developmental endpoint" may prevent incorrect universalist views of all individuals and allow for environments that value diversity as a resource (Miller, 2011, p. 198).

Additionally, recognizing learners as individuals involves considering their autonomy in addition to appreciating their identities and social contexts. As teachers function more as facilitators than masters of knowledge, learners have increased opportunities to develop their goals, identify their learning pathways, and even contribute to making assessment decisions. Compared to a more traditional model in which the decisions for learning rest with the teacher, sociocultural perspectives advocate for involving learners in the decision-making processes of "what to learn, how to study, and which [instructional] resources to use" (Grabinger et al., 2007, p. 7).

An **authentic context** is a scenario the learners may experience in real life. Learning within authentic contexts provides learners with opportunities to experience daily practice and explore realistic problems. Authentic activities contextualize learning and allow for a diverse application of skills and knowledge within real-world scenarios. Students' backgrounds, cultures, and locations should be considered when identifying contexts for social learning experiences. For example, authentic contexts for learners on the Florida coast differ from those in a rural town in the midwestern United States. As a result, the development of curriculum, instructional materials, and resources for learning experiences cannot be a one-size-fits-all approach. Instead, it should provide opportunities for teachers to modify the activities to ensure authenticity for their students.

An example of collaborative learning in authentic contexts is **anchored instruction**, which focuses on developing knowledge and skills through collaborative problem-solving experiences. Typically presented in a narrative format, anchored learning begins with the "anchor," or a story in which the problem is set, and uses multimedia outlets to allow learners to explore the problem (Bransford et al., 1990). As learners collaborate and engage with the material, the teacher becomes a coach and guides them in developing creative solutions to complex problems.

Learning Check

(T/F) The education field's collective understanding of learning development often incorrectly assumes universality due to the inequitable amount of research that has been done on white, middle-class individuals associated with Western tradition.

- [ ] True
- [ ] False

(T/F) Anchored instruction allows learners to engage in collaborative problem solving within learning contexts that provide for connection-building across the curriculum in order to develop meaning.

- [ ] True
- [ ] False

(MC) In her university class, Susan has been asked to write an essay on an important lesson learned in high school. However, Susan was homeschooled, attending a virtual high school part-time, supplemented with material from her parents. She is not sure how to approach the assignment. According to sociocultural learning theory, why is this assignment not working for Susan? (Select all that apply)

- [ ] the teacher assumed that one approach to learning was universal for all of the students
- [ ] the assignment is not authentic because it is not related to the student's real experiences
- [ ] there were no choices for Susan in writing this essay.

Sociocultural perspectives value learning through interaction, negotiation, and collaboration as learners solve authentic problems, emphasizing learning from experience and dialogue. The principles of collaborative practice go beyond social constructivism and cooperative learning by situating learning activities within **communities of practice** where novices and experts work and learn together. Collaborative learning environments encourage learners to think critically and apply knowledge and skills as they explore and solve problems embedded in real-life situations (Reeves et al., 2002). It promotes contextualization of learning in simulating practical problems, developing cultural skills through guided participation, and using language to communicate and internalize learning. Furthermore, “in interactive and collaborative instructional contexts, individuals have an opportunity for perspective taking and reflective thinking that may lead to higher levels of cognitive, social, and moral development, as well as self-esteem” (APA Work Group, 1997, p. 6).

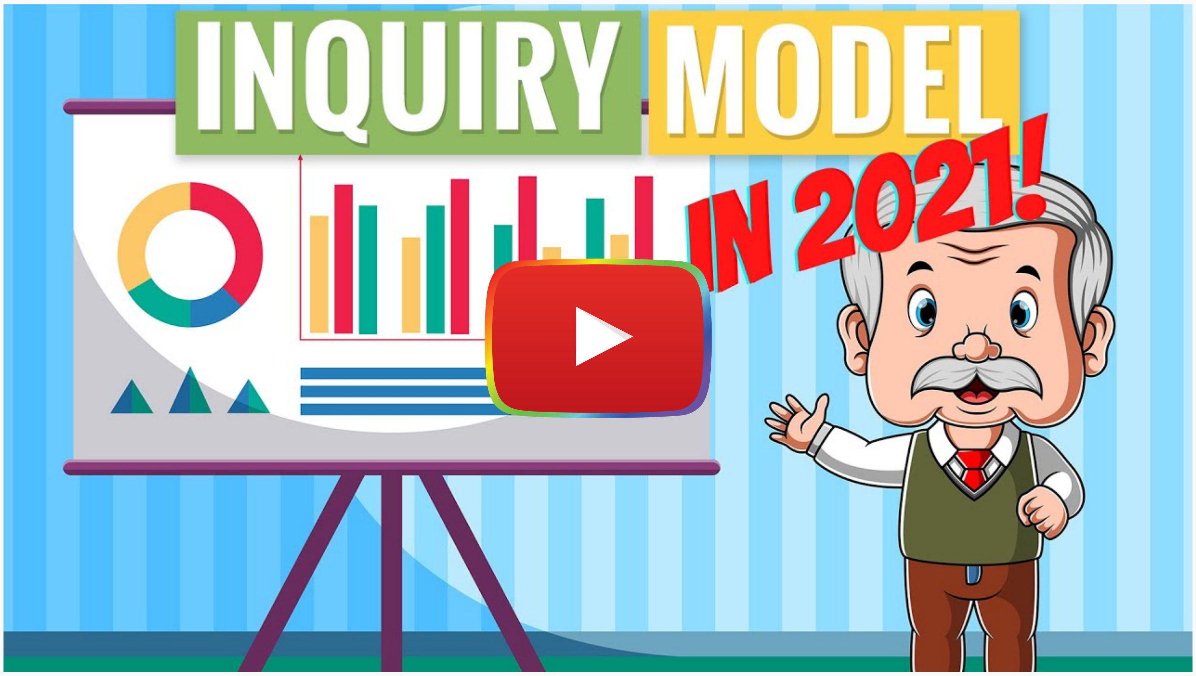
Teachers, trainers, and facilitators guide and support collaborative efforts as they help learners make sense of the problems, ask questions that promote deep understanding, and scaffold learning with tools and resources. When designing collaborative learning experiences, it is critical to foster learning in communities of practice, engage all learners, and facilitate collaboration.

Foster Learning in Communities of Practice

As instructional designers and educators plan collaborative learning experiences, they should find ways to help establish and foster communities of practice that enhance learning. Wenger (1998) identified **communities of practice** as groups of individuals who are engaged with each other on a shared project or focus and who share similar skills.

Approaches grounded in sociocultural theory attend to the discourse, norms, and practices associated with a particular community of practice and believe these are key to successful learning (Scott & Palincsar, 2013). As learners and those facilitating learning engage in authentic practices within the target context in communities, learning and transfer of knowledge and skills occur naturally and on deeper levels (Lave & Wenger, 1991). “People who use tools actively rather than just acquire them, by contrast, build an increasingly rich implicit understanding of the world in which they use the tools and of the tools themselves” (Brown et al., 1989, p. 33).

Community of inquiry is an instructional design framework for creating and supporting educational communities where groups of learners actively engage in constructing understanding. It provides valuable guidance about what elements and processes may be necessary when designing successful community-based learning experiences.



[Watch on YouTube](https://edtechbooks.org/-jczw)

XRP News. (2021, June 8). Community of inquiry model simply explained: Inquiry-based learning. [Video]. YouTube. https://edtechbooks.org/-jczw

Engage All Learners

Learners of all ages benefit from understanding expectations for a collaborative activity. Having clear goals and establishing rules for interaction provide support. The acronym PIES represents features of collaborative learning (Kagan, 1999) that instructional designers and teachers could utilize to support successful collaboration:

- **Positive interdependence** – the work that the group does is greater than if each individual worked alone.
- **Individual accountability** – each learner is responsible for some aspects of the work; participants should have a sense of shared authority over the process.
- **Equal participation** – a fair share of work is required; all participants should actively collaborate to co-construct understanding.
- **Simultaneous interaction** – learners are working together simultaneously instead of working on their own on separate pieces that are compiled at the end.

When creating learning experiences for adults, the tasks must be complex enough to foster positive interdependence and hold individuals accountable. Adult learners and more experienced younger collaborators may be able to organize themselves, assuming their roles and distributing tasks naturally. Instructional designers and teachers who prepare collaborative learning experiences for younger children or less experienced collaborators may consider supporting equal participation by assigning specific roles within learning teams (i.e., leader/facilitator, recorder, timekeeper, spokesperson).

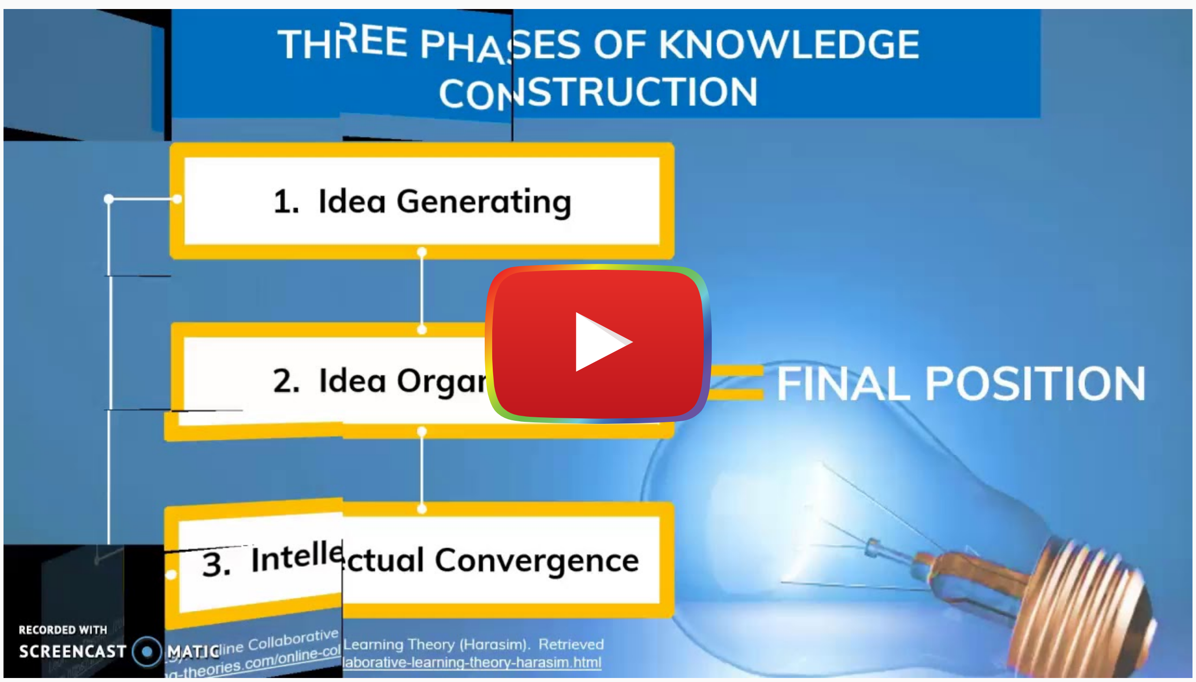
Such support helps establish communities of learners who are comfortable working with others across various contexts. It also assists learners from different backgrounds in understanding expectations and learning as they

Facilitate Collaboration Online

New technologies enable online collaborative learning experiences, offering significant access, flexibility, and economic advantages. They afford unique ways of interacting within communities of practice, promote synchronous and asynchronous collaboration, and enhance reflective thinking opportunities. Besides affording more democratic participation in the learning process, online technologies also provide a possibility of a greater diversity of participants than in a physical classroom, bringing about more cross-cultural connections to inspire social learning (Garrison & Akyol, 2013; Harasim, 2017).

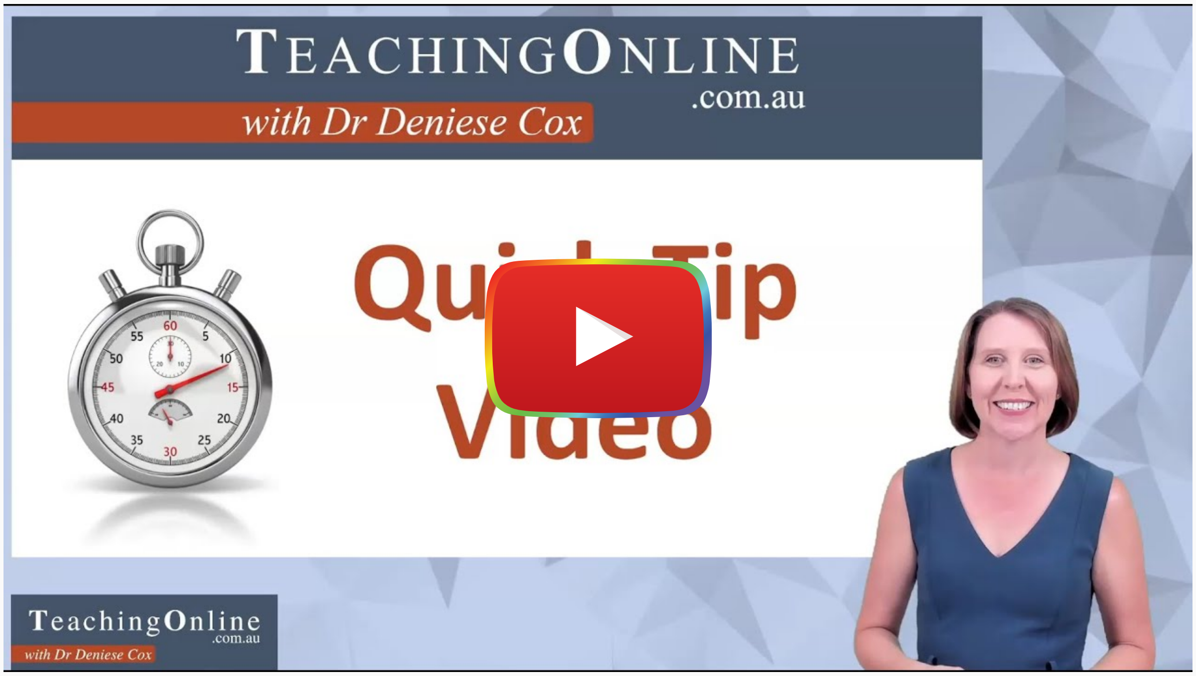
Higher-order learning that emerges in collaborative learning communities represents both the process and its outcomes. "Its quality and success are strongly influenced by the design features (i.e., the structure, types of interactions, sequences of activities) and the teaching approach (facilitating, mentoring, and guidance to support the integration of ideas into meaningful constructs)" (Allman, 2021, pp. 35-36) and must be carefully orchestrated. Two process-oriented models help instructional designers intentionally design critical discourse interaction opportunities necessary for meaningful learning: **online collaborative learning theory** (Harasim, 2017) and **the practical inquiry process** (Garrison & Akyol, 2013). Although intended for online learning, understanding these processes makes creating effective collaborative learning experiences possible in any environment (i.e., online, blended, technology-mediated, in-person).

Learn More About the Online Collaborative Learning Theory



Watch on YouTube

McDowell, K. (2019, June 3). Online collaborative learning theory. [Video]. YouTube. https://edtechbooks.org/-qbTw



Watch on YouTube

Teaching Online. (2022, March 6). Quick-tip: The 4 simple steps of a practical-inquiry process for deep topic engagement. [Video]. YouTube. https://edtechbooks.org/-AdFB

(T/F) Community of inquiry framework provides valuable guidance about what elements and processes may be necessary when designing and enacting successful community-based learning experiences.

- [ ] True
- [ ] False

(T/F) According to Kagan's PIES features of collaborative learning, learners have a greater potential to achieve more working individually than as a group.

- [ ] True
- [ ] False

(MC) Which of the following is NOT a shared characteristic among communities of practice:

- [ ] Situated cognition developed from interacting with others in real-life contexts
- [ ] Mutual engagement built from established norms
- [ ] Joint enterprise created by a shared understanding of what binds the group

Provide Assistance to Support Learning

As teachers and instructional designers create learning experiences for interaction, they need to strategically embed opportunities for assistance to support learning within the ZPD. The assistance of the more knowledgeable other, whether it is a teacher or peer, and the support through embedded scaffolds and technology, enable the learner to stretch their ability, learn beyond what they could do on their own, and develop skills and strategies they will eventually apply independently in other situations (Vygotsky, 1978).

Support Through Scaffolding

Instructional scaffolding can be embedded or contingent. **Embedded (hard) scaffolding** is any structure prepared ahead of the learning task that is expected to be difficult. The teacher or instructional designer anticipates points of difficulty and provides ways to support the learners. This can be as simple as building on prior knowledge, pre-teaching key vocabulary at the beginning of a lesson, using visual aids and graphic organizers, conducting checks for understanding, and revisiting key ideas strategically during the lesson. It can also be modeling valuable strategies such as think-aloud or mind maps and encouraging learners to use them effectively.

Embedded scaffolds could be used to support performance during assessments by providing clear instructions, rubrics, practice, and examples. In the case of digital learning experiences, scaffolds are not necessarily provided by individuals but may be embedded into the experience using technology. For example, **Learning Management Systems** (LMSs) help organize lesson content, activities, and assessments. Alternatively, think about how the multimedia content, learning checks, and examples from practice embedded in this chapter support your learning of the content.

guides the learner by providing just enough assistance, modeling, and highlighting critical features of the task while continually evaluating and adjusting supports as needed. The dynamic nature of interaction enables both the learner and the one providing the scaffold to influence each other and adjust their behavior as they collaborate. Typically, the expert is the teacher, but it could also be a peer or a group of peers collaboratively working together (reciprocal scaffolding). Each group member has their own experiences, knowledge, and understanding. As they work together on a shared task, they learn from each other and actively assist those that may need support. Technology tools, such as adaptive learning technologies and intelligent-tutoring systems, could also provide flexible assistance that meets learners' specific needs and is dynamically responsive.

Utilize Technology to Enhance Learning

Technology can provide support for learning in the classroom in many valuable ways. Through current and emerging online collaborative spaces (e.g., Google tools, Microsoft Teams, Zoom, wikis) as well as hands-on collaborative technology in the classroom (SMART tablets and iPads), students have robust opportunities to experience meaningful collaborative learning that embody the tenets of sociocultural learning (Polly, 2011). In addition, technological and online tools can assist with more effective communication, realistic simulations of real-world problem scenarios, and even greater flexibility when seeking to scaffold instruction within learners' ZPD.

Digital tools can make learning more visible for both the learner and the teacher and create a space for reflection and improvement (Mercer et al., 2019). Embracing technology within collaborative learning can also foster an equal distribution of voices compared to in-person groupings (Deal, 2009), providing opportunities for active participation for all students. Using technology to support the implementation of social learning theories in the classroom, students experience collaboration while refining 21st-century skills.

While the array of technology available to support social learning is beneficial, the volume of resources available for technology-based collaboration may be overwhelming to some groups of students. Therefore, incorporating different types of scaffolding based on individual class needs may be appropriate to ensure technology is used productively. In addition, by providing students with resources and being explicit about technology use, students may focus better on the actual problem-solving task rather than wrestling with technical issues.

(T/F) When scaffolding instruction, it is important for teachers to remove all levels of support when learners are stuck and unable to continue with the task.

- [ ] True
- [ ] False

(T/F) Utilizing different technological and online tools can lead to greater classroom equity by fostering an equal distribution of voices and providing greater flexibility when seeking to scaffold instruction within students' ZPD.

- [ ] True
- [ ] False

(MC) Instructional designers should consider providing assistance in technology-mediated contexts for these reasons, EXCEPT

- [ ] Second-language learners do not need assistance with technology as they are still learning the language
- [ ] the volume of resources available for online and in-person technology-based collaboration may be overwhelming to some students
- [ ] it ensures that technology is used productively
- [ ] it helps students focus on learning

Promote Active Learning

Humans are naturally curious and inquisitive beings. Therefore, instructional designers and teachers should take advantage and strive to increase engagement and active participation as they create meaningful learning experiences. Several instructional approaches may be employed to provide students with more agentive and autonomous roles in the learning process. **Dialogic teaching**, inquiry-based approaches, and **flipped classroom** models are a few such methods that place students in the nucleus of activity in the classroom.

Encourage Teaching Through Dialogue

Dialogic teaching is an approach where learning takes place through dialogue between the teacher and students. It harnesses the power of language to exchange ideas, facilitate thinking, and co-construct understanding (Mercer et al., 2019). The teacher and students learn together. They share ideas, listen to each other, and consider alternative viewpoints. All learners are encouraged to participate and explain, explore, analyze, evaluate, justify, and question. They build on each other's ideas and connect them into coherent and deepening lines of inquiry. Teachers talk less to give conceptualize ideas differently, and extend their understanding.

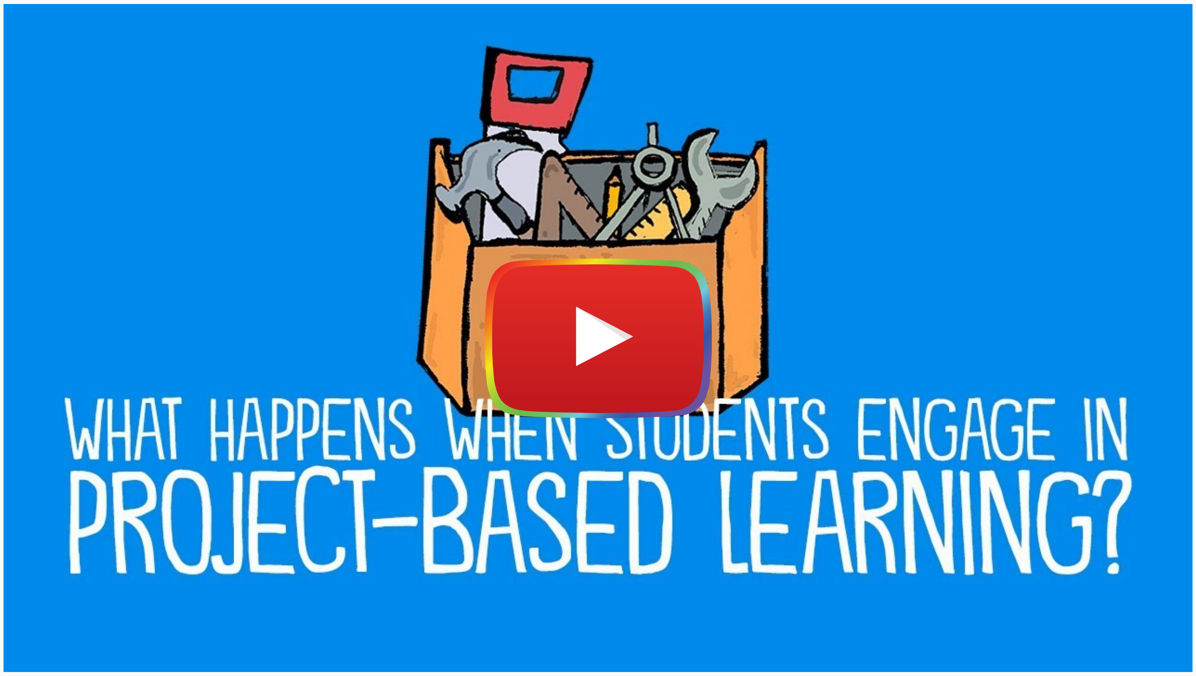
Learn More About Dialogic Learning

Watch on YouTube

Kemp, B. (2020, June 24). Dialogic teaching introduction. [Video] YouTube. https://edtechbooks.org/-KwoS

Nurture Inquiry

Inquiry-based approaches actively engage learners as they explore and solve authentic, complex problems through dialogue in collaborative learning environments. As students work together and conduct an inquiry, they learn content and apply their skills and knowledge. Three similar approaches that differ in focus and scope offer ways to design learning through inquiry: inquiry-based learning, problem-based learning, and project-based learning.



Watch on YouTube

Spencer, J. (2019, August 20). *What happens when students engage in project-based learning?* [Video]. YouTube. https://edtechbooks.org/-foCz

Flipped Learning

The **flipped classroom** is one way to maximize students' learning engagement. In a flipped classroom, students prepare for an upcoming lesson by learning content and watching instructional videos before class. Instead of using the class time for lecture and other passive knowledge and skill acquisition methods, students participate in active and social learning activities, a key component of sociocultural theories. Being able to prepare before class is a great equalizer.

Flipped learning enables students with diverse needs to spend as much time preparing as needed, using strategies to access the content and learn. They can use dictionaries or translation to access information and learn the language. They can pause, rewind, reread, and reflect on their learning as it is happening, a phenomenon that rarely occurs during a lecture given in class and in real-time (Educause, 2012; Brame, 2013). Preparing before class enables students to spend more time communicating about the subjects in meaningful ways, constructing knowledge with hands-on activities during class, and gaining a deeper understanding of the content (Educause, 2012).

[Watch on YouTube](https://edtechbooks.org/-uRhA)

Common Sense Education. (2016, July 12). What is flipped learning? [Video]. YouTube. https://edtechbooks.org/-uRhA

(MC) Dialogic learning approach enables (select all that apply)

- [ ] teacher and students learning together
- [ ] teachers to talk more to give information
- [ ] learners to consider alternate viewpoints
- [ ] teachers to assess students' understanding

(T/F) Inquiry-based approaches actively engage learners in exploration and solving authentic, complex problems in collaborative learning environments.

- [ ] True
- [ ] False

(T/F) The flipped classroom model enables learners with diverse needs to spend as much time as needed preparing to access the content and learn.

- [ ] True
- [ ] False

Summary

The notion of social origins of learning, the interrelationship of language and thought, and the Zone of Proximal Development are Vygotsky's most important contributions. Practical applications of sociocultural theory emphasize creating learner-centered instructional environments in authentic contexts, where learning by discovery, inquiry, active problem solving, and critical thinking are fostered through dialogue and collaboration with experts and peers in communities of learners. Encouraging self-directed lifelong learning habits, presenting authentic and cognitively challenging tasks, scaffolding learners' efforts, and providing authentic and dynamic assessment opportunities are all important aspects of this approach.

Sociocultural principles can be applied in effective and meaningful ways to design instruction across the curriculum for learners of different ages and various skills. They can be effectively integrated using a wide range of technologies and learning environments. The challenge remains for educators and instructional designers to elevate our practices from efficient, systemic teaching and instructional design approaches to a focus on individual learners and effective pedagogical practices that foster empowered learners ready to successfully negotiate the rapidly changing era of information. Technology is at our fingertips, and it is up to us to competently implement its unique affordances to promote new ways to educate and support deep, meaningful, and self-directed learning. Grounding our practices in sociocultural theory can significantly aid our efforts.

Consider what are common aspects of learning experiences that have been influenced by sociocultural views of learning? What are some advantages of designing learning experiences based on sociocultural views of learning?

Editor's Note

To read more on this topic, see the chapter titled "Sociocultural Perspectives of Learning" published in the first edition of this textbook.

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Motivation Theories on Learning

Kelvin Seifert & Rosemary Sutton

Learning
Motivation

Like motivation itself, theories of it are full of diversity. For convenience in navigating through the diversity, we have organized the chapter around six major theories or perspectives about motives and their sources. We call the topics (1) motives as behavior change, (2) motives as goals, (3) motives as interests, (4) motives as attributions about success, (5) motives as beliefs about self-efficacy, and (6) motives as self-determination. We end with a perspective called expectancy-value theory, which integrates ideas from some of the other six theories and partly as a result implies some additional suggestions for influencing students' motivations to learn in positive ways.

Editor's Note

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Not so long ago, a teacher named Barbara Fuller taught general science to elementary years students, and one of her units was about insects and spiders. As part of the unit, she had students search for insects and spiders around their own homes or apartments. They brought the creatures to school (safely in jars), answered a number of questions about them in their journals, and eventually gave brief oral reports about their findings to the class. The assignment seemed straightforward, but Barbara found that students responded to it in very different ways. Looking back, here is how Barbara described their responses:

> *I remember Jose couldn't wait to get started, and couldn't bear to end the assignment either! Every day he brought more bugs or spiders—eventually 25 different kinds. Every day he drew pictures of them in his journal and wrote copious notes about them. At the end he gave the best oral presentation I've ever seen from a third-grader; he called it "They Have Us Outnumbered!" I wish I had filmed it, he was so poised and so enthusiastic.*
>
> *Then there was Lindsey—the one who . . . always wanted to be the best in everything, regardless of whether it interested her. She started off the work rather slowly—just brought in a few bugs and only one*

of bringing a diversity of creatures as Jose was doing, she just brought more and more of the same ones—almost twenty dead house flies, as I recall! Her presentation was OK—I really could not give her a bad mark for it—but it wasn't as creative or insightful as Jose's. I think she was more concerned about her mark than about the material.

And there was Tobias—discouraging old Tobias. He did the work, but just barely. I noticed him looking a lot at other students' insect collections and at their journal entries. He wasn't cheating, I believe, just figuring out what the basic level of work was for the assignment—what he needed to do simply to avoid failing it. He brought in fewer bugs than most others, though still a number that was acceptable. He also wrote shorter answers in his journal and gave one of the shortest oral reports. It was all acceptable, but not much more than that.

And Zoey: she was quite a case! I never knew whether to laugh or cry about her. She didn't exactly resist doing the assignment, but she certainly liked to chat with other students. So she was easily distracted, and that cut down on getting her work done, especially about her journal entries. What really saved her—what kept her work at a reasonably high level of quality—were the two girls she ended up chatting with. The other two were already pretty motivated to do a lot with the assignment—create fine-looking bug collections, write good journal entries, and make interesting oral presentations. So when Zoey attempted chitchat with them, the conversations often ended up focusing on the assignment anyway! She had them to thank for keeping her mind on the work. I don't know what Zoey would have done without them.

As Barbara Fuller's recollections suggest, students assign various meanings and attitudes to academic activities—personal meanings and attitudes that arouse and direct their energies in different ways. We call these and their associated energizing and directing effects by the term *motivation* or sometimes *motivation to learn*. As you will see, differences in motivation are an important source of diversity in classrooms, comparable in importance to differences in prior knowledge, ability, or developmental readiness. When it comes to school learning, furthermore, students' motivations take on special importance because students' mere presence in class is (of course) no guarantee that students really want to learn. It is only a sign that students live in a society requiring young people to attend school. Since modern education is compulsory, teachers cannot take students' motivation for granted, and they have a responsibility to insure students' motivation to learn. Somehow or other, teachers must persuade students to want to do what students have to do anyway. This task—understanding and therefore influencing students' motivations to learn—is the focus of this chapter. Fortunately, as you will see, there are ways of accomplishing this task that respect students' choices, desires, and attitudes.

Like motivation itself, theories of it are full of diversity. For convenience in navigating through the diversity, we have organized the chapter around six major theories or perspectives about motives and their sources. We call the topics (1) motives as behavior change, (2) motives as goals, (3) motives as interests, (4) motives as attributions about success, (5) motives as beliefs about self-efficacy, and (6) motives as self-determination. We end with a perspective called *expectancy-value theory,* which integrates ideas from some of the other six theories and partly as a result implies some additional suggestions for influencing students' motivations to learn in positive ways.

Motives as Behavior

Sometimes it is useful to think of motivation not as something "inside" a student driving the student's behavior, but as *equivalent* to the student's outward behaviors. This is the perspective of behaviorism. In its most thorough-going form, behaviorism focuses almost completely on what can be directly seen or heard about a person's behavior and has relatively few comments about what may lie behind (or "underneath" or "inside") the behavior. When it comes to motivation, this perspective means minimizing or even ignoring the distinction between the inner drive or energy of students and the outward behaviors that express the drive or energy. The two are considered the same or nearly so.

multiple demands of teaching can limit the time available to determine what the behaviors mean. If a student asks a lot of questions during discussions, for example, is he or she curious about the material itself or just wanting to look intelligent in front of classmates and the teacher? In a class with many students and a busy agenda, there may not be a lot of time for a teacher to decide between these possibilities. In other cases, the problem may not be limited time as much as communication difficulties with a student. Consider a student who is still learning English or who belongs to a cultural community that uses patterns of conversation that are unfamiliar to the teacher or who has a disability that limits the student's general language skill. In these cases, discerning the student's inner motivations may take more time and effort. It is important to invest the extra time and effort for such students, but while a teacher is doing so, it is also important for her to guide and influence the students' behavior in constructive directions. That is where behaviorist approaches to motivation can help.

Operant Conditioning as a Way of Motivating

The most common version of the behavioral perspective on motivation is the theory of *operant conditioning*associated with B. F. Skinner (1938, 1957). To understand this model in terms of motivation, think of the *likelihood* of response as the motivation and the *reinforcement* as the motivator. Imagine, for example, that a student learns by operant conditioning to answer questions during class discussions: each time the student answers a question (the operant), the teacher praises (reinforces) this behavior. In addition to thinking of this situation as behavioral *learning,* however, you can also think of it in terms of *motivation:* the likelihood of the student answering questions (the motivation) is increasing because of the teacher's praise (the motivator).

Many concepts from operant conditioning, in fact, can be understood in motivational terms. Another one, for example, is the concept of *extinction,* the tendency for learned behaviors to become less likely when reinforcement no longer occurs—a sort of "unlearning" or at least a decrease in performance of previously learned behaviors. The decrease in performance frequency can be thought of as a loss of motivation, and removal of the reinforcement can be thought of as removal of the motivator. Table 1 summarizes this way of reframing operant conditioning in terms of motivation.

Table 1. Operant Conditioning as Learning and as Motivation

Concept	Definition phrased in terms of learning	Definition phrased in terms of motivation	Classroom Example
Operant	Behavior that becomes more likely because of reinforcement	Behavior that suggests an increase in motivation	Student listens to teacher's comments during lecture or discussion
Reinforcement	Stimulus that increases likelihood of a behavior	Stimulus that motivates	Teacher praises student for listening
Positive reinforcement	Stimulus that *increases*likelihood of a behavior by being *introduced* or *added* to a situation	Stimulus that motivates by its *presence;* an "incentive"	Teacher makes encouraging remarks about student's homework
Negative reinforcement	Stimulus that *increases* the likelihood of a behavior by being *removed* or taken away from a situation	Stimulus that motivates by its *absence* or *avoidance*	Teacher stops nagging student about late homework
Punishment	Stimulus that *decreases* the likelihood of a behavior by	Stimulus that *decreases*motivation by its	Teacher deducts points for late homework

Concept	learning	Motivation	Classroom Example
	being *introduced* or *added* to a situation	*presence*	
Extinction	Removal of reinforcement for a behavior	Removal of motivating stimulus that leads to decrease in motivation	Teacher stops commenting altogether about student's homework
Shaping successive approximations	Reinforcements for behaviors that gradually resemble (approximate) a final goal behavior	Stimuli that gradually shift motivation toward a final goal motivation	Teacher praises student for returning homework a bit closer to the deadline; gradually she praises for actually being on time
Continuous reinforcement	Reinforcement that occurs *each*time that an operant behavior occurs	Motivator that occurs *each* time a behavioral sign of motivation occurs	Teacher praises highly active student for *every* time he works for five minutes without interruption
Intermittent reinforcement	Reinforcement that *sometimes*occurs following an operant behavior, but not on every occasion	Motivator that occurs *sometimes*when a behavioral sign of motivation occurs, but not on every occasion	Teacher praises highly active student *sometimes* when he works without interruption, but not every time

Cautions about Behavioral Perspectives On Motivation

As we mentioned, behaviorist perspectives about motivation do reflect a classroom reality: that teachers sometimes lack time and therefore must focus simply on students' appropriate outward behavior. But there are nonetheless cautions about adopting this view. An obvious one is the ambiguity of students' specific behaviors; what looks like a sign of one motive to the teacher may in fact be a sign of some other motive to the student (DeGrandpre, 2000). If a student looks at the teacher intently while she is speaking, does it mean the student is motivated to learn or only that the student is daydreaming? If a student invariably looks away while the teacher is speaking, does it mean that the student is disrespectful of the teacher or that the student comes from a family or cultural group where *avoiding* eye contact actually shows more respect for a speaker than direct eye contact?

Another concern about behaviorist perspectives, including operant conditioning, is that it leads teachers to ignore students' choices and preferences and to "play God" by making choices on their behalf (Kohn, 1996). According to this criticism, the distinction between "inner" motives and expressions of motives in outward behavior does not disappear just because a teacher (or a psychological theory) chooses to treat a motive and the behavioral expression of a motive as equivalent. Students usually *do* know what they want or desire, and their wants or desires may not always correspond to what a teacher chooses to reinforce or ignore. Approaches that are exclusively behavioral, it is argued, are not sensitive enough to students' *intrinsic,* self-sustaining motivations. As it happens, help with being selective and thoughtful can be found in the other, more cognitively oriented theories of motivation. These use the goals, interests, and beliefs of students as ways of explaining differences in students' motives and in how the motives affect engagement with school. We turn to these cognitively oriented theories next, beginning with those focused on students' goals.

One way motives vary is by the kind of goals that students set for themselves and by how the goals support students' academic achievement. As you might suspect, some goals encourage academic achievement more than others, but even motives that do not concern academics explicitly tend to affect learning indirectly.

Goals That Contribute to Achievement

What kinds of achievement goals do students hold? Imagine three individuals, Maria, Sara, and Lindsay, who are taking algebra together. Maria's main concern is to learn the material as well as possible because she finds it interesting and because she believes it will be useful to her in later courses, perhaps at university. Hers is a mastery goal, because she wants primarily to learn or master the material. Sara, however, is concerned less about algebra than about getting top marks on the exams and in the course. Hers is a performance goal, because she is focused primarily on looking successful; learning algebra is merely a vehicle for performing well in the eyes of peers and teachers. Lindsay, for her part, is primarily concerned about avoiding a poor or failing mark. Hers is a performance-avoidance goal or failure-avoidance goal, because she is not really as concerned about learning algebra, as Maria is, or about competitive success, as Sara is; she is simply intending to avoid failure.

As you might imagine, mastery, performance, and performance-avoidance goals often are not experienced in pure form, but in combinations. If you play the clarinet in the school band, you might want to improve your technique simply because you enjoy playing as well as possible—essentially a mastery orientation. But you might also want to look talented in the eyes of classmates—a performance orientation. Another part of what you may wish, at least privately, is to avoid looking like a complete failure at playing the clarinet. One of these motives may predominate over the others, but they all may be present.

Mastery goals tend to be associated with enjoyment of learning the material at hand and in this sense represent an outcome that teachers often seek for students. By definition, therefore, they are a form of *intrinsic motivation.* As such, mastery goals have been found to be better than performance goals at sustaining students' interest in a subject. In one review of research about learning goals, for example, students with primarily mastery orientations toward a course they were taking not only tended to express greater interest in the course, but also continued to express interest well beyond the official end of the course and to enroll in further courses in the same subject (Harackiewicz et al., 2002; Wolters, 2004).

Performance goals, on the other hand, imply *extrinsic motivation* and tend to show the mixed effects of this orientation. A positive effect is that students with a performance orientation do tend to get higher grades than those who express primarily a mastery orientation. The advantage in grades occurs both in the short term (with individual assignments) and in the long term (with overall grade point average when graduating). But there is evidence that performance-oriented students do not actually learn material as deeply or permanently as students who are more mastery oriented (Midgley, Kaplan, & Middleton, 2001). A possible reason is that measures of performance—such as test scores—often reward relatively shallow memorization of information and therefore guide performance-oriented students away from processing the information thoughtfully or deeply. Another possible reason is that a performance orientation, by focusing on gaining recognition as the best among peers, encourages competition among peers. Giving and receiving help from classmates is thus not in the self-interest of a performance-oriented student, and the resulting isolation limits the student's learning.

Goals That Affect Achievement Indirectly

Failure-avoidant Goals

Failure-avoidant goals by nature undermine academic achievement. Often they are a negative byproduct of the competitiveness of performance goals (Urdan, 2004). If a teacher (and sometimes also fellow students) put too much emphasis on being the best in the class and if interest in learning the material therefore suffers, then some students may decide that success is beyond their reach or may not be desirable in any case. The alternative—simply avoiding with the teacher. Avoiding failure in this way is an example of self-handicapping—deliberate actions and choices that reduce chances of success. Students may self-handicap in a number of ways; in addition to not working hard, they may procrastinate about completing assignments, for example, or set goals that are unrealistically high.

Social Goals

Most students need and value relationships, both with classmates and with teachers, and often (though not always) they get a good deal of positive support from the relationships. But the effects of social relationships are complex and at times can work both for and against academic achievement. If a relationship with the teacher is important and reasonably positive, then the student is likely to try pleasing the teacher by working hard on assignments (Dowson & McInerney, 2003). Note, though, that this effect is closer to performance than mastery; the student is primarily concerned about looking good to someone else. If, on the other hand, a student is especially concerned about relationships with peers, the effects on achievement depend on the student's motives for the relationship as well as on peers' attitudes. The abilities and achievement motivation of peers themselves can also make a difference, but once again the effects vary depending on the context. Low achievement and motivation by peers affect an individual's academic motivation more in elementary school than in high school, more in learning mathematics than learning to read, and more if there is a wide range of abilities in a classroom than if there is a more narrow range (Burke & Sass, 2006).

In spite of these complexities, social relationships are valued so highly by most students that teachers should generally facilitate them, though also keep an eye on their nature and their consequent effects on achievement. Many assignments can be accomplished productively in groups, for example, as long as the groups are formed thoughtfully. But the majority of students' social contacts are likely always to come from students' own initiatives with each other in simply taking time to talk and interact. The teacher's job is to encourage these informal contacts, especially when they happen at times that support rather than interfere with learning.

Encouraging Mastery Goals

Even though a degree of performance orientation may be inevitable in school because of the mere presence of classmates, it does not have to take over students' academic motivation completely. Teachers can encourage mastery goals in various ways and should in fact do so, because a mastery orientation leads to more sustained, thoughtful learning, at least in classrooms, where classmates may sometimes debate and disagree with each other (Darnon, Butera, & Harackiewicz, 2006).

How can teachers do so? One way is to allow students to choose specific tasks or assignments for themselves, where possible, because their choices are more likely than usual to reflect prior personal interests, and hence be motivated more intrinsically than usual. The limitation of this strategy, of course, is that students may not see some of the connections between their prior interests and the curriculum topics at hand. In that case it also helps for the teacher to look for and point out the relevance of current topics or skills to students' personal interests and goals. Suppose, for example, that a student enjoys the latest styles of music. This interest may actually have connections with a wide range of school curriculum, such as:

- biology (because of the physiology of the ear and of hearing)
- physics or general science (because of the nature of musical acoustics)
- history (because of changes in musical styles over time)
- English (because of relationships of musical lyrics and themes with literary themes)
- foreign languages (because of comparisons of music and songs among cultures)

Still another way to encourage mastery orientation is to focus on students' individual effort and improvement as much as possible, rather than on comparing students' successes to each other. You can encourage this orientation by giving students detailed feedback about how they can improve performance, by arranging for students to collaborate on

Reflection

Much of education focuses on comparisons in grades, test scores, publications, and awards. How can you develop more of an orientation yourself for your own growth and learning, rather than comparative norms?

Motives as Interests

In addition to holding different kinds of goals—with consequent differences in academic motivation—students show obvious differences in levels of interest in the topics and tasks of the classroom. Suppose that two high school classmates, Frank and Jason, both are taking chemistry, specifically learning how to balance chemical equations. Frank finds the material boring and has to force himself to study it; as a result he spends only the time needed to learn the basic material and to complete the assignments at a basic level. Jason, on the other hand, enjoys the challenges of balancing chemical equations. He thinks of the task as an intriguing puzzle; he not only solves each of them, but also compares the problems to each other as he goes through them.

Frank's learning is based on effort compared to Jason's, whose learning is based more fully on interest. As the example implies, when students learn from interest, they tend to devote more attention to the topic than if they learn from effort (Hidi & Renninger, 2006). The finding is not surprising since interest is another aspect of intrinsic motivation—energy or drive that comes from within. A distinction between effort and interest is often artificial, however, because the two motives often get blended or combined in students' personal experiences. Most of us can remember times when we worked at a skill that we enjoyed and found interesting, but that also required effort to learn. The challenge for teachers is therefore to draw on and encourage students' interest as much as possible and thus keep the required effort within reasonable bounds—neither too hard nor too easy.

Situational Interest Versus Personal Interest

Students' interests vary in how deeply or permanently they are located within students. Situational interests are ones that are triggered temporarily by features of the immediate situation. Unusual sights, sounds, or words can stimulate situational interest. A teacher might show an interesting image on the overhead projector or play a brief bit of music or make a surprising comment in passing. At a more abstract level, unusual or surprising topics of discussion can also arouse interest when they are first introduced. Personal interests are relatively permanent preferences of the student and are usually expressed in a variety of situations. In the classroom, a student may (or may not) have a personal interest in particular topics, activities, or subject matter. Outside class, though, he or she usually has additional personal interests in particular non-academic activities (e.g. sports, music) or even in particular people (a celebrity, a friend who lives nearby). The non-academic personal interests may sometimes conflict with academic interest; it may be more interesting to go to the shopping mall with a friend than to study even your most favorite subject.

Motives Related to Attributions

Attributions are perceptions about the causes of success and failure. Suppose that you get a low mark on a test and are wondering what caused the low mark. You can construct various explanations for—make various attributions about—this failure. Maybe you did not study very hard; maybe the test itself was difficult; maybe you were unlucky; maybe you just are not smart enough. Each explanation attributes the failure to a different factor. The explanations that you settle upon may reflect the truth accurately—or then again, they may not. What is important about attributions is that they

Locus, Stability, and Controllability

Attributions vary in three underlying ways: locus, stability, and controllability. **Locus** of an attribution is the location (figuratively speaking) of the source of success or failure. If you attribute a top mark on a test to your ability, then the locus is internal; if you attribute the mark to the test's having easy questions, then the locus is external. The **stability** of an attribution is its relative permanence. If you attribute the mark to your ability, then the source of success is relatively stable—by definition, ability is a relatively lasting quality. If you attribute a top mark to the effort you put in to studying, then the source of success is unstable—effort can vary and has to be renewed on each occasion or else it disappears. The **controllability** of an attribution is the extent to which the individual can influence it. If you attribute a top mark to your effort at studying, then the source of success is relatively controllable—you can influence effort simply by deciding how much to study. But if you attribute the mark to simple luck, then the source of the success is uncontrollable—there is nothing that can influence random chance.

As you might suspect, the way that these attributions combine affects students' academic motivations in major ways. It usually helps both motivation and achievement if a student attributes academic successes and failures to factors that are internal and controllable, such as effort or a choice to use particular learning strategies (Dweck, 2000). Attributing successes to factors that are internal but stable or controllable (like ability), on the other hand, is both a blessing and a curse: sometimes it can create optimism about prospects for future success ("I always do well"), but it can also lead to indifference about correcting mistakes (Dweck, 2006), or even create pessimism if a student happens not to perform at the accustomed level ("Maybe I'm not as smart as I thought"). Worst of all for academic motivation are attributions, whether stable or not, related to external factors. Believing that performance depends simply on luck ("The teacher was in a bad mood when marking") or on excessive difficulty of material removes incentive for a student to invest in learning. All in all, then, it seems important for teachers to encourage internal, stable attributions about success.

Teachers can influence students' attributions in various ways. It's useful to frame the teachers' own explanations of success and failure around internal, controllable factors. Instead of telling a student: "Good work! You're smart!", try saying: "Good work! Your effort really made a difference, didn't it?" If a student fails, instead of saying,"Too bad! This material is just too hard for you," try saying, "Let's find a strategy for practicing this more, and then you can try again." In both cases the first option emphasizes uncontrollable factors (effort, difficulty level), and the second option emphasizes internal, controllable factors (effort, use of specific strategies).

Such attributions will only be convincing, however, if teachers provide appropriate conditions for students to learn—conditions in which students' efforts really do pay off. There are three conditions that have to be in place in particular. First, academic tasks and materials actually have to be at about the right level of difficulty. If you give problems in advanced calculus to a first-grade student, the student will not only fail them but also be justified in attributing the failure to an external factor, task difficulty. If assignments are assessed in ways that produce highly variable, unreliable marks, then students will rightly attribute their performance to an external, unstable source: luck. Both circumstances will interfere with motivation.

Second, teachers also need to be ready to give help to individuals who need it—even if they believe that an assignment is easy enough or clear enough that students should not need individual help. Third, teachers need to remember that ability—usually considered a relatively stable factor—often actually changes incrementally over the long term. Effort and its results appear relatively immediately; a student expends effort this week, this day, or even at this very moment, and the effort (if not the results) are visible right away. But ability may take longer to show itself.

Motivation as Self-efficacy

In addition to being influenced by their goals, interests, and attributions, students' motives are affected by specific beliefs about the student's personal capacities. In self-efficacy theory the beliefs become a primary, explicit explanation can write an acceptable term paper, for example, or repair an automobile, or make friends with the new student in class. These are relatively specific beliefs and tasks. Self-efficacy is not about whether you believe that you are intelligent in general, whether you always like working with mechanical things, or think that you are generally a likeable person. These more general judgments are better regarded as various mixtures of self-concepts (beliefs about general personal identity) or of self-esteem (evaluations of identity). They are important in their own right, and sometimes influence motivation, but only indirectly (Bong & Skaalvik, 2004). Self-efficacy beliefs, furthermore, are not the same as "true" or documented skill or ability. They are self-constructed, meaning that they are personally developed perceptions. As with confidence, it is possible to have either too much or too little self-efficacy. The optimum level seems to be either at or slightly above true capacity (Bandura, 1997). As we indicate below, large discrepancies between self-efficacy and ability can create motivational problems for the individual.

Effects of Self-efficacy On Students' Behavior

Self-efficacy may sound like a uniformly desirable quality, but research as well as teachers' experience suggests that its effects are a bit more complicated than they first appear. Self-efficacy has three main effects, each of which has both a "dark" or undesirable side and a positive or desirable side. The first effect is that self-efficacy makes students more willing to choose tasks where they already feel confident of succeeding. Since self-efficacy is self-constructed, furthermore, it is also possible for students to miscalculate or misperceive their true skill, and the misperceptions themselves can have complex effects on students' motivations. A second effect of high self-efficacy is to increase a persistence at relevant tasks. If you believe that you can solve crossword puzzles, but encounter one that takes longer than usual, then you are more likely to work longer at the puzzle until you (hopefully) really do solve it. This is probably a desirable behavior in many situations, unless the persistence happens to interfere with other, more important tasks (what if you should be doing homework instead of working on crossword puzzles?).

Third, high self-efficacy for a task not only increases a person's persistence at the task, but also improves their ability to cope with stressful conditions and to recover their motivation following outright failures. Suppose that you have two assignments—an essay and a science lab report—due on the same day, and this circumstance promises to make your life hectic as you approach the deadline. You will cope better with the stress of multiple assignments if you already believe yourself capable of doing both of the tasks, than if you believe yourself capable of doing just one of them or (especially) of doing neither. The bad news, at least from a teacher's point of view, is that the same resilience can sometimes also serve non-academic and non-school purposes. How so? Suppose, instead of two school assignments due on the same day, a student has only one school assignment due, but also holds a part-time evening job as a server in a local restaurant. Suppose, further, that the student has high self-efficacy for both of these tasks; he believes, in other words, that he is capable of completing the assignment as well as continuing to work at the job.

Learned Helplessness and Self-efficacy

If a person's sense of self-efficacy is very low, he or she can develop learned helplessness, a perception of complete lack of control in mastering a task. The attitude is similar to depression, a pervasive feeling of apathy and a belief that effort makes no difference and does not lead to success. Learned helplessness was originally studied from the behaviorist perspective of classical and operant conditioning by the psychologist Martin Seligman (1995). The studies used a somewhat "gloomy" experimental procedure in which an animal, such as a rat or a dog, was repeatedly shocked in a cage in a way that prevented the animal from escaping the shocks. In a later phase of the procedure, conditions were changed so that the animal could avoid the shocks by merely moving from one side of the cage to the other. Yet frequently they did not bother to do so! Seligman called this behavior learned helplessness. In people, learned helplessness leads to characteristic ways of dealing with problems. They tend to attribute the source of a problem to themselves, to generalize the problem to many aspects of life, and to see the problem as lasting or permanent. More optimistic individuals, in contrast, are more likely to attribute a problem to outside sources, to see it as specific to a particular situation or activity, and to see it as temporary or time-limited.

Psychologists who study self-efficacy have identified four major sources of self-efficacy beliefs (Pajares & Schunk, 2001, 2002). In order of importance they are (1) prior experiences of mastering tasks, (2) watching others' mastering tasks, (3) messages or "persuasion" from others, and (4) emotions related to stress and discomfort. Fortunately the first three can be influenced by teachers directly, and even the fourth can sometimes be influenced indirectly by appropriate interpretive comments from the teacher or others.

A Caution: Motivation as Content Versus Motivation as Process

A caution about self-efficacy theory is its heavy emphasis on just the process of motivation, at the expense of the content of motivation. The basic self-efficacy model has much to say about how beliefs affect behavior, but relatively little to say about which beliefs and tasks are especially satisfying or lead to the greatest well-being in students. The answer to this question is important to know, since teachers might then select tasks as much as possible that are intrinsically satisfying, and not merely achievable.

Motivation as Self-determination

Common sense suggests that human motivations originate from some sort of inner "need". We all think of ourselves as having various "needs", a need for food, for example, or a need for companionship—that influences our choices and activities. This same idea also forms part of some theoretical accounts of motivation, though the theories differ in the needs that they emphasize or recognize.

According to Maslow and his hierarchy of needs, individuals must satisfy physical survival needs before they seek to satisfy needs of belonging, they satisfy belonging needs before esteem needs, and so on. In theory, too, people have both deficit needs and growth needs, and the deficit needs must be satisfied before growth needs can influence behavior (Maslow, 1970). In Maslow's theory, as in others that use the concept, a need is a relatively lasting condition or feeling that requires relief or satisfaction and that tends to influence action over the long term. Some needs may decrease when satisfied (like hunger), but others may not (like curiosity). Either way, needs differ from the selfefficacy beliefs discussed earlier, which are relatively specific and cognitive, and affect particular tasks and behaviors fairly directly.

A recent theory of motivation based on the idea of needs is self-determination theory, proposed by the psychologists Edward Deci and Richard Ryan (2000), among others. The theory proposes that understanding motivation requires taking into account three basic human needs:

- autonomy—the need to feel free of external constraints on behavior
- competence—the need to feel capable or skilled
- relatedness—the need to feel connected or involved with others

Note that these needs are all psychological, not physical; hunger and sex, for example, are not on the list. They are also about personal growth or development, not about deficits that a person tries to reduce or eliminate. Unlike food (in behaviorism) or safety (in Maslow's hierarchy), you can never get enough of autonomy, competence, or relatedness. You (and your students) will seek to enhance these continually throughout life

The key idea of self-determination theory is that when persons (such as you or one of your students) feel that these basic needs are reasonably well met, they tend to perceive their actions and choices to be intrinsically motivated or "self-determined". In that case they can turn their attention to a variety of activities that they find attractive or important, but that do not relate directly to their basic needs. Among your students, for example, some individuals might read books that you have suggested, and others might listen attentively when you explain key concepts from the unit that you happen to be teaching. If one or more basic needs are not met well, however, people will tend to feel coerced by outside pressures or external incentives. They may become preoccupied, in fact, with satisfying whatever need has not

Self-determination and Intrinsic Motivation

In proposing the importance of needs, then, self-determination theory is asserting the importance of intrinsic motivation. The self-determination version of intrinsic motivation emphasizes a person's perception of freedom, rather than the presence or absence of "real" constraints on action. Self-determination means a person feels free, even if the person is also operating within certain external constraints. In principle, a student can experience self-determination even if the student must, for example, live within externally imposed rules of appropriate classroom behavior. To achieve a feeling of self-determination, however, the student's basic needs must be met—needs for autonomy, competence, and relatedness. In motivating students, then, the bottom line is that teachers have an interest in helping students to meet their basic needs, and in not letting school rules or the teachers' own leadership styles interfere with or block satisfaction of students' basic needs.

Using Self-determination Theory in the Classroom

What are some teaching strategies for supporting students' needs? Educational researchers have studied this question from a variety of directions, and their resulting recommendations converge and overlap in a number of ways. For convenience, the recommendations can be grouped according to the basic need that they address, beginning with the need for autonomy. A major part of supporting autonomy is to give students choices wherever possible (Ryan & Lynch, 2003). The choices that encourage the greatest feelings of self-control, obviously, are ones that are about relatively major issues or that have relatively significant consequences for students, such as whom to choose as partners for a major group project. But choices also encourage some feeling of self-control even when they are about relatively minor issues, such as how to organize your desk or what kind of folder to use for storing your papers at school. It is important, furthermore, to offer choices to all students, including students needing explicit directions in order to work successfully; avoid reserving choices for only the best students or giving up offering choices altogether to students who fall behind or who need extra help. All students will feel more self-determined and therefore more motivated if they have choices of some sort. Teachers can also support students' autonomy more directly by minimizing external rewards (like grades) and comparisons among students' performance, and by orienting and responding themselves to students' expressed goals and interests.

A second strategy for using self-determination theory is to support students' needs for competence. The most obvious way to make students feel competent is by selecting activities which are challenging but nonetheless achievable with reasonable effort and assistance (Elliott, McGregor, & Thrash, 2004). There are some strategies that are generally effective even if you are not yet in a position to know the students well. One is to emphasize activities that require active response from students. Sometimes this simply means selecting projects, experiments, discussions and the like that require students to do more than simply listen. Other times it means expecting active responses in all interactions with students. Another generally effective way to support competence is to respond and give feedback as immediately as possible.

A third strategy for using self-determination theory is to support students' relational needs. The main way of support students' need to relate to others is to arrange activities in which students work together in ways that are mutually supportive, that recognize students' diversity, and minimize competition among individuals. You can, for example, deliberately arrange projects that require a variety of talents; some educators call such activities "rich group work" (Cohen, 1994; Cohen, Brody, & Sapon-Shevin, 2004). As a teacher, you can encourage the development of your own relationships with class members. Your goal, as teacher, is to demonstrate caring and interest in your students not just as students, but as people.

Keeping Self-determination in Perspective

In certain ways self-determination theory provides a sensible way to think about students' intrinsic motivation and therefore to think about how to get them to manage their own learning. A particular strength of the theory is that it lingering questions about the limitations of self-determination theory. One is whether merely providing choices actually improves students' learning, or simply improves their satisfaction with learning. Another question is whether it is possible to overdo attention to students' needs—and again there is evidence for both favoring and contradicting this possibility. Too many choices can actually make anyone (not just a student) frustrated and dissatisfied with a choice the person actually does make (Schwartz, 2004).

Target: A Model for Integrating Ideas about Motivation

A model of motivation that integrates many ideas about motivation, including those in this chapter, has been developed by Carole Ames (1990, 1992). The acronym or abbreviated name for the program is TARGET, which stands for six elements of effective motivation:

- Task
- Authority
- Recognition
- Grouping
- Evaluating
- Time

Each of the elements contributes to students' motivation either directly or indirectly.

Task

As explained earlier, students experience tasks in terms of their value, their expectation of success, and their authenticity. The value of a task is assessed by its importance, interest to the student, usefulness or utility, and the cost in terms of effort and time to achieve it. Expectation of success is assessed by a student's perception of the difficulty of a task. Generally a middling level of difficulty is optimal for students; too easy, and the task seems trivial (not valuable or meaningful), and too hard, and the task seems unlikely to succeed and in this sense useless. Authenticity refers to how much a task relates to real-life experiences of students; the more it does so, the more it can build on students' interests and goals, and the more meaningful and motivating it becomes.

Authority

Motivation is enhanced if students feel a degree of autonomy or responsibility for a learning task. Autonomy strengthens self-efficacy and self-determination—two valued and motivating attitudes described earlier in this chapter. Where possible, teachers can enhance autonomy by offering students' choices about assignments and by encouraging them to take initiative about their own learning.

Recognition

Teachers can support students' motivation by recognizing their achievements appropriately. Much depends, however, on how this is done; as discussed earlier, praise sometimes undermines performance. It is not especially effective if praise is very general and lacking in detailed reasons for the praise; or if praise is for qualities which a student cannot influence (like intelligence instead of effort); or if praise is offered so widely that it loses meaning or even becomes a signal that performance has been substandard. Many of these paradoxical effects are described by self-determination and self-efficacy theory (and were explained earlier in this chapter).

Grouping

Motivation is affected by how students are grouped together for their work—a topic discussed in more detail in Chapter 8 ("Instructional Strategies"). There are many ways to group students, but they tend to fall into three types: cooperative, part of a final grade, in common. In competitive learning, students work individually, and their grades reflect comparisons among the students (for example, their performances are ranked relative to each other, or they are "graded on a curve"). In individualistic learning, students work by themselves, but their grades are unrelated to the performance of classmates. Research that compares these three forms of grouping tends to favor cooperative learning groups, which apparently supports students' need for belonging—an idea important in self-determination theory discussed earlier in this chapter.

Evaluation

Grouping structures obviously affect how students' efforts are evaluated. A focus on comparing students, as happens with competitive structures, can distract students from thinking about the material to be learned, and to focus instead on how they appear to external authorities; the question shifts from "What am I learning?" to "What will the teacher think about my performance?" A focus on cooperative learning, on the other hand, can have doubleedged effects: students are encouraged to help their group mates, but may also be tempted to rely excessively on others' efforts or alternatively to ignore each other's contributions and overspecialize their own contributions. Some compromise between cooperative and individualistic structures seems to create optimal motivation for learning (Slavin, 1995).

Time

As every teacher knows, students vary in the amount of time needed to learn almost any material or task. Accommodating the differences can be challenging, but also important for maximizing students' motivation. School days are often filled with interruptions and fixed intervals of time devoted to non-academic activities—facts that make it difficult to be flexible about granting individuals different amounts of time to complete academic tasks. Nonetheless a degree of flexibility is usually possible: larger blocks of time can sometimes be created for important activities (for example, writing an essay), and sometimes enrichment activities can be arranged for some students while others receive extra attention from the teacher on core or basic tasks.

Chapter Summary

Motivation—the energy or drive that gives behavior direction and focus—can be understood in a variety of ways, each of which has implications for teaching. One perspective on motivation comes from behaviorism, and equates underlying drives or motives with their outward, visible expression in behavior. Most others, however, come from cognitive theories of learning and development. Motives are affected by the kind of goals set by students—whether they are oriented to mastery, performance, failure-avoidance, or social contact. They are also affected by students' interests, both personal and situational. And they are affected by students' attributions about the causes of success and failure—whether they perceive the causes are due to ability, effort, task difficulty, or luck.

A major current perspective about motivation is based on self-efficacy theory, which focuses on a person's belief that he or she is capable of carrying out or mastering a task. High self-efficacy affects students' choice of tasks, their persistence at tasks, and their resilience in the face of failure. It helps to prevent learned helplessness, a perception of complete lack of control over mastery or success. Teachers can encourage high self-efficacy beliefs by providing students with experiences of mastery and opportunities to see others' experiences of mastery, by offering well-timed messages persuading them of their capacity for success, and by interpreting students' emotional reactions to success, failure and stress.

An extension of self-efficacy theory is self-determination theory, which is based on the idea that everyone has basic needs for autonomy, competence, and relatedness to others. According to the theory, students will be motivated more intrinsically if these three needs are met as much as possible. A variety of strategies can assist teachers in doing so. One program for doing so is called TARGET; it draws on ideas from several theories of motivation to make practical recommendations about motivating students.

Albert Bandura

Attributions of success or failure

Autonomy, need for

Behaviorist perspective on motivation

Competence, need for

Failure-avoidant goals

Intrinsic motivation

Jigsaw classroom

Learned helplessness

Mastery goals

Motivation Need for relatedness

Performance goals

Personal interests

Self-determination theory

Self-efficacy

Situational interests

TARGET

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Further Resources

This page lists several materials and links related to motivating students in classroom situations.

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Dr. Kelvin Seifert is a professor at the University of Manitoba in Canada. Dr. Seifert's research has focused on several areas, including alternatives to commercial textbooks in teaching introductory courses. He is the editor of two online journals, the Canadian Journal of Educational Administration and Policy (CJEAP) and Teaching Educational Psychology (TEP). He was previously the head of the Department of Educational Administration, Foundations, and Psychology at the University of Manitoba. He received his Ph.D. in education and psychology from the University of Michigan.

Rosemary Sutton

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Dr. Rosemary Sutton began her career as an educator teaching junior high and high school math in New Zealand. She then moved to the USA earning a master's in Educational Psychology from the University of Illinois and a PhD in Human Development from Pennsylvania State University. In 1983 she accepted a teaching position at Cleveland State University and became a tenured professor. Rosemary then moved to administration in 2004, becoming CSU's Director of Assessment, then Vice Provost for Undergraduate Studies, and finally Vice Provost for Academic Programs. In 2013, she was appointed Vice President for Student Learning and Success at Cascadia College.

Informal Learning

Tim Boileau

In today's digitally connected world we are constantly acquiring new personal knowledge and skills, discovering new methods of work and ways to earn a living, solving problems, and changing the way we create, access and share information, through informal learning. The topic of informal learning can be discussed in many different contexts and from a variety of theoretical perspectives. For the purposes of this chapter, informal learning is examined through the lens of lifelong learning and performance, primarily as it relates to adult learners. Jay Cross (2007) may be credited for popularizing the term "informal learning", although he claimed to have first heard it from Peter Henschel sometime during the mid-1990s, who at the time was director of the Institute for Research on Learning (IRL), when he said:

> *People are learning all the time, in varied settings and often most effectively in the context of work itself. 'Training'—formal learning of all kinds—channels some important learning but doesn't carry the heaviest load. The workhorse of the knowledge economy has been, and continues to be, informal learning. (Cross, 2007, p. xiii)*

Indeed, the concept of informal learning has been around for many years preceding the peak of the industrial revolution during the 19th century in the form of guild support for traditional apprenticeships, and is ubiquitous in the knowledge-based economy of the 21st century in the form of cognitive apprenticeship (Collins & Kapur, 2014).

From a performance perspective, informal learning occurs through self-initiated activity undertaken by people in a work setting, resulting in the creation of new skills and knowledge, in the completion of a job or task (Boileau, 2011). In other words, informal learning is situated in meaningful experiences that are built on top of prior experiences and pre-existing knowledge constructs, thereby facilitating the development of new tacit and explicit knowledge. This is different from formal learning where the emphasis is on transfer of explicit knowledge from instructor to learner, typically associated with a separation of time and space between the formal learning event and application of the knowledge or skill. In this scenario, additional performance support is often needed in order to close the gap between existing knowledge and skills, and expected performance. According to Boileau (2011, p. 13), "Humans learn when they perceive a need to know, and evidence of learning is in their ability to do something they could not do before."

In this chapter, I explore the nuances of informal learning to better understand its unique role in lifelong learning and performance. The remainder of this chapter is organized in the following sections:

- Definition of Informal vs. Formal Learning
- Informal Learning Trends and Issues
- Informal Learning and Culture

Definition of Informal vs. Formal Learning

A review of the literature on the definition of informal vs. formal learning shows that much ambiguity exists, leading to contradiction and disagreement among scholars (Czerkawski, 2016). As I will argue in this section, informal and formal learning can be shown to coexist at opposite ends of a continuum, with most learning occurring somewhere in between "must come about as a result of the learner's experience and interaction with the world." Note that the first part of this definition emphasizes outcomes of the learning experience in terms of purposeful and intentional change occurring within the learner as a consequence of the learning experience provided via the learning setting. The second part recognizes that learning is inherently social and that authentic learning is achieved only through interaction with the world. This premise is reflected in the "Seven Principles of Learning" provided by Peter Henschel of the Institute for Research on Learning, at TechLearn 1999 (Henschel, 2001):

- Learning is fundamentally social.
- Knowledge is integrated in the life of communities.
- Learning is an act of participation.
- Knowing depends on engagement in practice.
- Engagement is inseparable from empowerment.
- Failure to Learn is often the result of exclusion from participation.
- We are all lifelong learners.

Learning may also be described using different classifications linked to the setting or circumstances in which the learning is most likely to occur, such as formal, non-formal, and informal learning. Taking a brief look at this typology, formal learning implies learning settings provided by educational institutions where the primary mission is the construction of new knowledge. Non-formal learning settings may be found in organizations and businesses within the community where the primary mission is not necessarily educational. However, formal learning activities are present such as in the delivery of specialized training that is linked to achieving the goals of the organization (Coombs, Prosser, & Ahmed, 1973). Informal learning, on the other hand, refers to embedded learning activities that are linked to performance, in the setting of one's everyday life. Within each category, there are identifiable subcategories representing different learning taxonomies. Merriam and Bierema (2014) identified four sub-types of learning specific to informal learning, which can be summarized as:

- Self-directed learning – learner-initiated and -guided learning activity including goal setting, resource identification, strategy selection, and evaluation of outcomes.
- Incidental learning – an accidental by-product of another learning activity that occurs outside of the learner's direct stream of consciousness as an unplanned or unintended consequence of doing something else.
- Tacit learning – the most subtle form of informal learning, which occurs at the subconscious level based on intuition, personal experience, or emotion that is unique to the individual learner.
- Integrative learning – integration of non-conscious tacit knowledge with conscious learning activities providing creative insight through non-linear implicit processing.

In the training industry, informal learning is often discussed in the context of the "70:20:10 Rule" (please see Association for Talent Development (ATD) at www.td.org and do a search on 70:20:10). Generally speaking, this suggests that: 70% of learning occurs through informal or on-the-job learning; 20% through mentoring and other specialized developmental relationships; and the remaining 10% through formal learning including course work and associated reading.

There are two important takeaways from the assertion of the so-called 70:20:10 Rule, as it relates to workplace learning. First, there is a growing body of research providing insight into just how widespread and embedded informal learning is in the lives of adult learners, with estimates of as high as 70-90% of all learning over the course of a lifetime, occurring via informal learning activity (Merriam & Bierema, 2014). Specific to learning about science, Falk and Dierking (2010) placed the estimate even higher, with as much as 95% of all science learning occurring outside of school, given the richness, availability, and increased access to "free-choice" (i.e., informal) digital learning resources. Based on this premise, Falk and Dierking (2010) contended that a policy of increased investment in informal learning resources would provide a cost-effective way to increase public understanding of science. The second takeaway is the recognition that formal and informal learning occurs along a continuum—comprised of both formal and informal learning activities, In the following illustration, Cross (2007) presented what he referred to as the spending/outcome paradox of learning. The suggested paradox is that while formal learning represents 80% of an organization's training budget, it provides a mere 20% return on learning in terms of performance outcomes. Conversely, informal learning on average represents 20% of training resources, yet delivers 80% of the learning occurring within the organization, measured in terms of performance or potential performance. The spending/outcome paradox remains a global challenge as noted by De Grip (2015), "Policies tend to emphasize education and formal training, and most firms do not have strategies to optimize the gains from informal learning at work." (p. 1).

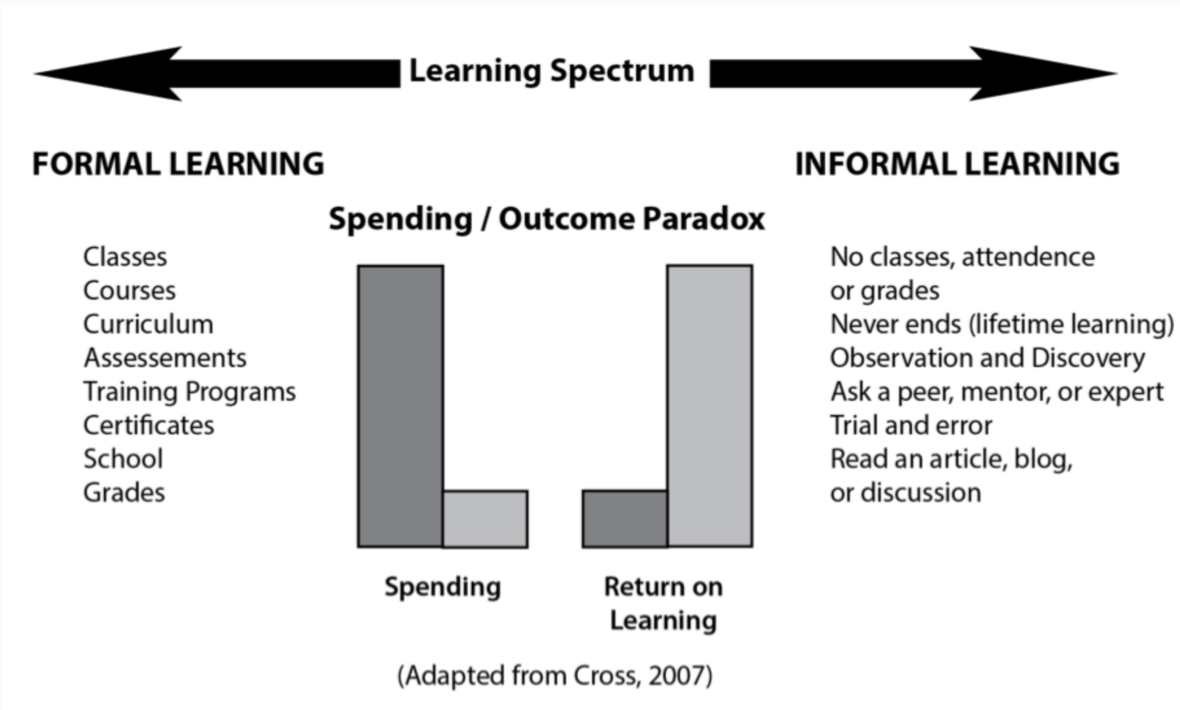

Figure 1. Learning spectrum

This leads us to a definition of *informal learning* as "the unofficial, unscheduled, impromptu way people learn to do their jobs . . . Informal learning is like riding a bike; the rider [learner] chooses the destination, the speed, and the route." (Cross, 2007, p. 236). In other words, learners decide what they need to learn and then establish their own learning objectives and agenda. In addition, learners determine when they should learn, and select the format and modality that best meets their needs. Perhaps most importantly, the learner is responsible for organizing and managing his or her own learning-related activities. To fully engage learners and to ensure that a transfer of knowledge occurs, informal learning should be authentic and ideally occur in the workplace or other performance setting, be situated in a meaningful context that builds on prior knowledge, and employ strategies and activities to promote transfer of knowledge (Boileau, 2011). In informal learning, learners are "pulled" into the learning experience based on a problem, or identified knowledge and skills gap, which is determined by the learner who then engages in learning activities intended to close the knowledge gap or otherwise mitigate the performance challenge or problem.

In contrast, in *formal learning*, learning objectives and curricula are determined by someone else. Formal learning or "book learning" is what most people in western culture think of when they envision learning in terms of schools, classrooms, and instructors who decide what, when, and how learning is to take place. "Formal learning is like riding a that are established by someone other than the learner.

In this section, I have discussed informal and formal learning as co-existing in a spectrum or continuum of learning activities linked to experience and performance context over the course of a lifetime, as opposed to dichotomous branches of learning that are fixed in time and space. This is an important precept to keep in mind because increasingly, blended learning experiences may include elements or activities associated with formal learning settings such as lectures or media-based presentations, along with informal learning activities such as discussions with peers, Web-based searches for examples, and practice experimenting with new techniques and tools (Lohman, 2006).

Informal Learning Trends and Issues

This section examines some of the trends and issues associated with informal learning from an individual and organizational perspective. In previous generations, learning was (and still is) often viewed as separate from performance, and linked to identifiable stages of human social-cultural development. In terms of formal learning, this includes primary and secondary education (K-12) to prepare an individual for participation in society, whereas post-secondary education has historically provided additional preparation for a career with increased earnings potential. Informal learning, as discussed in the preceding sections, addresses learning in terms of a series of non-linear episodic events, experiences, and activities occurring in the real world over the course of a lifetime, having financial and social consequences for individuals and organizations.

Science learning. There is increased recognition of the need to support lifelong science learning in order to meet the growing demand for science and engineering jobs in a modern global economy. It can be argued that science literacy, acquired through informal learning, is essential to economic growth (as discussed in the next topic), and to promoting the shared cultural values of a democratic society. According to Falk et al. (2007), "the majority of the public constructs much of its understanding of science over the course of their lives, gathering information from many places and contexts, and for a diversity of reasons." (p. 455). Evidence of this trend can be seen in new standards for compulsory testing and curriculum changes, placing greater emphasis on STEM (science, technology, engineering, and mathematics) subjects in publicly funded K-12 education. Yet, the average adult spends a small fraction of their life (1-3 percent) in formal education related to science learning (Falk, Storksdieck, & Dierking, 2007). Indeed, the research literature suggests that most science learning, as with other domains of learning, occurs informally and is driven by self-identified needs and interests of learners. This suggests that informal learning activities within the workplace, personal investigation using internet-based tools and resources, and active leisure pursuits such as visits to museums, zoos and aquariums, and national parks account for the majority of science learning in America (Falk & Dierking, 2010).

Other forms of informal science learning include hobbies such as model rockets and drones, organic and sustainable farming, beekeeping, mineralogy, and amateur astronomy. Life events may also trigger a personal need for informal science learning via the web such as when individuals are diagnosed with an illness like cancer or heart disease, or in the wake of environmental disasters such as oil spills, the discovery of radon gas in rock, or tracking the path of a hurricane. The Internet now represents the major source of science information for adults and children, with the tipping point occurring in 2006, when the Internet surpassed broadcast media as a source for public science information, according to the Pew Internet and American Life Project (Falk & Dierking, 2010). In a similar fashion, more people now turn to the Internet for medical diagnostic information using services like WebMD.com, before scheduling an appointment with their physician.

Return on learning within organizations. The implications of informal learning for organizations are significant in terms of expectations for individual and organizational performance. Specifically, *return on learning* (i.e., return on spending for learning) has increasingly become linked to an organization's bottom-line. It is no longer enough to simply have well-trained employees with advanced degrees and certifications gained through formal education and training, unless employees are also able to demonstrate advanced skills leading to valued on-the-job performance outcomes. The result development. This trend is supported by a growing body of evidence from the Organisation for Economic Co-operation and Development (OECD.org), suggesting that informal learning in the workplace is a principal driver of human capital development for employees of all age groups, with the greatest impact shown in the performance of younger workers as advanced learning and skills are attained through work experience (De Grip, 2015).

Microtraining. As previously suggested, organizations have continued to over-invest in and, in some instances, overestimate the value of formal training programs relative to the spending/outcome paradox and return on learning, while potentially missing out on opportunities to fully leverage informal learning processes (Cross, 2007). *Microtraining* provides a possible mechanism to help address this perceived imbalance, by focusing attention along the entire learning spectrum, as opposed to a strict separation of learning activities between formal and informal learning domains. Microtraining is an instructional technology intervention that integrates formal with informal learning activities, using short learning segments designed for rapid development and dissemination of knowledge that can be completed in 15-minute time blocks, in close proximity to the work setting (De Vries & Brall, 2008). According to De Vries and Brall (2008), microtraining learning segments are used to provide a structure combining semi-formal learning activities with informal and ad hoc learning processes. This structure begins with activation of prior knowledge, followed by demonstration/practice, feedback session, and transfer strategy. In addition, all microtraining segments should promote critical thinking and reflection on work, to facilitate deeper learning.

The microtraining approach is generally well suited for performance remediation, knowledge refreshing, and development of mastery in topics already familiar to learners. Conversely, microtraining may be less ideally suited for novice learners unless it is combined with other strategies for scaffolding learning in order to build prerequisite knowledge and skills. The primary benefit of microtraining is in its ability to provide just-in-time, non-formal training within the work setting, causing minimal disruption to the daily work schedule as employees considered vital to the enterprise are not required to travel to another location in order for learning to occur (De Vries & Brall, 2008).

Microtraining draws from the theoretical foundations of constructivism and connectivism, recognizing the social aspects of informal learning, and the role of learning communities within communities of practice, for facilitation of lifelong learning. Learners play a central role in contributing to the collective knowledge of the community while building their personal sense of identity, at the same time providing a positive incentive for sustained participation in the learning community (Lave & Wenger, 1991). Organizations committed to microtraining understandably play an instrumental role in enabling communities of practice. In this capacity, the organization commits the resources to support development of microtraining learning units. Implementation of microtraining via learning communities also requires different roles for learners and trainers than those traditionally held within the organization. Specifically, learners assume primary responsibility for personal and team learning processes; whereas the trainer’s role shifts from presenter to learning coach/facilitator in support of informal learning activities.

Microlearning. A closely related trend is *microlearning*, which is an emergent informal learning strategy intended to quickly close gaps in knowledge and skills, in the context of completing a task. Microlearning is most often mediated by Web 2.0 technology on mobile devices, involving short bursts of inter-connected and loosely coupled learning activities, having a narrow topical focus (Buchem & Hamelmann, 2010). In other words, microlearning tends to build depth, as opposed to breadth of knowledge, particularly when the learning event is situated in the performance of a skill needed to complete a task.

Microlearning is dependent upon access to microcontent, referring to small, user-created, granular pieces of content or learning objects in varied media format ranging from a YouTube video to a Wikipedia entry, intended to convey a single concept or idea. Learners engage in microlearning activities to find immediate answers to questions that arise in completing a task such as “how does this work?”, or “what does this mean?”, or “who said that?”. A common theme is that the microlearning event triggered by the informal learning inquiry draws context from the learning setting and performance task at hand, where immediacy in the application of learning is the primary objective. This type of episodic

- Diversity of sources – Sources for microlearning activities include a range of options and services in diverse media formats including blogs, wikis, Kahn Academy video courses and lessons, YouTube tutorials, infographics, TEDTalks, and an increasing number of Open Educational Resources (OER).
- Learning types – Microlearning may be applied to a wide range of learning types, goals, preferences, and theoretical frameworks (e.g., cognitivist, constructivist, connectivist), producing mashups of informal and formal learning activities.
- Cost – Production costs of learning objects used in microlearning tend to be lower than traditional course development costs given the brevity and narrow topical focus of learning episodes. As the range of topics and number of Open Educational Resources continues to rise, content costs should be expected to continue to decline.
- Access – Increased Web 2.0 and mobile access for content production and consumption has made microlearning ubiquitous for learners in many parts of the world, via learner-defined Personal Learning Environments (PLE) where all you need is a smartphone to participate.
- Connected learning – Microlearning facilitated by social media technologies (e.g., Facebook, Twitter, LinkedIn) provides new ways for collaborative and cooperative learning to occur via Personal Learning Networks (PLN) and within Communities of Practice (CoP).

Performance support tools. Another informal learning trend is Performance Support Tools (PST). Rossett and Schafer (2007) defined performance support as “A helper in life and work, performance support is a repository for information, processes, and perspectives that inform and guide planning and action.” (p. 2). Performance support tools are in many ways analogous to the concepts and affordances discussed with microlearning. Indeed, many of the tools and activities used to support learning and performance discussed in the preceding paragraphs have existed since the early days of personal computing and the Internet, in the form of Electronic Performance Support Systems (EPSS). Gery (1991) first coined the term EPSS as the intentional and purposeful integration of technology, information and cognitive tools to provide on-demand access to expert advice, guidance, assistance, and training to facilitate high performance levels on the job, while requiring minimal support from others.

Performance Support Tools serve as job-aids to help facilitate completion of a task or achievement of a goal, while at the same time have a mediating effect on informal learning activities that support desired performance outcomes (Boileau, 2011). This results in the formation of reproducible patterns for learning and performance, comprised of linked actions and operations that are aligned with performance outcomes, adding to the learner’s personal knowledge and skills repertoire. Over time, these regular and recurring patterns in learning and performance activity systems can evolve into practices shared by other members of the community of practice (Greeno & Engeström, 2014). These practices are shaped by and, in turn, shape the way PSTs are used to support learning and to affect the transfer of knowledge and skills to on-the-job performance. Information and communications technology (e.g., social media) has been shown to have a mediating effect on practice, using digital representation of signs and symbols for linguistic communication, along with knowledge objects that are produced and exist within the community (Boileau, 2011).

As previously stated, Rossett and Schafer (2007) viewed this effect on practice in terms of support for performance, specifically by building a repository of externally curated information, processes, resources and perspectives that inform and guide performance planning and execution, using performance support tools. This approach is less concerned with new knowledge acquisition and more so in direct application and transfer of knowledge, mediated by PSTs.

Rossett and Schafer (2007) further categorized PSTs as sidekicks and planners. A *sidekick* functions as a job aid in the context of specific types of activity performed in realtime, concurrent with the task at hand. An example of a sidekick is a GPS navigation system (e.g., Google® maps application on a mobile device) providing turn-by-turn navigational instructions in the situated context of operating a vehicle.

be accessing Google® Maps via the Web to determine (i.e., plan) the most efficient route of travel between two pre-determined points, in advance of starting the trip.

A distinction can be made between performance support tools and other types of tools such as a file cabinet or office chair, used to support informal learning and performance. The difference with non-PST tools is that there is no innate support for the informal learning or performance activity; there is only potential support for manipulating the environment to make it more conducive to achieving the goal for the activity. In a similar manner, "Instruction is not performance support. It is planned experience that enables an individual to acquire skills and knowledge to advance the capability to perform." (Rossett & Schafer, 2007, p. 5). In other words, there is a separation between the learning event and the performance context. Performance support for informal learning may be further characterized by looking at four factors: convergence, simplicity, relevance to performance, and personalization (Rossett & Schafer, 2007).

- Convergence is rooted in proximity, meaning that the information and guidance to support learning is situated where the learner/performer and task or challenge exists.
- Simplicity means having a focus on the content in the here and now, to accomplish a task or to quickly close a gap in skills and knowledge.
- Relevance increases support for the performer, ensuring the right tools for the job to accomplish his or her goals in a specific context, resulting in increased learner motivation.
- Personalization allows the learner to dynamically adjust the level of information and support needed, according to the needs of the situation and the prior experience of the learner. Personalization also facilitates user-generated content adding new insight and lessons learned, thus increasing the utility of the tool and contributing new artifacts to the collective body of knowledge available to the community of practice, via a more integrative user experience.

Digital open badging. As opportunities for informal learning continue to increase for personal and professional development across different industries and disciplines, a question on the minds of many learners is how informal learning achievements may be recognized (Law, 2015). *Digital open badges* provide validated recognition of participation and achievement from informal learning activities, and evidence of learning milestones such as completion of a microtraining learning segment. The use of digital badges can also be seen with formal learning in educational institutions, as a motivational tool and in the form of micro-credentials to demonstrate incremental achievement in a variety of education settings.

The amount of OER content available to support informal learning has increased exponentially in recent years in support of microlearning. Concurrent with the increase in OER is the emergence of different business models to support the issuance of digital open badges. For example, learners can access OER content for free, through a variety of MOOC (Massive Open Online Course) service providers such as EdX and Coursera. These services provide access to hundreds of courses for free. If you would like to receive a micro-credential (i.e., certificate) as evidence of successful completion, however, you are required to pay a nominal fee. This changes our definition of informal learning provided by Cross (2007) when learners begin to pay-for certification by MOOC providers, because informal learning is no longer anonymous when attendance is tracked and grades are issued (Law, 2015). This trend is expected to continue according to Law (2015) as "learners in an informal environment are willing to pay for certification and recognition of unsupported informal learning." (p. 232).

Summary. In this section, we have examined some of the trends, issues, and tools used to facilitate informal learning, noting the emergence of four themes. First is that informal learning is situated in performance, knowledge development, or in completion of a task, and is driven by intrinsic as well as extrinsic motivation. Second, as organizations refocus their attention from training to talent management, they look to innovative methods and learner-centered processes to enable communities of practice. Third is that technology and more specifically, performance support tools are at the forefront of informal learning, serving as job-aids intended to mediate informal learning activities that support job performance. Finally, the use of digital open badges is expected to increase, to eventually provide validated evidence of informal learning outcomes.

I conclude this chapter by considering the role of culture in learning. The paradigm used to understand informal learning is influenced by a set of assumptions around learning that are firmly rooted in culture. For example, the concept of informal learning in the West is inevitably linked to Western philosophies such as liberalism, progressivism, humanism, behaviorism, and radicalism (Merriam & Bierema, 2014). This provides a unique cultural lens through which learning events and activities are perceived that is further shaped by personal experience and access to information surrounding global events, which may vastly differ from the view of education and learning held by people living in different cultural settings from our own. Ironically, while informal or experiential learning is clearly evident in all cultures, "it is less valued in the West where formal book knowledge predominates." (Merriam & Bierema, 2014, p. 243). It is also interesting to note that this is consistent with the "spending/outcome paradox" noted by Cross (2007) that was discussed earlier in this chapter.

Merriam and Bierema (2014) identified three themes in knowing and learning that are more prevalent among **non**-Western cultures, characterized as communal, lifelong and informal, and holistic. To say that learning is *communal*implies that it is situated within the community as a means for collaborative knowledge development that benefits from, and exists within, the entire community through strong interdependency and relationships among the members. This stands in contrast with Western culture in which the learner is more typically viewed from an individualistic and independent perspective. The second theme is that informal learning is a *lifelong* pursuit that is also situated within the communal ethic (Merriam & Kim, 2011). The concept of informal lifelong learning is evident in the Buddhist principles of mindfulness; can be seen in the African cultural expectation that members of the community share their knowledge with each other for the benefit of the community at large; and may be found in the words of the Prophet Muhammad: to "Seek knowledge from the cradle to the grave." Finally, the culturally-based theme of informal learning as *holistic* represents a clear shift from a Western emphasis on cognitive knowing, to alternative types of learning that include: somatic, spiritual, emotional, moral, experiential and social learning (Merriam & Kim, 2011).

Approaching informal learning from a more culturally holistic perspective creates new opportunities to increase cultural sensitivity among increasingly diverse learner and worker populations, by recognizing that learning is embedded in performance activities and in the experiences of everyday life.

Application Exercises

- Take five minutes and think about your own experiences with informal learning. How has technology influenced your informal learning? Give your best assumption of how much informal learning occurs outside of a technological medium vs. how much informal learning occurs through a technological medium.
- Think of a work or school situation where learning was formal. Knowing that there is a better chance of meeting learning outcomes with informal learning, what adjustments would you make to create a more informal learning experience?

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Connectivism

George Siemens

Connectivism is a theory that attempts to explain the link between individual and organizational learning. This paper was originally published on Siemens's personal website in 2004 before being published in the International Journal of Instructional Technology and Distance Learning. It has been cited thousands of times and is considered a landmark theory for the Internet age.

Editor's Note

This landmark paper, originally published on Siemens's personal website in 2004 before being published in the International Journal of Instructional Technology and Distance Learning, has been cited thousands of times and is considered a landmark theory for the Internet age. Siemens has since added a website to explore this concept.

Siemens, G. (2004). *Connectivism: A learning theory for the digital age.* Retrieved from http://www.elearnspace.org/Articles/connectivism.htm

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Introduction

Behaviorism, **cognitivism**, and **constructivism** are the three broad learning theories most often utilized in the creation of instructional environments. These theories, however, were developed in a time when learning was not impacted through technology. Over the last twenty years, technology has reorganized how we live, how we communicate, and how we learn. Learning needs and theories that describe learning principles and processes, should be reflective of underlying social environments. Vaill emphasizes that "learning must be a way of being—an ongoing set of attitudes and actions by individuals and groups that they employ to try to keep abreast of the surprising, novel, messy, obtrusive, recurring events . . ." (1996, p. 42).

Learners as little as forty years ago would complete the required schooling and enter a career that would often last a lifetime. Information development was slow. The life of knowledge was measured in decades. Today, these foundational principles have been altered. Knowledge is growing exponentially. In many fields the life of knowledge is now measured in months and years. Gonzalez (2004) describes the challenges of rapidly diminishing knowledge life:

> *was not known 10 years ago. The amount of knowledge in the world has doubled in the past 10 years and is doubling every 18 months according to the American Society of Training and Documentation (ASTD). To combat the shrinking half-life of knowledge, organizations have been forced to develop new methods of deploying instruction.*

Some significant trends in learning:

- Many learners will move into a variety of different, possibly unrelated fields over the course of their lifetime.
- Informal learning is a significant aspect of our learning experience. Formal education no longer comprises the majority of our learning. Learning now occurs in a variety of ways—through communities of practice, personal **networks**, and through completion of work-related tasks.
- Learning is a continual process, lasting for a lifetime. Learning and work related activities are no longer separate. In many situations, they are the same.
- Technology is altering (rewiring) our brains. The tools we use define and shape our thinking.
- The organization and the individual are both learning organisms. Increased attention to knowledge management highlights the need for a theory that attempts to explain the link between individual and organizational learning.
- Many of the processes previously handled by learning theories (especially in cognitive information processing) can now be off-loaded to, or supported by, technology.
- Know-how and know-what is being supplemented with know-where (the understanding of where to find knowledge needed).

Background

Driscoll (2000) defines learning as "a persisting change in human performance or performance potential…[which] must come about as a result of the learner's experience and interaction with the world" (p. 11). This definition encompasses many of the attributes commonly associated with behaviorism, cognitivism, and constructivism—namely, learning as a lasting changed state (emotional, mental, physiological (i.e., skills)) brought about as a result of experiences and interactions with content or other people.

Driscoll (2000, pp. 14–17) explores some of the complexities of defining learning. Debate centers on:

- Valid sources of knowledge—Do we gain knowledge through experiences? Is it innate (present at birth)? Do we acquire it through thinking and reasoning?
- Content of knowledge—Is knowledge actually knowable? Is it directly knowable through human experience?
- The final consideration focuses on three epistemological traditions in relation to learning: Objectivism, Pragmatism, and Interpretivism
  - **Objectivism** (similar to behaviorism) states that reality is external and is objective, and knowledge is gained through experiences.
  - **Pragmatism** (similar to cognitivism) states that reality is interpreted, and knowledge is negotiated through experience and thinking.
  - **Interpretivism** (similar to constructivism) states that reality is internal, and knowledge is constructed.

All of these learning theories hold the notion that knowledge is an objective (or a state) that is attainable (if not already innate) through either reasoning or experiences. Behaviorism, cognitivism, and constructivism (built on the epistemological traditions) attempt to address how it is that a person learns.

Behaviorism states that learning is largely unknowable, that is, we can't possibly understand what goes on inside a person (the "**black box theory**"). Gredler (2001) expresses behaviorism as being comprised of several theories that make three assumptions about learning:

3. Learning is about behaviour change

Cognitivism often takes a computer information processing model. Learning is viewed as a process of inputs, managed in **short term memory**, and coded for long-term recall. Cindy Buell details this process: "In cognitive theories, knowledge is viewed as symbolic mental constructs in the learner's mind, and the learning process is the means by which these symbolic representations are committed to memory."

Constructivism suggests that learners create knowledge as they attempt to understand their experiences (Driscoll, 2000, p. 376). Behaviorism and cognitivism view knowledge as external to the learner and the learning process as the act of internalizing knowledge. Constructivism assumes that learners are not empty vessels to be filled with knowledge. Instead, learners are actively attempting to create meaning. Learners often select and pursue their own learning. Constructivist principles acknowledge that real-life learning is messy and complex. Classrooms which emulate the "fuzziness" of this learning will be more effective in preparing learners for life-long learning.

Learning Check

What model does cognitivism take?

- [ ] A "black box" model. We can't understand what goes on inside someone's head.
- [ ] A perpetual creation model. Knowledge and meaning are created as learners strive to understand the experiences they have.
- [ ] A computer information processing model. Learning is a continuous process of managing, then coding, various inputs.

How do the epistemological traditions relate to the three learning theories discussed in this chapter?

- [ ] Objectivism is similar to cognitivism, pragmatism is similar to constructivism, and interpretivism is similar to behaviorism.
- [ ] Objectivism is similar to behaviorism, pragmatism is similar to cognitivism, and interpretivism is similar to constructivism.
- [ ] Objectivism is similar to constructivism, pragmatism is similar to behaviorism, and interpretivism is similar to cognitivism.

Limitations of Behaviorism, Cognitivism, and Constructivism

A central tenet of most learning theories is that learning occurs inside a person. Even social constructivist views, which hold that learning is a socially enacted process, promotes the principality of the individual (and her/his physical organizations.

Learning theories are concerned with the actual process of learning, not with the value of what is being learned. In a networked world, the very manner of information that we acquire is worth exploring. The need to evaluate the worthiness of learning something is a meta-skill that is applied before learning itself begins. When knowledge is subject to **paucity**, the process of assessing worthiness is assumed to be intrinsic to learning. When knowledge is abundant, the rapid evaluation of knowledge is important. Additional concerns arise from the rapid increase in information. In today's environment, action is often needed without personal learning—that is, we need to act by drawing information outside of our primary knowledge. The ability to synthesize and recognize connections and patterns is a valuable skill.

Many important questions are raised when established learning theories are seen through technology. The natural attempt of theorists is to continue to revise and evolve theories as conditions change. At some point, however, the underlying conditions have altered so significantly, that further modification is no longer sensible. An entirely new approach is needed.

Some questions to explore in relation to learning theories and the impact of technology and new sciences (chaos and networks) on learning:

- How are learning theories impacted when knowledge is no longer acquired in the linear manner?
- What adjustments need to be made with learning theories when technology performs many of the cognitive operations previously performed by learners (information storage and retrieval).
- How can we continue to stay current in a rapidly evolving information ecology?
- How do learning theories address moments where performance is needed in the absence of complete understanding?
- What is the impact of networks and **complexity theories** on learning?
- What is the impact of chaos as a complex pattern recognition process on learning?
- With increased recognition of interconnections in differing fields of knowledge, how are systems and **ecology theories** perceived in light of learning tasks?

An Alternative Theory

Including technology and connection making as learning activities begins to move learning theories into a digital age. We can no longer personally experience and acquire learning that we need to act. We derive our competence from forming connections. Karen Stephenson states:

> *Experience has long been considered the best teacher of knowledge. Since we cannot experience everything, other people's experiences, and hence other people, become the surrogate for knowledge. 'I store my knowledge in my friends' is an* ***axiom*** *for collecting knowledge through collecting people (undated).*

Chaos is a new reality for knowledge workers. ScienceWeek (2004) quotes Nigel Calder's definition that chaos is "a cryptic form of order." Chaos is the breakdown of predictability, evidenced in complicated arrangements that initially defy order. Unlike constructivism, which states that learners attempt to foster understanding by meaning making tasks, chaos states that the meaning exists—the learner's challenge is to recognize the patterns which appear to be hidden. Meaning-making and forming connections between specialized communities are important activities.

Chaos, as a science, recognizes the connection of everything to everything. Gleick (1987) states: "In weather, for example, this translates into what is only half-jokingly known as the Butterfly Effect—the notion that a butterfly stirring the air today in Peking can transform storm systems next month in New York" (p. 8). This analogy highlights a real challenge: "sensitive dependence on initial conditions" profoundly impacts what we learn and how we act based on our key learning task.

Luis Mateus Rocha (1998) defines self-organization as the “spontaneous formation of well organized structures, patterns, or behaviors, from random initial conditions.” (p.3). Learning, as a self-organizing process requires that the system (personal or organizational learning systems) “be informationally open, that is, for it to be able to classify its own interaction with an environment, it must be able to change its structure . . .” (p.4). Wiley and Edwards acknowledge the importance of self-organization as a learning process: “Jacobs argues that communities self-organize is a manner similar to social insects: instead of thousands of ants crossing each other’s pheromone trails and changing their behavior accordingly, thousands of humans pass each other on the sidewalk and change their behavior accordingly.” Self-organization on a personal level is a micro-process of the larger self-organizing knowledge **constructs** created within corporate or institutional environments. The capacity to form connections between sources of information, and thereby create useful information patterns, is required to learn in our knowledge economy.

Networks, Small Worlds, Weak Ties

A network can simply be defined as connections between entities. Computer networks, power grids, and social networks all function on the simple principle that people, groups, systems, **nodes**, entities can be connected to create an integrated whole. Alterations within the network have ripple effects on the whole.

Albert-László Barabási states that “nodes always compete for connections because links represent survival in an interconnected world” (2002, p. 106). This competition is largely dulled within a personal learning network, but the placing of value on certain nodes over others is a reality. Nodes that successfully acquire greater profile will be more successful at acquiring additional connections. In a learning sense, the likelihood that a concept of learning will be linked depends on how well it is currently linked. Nodes (can be fields, ideas, communities) that specialize and gain recognition for their expertise have greater chances of recognition, thus resulting in cross-pollination of learning communities.

Weak ties are links or bridges that allow short connections between information. Our small world networks are generally populated with people whose interests and knowledge are similar to ours. Finding a new job, as an example, often occurs through weak ties. This principle has great merit in the notion of serendipity, innovation, and creativity. Connections between disparate ideas and fields can create new innovations.

Learning Check

(True/False) Constructivism suggests that learners create meaning, whereas chaos suggests that learners uncover preexisting meaning.

- [ ] True
- [ ] False

Connectivism

Connectivism is the integration of principles explored by chaos, network, and complexity and **self-organization theories**. Learning is a process that occurs within nebulous environments of shifting core elements—not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an

Connectivism is driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognize when new information alters the landscape based on decisions made yesterday is also critical.

Principles of connectivism:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- **Currency** (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Connectivism also addresses the challenges that many corporations face in knowledge management activities. Knowledge that resides in a database needs to be connected with the right people in the right context in order to be classified as learning. Behaviorism, cognitivism, and constructivism do not attempt to address the challenges of organizational knowledge and transference.

Information flow within an organization is an important element in organizational effectiveness. In a **knowledge economy**, the flow of information is the equivalent of the oil pipe in an industrial economy. Creating, preserving, and utilizing information flow should be a key organizational activity. Knowledge flow can be likened to a river that meanders through the ecology of an organization. In certain areas, the river pools and in other areas it ebbs. The health of the learning ecology of the organization depends on effective nurturing of information flow.

Social network analysis is an additional element in understanding learning models in a digital era. Art Kleiner (2002) explores Karen Stephenson's "quantum theory of trust" which "explains not just how to recognize the collective cognitive capability of an organization, but how to cultivate and increase it." Within social networks, hubs are well-connected people who are able to foster and maintain knowledge flow. Their interdependence results in effective knowledge flow, enabling the personal understanding of the state of activities organizationally.

The starting point of connectivism is the individual. Personal knowledge is comprised of a network, which feeds into organizations and institutions, which in turn feed back into the network, and then continue to provide learning to individual. This cycle of knowledge development (personal to network to organization) allows learners to remain current in their field through the connections they have formed.

Landauer and Dumais (1997) explore the phenomenon that "people have much more knowledge than appears to be present in the information to which they have been exposed." They provide a connectivist focus in stating "the simple notion that some domains of knowledge contain vast numbers of weak interrelations that, if properly exploited, can greatly amplify learning by a process of inference." The value of pattern recognition and connecting our own "small worlds of knowledge" are apparent in the exponential impact provided to our personal learning.

John Seely Brown presents an interesting notion that the internet leverages the small efforts of many with the large efforts of few. The central premise is that connections created with unusual nodes supports and intensifies existing large effort activities. Brown provides the example of a Maricopa County Community College system project that links senior citizens with elementary school students in a mentor program. Because the children "listen to these 'grandparents' better than they do their own parents, the mentoring really helps the teachers . . . the small efforts of the

Learning Check

(True/False) Connectivism suggests that learning is the process of creating and maintaining connections between information sources.

- [ ] True
- [ ] False

The author of this chapter suggests that, according to connectivism, learning is like maintaining what?

- [ ] A continually growing forest
- [ ] A meandering river
- [ ] A tumultuous ocean
- [ ] An unpredictable wind

Implications

The notion of connectivism has implications in all aspects of life. This paper largely focuses on its impact on learning, but the following aspects are also impacted:

- Management and leadership. The management and marshalling of resources to achieve desired outcomes is a significant challenge. Realizing that complete knowledge cannot exist in the mind of one person requires a different approach to creating an overview of the situation. Diverse teams of varying viewpoints are a critical structure for completely exploring ideas. Innovation is also an additional challenge. Most of the revolutionary ideas of today at one time existed as a fringe element. An organizations ability to foster, nurture, and synthesize the impacts of varying views of information is critical to knowledge economy survival. Speed of "idea to implementation" is also improved in a systems view of learning.
- Media, news, information. This trend is well under way. Mainstream media organizations are being challenged by the open, real-time, two-way information flow of blogging.
- Personal knowledge management in relation to organizational knowledge management
- Design of learning environments

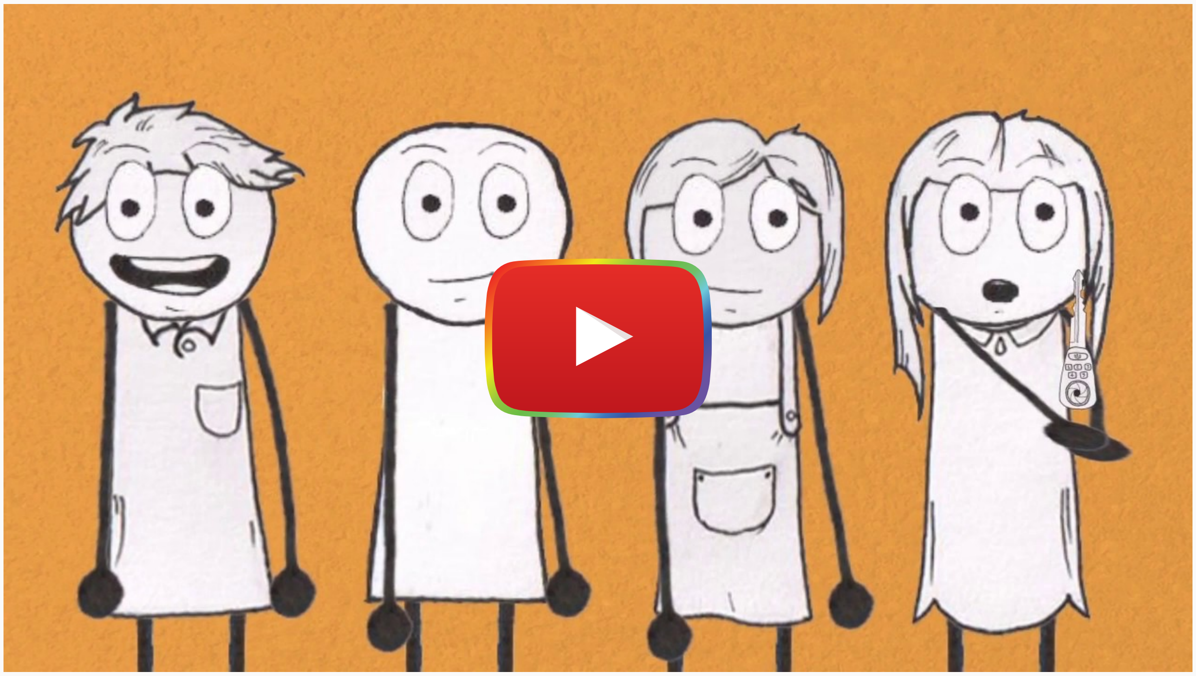
Conclusion

The pipe is more important than the content within the pipe. Our ability to learn what we need for tomorrow is more important than what we know today. A real challenge for any learning theory is to actuate known knowledge at the point important than what the learner currently possesses.

Connectivism presents a model of learning that acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity. How people work and function is altered when new tools are utilized. The field of education has been slow to recognize both the impact of new learning tools and the environmental changes in what it means to learn. Connectivism provides insight into learning skills and tasks needed for learners to flourish in a digital era.

LIDT in the World

With the constant evolution of technology comes the constant influx of information. Watch the video below to learn more about media literacy:



Watch on YouTube

Write one to two paragraphs reflecting on how media literacy can be interpreted through the lens of connectivism. Here are some questions you may want to think about:

- How does improving media literacy relate to the process of connecting nodes or information sources?
- How does the principle of "currency," as discussed in the chapter, relate to both connectivism and media literacy?

- Use a comparison chart (such as a T-chart or Venn Diagram) to compare elements of Connectivism with elements of Behaviorism, Cognitivism, or Constructivism.
- According to connectivism, how has the rapid increase of access to knowledge affected the way we should view knowledge?
- Think of the most recent job you have held. How did the principles of connectivism affect the way you learned in that job?
- How would you summarize the main points of connectivism if you had to explain it to a friend with no background in this area?

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Using the First Principles of Instruction to Make Instruction Effective, Efficient, and Engaging

M. David Merrill

For over 50 years my career has been focused on one very important question: "What makes instruction effective, efficient, and engaging?" I decided that e-learning should refer to the quality of the instruction, not merely to how it is delivered, so I labeled effective, efficient, and engaging instruction as e3 instruction. In this brief presentation I will try to share a little of what I've learned. Perhaps the underlying message of my studies and this presentation is this simple statement: **"Information alone is not instruction!"**

In 1964, in our research lab at the University of Illinois, we were sending messages from one computer to another via ARPANET. Little did we realize the fantastic potential of this experimental communication from computer to computer. Unfortunately for our subsequent fortunes, none of us in that lab envisioned the Internet and the World Wide Web and the impact that this invention would have on communication, the availability of information, social interaction, commerce, education, and almost every other aspect of our lives.

"Information Alone is Not Instruction!"

In 1963, I was doing my student teaching in a junior high school; my subject was American history. Unfortunately for this experience, my major was psychology with a minor in mathematics. I never had an American history class in my entire college career. The students' textbook was woefully inadequate, so I spent my evenings poring through the American Encyclopedia, which fortunately was resident in my home. This paucity of information left me very underprepared for teaching these students. However, thanks to the ongoing presidential election (Nixon vs Kennedy), there was a debate on television that I could use as a springboard to teach a little about the electoral process, the Electoral College, and something about our two-party system of government.

But today, thanks to the Internet, interested learners can find information about almost anything in the world, whether current events or historical events. Teaching American history to junior high students today would be so much easier because of the almost unlimited amount of information in all different media that is available, including audio, video, animation, as well as text. But is access to this wealth of information instruction? What I've learned from my study of this question is that the answer is an emphatic NO! I repeat, **Information alone is not instruction**.

Motivation

All of us have heard the saying that "students didn't learn because they just weren't motivated." Or that "motivation is the most important part of learning." Or "we really need to find a way to motivate our students." What is it that causes motivation? People have often asked me, "Is motivation one of your first principles of instruction?" The answer is no; motivation is not something we can do, motivation is an outcome. So, if it is an outcome, what causes motivation? Motivation comes from learning; the greatest motivation comes when people learn. We are wired to learn; all of us love to learn; every student loves to learn. And, generally, we are motivated by those things that we find we are good at. For ended up as last shag on the girls' team. That was very embarrassing for me, so, I lost interest in sports; I did not want to be a sports person. Consequently, I never pursued sports. On the other hand, somewhere in my youth I was given a scale model train. I was very interested in trains, but in this case one of my father's friends showed me how to build scenery and how to make a model railroad that looked like the real world. I became very interested in building a model railroad. I have continued to follow this interest throughout my life. Why was I motivated to do this? Because I was good at it, because I learned things about how to build a realistic model. The more I learned, the more interested I became. We need to find ways to motivate our students, and that comes from promoting learning. Learning comes when we apply the effective and engaging principles of instruction.

Typical Instructional Sequence

In my experience I have had the opportunity to review many courses. Figure 1 illustrates a common instructional sequence that I have observed.

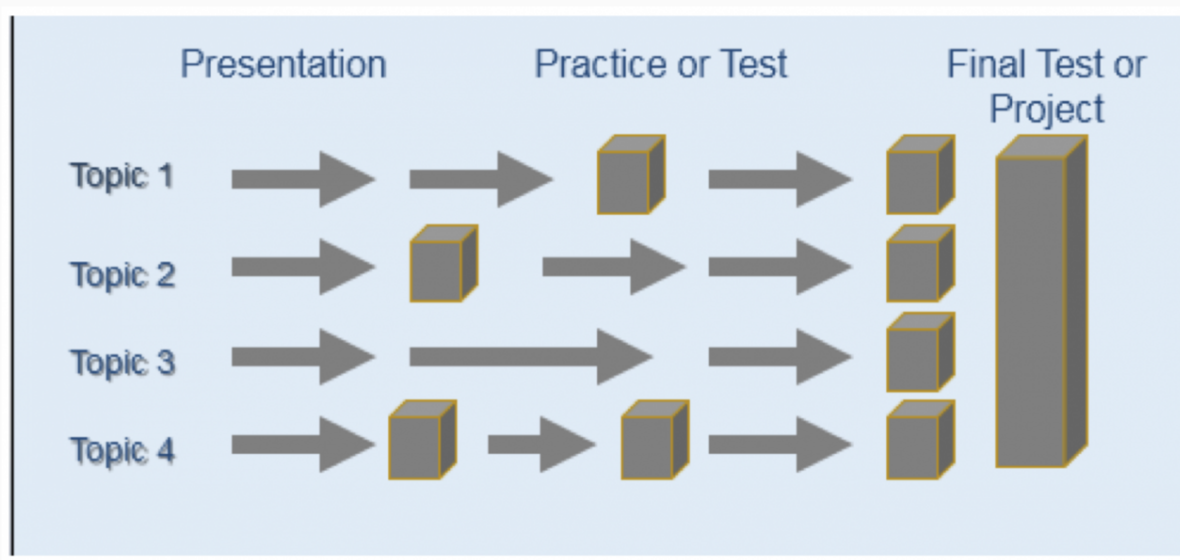

Figure 1. Typical Instructional Sequence

The course or module consists of a list of topics representing the content of the course. Information about the topic is presented, represented by the arrows. Occasionally a quiz or exercise is inserted to help illustrate the topic, represented by the boxes. The sequence is to teach one topic at a time. At the end of the course or module there is a culminating final test, or in some cases a final project, that asks the students to apply the topic to complete some t*ask* or solve some problem.

Sometimes this sequence is very effective in enabling students to gain skills or to learn to solve problems. Too often, however, this sequence is ineffective and not engaging for students. The effectiveness of this sequence and the degree of engagement it promotes for learners depends on the type of learning events that are represented by the arrows and the boxes in this diagram.

There are many different types of instructional or learning events. Perhaps the most frequently used learning event is to present information or *Tell*. This *Tell* can take many forms, including lectures, videos, text books, and PowerPoint presentations.

The next most frequent instructional or learning event is to have learners remember what they were told, what they read, or what they saw. This remember instructional event we will label as *Ask*. Even though *Tell* and *Ask* are the most frequently used instructional events, if they are the only instructional events used then the *Tell–Ask* instructional sequence is the least effective instructional strategy.

If the arrows in Figure 1 represent *Tell* learning events and the boxes represent *Ask* learning events, then this module is not going to be very effective and most likely will not prepare learners to adequately complete a project using the information taught. If the culminating learning activity is an *Ask* final exam, learners may be able to score well on this exam. However, a good score on an *Ask* exam does little to prepare learners to apply the ideas taught to the solution of a complex problem or completion of a complex t*ask*.

A little history is in order. In 1999 Charles Reigeluth published a collection of papers on Instructional Design Theories and Models. In the preface to this book he indicates that there are many different kinds of instructional theories and that instructional designers need to be familiar with these different approaches and select the best approach or combination of approaches that they feel are appropriate for their particular instructional situation. I challenged Dr. Reigeluth, suggesting that while these different theories stressed different aspects of instruction and used different vocabulary to describe their model and methods, that fundamentally, at a deep level, they were all based on a common set of principles. Dr. Reigeluth kindly suggested that he didn't think that my assumption was correct, but if I felt strongly about it that perhaps I should try to find evidence for my assumption.

I took the challenge and spent the next year or two studying these various instructional theories. The result was the publication in 2002 of my often-referenced paper on First principles of Instruction (Merrill, 2002). I have spent the time since in refining my proposition in a series of papers and chapters on First Principles. In 2013, I finally published my book *First Principles of Instruction* (Merrill, 2013) that elaborated these principles, provided a set of suggestions for how these principles might be implemented in various models of instruction, and provided a variety of instructional samples that illustrate the implementation of First Principles in a range of content areas and in different educational contexts, including training, public schools, and higher education.

First Principles of Instruction

Principles are statements of relationships that are true under appropriate conditions. In instruction these relationships are between different kinds of learning events and the effect that participating in these learning events has on the acquisition of problem-solving skills. I identified five general principles that comprise First Principles of Instruction. As I reviewed the literature on instructional design theories and models, I tried to be as parsimonious as possible by selecting only a few general principles that would account for the most fundamental learning activities that are necessary for effective, efficient, and engaging instruction.

Activation: Learning is promoted when learners activate a mental model of their prior knowledge as a foundation for new skills. A frequently cited axiom of education is to start where the learner is. Activation is the principle that attempts to activate a relevant mental model already acquired by the learner in order to assist him or her to adapt this mental model to the new skills to be acquired.

Demonstration: Learning is promoted when learners observe a demonstration of the skills to be learned. I carefully avoided the word presentation for this principle. Much instruction consists largely or entirely of presentation. What is often missing is demonstration, show me. Hence, the demonstration principle is best implemented by *Tell–Show* learning events where appropriate information is accompanied by appropriate examples.

assessment tool. But remembering information is insufficient for being able to identify newly encountered instances of some object or event. Remembering is also insufficient to be able to execute a set of steps in a procedure or to grasp the events of a process. Learners need to apply their newly acquired skills to actually doing a t*ask* or actually solving a problem.

Integration: Learning is promoted when learners share, reflect on, and defend their work by peer-collaboration and peer-critique. Deep learning requires learners to integrate their newly acquired skills into those mental models they have already acquired. One way to insure this deep processing is for learners to collaborate with other learners in solving problems or doing complex tasks. Another learning event that facilitates deep processing is when learners go public with their knowledge in an effort to critique other learners or to defend their work when it is critiqued by other learners.

Problem-centered: Learning is promoted when learners are engaged in a problem-centered strategy involving a progression of whole real-world *task*s. The eventual purpose of all instruction is to learn to solve complex problems or complete complex tasks, either by themselves or in collaboration with other learners. This is accomplished best when the problem to be solved or the *task* to be completed is identified and demonstrated to learners early in the instructional sequence. Subsequent component skills required for problem solving or for completing a complex task are best acquired in the context of trying to solve a real instance of the problem or complete a real instance of the task.

Support for First Principles of Instruction

Do First Principles of Instruction actually promote more effective, efficient, and engaging instruction?

A study conducted by NETg (Thompson Learning, 2002), a company that sells instruction to teach computer applications, compared their off-the-shelf version of their Excel instruction, which is topic-centered, with a problem-centered version of this course that was developed following First Principles. Participants in the experiment came from a number of different companies that were clients of NETg. The assessment for both groups consisted of developing a spreadsheet for three real-world Excel problems. The problem-centered group scored significantly higher, required significantly less time to complete the problems, and expressed a higher level of satisfaction than the topic-centered group. All differences were statistically significant beyond the .001 level.

A doctoral student at Florida State University completed a dissertation study comparing a topic-centered course teaching Flash programing with a problem-centered course (Rosenberg-Kima, 2011). This study was carefully controlled so that the variable was merely the arrangement of the skill instruction in the context of problems or taught skill-by-skill. The learning events for both groups were identical except for the order and context in which they were taught. On a transfer Flash problem that required students to apply their Flash programing skills to a new problem, the problem-centered group scored significantly higher than the topic-centered group and felt the instruction was more relevant and resulted in more confidence in their performance. There was no time difference between the two groups for completing the final project.

A professor at Indiana University designed a student evaluation questionnaire that had students indicate whether the course being evaluated included First Principles of Instruction (Frick, Chadha, Watson, & Zlatkovska, 2010). The correlations all showed that the extent to which First Principles are included in a course correlates with student rating of instructor quality and their rating of satisfaction with the course. Students also spent more time on task and were judged by their instructors to have made more learning progress when the courses involved First Principles of Instruction. This data was collected in three different studies.

The conclusion that can be drawn from these three different and independent studies of First Principles clearly shows that courses based on First Principles do facilitate effectiveness, efficiency, and learner satisfaction.

When I'm asked to review course material, my approach is to immediately turn to Module 3 of the material. By then the course is usually into the heart of the content, and the introductory material is finished. What do I look for first? Examples. Does the content include examples, demonstrations, or simulations of the ideas being taught? Adding demonstration to a course will result in a significant increment in the effectiveness of the course.

Do most courses include such demonstration? MOOCs are a recent very popular way to deliver instruction. How well do these *Massive Open Online Courses* implement First Principles of Instruction? Anoush Margaryan and her colleagues (Margaryan, Bianco, Littlejohn, 2015) published an important paper titled Instructional Quality of Massive Online Courses (MOOCs) that addresses this question. They carefully analyzed 76 MOOCs representing a wide variety of content sponsored by a number of different institutions to determine the extent that these courses implemented First Principles of Instruction. Their overall conclusion was that most of these courses failed to implement these principles.

The demonstration principle, providing examples of the content being taught, is fundamental for effective instruction and engaging instruction. How many of these MOOCs implemented this principle? Only 3 out of the 76 MOOCs analyzed included appropriate demonstration. The effectiveness and engagement in these MOOCs could be significantly increased by adding relevant and appropriate demonstration.

Application Principle

When I'm asked to review a course, the second type of learning event I look for is application that is consistent with and appropriate for the type of learning involved. Remembering a definition or series of steps is not application. There are two types of application that are most important but too often not included. *DOid* or *DOidentify* requires learners to recognize new divergent examples of an object or event when they encounter it. *DOidentify* is also the initial application required when learning the steps of a procedure or process. The learner must first recognize a correctly executed step when they see it, and they must also recognize the consequence that resulted from the execution of the step. Once they can recognize appropriate steps and appropriate consequences for these steps, then *DOexecute* is the next level of application. *DOexecute* requires learners to actually perform or execute the steps of a procedure. When appropriate application is missing, the effectiveness of a course is significantly increased when appropriate application learning events are added.

MOOCs are often about teaching learners new skills. Did the MOOCs in the study cited above include appropriate application for these skills? They fared better than they did for demonstration. At least 46 of the 76 MOOCs did include some form of application. This still leaves 30 MOOCs in this study without application of any kind. However, on careful analysis of the sufficiency and appropriateness of the application included, it was found that only 13 of the MOOCs in this study had appropriate and sufficient application.

Learning Events

While *Tell* and *Ask* are the most frequently used learning events, as we have seen, a strategy that uses only these two learning events is not an effective or engaging strategy. Learning to solve problems and to do complex tasks is facilitated when a *Tell* instructional strategy is enhanced by adding demonstration or *Show* learning events. A *Tell-Show* sequence is more effective than a *Tell* only sequence.

Learning to solve problems and to do complex tasks is facilitated even more when a *Tell-Show* strategy is further enhanced by adding *Do* instructional events. These *Do* learning events are most appropriate when they require learners to identify unencountered instances of some object or event (*DOidentify* learning events) and when they require learners to execute the steps in a procedure or observe the steps in a process (*DOexecute* learning events). A *Tell-Show-Do* sequence is even more effective than a *Tell-Show* instructional sequence.

Much existing instruction can be considerably enhanced by the addition of appropriate *Show* and *Do* learning events. If the arrows in Figure 1 consist of *Tell* and *Show* learning events and the boxes consist of *Do* learning events and if the final project is not merely a remember or *Ask* assessment but the opportunity for learners to apply the skills they have from *Tell-Ask* learning events in this typical instructional sequence to *Tell-Show-Do* learning events.

How to Revise Existing Instruction

Much existing instruction is primarily *Tell-Ask* instruction. This instruction can be significantly enhanced by the demonstration of appropriate examples (*Show* learning events) and even further enhanced by the addition of appropriate application activities (*Do* learning events).

The fundamental instructional design procedure to enhance existing instruction is fairly straightforward. Start by identifying the topics that are taught in a given module. Create a matrix and list these topics in the left column of a matrix. Across the top of the matrix list the four primary learning event types: *Tell, Ask, Show, and Do.*

Second, identify the *Tell* information for each topic and reference it in the *Tell* column. Review this information to ensure that each topic is accurate and sufficient for the goals of the instruction.

Third, identify existing *Show* learning events for each topic. If the existing instruction does not include appropriate or sufficient examples of each of the concepts, principles, procedures, or processes listed, then identify or create appropriate examples for inclusion in the module. Creating a matrix to use as a cross reference for the new content examples can help identify areas where new activities need to be placed in the course.

Fourth, identify existing *Do* learning events for each topic. If the existing instruction does not include appropriate or sufficient *Do* learning events, then identify or create appropriate *Do-identify* or *Do-execute* learning events for inclusion in the module.

Finally, assemble the new demonstrations and applications into the module for more effective, efficient, and engaging instruction.

The Context Problem

Even after appropriate demonstration and application learning events are added to this traditional instructional sequence, there is still a potential problem that keeps this instructional sequence from being as effective, efficient, and engaging as possible. In this sequence topics are taught one-on-one. The demonstration and application learning events added to a *Tell* sequence are usually examples that apply to only a single component skill and are merely a small part of solving a whole problem. Too often learners fail to see the relevance of some of these individual skills learned out of context. We have all experienced the often used explanation: “You won’t understand this now, but later it will be very important to you.” If “later” in this situation is several days or weeks there is a good possibility that the learners will have forgotten the component skill before they get to actually use this skill in solving a whole problem or doing a whole task. Or, if learners do not see the relevance of a particular skill they may fail to actually learn the skill or they are unable to identify a mental model into which they can incorporate this skill. Then, when it is time to use this skill in the solution of a whole problem, learners are unable to retrieve the skill because it was merely memorized rather than understood. Furthermore, if solving a whole problem or doing a whole task is the final project for a module or course, there may be no opportunity to get feedback and revise the project.

Is there a better sequence that is more effective, efficient, and engaging than this typical sequence?

Problem-centered

To maximize engagement in learning a new problem solving skill, learners need to acquire these skills in the context of the problem they are learning to solve or the task they are learning to complete. If learners first activate a relevant mental model (activation principle) and then are shown an example of the problem they will learn to solve and how to solve this problem, they are more likely to see the relevance of each individual component skill when it is taught, and

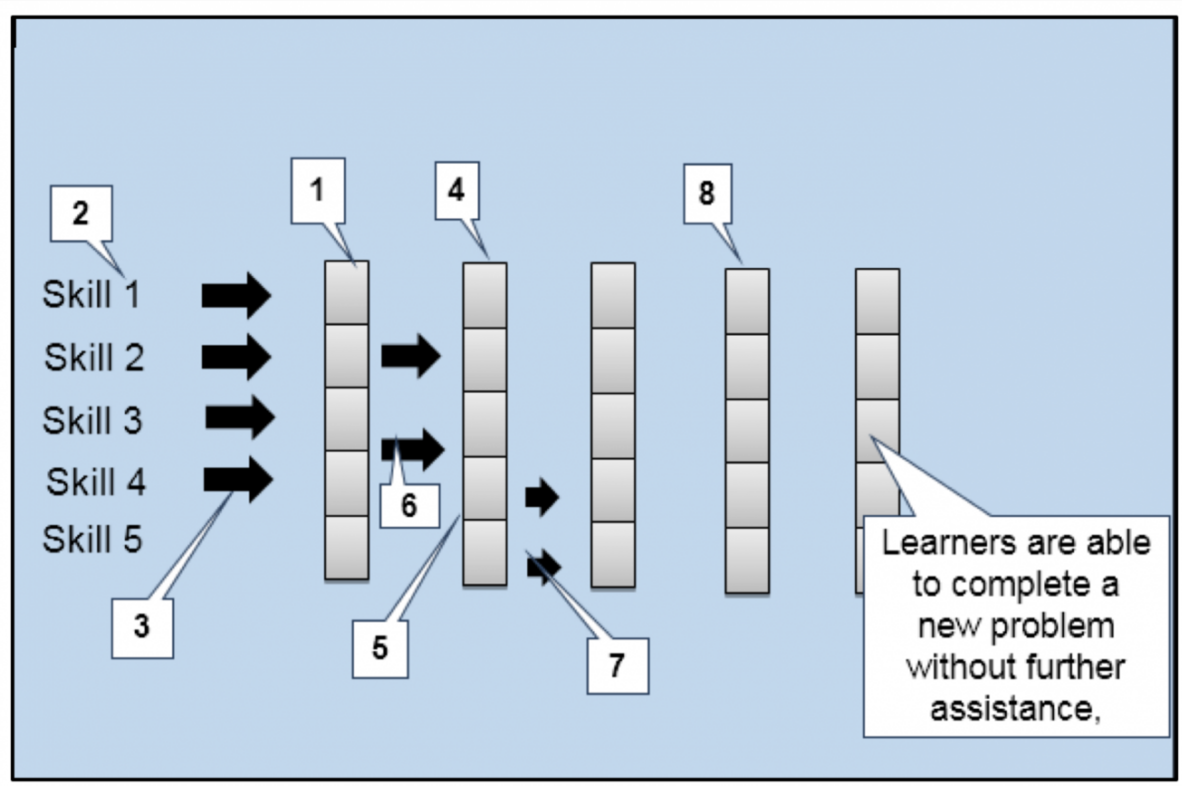

Figure 2. Problem-Centered Instructional Sequence

Does existing instruction use a problem-centered sequence in instruction? Even though many MOOCs are designed to facilitate problem solving, Margaryan and her colleagues found that only 8 of the 76 MOOCs they analyzed were problem-centered. Several previous surveys of existing instruction in a variety of contexts found that most courses do not use a problem-centered instructional sequence or even involve students in the solution of real-world problems as a final project.

A typical instructional sequence is topic-centered; that is, each topic is taught one-by-one, and then at the end of the module or course learners are expected to apply each of these topics in the solution of a final problem or the completion of a final task. Figure 2 illustrates a problem-centered sequence that turns this sequence around. Rather than telling an objective for the module, which is a form of information, the (1) first learning activity is to show a whole instance of the problem that learners are being taught to solve. This demonstration also provides an overview of the solution to the problem or the execution of the task. (2) Students are then told information about the component skills necessary for the solution of this instance of the problem and (3) shown how each of these component skills contributes to the solution of the problem. (4) After this *Tell–Show* demonstration for the first instance of the problem is complete, a second problem instance is identified and shown to learners. (5) The learner is then required to apply the previously acquired component skills to this second problem (*Do*). (6) Some of the component skills may require some additional information or a different way of using the skill to solve this second instance of the problem. Learners are then told this new information and (7) shown its application to another instance of the problem. Note that the *Tell-Show-Do* for each component skill or topic is now distributed across different instances of the problem. The first instance of the problem was primarily *Tell-Show*. The second instance of the problem is a combination of *Tell-Show* for

(*Do*) for each new instance of the problem. The sequence is complete when learners are required to solve a new instance of the problem without additional guidance.

In a problem-centered instructional sequence learners are more likely to see the relevance of each new component skill. This sequence will provide multiple opportunities for learners to apply these newly acquired component skills in the context of real instances of the problem. It enables learners to see the relationship among the individual component skills in the context of each new instance of the problem. It also provides gradually diminishing guidance to learners until they are able to solve a new instance of the problem with little guidance.

Instruction that is revised to include a *Tell-Show-Do* sequence of learning events all in the context of solving a progression of instances of a whole problem or a whole task has the potential ofmaximally engaging students while providing efficient and effective learning activities.

Recommendation

In summary: Designers may want to analyze their courses. Perhaps the effectiveness, efficiency, and especially the engagement of a course may be enhanced by adding appropriate demonstration and application and by using a problem-centered instructional sequence. Does the course include appropriate and adequate demonstration? Does it include appropriate and adequate application? Are the skills taught in the context of an increasingly complex progression of instances of the problem?

Conclusion

Motivation is an outcome, not a cause. What promotes engagement and hence motivation? Effective, efficient, and engaging instruction. What promotes effective, efficient, and engaging instruction? First Principles of Instruction: Activation, Demonstration, Application, Integration, and Problem-centered. In this paper we have emphasized the demonstration and application principle and a problem-centered instructional sequence.

> To learn more, see *First Principles of Instruction: Revised Edition*, authored by David Merrill and Theodore Frick, and available on Amazon.

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Bloom's Taxonomy

Purnima Valiathan

Benjamin Bloom and his associates developed a taxonomy of different kinds of thinking and learning. The taxonomy is divided into three parts: the cognitive, affective, and the psychomotor domains. In this chapter, we will address how the taxonomy was developed, how it evolved, and how educators use it for teaching purposes.

Is the mental effort required to recall a definition the same as the mental effort needed to write an essay—what about recalling multiplication tables versus solving an equation? In both cases the latter will involve greater mental processing than the former, right? Benjamin Bloom and his associates recognized this and developed a taxonomy of different kinds of thinking and learning, which is popularly known as Bloom's taxonomy. In this chapter, we will address how the taxonomy was developed, how it evolved, and how educators use it for teaching purposes.

Evolution of the Taxonomy

The Taxonomy of Educational Objectives handbook (Bloom et al., 1956) is a book that explains how students learn and details the cognitive domain. It was published in 1956 (a first volume focused on cognitive objectives) after a series of conferences from 1949 to 1953 in which Benjamin S. Bloom was ably assisted by his colleagues, Max D. Engelhart, Edward J. Furst, Walker H. Hill, and David R. Krathwohl. The conferences sought to improve communication between educators about the design of curricula and educational examinations. In 1964, the second volume in the series (Krathwohl et al., 1964), focusing on affective outcomes, was published. Around eight years later in1972, Elizabeth Simpson built the taxonomy of the psychomotor domain based on the work of Bloom and others (Simpson, 1966). A revised version of the taxonomy for the cognitive domain was later created in 2001 (Krathwohl, 2002).

Figure 1. Evolution of Bloom's Taxonomy

Purpose of the Taxonomy

Why was the taxonomy developed? In the handbooks, the authors explained that the taxonomy was created to

- create a common ground between schools for exchanging information about curriculum and evaluation devices;
- provide teachers with a framework to identify whether the educational goals that they have identified are lower or higher-order thinking goals, and
- help teachers define objectives in such a manner that it becomes easy to plan learning experiences and develop evaluation devices (Bloom et al., 1956).

The team had been previously concerned about the presence of “nebulous” terms and a lack of common understanding amongst educators regarding educational objectives. As they stated in the handbook: “For example, some teachers believe their students should “really understand,” others want their students to internalize knowledge; still others want their students to “grasp the core or essence,” or “comprehend.” Do they all mean the same thing?” (p. 1).

Things to Consider

Bloom’s taxonomy is an excellent framework that differentiates between lower-order thinking skills and higher-order thinking skills. However, the following points must be kept in mind when we use Bloom’s taxonomy.

Bloom’s taxonomy was developed after going through many educational outcomes that existed across various schools in America (Bloom et al., 1956). In that sense, the group worked backwards, identifying existing educational outcomes and then the taxonomy based on these outcomes.

Though referred to as a taxonomy, the framework is more of a classification of student behaviors that represent the intended educational outcomes (Kompa, n.d.). A taxonomy is evidence-based, while classification is a method to communicate ideas in a way that is useful and suggests potential actions.

The Taxonomy

The taxonomy is divided into three parts: the cognitive, affective, and the psychomotor domains. The handbook published in 1956 described the three domains but detailed only the cognitive domain.

- The **cognitive domain** refers to knowledge attainment, and mental or intellectual processes, such as the ability to solve a mathematical problem or write an essay. Let’s consider this example from mathematics: “Students will be able to understand that perimeter and area have a relationship and recognize and apply their new knowledge in real-life situations.” To achieve this learning outcome, a student must recall the definitions of perimeter and area, understand how the two differ, recall the formula to calculate these, and use this information to find out the perimeter and area of something in real life (e.g. a playground).These are mental processes that take place in the brain; hence, they fall within the ambit of the cognitive domain.
- The **affective domain** addresses emotional aspects reflected via learners' beliefs, values, and interests, such as the ability to appreciate and/or empathize. An example of the learning outcome in this domain for the mathematics topic on area and perimeter could be the following: “Students will value the need for learning about area and perimeter. They will demonstrate this by listening to the teacher, responding to their questions, and clarifying doubts.”
- The **psychomotor domain** addresses skills that are cultivated through neuromuscular motor activities, such as the ability to write, or wield a scalpel with precision. In our mathematics example, the learning outcome on the topic of area and perimeter may be, “Students will be able to draw a rectangle for a given area and perimeter using geometry tools.” This task requires motor coordination and will fall in the purview of the psychomotor domain.

In the cognitive domain, Bloom and his collaborators (Bloom et al., 1956) identified and defined six levels of cognitive complexity: knowledge, comprehension, application, analysis, synthesis, and evaluation. These levels were arranged hierarchically on a continuum ranging from simple to complex and from concrete to abstract. Each category also had sub-categories, as displayed in the following table, recreated from their original work (Bloom et al., 1956):

Levels	Categories as sub-categories

Knowledge	• Knowledge of specifics
	  ◦ *Knowledge of terminology*
	  ◦ *Knowledge of specific facts*
	• Knowledge of ways and means of dealing with specifics
	  ◦ *Knowledge of conventions*
	  ◦ *Knowledge of trends and sequences*
	  ◦ *Knowledge of classifications and categories*
	  ◦ *Knowledge of criteria*
	  ◦ *Knowledge of methodology*
	• Knowledge of universals and abstractions in a field
	  ◦ *Knowledge of principles and generalizations*
	  ◦ *Knowledge of theories and structures*

Comprehension	• Translation • Interpretation • Extrapolation
Application	Note: The original taxonomy had no sub-categories under Application
Analysis	• Analysis of elements • Analysis of relationships • Analysis of organizational principles
Synthesis	• Production of a unique communication • Production of a plan or a proposed set of operations • Derivation of a set of abstract relations
Evaluation	• Evaluation in terms of internal evidence • Judgements in terms of external **criteria**

Table 1. Structure of the Original Taxonomy

Since the categories are arranged hierarchically, the taxonomy implies that higher levels of cognition are built upon the lower levels. Intellectual operations increase in complexity from the first level, that is "Knowledge", to the last level, which is "Evaluation". There's often a misunderstanding that lower levels are less desirable than higher levels. This is not true because unless you master the lower levels, you cannot achieve the higher levels. As is stated in the handbook: "While it is recognized that knowledge is involved in the more complex major categories of the taxonomy (2.00 to 6.00), the knowledge category differs from the others in that remembering 'is the major psychological process involved here, while in the other categories the remembering is only one part of a much more complex process of relating, judging, and reorganizing" (Bloom et al., 1956, p. 62).

The higher-level thinking skills involve utilizing knowledge and understanding in new situations, or in a form that is very different from how it was learned initially. In short, the taxonomy was divided into two parts: (a) the simple behavior of remembering or recalling knowledge, and (b) the more complex behaviors of the abilities and skills.

A student recites the poem, "Stopping by Woods on a Snowy Evening" by Robert Frost. What is the cognitive level of this task?

- Remember
- Analyze
- Understand

A teacher gives her Grade 2 class a worksheet of multiplication tables to complete. Which domains will be involved in completing this task?

- Affective
- Cognitive
- Psychomotor

Kindergarten students practice writing the English alphabet using stencils. Which domain does this task address?

- Cognitive
- Affective
- Psychomotor

A Grade 10 class is tasked with discussing the historical importance of the novel *Pride and Prejudice* and its importance to the development of English literature. Which cognitive level does this address?

- Evaluate
- Create
- Apply

A student is working on a presentation using presentation software. The topic of the presentation is "Sustainable Living and Reducing Carbon Footprints." Which domains will be addressed through this task?

- Cognitive

- [ ] Psychomotor

Criticism Of the Taxonomy

The taxonomy was designed to help educators state educational objectives, develop evaluation devices, and identify instructional strategies (Bloom et al., 1956). Thus, the taxonomy was meant to be used as a cognitive tool or job-aid for educators. However, a problem with cognitive tools is that they are representations of thought, and that is inherently problematic. While the creators of such tools may take into consideration how users will comprehend and use the tool, it is not possible to anticipate all the ways in which they will understand and use the tool. A common refrain of educators was that the taxonomy was mired in ambiguity, and a consensus on the levels was difficult to achieve (Soozandehfar & Adeli, 2016, p. 3). For example, an educational objective may be classified into either of the two lowest levels (knowledge or comprehension) or into any of the four highest levels (application, analysis, synthesis, or evaluation) by different educators (Soozandehfar & Adeli, 2016, p. 5). In addition, critics argued that the taxonomy was not based on research and evidence (Kompa, n.d.). The taxonomy is also criticized for the creation of a hierarchy (lower-order thinking to higher-order thinking), which according to some educationists is not how the human brain works (Kompa, n.d.). For instance, we may analyze content in order to understand it. Lastly, there have been a number of articles, which propagate the view that the lowest level, "remember" is not important, and educators must strive to achieve the higher-order learning outcomes (Soozandehfar & Adeli, 2016, p. 5). In other words, lower-order skills (i.e., knowledge and comprehension) are considered less critical and invaluable, which is not true.

Revised Taxonomy

Because of some of the criticism of the taxonomy, the framework was revised 45 years later by David R. Krathwohl, professor at the Syracuse University. This work is published in the journal, *Theory into Practice*, Volume 41, Number 4, Autumn 2002. The main revisions included the following: (a) change in terminology and in structure, (b) emphasis on subcategories, and (c) one-dimensional to two-dimensional.

Change in Terminology and in Structure

Verbs are now used to refer to all the levels: "Remember" (in place of "Knowledge"), "Understand" (in place of "Comprehension"), "Apply," "Analyze," "Evaluate" and "Create." The levels "Synthesis" and "Evaluate" have been interchanged, with "Evaluate" at level five, while "Synthesis" (Create) is at level six.

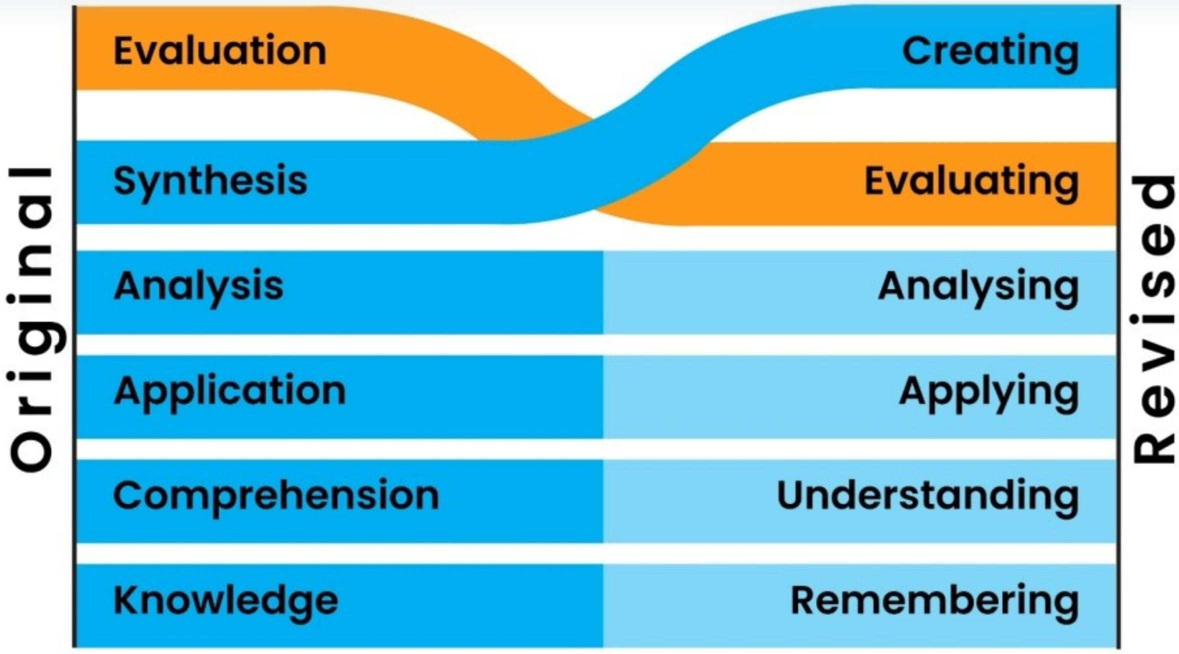

Figure 2. Revised Taxonomy

Emphasis on Subcategories

While the earlier taxonomy placed emphasis on the main categories, that is the levels, the revised taxonomy is placed on the sub-categories.

Level	Sub-categories
Level 1: Remember	Recognizing Recalling
Level 2: Understand	Interpreting Exemplifying Classifying Summarizing Inferring Comparing Explaining
Level 3: Apply	Executing Implementing
Level 4: Analyze	Differentiating Organizing Attributing
Level 5: Evaluate	Checking Critiquing

Level 6: Create	Generating Planning Producing

One-Dimensional and Two-Dimensional

This is a major structural change that was introduced in the revised taxonomy. The new “Knowledge” dimension was reorganized, and the number of sub-categories under this was increased to four. The increase in sub-categories was a result of a better understanding of cognitive psychology. Metacognition, a fourth category, was added to the Knowledge category. The table below depicts the Knowledge dimension and the sub-categories.

Category (Knowledge)	Sub-categories	Description
Knowledge Dimension	Factual Knowledge	Factual knowledge refers to knowing isolated bits of information in the form of discrete facts. Some examples are knowing the capital of countries, significant historical dates, components of the food pyramid, names of American Presidents, major battles of WWII, etc.
	Conceptual knowledge	Conceptual knowledge involves understanding relationships between various elements within a larger structure, such as classification and categories. For example, species of animals, different kinds of arguments, geological eras, Newton's laws of motion, principles of democracy, the theory of evolution, and so on.
	Procedural knowledge	The knowledge of a specific methodology, or sequence of steps required to complete a task, is known as procedural knowledge. Some examples are knowing how to solve equations, how to create and save a document using Microsoft Word, or the procedure to perform chemical experiments in a lab.
	Metacognitive knowledge	Metacognition refers to the learner's ability to be aware of their own thinking processes. Knowing how to memorize facts quickly and easily or adopt strategies for comprehending new and complex material are examples of metacognitive knowledge.

In a literature class, when teaching the poem, "The Daffodils", by William Wordsworth, the following tasks are set:

After reading the poem together as a class, students are asked to recite the first stanza of the poem followed by a question prompt such as, "What is the poet comparing the daffodils with and what resemblance does he find?" This is then followed by a task where students are told to describe the scene in the poem in their own words. Next, the students are asked to analyze the mood of the poem and poet. Finally, the students are tasked with writing a poem on nature, similar to the theme of "The Daffodils."

1. Which levels of Bloom's taxonomy in the cognitive domain can you identify?
2. Is the psychomotor domain being addressed in any way in this example? If yes, how?

Applying Bloom's Taxonomy

Though it was developed in 1956, Bloom’s taxonomy is still relevant to educators. In current times, curriculum developers, teachers, and instructional designers apply the revised version of the taxonomy in the following ways:

1. **Content Structuring:** As per Bloom’s taxonomy, learners must complete the initial levels of thinking before moving to the higher ones. When designers plan to teach a concept, this framework can help them present learning materials in a simple to complex sequence. Basically, the designer will introduce simple facts, then move on to concepts, before addressing more complex thinking tasks such as application, analysis, evaluation, and synthesis. For instance, if the person using the taxonomy were a teacher, they would first introduce the components of a story (plot, characters, conflict, and resolution) before asking their students to write a story. Typically, in lower grades within K-12, information recall is the focus; in the middle grades, understanding and application of concepts is emphasized; and in the higher grades, students work on analyzing, evaluating, and synthesizing concepts and principles.
2. **Teaching and reinforcing:** An understanding of the different levels in Bloom’s taxonomy helps instructors decide whether a previously taught concept needs to be reinforced. To continue with our example, if learners can recall the components of a story but are struggling to write one, the teacher may select examples from different stories to highlight each component so that the students develop an understanding of the components. In addition, the teacher may also ask students to read a story and identify these components on their own, and then provide feedback.
3. **Assessing:** A very good application of Bloom’s taxonomy is the mapping of questions to the level at which the learning outcomes are set. If the learning outcome is set at a recall level, then teachers must create questions that test learners for recall to ensure that the assessment is valid (a valid test is one that measures what it claims to measure). For example, if the learning outcome is to recall and understand the components of a story, the test should not assess students’ abilities to write a story. This would be inappropriate and a misalignment between the learning objective, the teaching, and the assessment; this may cause students to feel frustrated. But, if the learning outcome is to develop the ability to write a story, and the instruction focused on developing skills for this learning outcome, then the assessment must test if learners can write a story.

Note: It’s important to remember that it may not be possible in certain disciplines to map all the levels because different disciplines require different types of thinking. For instance, a pilot being trained is not typically expected to be “creative”; rather they are expected to follow standard operating procedures. On the other hand, the discipline of “art” will require high levels of creativity. In short, the value and priority of the levels will differ across disciplines. Further, the interpretation of levels changes across grades. For example, writing a story will be “synthesis” in the primary grades, but

Applying the Taxonomy: Case Study

LIDT in the World: "Using Teaching Cases for Achieving Bloom's High-Order Cognitive Levels: An Application in Technically Oriented Information Systems Course" (Tan, 2017)

This research demonstrates how case studies were used to connect theory with real-world examples in teaching a computing course. This course is taken by students pursuing the undergraduate degree program in Information Systems at the Singapore Management University. As part of this initiative, three types of case studies were used to teach how to design an **Enterprise Web Portal**. These case studies were used to accomplish different learning outcomes mapped to the various cognitive levels in the revised Bloom's taxonomy. This initiative was tracked over two academic years through surveys. The outcome revealed that teaching in this way helped students achieve higher-order cognitive levels, such as evaluating and creating.

In this research initiative, the three types of case studies, which were introduced by the researchers, were: a storytelling case, a design-and-problem-solving case, and a create-design-implement case as part of the course. This is how the researchers described the three cases:

1. Cases where problems and solutions (or options) are described within the case and do not involve technical tasks are storytelling cases. This type of case study addresses the remembering, understanding, and applying cognitive levels.
2. Cases where students analyze scenarios in order to design a solution to address the stated needs are problem-solving cases. These scenarios are not real, but mimic **conditions** in the real world. This type of case aims to address the analysis level along with remembering, understanding, and applying.
3. Cases in which students are provided with real-world situations and are expected to create a scenario and identify needs in order to design a solution by configuring the features of packaged software, and customizing it are create-design-implement cases. This type of case addressed the applying, analyzing, evaluating, and creating cognitive levels.

Through this study, the researchers gathered empirical evidence that proved how, by using case studies, students achieved outcomes at higher cognitive levels of the revised Bloom's taxonomy. The initiative gave students an opportunity to see their solutions in action, and the implications of their design decisions. In addition, it helped to prepare students for a career in the real world.

Reflect: What role did an understanding of Bloom's taxonomy play in helping this case-based learning to be successful?

Robert Mager

A chapter on learning outcomes is not complete without mentioning Robert Mager and his seminal work in this area. Mager came up with a format for writing learning outcomes. He referred to learning outcomes as behavioral objectives and proposed that a well-written behavioral objective has three parts (Mager, 1962, p. 41):

- **Criteria:** the standards for measuring the performance

Here is an example of a learning outcome written using Mager's format with a breakup of the three components:

> ### Example
>
> **Learning outcome:** Write an original, compelling, and engaging story in the fantasy genre.
>
> **Terminal Behavior:** Write a story
>
> **Condition:** Fantasy genre
>
> **Criteria:** Original, compelling, and engaging

Writing learning outcomes using this format makes the outcomes verbose and complex. Hence, most educators apply the performance part and drop the condition and criteria. The condition is stated if there are multiple ways to complete a task and only one of these is being taught and assessed. In our example above, there are many genres of story-writing, so it is important to specify which one is being taught and assessed—hence, it is useful to describe the condition. Criteria are stated as part of the learning outcome for subjective content, where a rubric is to be used to evaluate. If the learners are being assessed through objective questions, then the passing score becomes the criteria and does not need to be specifically stated in the learning outcome statement (Tucker, 2023).

Of the three components, Mager emphasized terminal behavior, which he stated must be written using specific and measurable verbs. The emphasis on verbs was placed because Mager considered that they helped to measure the success or failure of the learner in completing a learning task. He advised that the use of ambiguous verbs, such as "know" and "understand" be avoided when writing behavioral objectives (Mager, 1962, p. 11).

Summary

Similar to other teaching-learning frameworks, Bloom's taxonomy has advantages and disadvantages. The strength in the taxonomy lies in how it structures the thinking process and connects it with learning. Educators who use the taxonomy thoughtfully can make informed decisions while teaching and ensure that they plan and design learning events that will help develop different thinking skills. However, there is also the possibility that teachers may select learning outcomes that they think are desirable without much thinking or planning. This will do more harm than good. To summarize, it is important to understand that Bloom's taxonomy is a descriptive framework that illustrates the complex nature of the thinking process and provides a structure for understanding it. It must not be used as a prescriptive framework (a template) where designers pick verbs from a readily available list without giving much thought to whether the learning outcome is applicable in the given context or not.

1. A student recites the poem, "Stopping by Woods on a Snowy Evening" by Robert Frost. What is the cognitive level of this task?
   This task is at the Remember level, since the student is recalling the poem from memory.
2. A teacher gives her Grade 2 class a worksheet of multiplication tables to complete. Which domains will be involved in completing this task?
   Cognitive and psychomotor, since the students will recall the times tables (cognitive) and use a pencil to complete the activity (psychomotor).
3. Students practice writing the English alphabet using stencils. Which domain does this task address?
   This task will address the psychomotor domain because the focus is on motor skills.
4. A Grade 10 class is tasked with discussing the historical importance of the novel Pride and Prejudice and its importance to the development of English literature. Which cognitive level does this address?
   This task will involve evaluating the novel on certain parameters (historical importance and importance in the development of English literature) and is thus at the Evaluate level.
5. A student is working on a presentation using presentation software. The topic of the presentation is "Sustainable Living and Reducing Carbon Footprints". Which domains will be addressed through this task?
   Cognitive, Affective & Psychomotor domains will be involved. Knowing, understanding, analyzing and applying information on sustainable living (Cognitive); knowing how to use software (cognitive); appreciating the need to live sustainably (Affective) and using computer peripherals, such as mouse or touchpad and keyboard (Psychomotor).

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Suggested Readings

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Access it online or download it at
https://edtechbooks.org/foundations_of_learn/blooms_taxonomy.

Instructional Design Models

Tonia A. Dousay & Jill E. Stefaniak

Design | Instructional Design | Instructional Design Models

Phases of rapid development in the field of learning and instructional design technology have given way to dozens of instructional design models. These models often form the foundation of instructional design courses, introducing students to the field. However, broad and specific misconceptions often drive new designers to overly rely on models to guide them through an applied instructional design process. In this chapter, we explore a brief history of instructional design models, common components of models, commonly referenced models, and resources and advice for instructional designers as they engage in the instructional development process.

Researchers and practitioners have spent the past 60 years attempting to define and create models of design with the intent to improve instruction. As part of a joint, inter-university project, Barson (1967) defined instructional development as the systematic process for improving instruction. While the project report provides a guiding definition to frame and study instructional design (ID), it also cautions that many different conditions influence learning, including the use of media and the hazards of generalizing any sort of model. This caution continues to serve as a limitation on ID practice and research, as evidenced by current and past ID models.

Soon after World Wars I and II, experts in the field recognized that systematic approaches to developing instruction were a popular idea, highlighting that ID methods vary from simple to complex (Twelker et al., 1972). These historical observations predicted the reality where every instructional design project is always unique, with no two projects progressing through the design process the same way. The differences, sometimes subtle while at other times significant, have given way to dozens of different models used with varying popularity in a wide variety of learning contexts.

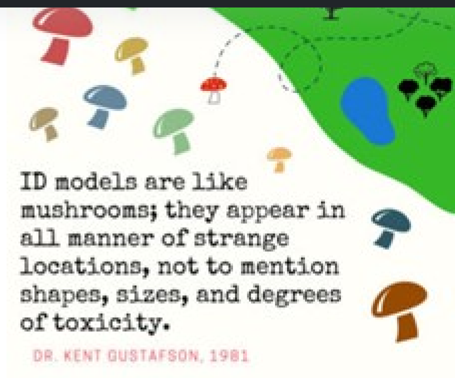

Figure 1. Mushrooms

In the midst of an explosion of models and theories, Gustafson (1991) drafted his first monograph that would become the Survey of Instructional Development Models, now in its fifth edition (Branch & Dousay, 2015). The book provides brief overviews of instructional design models, classifying them within the context of classroom-, product-, and process-oriented instructional problems. Also known as "the pencils book," this resource provides a concise summary to help novice instructional designers visualize different design approaches. It also assists more advanced instructional designers with an annotated bibliography on current practice and research. However, this text is just one of many often used in the study and practice of instructional design. Those seeking to expand their knowledge of design processes can learn much from the rich history and theoretical development over decades in the field. (See the Additional Resources section for suggestions.)

In this chapter, we explore a brief history of instructional design models, common components of models, commonly referenced models, and resources and advice for instructional designers as they engage in the instructional design process.

Historical Context

The field of Learning and Instructional Design Technology (LIDT) has experienced many periods of rapid development. Reiser (2001) noted that training programs during World War II sparked the efforts to identify efficient, systematic approaches to learning and instructional design. It would be another 20 years before the first models emerged, but the 1960s and 1970s gave way to extracting instructional technology and design processes from conversations about multimedia development (Reiser, 2017), which in turn produced more than three dozen different instructional design models referenced in literature between 1970 and 2005 (Branch & Dousay, 2015; Gustafson, 1991; Gustafson & Branch, 1997, 2002).

These models help designers, and sometimes educational **stakeholders**, simplify the complex reality of instructional design and apply generic components across multiple contexts (Gustafson & Branch, 2002), thus creating standardized approaches to design within an organization. However, Molenda (2017) observed that standardization of processes and terminology triggered interest in the field. This presents an interesting relationship between defining the field of instructional design and perpetuating its existence. As designers seek to justify their role in education—whether K-12, higher education, or industry—they often refer to existing models or generate a new model to fit their context. These new models then become a reference point for other designers and/or organizations. This relationship contributes to contentions when teaching and practicing ID.

Differences exist between academic instructional design and industry expectations when it comes to how instructional design models are referenced and used. Many introductory instructional design courses introduce students to models and rely on models to guide students through an applied instructional design process. Within these introductory courses, students who are new to the field have an opportunity to navigate the instructional design process in a scaffolded manner led by their instructor.

More specifically, coursework can use models as a mechanism to explore ID aptitudes. Several studies conducted over the last decade examined competencies expected of instructional designers (Ritzhaupt & Kumar, 2015; Ritzhaupt & Martin, 2014). These studies support the need for instructional designers to be knowledgeable of design and commonly recognized design processes. Further, context analysis studies of instructional design job postings reveal that employers expect instructional designers to be knowledgeable about a variety of processes and models such as ADDIE, Agile, SAM, Rapid deployment, Bloom's taxonomy, ARCS, and Gagne's Conditions of Learning (Kang & Ritzhaupt, 2015; Klein & Kelly, 2018; Raynis, 2018; Wang et al., 2021). Recognizing that job postings explicitly ask instructional designers to demonstrate knowledge and application of instructional design models, we suggest that instructional design programs prepare students to recognize multiple instructional design models in addition to understanding how to navigate through the instructional design process while using a systemic lens.

Learn More

Listen to Dr. Jill Stefaniak discuss the systemic consequences of the models designers use in the real world:

https://open.spotify.com/episode/303XBqCaMKGNV0YkEwKpIz

Systemic Nature

In addition to criticisms that ID models do not accurately convey the iterative nature of design, others denounce models for a lack of systemic implications. In a systematic review examining the systemic reach of ID models, Stefaniak and Xu (2020) found that a majority of studies did not address the interrelationships between instructional processes and activities related to instructional design. Rather, applications rely heavily on using a model to guide the design and development of a product. Thus, we must attend to the systemic implications of learning and applying models.

Systems are dynamic, in nature, and constantly changing as new information and inputs to the system become available (Richardson & Chemero, 2014). Gibbons (2003) argued that the field's existing ID models focus on the medium rather than the design process. Treating models in this way places emphasis on the product, relegating the steps conveyed within an ID model to **prescriptive** or procedural-based actions or steps. However, such an approach does not reflect the complexities that exist with systems, including **learning design** (Gibbons, 2014).

The pencils book emphasizes that models should be used to "serve as conceptual, management, and communication tools" (Branch & Dousay, 2015, p. 23) for supporting instructional design efforts. Thus, we strongly recommend that instructional designers approach the use of ID models by thinking of them as blueprints to frame design activities within the overarching system. By shifting focus on the design process as opposed to the development of a product, instructional designers may be more apt to embrace the iterative nature of design and integrate design decisions that consider the dynamic complexities of the system.

Consider the blueprint analogy described here and pretend that you are a builder who has been contracted to design and build a single-story house for a multi-generational family. The preliminary meeting with the client reveals a need for a four-bedroom/two-bathroom home with a kitchen, living area, and detached garage. Based on these needs, your architect produces a blueprint of a two-story residence. The bathrooms are designed for shower-bathtub combinations using curtains and rods. One bedroom is located on the main floor while the other three are located on the second floor. Notes for flooring indicate using tile or hardwood throughout the residence.

As your crew raises the exterior and interior walls and supports, you share the blueprint with the clients and invite them to walk through the home. During the conversation, you learn that the eldest member of the family has accessibility needs. They are unable to walk without assistance and do not do well on slippery surfaces. Their bedroom will need to be on the main floor, and they need an Americans with Disabilities Act (ADA)-compliant bathroom with space for a walker to turn around and an open entry shower.

What do you do? How do you modify the blueprint to account for these accommodations?

Reflect on how the builder has to modify their blueprint to accommodate the needs of their client and meet ADA standards. Think about how this might relate to how an instructional designer may be required to adapt and modify their instructional design blueprints as information becomes available throughout a design project.

Process vs. Models

The process of analyzing, designing, developing, implementing, and evaluating (ADDIE) forms the basic underlying procedure (illustrated in Figure 2) that is a distinct component of instructional design regardless of which model is used (Gustafson & Branch, 1997). Branch (2009) said it well when he conceptualized the phases of the ADDIE process as follows:

Figure 2. The ADDIE Process

3. Develop – Generate and validate the learning resources.
4. Implement – Prepare the learning environment and engage the students.
5. Evaluate – Assess the quality of the instructional products and processes, both before and after implementation (p. 3).

Learn More

Watch Dr. Rob Branch chat with *Off-the-Cuff*: ADDIE is not a model:

https://www.youtube.com/watch?v=DfQvTMxTDds

Notice the use of the term "process" rather than "model." For ID purposes, we define a process as a series of steps necessary to reach an end result. Similarly, we define a model as the specific instance of a process that can be imitated or emulated. In other words, a model seeks to personalize the generic into distinct functions for a specific context. Thus, when discussing the instructional design process, we often refer to ADDIE as the overarching **paradigm** or framework by which we can explain individual models. The prescribed steps of a model can be mapped or aligned back to the phases of the ADDIE process.

This discussion might also be facilitated with a business example. Consider the concept of process mapping; it helps organizations assess operational procedures as they are currently practiced (Hunt, 1996). Analytically mapping the process to identify the steps carried out in practice leads to process modeling, an exercise in optimization. In other words, modeling helps move processes to the desired state tailored to the unique needs of an organization. Many businesses of a similar type find that they have similar processes. However, through process modeling, their processes are customized to meet their needs.

The relationship between ADDIE and instructional design models functions much like this business world scenario. As instructional designers, we often follow the same process (i.e., ADDIE). However, through modeling, we customize the process to meet the needs of our instructional context and of our learners, stakeholders, resources, and modes of delivery. Models assist us in selecting or developing appropriate operational tools and techniques as we design.

Modeling the Process

Consider the following examples. The plan, implement, evaluate (PIE) model from Newby, Stepich, Lehman, and Russell (1996) encourages designers to consider how technology assists with instructional design, focusing on the what, when, why, and how. This phase produces an artifact or plan that is then put into action during implementation, followed by evaluating learner performance and instruction effectiveness. During planning, designers work through a series of questions related to the teacher, learner, and technology resources. The questions are answered while also taking into consideration the implementation and evaluation components of the instructional problem. When considered through the lens of the ADDIE process, PIE combines the analyzing, designing, and developing phases into a singular focus area, which is somewhat illustrated by the depiction in Figure 3.

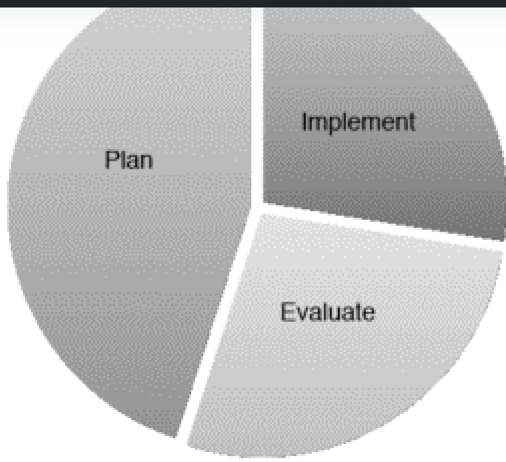

Figure 3. The PIE Model

Similarly, the Diamond (1989) model prescribes Phase I "Project Selection and Design" and Phase II "Production, Implementation, and Evaluation for Each Unit." Phase I of the Diamond model combines analyzing and designing, while Phase II combines developing, implementing, and evaluating. Robert Diamond placed an emphasis on the second phase of the model by prescribing an in-depth, parallel development system to write objectives, design evaluation instruments, select instructional strategies, and evaluate existing resources. As a result, new resources consider previously designed evaluation instruments. The evaluation is again consulted during the implementation, summative evaluation, and revision of the instructional system. These two examples help demonstrate what meaning is behind ADDIE being the general process and models being specific applications. (For further discussion of how aspects of specific models align with the ADDIE process, see Dousay and Logan, 2011.)

ID Models in Practice

Models serve as a source of research questions as we seek to develop a comprehensive theory of instructional development. Rarely are these models tested through a rigorous assessment of their results against predetermined criteria. Rather, ID models with wide distribution and acceptance gain their credibility by being found useful by practitioners who frequently adapt and modify them to match specific conditions (Branch & Dousay, 2015, p. 24). Thus, popularity serves as a form of validation for these design models. However, a wise instructional designer knows when to use, adapt, or create a new model of instructional design to fit their purposes.

Because there are so many different ID models, how do we choose which one to use? In framing this conversation, the Survey of ID Models (Branch & Dousay, 2015) serves as a foundation, but by no means should be the sole reference. A total of 36 different instructional design models (see Table 1 for a summary) have been covered in the pencils book since its first edition, and this list does not include every model created or used. Still, this list of models is useful in providing a concise guide to some of the more common approaches to instructional design.

Model Name[a]	1st Ed 1981	2nd Ed 1991	3rd Ed 1997	4th Ed 2002	5th Ed 2015	6th Ed 2022
Organization Development[b]						
Blake & Mouton (1971)	x					
Blondin (1977)	x					

Model Name[a]	1st Ed 1981	2nd Ed 1991	3rd Ed 1997	4th Ed 2002	5th Ed 2015	6th Ed 2022
Classroom-Oriented						
3PD (Sims & Jones, 2002)					x	
4C/ID (van Merriënboer, 1997)					x	x
ASSURE (Heinich, Molenda, & Russell, 1982)		x	x	x	x	x
Briggs (1970)	x					
DeCecco (1968)	x					
Dick & Reiser (1989)		x	x			
Gerlach & Ely (1971)	x	x	x	x	x	x
Learning Systems Design (Davis, Alexander, & Yelon, 1974)	x					
Morrison, Ross, Kemp, & Kalman (Kemp, 1977)	x	x	x	x	x	x
PIE (Newby et al., 1996)				x	x	
UbD (Wiggins & McTigue, 2000)					x	x
Model Name[a]	**1st Ed 1981**	**2nd Ed 1991**	**3rd Ed 1997**	**4th Ed 2002**	**5th Ed 2015**	**6th Ed 2022**
Product-Oriented						
Agile (Beck et al., 2001)					x	x
Baker & Schutz (1971)	x					

Banathy (1968)	x					
Bates (1995)				x	x	
Bergman & Moore (1990)		x	x	x	x	
CASCADE (Nieveen, 1997)				x	x	
de Hoog, de Jong, & de Vries (1994)				x	x	
Leshin, Pollock, & Reigeluth (1992)		x	x			
Van Patten (1989)		x	x			

Model Name[a]	1st Ed 1981	2nd Ed 1991	3rd Ed 1997	4th Ed 2002	5th Ed 2015	6th Ed 2022
Systems-Oriented						
Courseware Development Process (Control Data Corporation, 1979)	x					
Culture Based Model (Young, 2008)						x
Diamond (1989)		x	x	x	x	x
Dick, Carey, & Carey (Dick & Carey, 1978)		x	x	x	x	x
Gilbert (1978) Front End Analysis	x					
Instructional Development Institute (Twelker et al., 1972)	x	x	x			

ILDF (Dabbagh & Bannan-Ritland, 2004)					x	
IPISD (Branson, Rayner, Cox, Furman, & King, 1975)	x	x	x	x	x	x
IPDM (Gentry, 1993)			x	x	x	x
ISD Model 2 (Seels & Glasgow, 1997)		x		x	x	x
Layers of Necessity (Tessmer & Wedman, 1990)						x
Pebble in the Pond (Merrill, 2002)					x	x
Rapid Collaborative Prototyping (Dorsey, Goodrum, & Schwen, 1997)				x	x	
Smith & Ragan (1993)			x	x	x	x
TOTAL	**13**	**12**	**13**	**15**	**21**	**15**

Table 1. Instructional Design Models included in editions of the Survey text
[a] All references refer to the original or first edition of a model; however, the current name of the model as well as current scholars affiliated with the model may vary from the original iteration.
[b] Organization development was removed from the pencils book in the 2nd edition.
[b] The orientation categories (classroom, product, and systems) were removed from the pencils book in the 6th edition.

Determining which ID model to use might best be decided by taking into account a few factors. First, what is the anticipated delivery format? Will the instruction be **synchronous** online, synchronous face to face, **asynchronous** online, or some combination of these formats? Additionally, some models are better tailored for online contexts, such as Dick and Carey (1978); Bates (1995); Dabbagh and Bannan-Ritland (2004); or Morrison, Ross, Kemp, Kalman, and Kemp (2012).

Another way to think about how to select a model involves accounting for the context or anticipated output. Is the instruction intended for a classroom? In that case, consider 3PD (Sims & Jones, 2002); 4C/ID (van Merriënboer, 1997);

(Wiggins & McTigue, 2000). Perhaps the instructional context involves producing an instructional product handed over to another organization or group. In this case, consider Agile (Beck et al., 2001); Baker & Schutz (1971); Banathy (1968); Bates (1995); Bergman & Moore (1990); CASCADE (Nieveen, 1997); de Hoog, de Jong, & de Vries (1994); Leshin, Pollock, & Reigeluth (1992); or Van Patten (1989). Lastly, perhaps your context prescribes developing a system, such as a full-scale curriculum. These instructional projects may benefit from the courseware development process (Control Data Corporation, 1979); culture based model (Young, 2008); Diamond (1989); Dick, Carey, & Carey (Dick & Carey, 1978); Gilbert (1978) front end analysis; Instructional Development Institute (Twelker et al., 1972); ILDF (Dabbagh & Bannan-Ritland, 2004); IPISD (Branson et al., 1975); IPDM (Gentry, 1993); ISD model 2 (Seels & Glasgow, 1997); layers of necessity (Tessmer & Wedman, 1990); pebble in the pond (Merrill, 2002); rapid collaborative **prototyping** (Dorsey et al., 1997); or Smith & Ragan (1993) models.

Conclusion

This chapter synthesizes nearly 60 years of practice and study of ID models. From K-12 to higher education and industry, dozens of models continue to guide efforts that systematically design learning. However, when learning and practicing ID, it is easy to become constrained by models or lose sight of their role in systemic applications. Thus, we strongly recommend developing ID competencies indicative of design processes. Deciding which model to use does not need to be a cumbersome or overwhelming process. So long as a designer can align components of an instructional problem with the priorities of a particular model, they will likely be met with success through a systems thinking approach.

Think About It!

- While processes and models can be useful, why do you think it is important to maintain flexibility in designing instruction?
- What are some things to consider when selecting an instructional design model? Are there particular models you have used for specific projects?
- Think about a recent instructional design project you completed. Make a list of items you were required to modify or adjust throughout the project. How many times did you have to revisit certain phases of the instructional design process?

Editor's Note

To read more on this topic, see the chapter titled "Instructional Design Models" published in the first edition of this textbook.

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Additional Resources

The following resources represent a broad collection of discussion, debate, and research in the field of learning and instructional design. The list has been compiled from resources such as the Survey of Instructional Design Models (Branch & Dousay, 2015), reading lists from graduate programs in LIDT, and publications sponsored by the Association for Educational Communications & Technology. However, the list should not be considered exhaustive. It is provided here as a starting point for individuals or organizations seeking to learn more about the field and how models are developed and implemented.

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ISD and Functional Design Layering

Andrew Gibbons & Jason K. McDonald

This chapter has two purposes. First, we contrast two approaches to instructional design—the traditional Instructional Systems Design (ISD) process and an alternative view known as Functional Design Layering (FDL). In our review, we describe the background of each approach, the problem(s) each approach attempts to solve, and the types of decisions each approach prepares instructional designers to make. Second, we show how these different approaches play complementary roles in the practice of instructional design. When considered together, they offer a more robust conception of how instructional designs can be created. Essentially, ISD focuses on design process at the expense of internal design structure, whereas FLD focuses on internal design structure and proposes a naturalistic view of design decision order that is more closely aligned with actual designer practice. Considered together, these contrasting approaches become mutually strengthening, providing the designer with a wider range of design questions and design process options.

Instructional Systems Design: Origins

The focus of Instructional Systems Design (ISD) is on ensuring instructional designers follow a process that will enable them to create powerful instructional (or learning) systems. Its foundations can be traced to the book *Psychological Principles in System Development* (Heretofore referenced to as *PPSD*) (Gagné, 1965). Here, Gagné described training and education systems as "man-made 'synthetic' organisms, whose components, subsystems, and interactive mechanisms have analogous functions to those of biological organisms . . . " (Gagné, p. 12). If there was an enduring idea in the original expression of *PPSD*, it was the concept of a system as an organic, adaptive entity, with the system's functions being the point of departure for design.

> *Planning for the development of a system begins with a series of decisions regarding the functions to be performed by various parts of the system in their subordinate contributions to a total complex which will accomplish system goals. (Gagné, p. 34)*

Gagné was proposing that the basis for system design was an inventory of the functions the designed system would perform. However, a gradual shift in the interpretation of the term "function" that occurred over time was pivotal in shaping the eventual form of ISD. Chapters of *PPSD* were weighted heavily in terms of design processes, so it became accepted that *design* functions—as opposed to *system* functions—should be the more central concern. Processes like target population analyses, task analyses, and the selection of media came to predominate the design approach; the study of internal instructional artifact functionalities such as content and strategy structuring, message and learner control design, and message representation became secondary.

The theme of "systems development" from *PPSD* was amplified over several decades by Gagné and many of his colleagues, morphing over time into the "systems approach" to instructional design. What resulted was a body of design process prescriptions that is still the dominant approach taught in graduate-level instructional design programs and commercial industrial training manuals (Curry et al., 2021; Etmer et al., 2013; Gagné, 2004).

instructional design industry (Briggs et al., 1991; Dick et al., 2009; Gustafson, 1981; Gustafson & Powell, 1991; Heinich et al., 1996; Kemp, Morrison, & Ross, 1994; Reiser & Dick, 1996; Smith & Ragan, 1999). To aid widespread dissemination of ISD models, it became necessary to simplify them for a variety of non-academic audiences. For example, the multi-volume *Interservice Procedures for Instructional Systems Development* (Branson et al., 1975) attempted to place instructional design practice in the hands of untrained military and government designers. This, and other likeminded process descriptions, were used to train a large number of novice designers in military and government service who, after gaining a degree of experience, eventually found career paths leading to general commerce and industry.

There were many beneficial outcomes from the widespread dissemination of ISD models: project management became more predictable because design was packaged as a set of standard processes; design projects became more schedulable and manageable; designers with minimum training could gain entry to a career path with a reasonable threshold that did not require a specialized degree; and the training function itself could be assimilated by large training organizations as a source of improved workforce performance. Design defined as a collection of processes proved to have many uses, and the domination of the field by an engineering frame of mind—unbalanced by alternative views—lasted until the 1980s and 1990s, when a more searching view of design processes independent of disciplines became a topic of intensive study.

Alternative Approaches to Design Emerge

ISD emerged in an environment where many design fields (e.g. architecture, product design; see Cross, 2007), not just instructional design, were dominantly focused on a process-centric approach to systems development (Banathy, 1968; Briggs, 1967; Diamond, 1997; Hamreus, 1968; Gerlach & Ely, 1980). However, in many of these fields, alternative ways of thinking about design started to emerge and found popularity as process models were found to be inflexible in some applications and generally untrue to the natural decision-making patterns of designers in practice. Systematic design models logically begin with multiple analyses for a complete survey of the design and implementation environment, including user demographics, existing resources, resource constraints, and even organizational politics. But, in practice, designers don't wait for analysis results before they begin to hypothesize the broad outlines of one or more possible design configurations. Moreover, designers found that these design hypotheses feed back into the analysis process, leading to further analysis to support or cancel a particular design hypothesis. Schön (1987) refers to this as the "conversation" (p. 43) between the designer and the design problem: a back-and-forth exchange between analysis findings and design hypotheses, with hypotheses leading to further analysis.

Alternative approaches to design became a current topic in many design fields in the 1980s and 1990s, as design itself became a topic of study, promoted by the work of Simon (1999), Alexander (1964, 1977), Jones (1970), Darke (1979), Schön (1987), Kelley (2005), Dorst (2011), Cross (2018), and others. Even in engineering fields such as aviation design, researchers like Vincenti (1990) recognized that the exact nature of design questions and goals was refined in the process of making designs that worked. Schön's description of the reflective practitioner showed the designer studying the internal structures and functions of designed artifacts in terms of design languages describing artifact functions rather than design process functions.

The foregrounding of *artifact* functions and design thinking not only raised questions about how designers solve problems, but also questions about the nature of designs themselves. Darke (1979) proposed the concept of the "primary generator" of a design, a structural concept around which the remainder of the design could coalesce. Schön (1987) and Reinfrank & Evenson (1996) described the concept of design language and suggested that function-specific design languages existed within the "layers" of a design. Separation of functional layers in the design of computers, software, and architecture (Brand, 1994) echoed this concept, describing how the modularization of designs made possible by layer structures gave the designed artifact a longer service life, since changes could be made to layer designs with minimal disruption of other layers. An extended case study of layered design by Baldwin and Clark (2000) showed that layered or modularized designs made the escape from computers with monolithic designs possible, design layering based on artifact functionality is found today in virtually all design fields and provides major economic benefits. Today, fields that do not consider design layers and the modularity they afford are denied access to product maintainability and the attendant economic value.

Revisiting the Interpreting of "Function" in Instructional Systems (Functional Design Layering)

Fresh ideas about design and design theory have been slow to reach the instructional design field. There have been critical reviews of ISD and its dominance (Bichelmeyer et al, 2006; Gibbons et al, 2010, 2013, 2014; Gordon & Zemke, 2000; Merrill et al., 1990; Smith, 2008; Smith & Boling, 2009), but alternatives to ISD as the sole approach to design have been slow to emerge and find a place in academic literature and academic design programs. This may be due to an early (mis) interpretation in the field, where the term "function" was used to refer to "design" function. Revisiting Gagné's original description of "function" as expressed in *PPSD* would lead to a much different view of instructional design today, if it referred to the functional elements of the artifact being designed as well as the functions of designing. The ISD model focuses the designer's attention on functions performed by the designer; instead, we might also consider the functions carried out as subprocesses within the artifact being designed.

Gagné originally suggested that:

> *Because of the nature of a synthetic organism, the functioning of its parts and subsystems may be studied directly, thus providing a means of developing systematic accounts of the processes of interaction within the system as well as their effects on total system functioning. (Gagné, 1965, p. 12)*

Focus on the functions of the "organism" opens a new perspective on instructional design and the act of designing instructional experiences.

A functional (or architectural) theory of instructional design proposed by Gibbons (2009, 2014) takes this approach. To create organic designs—designs that can change and adapt dynamically with changes in external conditions—one must consider the functions performed by the "organism" itself—the artifact being designed. Brand (buildings) demonstrates that buildings possess life-extending properties if they have been designed according to a separation of functional "layers," each layer being a functional design subproblem: exterior skin layer design, separate from an interior spaces design; the separation of services design (electrical systems, plumbing) from the design of supporting structures and foundational elements (Figure 1).

A functional approach of this kind does not preclude the parallel use of a process-centered design process model; it enhances it by offering the designer a more flexible approach to the ordering of design decisions and analyses.

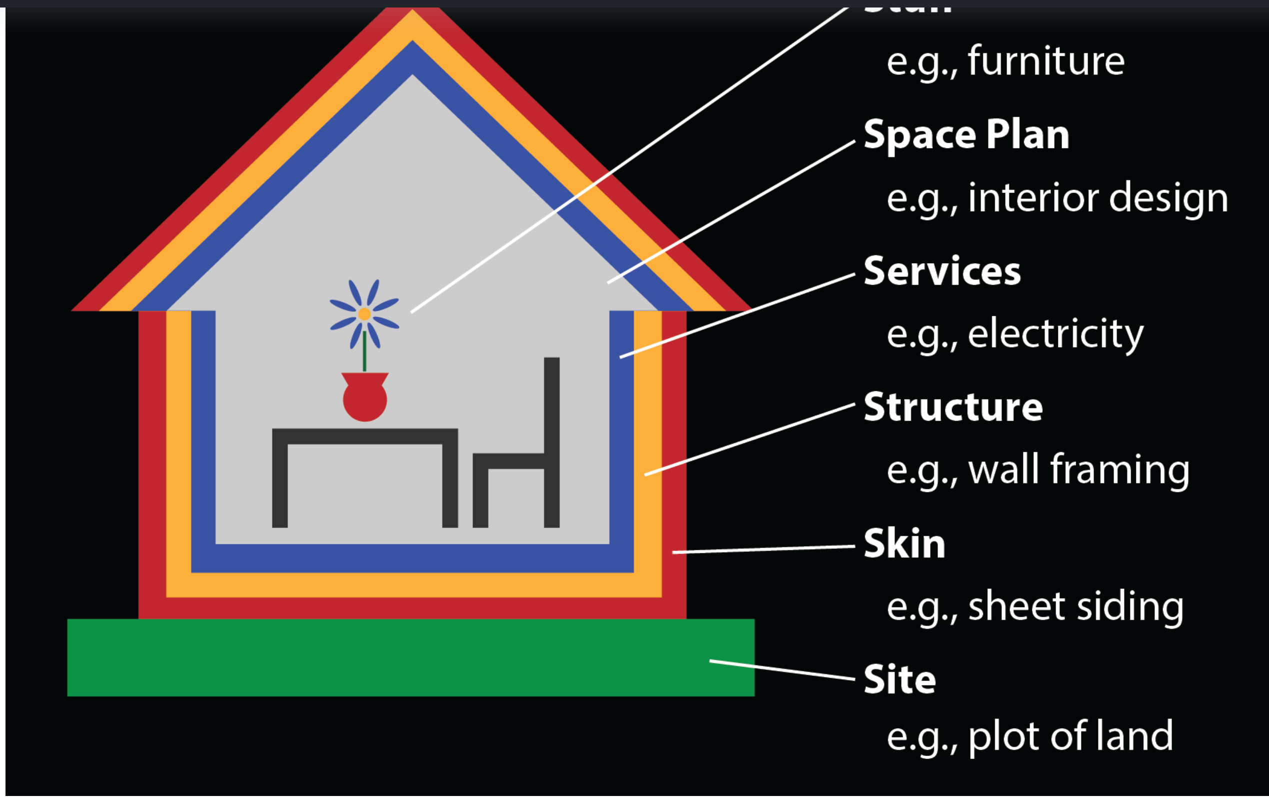

Figure 1. The Layers of a Building's Design (adapted from Brand, 1994).

An automotive design team will approach the design of a new car with a process model in one hand and a description of the functions of the automotive product in the other. The process model makes design manageable, while the functional artifact model points out the very substance of the design. Functions of an automobile artifact design include certain essentials such as propulsion systems, traction systems, braking systems, and steering systems. Each of these systems is supplied with the language terms related to each layer of the design: "engine," "wheel," "brake." These are designable artifact elements, and a specialist in designing one part will know the language of that part's design. Each layer design over time decomposes into subsystems (e.g., "brake pad" or "caliper") to be designed. This artifact-focused approach is equally valuable and equally as valid as the process approach. The approaches complement each other with their strengths.

Gibbons (2014) proposes a list of generic instructional functions as a minimal set for instructional artifacts. These include:

- The formation of sequenced packages of elemental **message** packets to provide substance for the formation and projection of representations (a Message Layer)
- The description of the **device means** and a **device-related language** for use by the learner in communication of messages back to the instructional source (a Control Layer)
- The definition of instructional/experiential **events** and a plan for their sequencing (a Strategy Layer)
- A system for describing and capturing constituent parcels of **"knowables" and "performance expertise"** (a Content Layer)
- A system for **recording and analyzing** interactions and learner action patterns (a Data Management Layer)
- Directions for operating the experience-enacting **delivery platform** or mechanism (human or computerized) capable of bringing together and coordinating events, content parcels, message and control elements, representations, recordings, and analyses (a Media-Logic Layer).

Seven Basic Layers for Instructional Systems

Each instructional function in an artifact can be described in terms of a layer, or a specific design problem to be addressed. Gibbons (2014) proposed seven basic layers for instructional systems.

Representation layer – The parts of instruction that learners directly see, hear, touch, etc. (seeing an image on the screen; hearing a voice explain a concept).

Message layer – The underlying instructional intentions that are given concrete shape by various representations (the intention behind explaining a procedure; the intention behind presenting possible actions and consequences).

Control layer – The ways learners act in the instructional environment (using a keyboard to enter text into an online form; raising a hand to alert a teacher they want to speak).

Strategy layer – The plans for instructional events and interactions, along with the sequence of how learners experience those events/interactions (explanation-demonstration-practice; solving authentic problems).

Content layer – The underlying subject matter that forms the "raw material" of instruction (a skill to be performed; a body of knowledge to master).

Data management layer – How information about the instruction is gathered, stored, analyzed, and reported (how much time learners spent in a system; students' scores on a test).

Media-logic layer – How all the other layers are brought together, coordinated, and adjusted throughout instruction (learning management systems; computer operating systems).

It is proposed that this list of functions represents an essential abstract of the instructional artifact. These functions are performed to facilitate instructional experiences, regardless of the delivery medium chosen by the designer, the designer's instructional philosophy or strategy preference, or their preferred theoretical stance. Therefore, they represent a core of artifact functions to be designed. As in the automobile design example, each layer of the design poses questions and choices. This makes available to the designer a variety of design language options for each layer and associated theories of representation design, message formation and interaction, control design, and so forth. Most importantly, it makes the designer aware of a host of design questions that under a process design approach are defaulted because they do not always appear to the designer as choices.

theory agnostic, accommodates the designer's preference for instructional theory. The basic inventory of layers (and sublayers) described above does not change with advances in theory and technology as much as it is added to, detailed, and subdivided by them. New discoveries may add new sublayers and design specialties, but there is always the need for a representation function, a message formation function, a control function, a strategic function, and a function that parcels out elements of the knowledge and action constituents.

The Relationship of ISD and Functional Layer Design (FLD)

ISD & Functional Layer Design (FLD) differ in the way they define the design problem. ISD refracts system design functions through a process prism, breaking the problem down in terms of *design process* functions; FLD refracts system design through the artifact's prism, breaking the problem down in terms of the artifact functions to be designed (Figure 2).

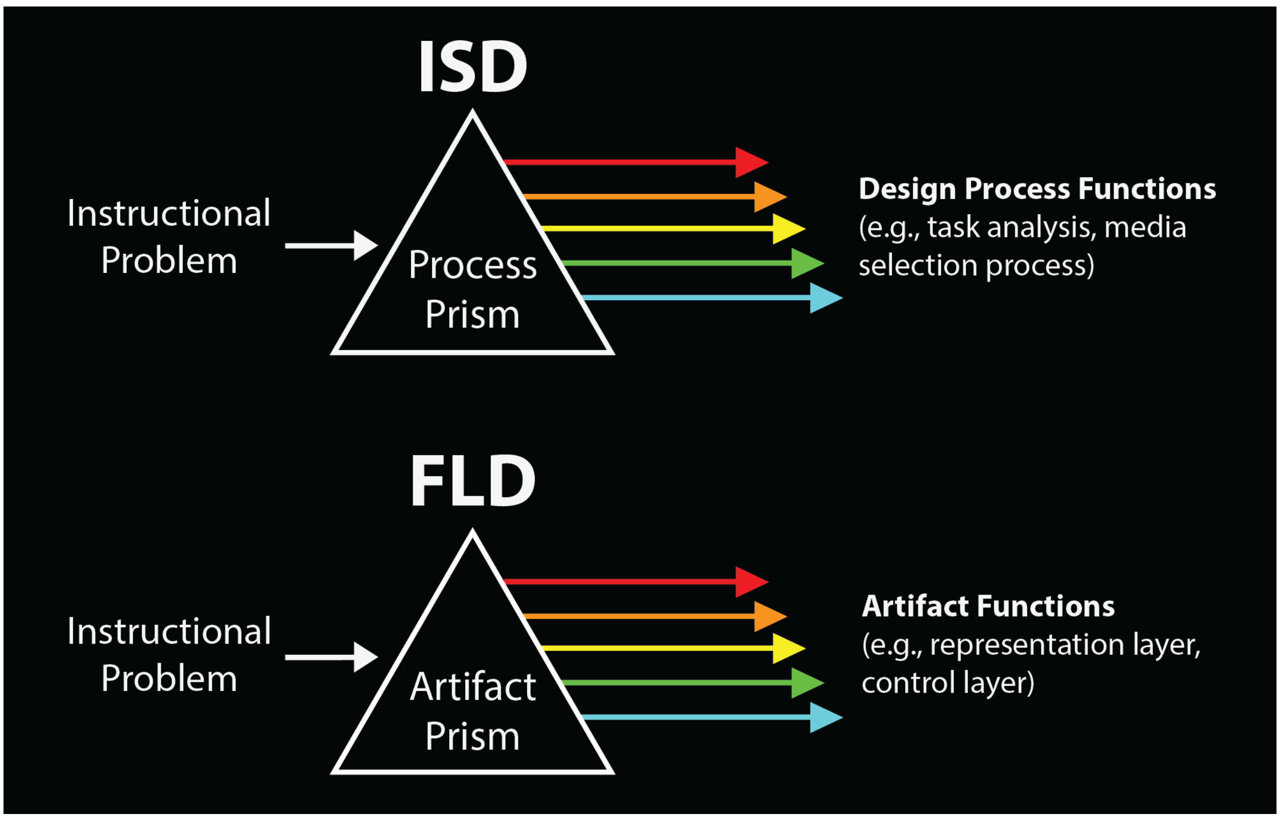

Figure 2. The Differing Lenses of ISD and FLD

For example, whereas ISD specifies a general logical order to design processes, the order of design decision making in layered designs is not sequential in the same sense. It is not necessary—and in some cases may be counterproductive—to adhere to a strict delineation of analysis, design, development, implementation, and evaluation phases. Instead, design can proceed according to and within the most important constraints and fortunate opportunities (Baldwin & Clark, 2000; Gross et al., 1987; Norman, 2002). The design decisions to be considered first depend on the constraints given with the design problem. Often design decisions related to a particular layer come ready-made, as in the case of a media constraint or a client's preference for strategy.

Design decisions within multiple layers may be advanced (after a sufficient amount of analysis) at the same time as joint hypotheses and tested and then modified and retested. New constraints result from the making firm of a particular configuration of layer properties. These in turn limit the range of choices left open for the designer. Design proceeds in the level of detail the designer selects. This is an especially useful principles that allows higher levels of the design to be completed by a designer, leading to additional design details to be filled in by layer specialists (e.g., artists, programmers, writers, experience designers, and editors). During this unfixed order of decision making, principles of design thinking can be explored, and the order for making decisions becomes tailored to the problem's context.

However, because of these contrasting approaches, ISD and FLD are actually mutually strengthening. The process view of design leads to the exploration and improvement of design processes; it reminds the designer that the creative process must be, at the same time, manageable. The artifact view leads to the exploration of the inner structures of artifacts and reminds the designer that the details of designs interact at many levels with theories of cognitive processes and instructional theory. These seemingly antagonistic approaches should together redefine our approach to designing and open new avenues to the design thinking of other design fields to sharpen and clarify the concepts we pass on to a new generation of designers.

Understanding the functional layers within an instructional design offers you conceptual resources to describe at a great level of precision how and why the design works as it does. The purpose of this activity is to practice analyzing a design from the perspective of the layers of which it is composed. It will also help you explain the different kinds of decisions ISD and FDL allow designers to make.

1. Identify an instructional design you are currently working on or that you have worked on recently. This could be a class project or an assignment from your place of employment. If you do not have a ready design to analyze, identify one with which you are reasonably familiar (perhaps a piece of instructional software or an online course you have recently completed).
2. Consider the design from the perspective of ISD, or, as discussed in the chapter above, the "functions performed by the designer." In a brief list, specify the decisions that ISD has helped, or could help, you make in service of completing this design. If you need assistance making your list, see this chapter on instructional design models elsewhere in this book.
3. Now consider the design from the perspective of FDL, or the "functions carried out as subprocesses within the artifact designed." Create another list that identifies at least one meaningful function in each of the seven layers described in this chapter. Also consider: are there other layers in this design that perform a function distinct from the basic set? If so, identify them and the function they are performing.
4. Compare your two lists. What are the differences? Are there any similarities?
5. In a short reflection (2–3 paragraphs), summarize what this activity illustrated about the purposes and benefits of FDL. Take into account questions like: What does examining a design from the perspective of FDL offer that other perspectives (like ISD) do not? What do you think it means that, together, ISD and FDL "offer a more robust conception of how instructional designs can be created"? How can you include FDL in your personal design practice? How can it help you create more complete, coherent, and effective designs?

For Further Thought

As part of this activity, you may also want to carry out some thought experiments such as:

1. What would happen to the overall design if you changed the function performed by one of the layers you identified? Speculate on how the design might be more or less effective by making a change.
2. How do the functions within each layer work together to contribute towards a whole? Can you find any elements you (or the designer) did to make the connections between layers work better, or somehow be more meaningful?

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Dr. McDonald's research focuses around advancing instructional design practice and education. In particular, he studies the field's tendency to flatten/redefine educational issues in terms of problems that can be solved through the design of technology products, and how alternative framings of the field's purpose and practices can resist these reductive tendencies.

At BYU, Dr. McDonald has taught courses in instructional design, using stories for learning purposes, project management, learning theory, and design theory. His work can be found at his website: http://jkmcdonald.com/

Access it online or download it at https://edtechbooks.org/foundations_of_learn/design_layers.

Design Thinking and Agile Design

New Trends or Just Good Design Practice?

Vanessa Svihla

While most instructional design courses and much of the instructional design industry focus on ADDIE (Analysis, Design, Development, Implementation, Evaluation), approaches such as design thinking, human-centered design, and agile methods like SAM (Successive Approximation Model), have drawn attention. This chapter unpacks what we know about design thinking and presents a concise history of design thinking to situate it within the broader design research field. It then traces its emergence in other fields. The chapter considers lessons for instructional designers and concludes by setting an agenda to address issues for scholarship, teaching, and practice.

Many depictions of design process, and a majority of early design learning experiences, depict design as rather linear, or "waterfall," view of design (Figure 1). This depiction was originally proposed as a flawed model in 1970 (Royce, 1970), yet it is still relatively common. It also contrasts with what researchers have documented as expert design practice.

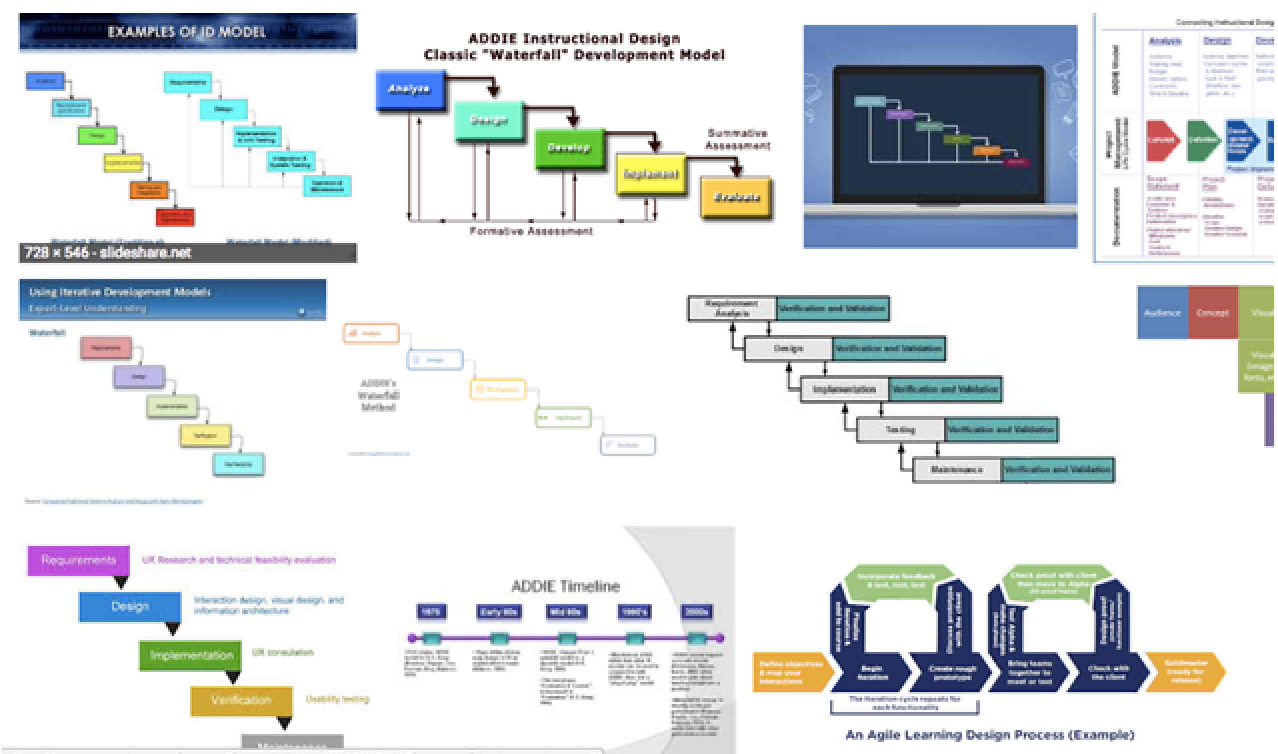


Figure 1. Google Image search results of design as a waterfall model

Yet, 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 agile methods, **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:

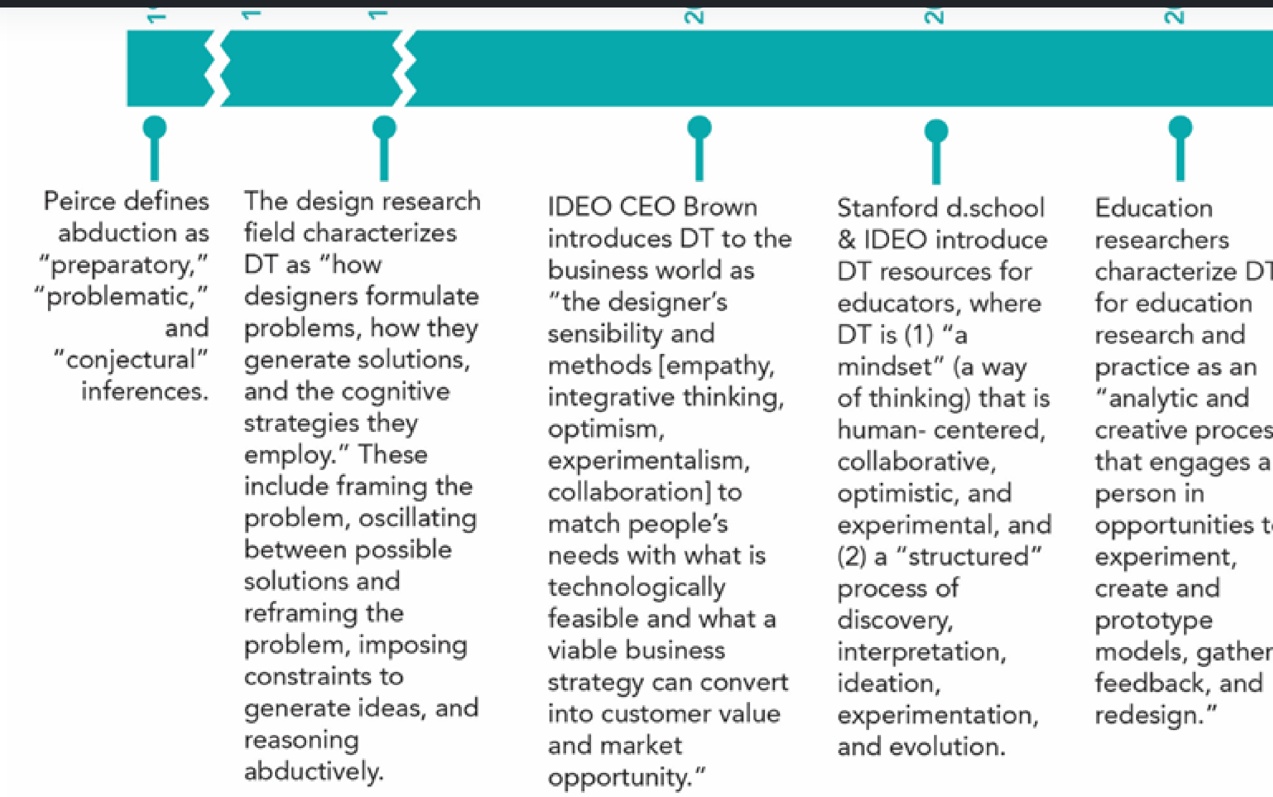
- Design thinking seems both useful and cool, but I have to practice a more traditional approach like ADDIE or waterfall. Can I integrate agile methods and design thinking into my practice?
- Design thinking—particularly the work by **IDEO**—is inspiring. As an instructional designer, can design thinking 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 and agile design 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. Further, there is not even agreement on what the outcomes might be if a designer is adept at design thinking (Rodgers, 2013). If we look at definitions over time and across fields (Figure 2), we notice most researchers reference design thinking as methods, practices or processes (Rowe, 1987). A few others reference cognition, mindset (ways of thinking), or values (e.g., practicality, empathy) (Cross, 1982). This reflects the desire to understand both what designers do and how and when they know to do it (Adams et al., 2011). In later definitions, design thinking is more clearly connected to creativity and innovation (Wylant, 2008); while mentioned in early design research publications (e.g., Buchanan, 1992), innovation was treated as relatively implicit.

Figure 2. A timeline of key developments in characterizations of design thinking (DT) across fields, authors, and over time (Brown, 2008; Cross et al., 1992; d.school, 2012; IDEO, 2011; Peirce Edition Project, 1998; Razzouk & Shute, 2012; Rodgers, 2013).



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Design thinking has only recently become a topic in instructional design and educational technology (Stefaniak & Xu, 2020). Indeed, we can identify four primary ways that design thinking has been used in prominent instructional design journals (i.e., *TechTrends*, *Educational Technology Research and Development*, *The British Journal of Educational Technology*, and *The Journal of Applied Instructional Design*) (Figure 3). Papers most commonly reference the IDEO approach as an aspirational practice for instructional design. Next, papers reference design thinking in order to investigate how instructional designers approach designing. Some papers reference the idea that teachers are designers who engage in design thinking; these papers tend to reference Chai et al. (2011), who define design thinking as "the mode of thinking which is concerned more with improving ideas into useful artefacts or processes rather than the belief mode of thinking which is predominantly concerned with the true value of knowledge claims" (p. 1191). Finally, a couple papers investigate design thinking as a learning outcome for students, typically in STEM. Thus, of the 35 papers that cite design thinking, about half use design thinking in line with the field that created the term, and about half reference the idea as popularized by IDEO. This suggests that the former may be more useful for those doing research, while the latter may provide inspiration to designers seeking alternatives to ADDIE. But let's take a more nuanced look at design thinking to consider how research on design thinking can also inspire practice.

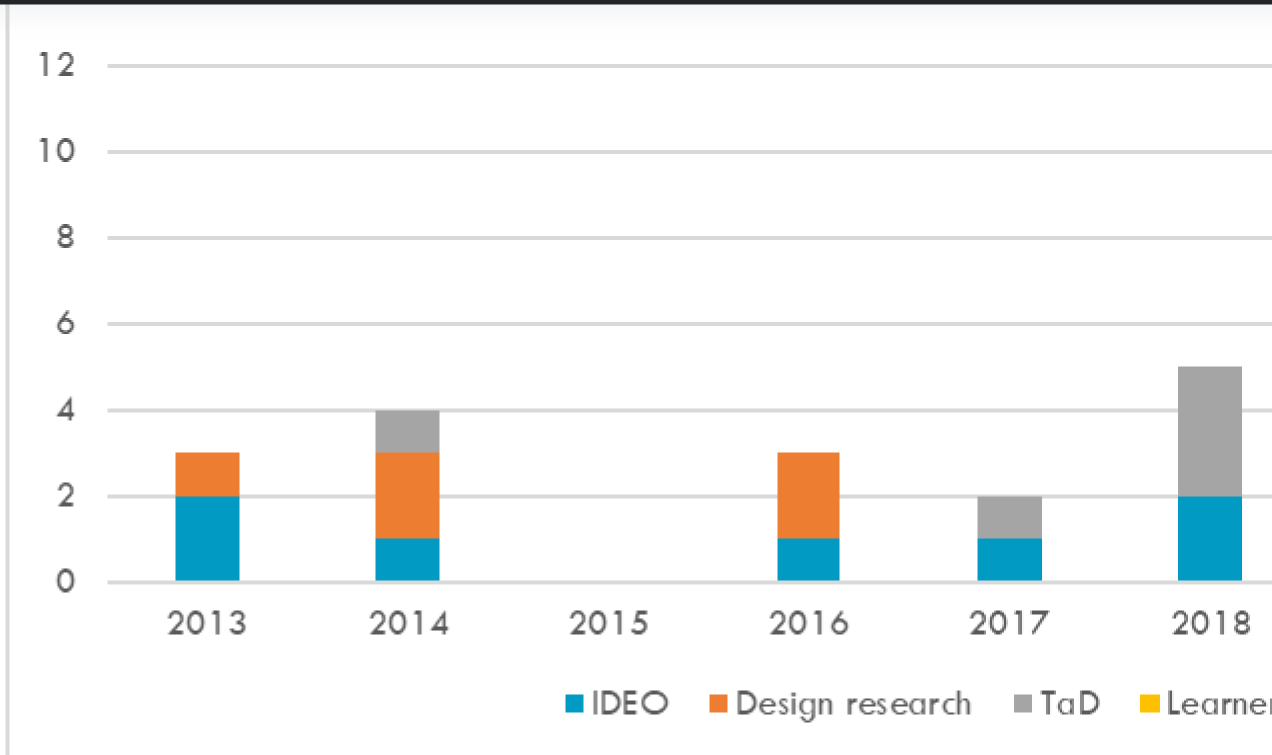


Figure 3. Number of papers in prominent instructional design journals that cite design thinking.

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 carry out their work. Initially, design thinking was proposed because 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 *abductively* (Dorst, 2011; Kolko, 2010). When designers think abductively, they fill gaps in knowledge about the problem and about the kinds of solutions that can solve it, drawing inferences based on precedent—their past design work, their preferences, and experiences with designs—and on what they understand the problem to be.

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.

Example: Jeff and Paloma are instructional designers working with a client, Mr. Yazzie, who represents a coalition of tribal nations across the American Southwest. The coalition has requested a supplemental training on research ethics with Indigenous communities. Jeff's initial idea seamlessly matches the style of the existing training supplied by the Collaborative Institutional Training Initiative (CITI) program, consisting of text and multiple-choice questions. What precedent shapes both the CITI training and Jeff's idea?

A critical difference between scientific thinking and design thinking is the treatment of the problem. In scientific thinking, the problem is treated as solvable through empirical reasoning, whereas in design thinking, problems are tentative—sometimes irrational—conjectures (Diethelm, 2016). This type of thinking is suppositional, meaning the designer explores if-then and what-if scenarios to **iteratively** frame the problem (Dorst, 2011). As designers do this kind of work, they jointly frame the problem and pose 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 truly know what the design problem is until it is solved! This means that when doing design iteratively, we are changing the design problem multiple times. But how can we manage such changes efficiently? One answer is agile design.

Learning Check

Which of the following best characterizes design thinking, as defined by the design research community?

- A sequence of steps (Empathize, Define, Ideate, Prototype, Test) that is an alternative to ADDIE
- Using inductive reasoning systematically
- Using abductive reasoning in framing and reframing problems
- Using deductive reasoning to fill in gaps in understanding

Agile design, with its emphasis on rapid prototyping, testing and iteration, was proposed to improve software design processes. Later canonized in the *Manifesto for Agile Software Development* (Beck et al., 2001), early advocates argued that this change in software design process was urgently needed in “the living human world” that was affected by “increasingly computer-based systems […] while the existing discipline of software engineering has no way of dealing with this systematically” (Floyd, 1988, p. 25). With the influence of new technologies on educational settings, it was natural for instructional designers to look to software design for inspiration. Indeed, Tripp and Bichelmeyer introduced instructional designers to rapid prototyping methods while these same methods were still being developed in the software design field (1990). They explained that traditional ID models were based on “naive idealizations of how design takes place” (p. 43) and that ID practice already included similar approaches (e.g., **formative evaluation** and

LIDT in the World: Lesson #2 for ID

Our use of instructional designs tends to be short-lived, making them subject to iteration and adaptation to meet emergent changes in learning needs, context, or learning goals. Each new solution is linked to a reframing of the problem. As agile designers, we can embrace this iteration agentively, reframing the problem as we work based on insights gained from testing early, **low fidelity prototypes** with **stakeholders**.

Example: Jeff and Paloma, uncertain whether Mr. Yazzie will prefer a training that matches the existing CITI training, develop five design ideas as hand-drawn sketches, annotated with notes. They share these with Mr. Yazzie and a few of the intended learners. In doing so, they realize that matching the CITI training holds some appeal for the learners, but Mr. Yazzie and the designers realize it seems unlikely to support the complex learning needs.

In addition to presenting annotated sketches, what do you think Jeff and Paloma did to reach an understanding with Mr. Yazzie that matching the CITI training might not suffice? In other words, how can designers bring their low-fidelity prototypes to life for clients and learners?

Imagine instead that the designers did not share any design ideas that matched the CITI training. How do you think Mr. Yazzie and the learners might have responded?

Sometimes, presented with low-fidelity prototypes, clients feel concern about the lack of professional quality. What do you think Jeff and Paloma did to avoid this?

As they are practiced, agile methods, including SAM (Allen, 2012), frequently involve stakeholders in the design process (Fox et al., 2008). Working contextually and iteratively can help clients see the value of a proposed design solution and understand better how—and if—it will function as needed (Tripp & Bichelmeyer, 1990). One challenge designers encounter is that stakeholders may react to sketches and prototypes in unexpected ways. They may think low fidelity versions are unprofessional, but may consider polished representations are more functional and finalized, and then be unsure about what can still be changed, and focus feedback on superficial or aesthetic aspects.

Other design methods that engage stakeholders early in the design process, such as participatory design (Muller & Druin, 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 approach, let's consider design characteristics made relevant by comparing them with more traditional methods like ADDIE, which as we have noted, is often depicted as a linear process. Like agile design, these methods tend to be iterative. Whereas in ADDIE, the designer is responsible for collecting information about stakeholders, in agile methods, designers tend to include stakeholders in more varied ways, even inviting stakeholders to generate possible design ideas and help frame the design problem.

When designing with stakeholders, we gain access to their perspectives and give them more ownership over the design. However, it can be difficult to help them be visionary. Consider early smartphone design. Early versions had keyboards and very small screens. Each new version was incrementally different from the prior version. If we had asked stakeholders 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.

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. For instance, rather than asking for improvements on known, existing designs, designers can inquire about other meaningful learning experiences that they value.

Example: Jeff and Paloma share the CITI training and ask Mr. Yazzie and the intended learners to describe what they would prefer in a training. Their ideas include making the CITI training more accessible, such as increasing the font size on the resources, adding more pictures, and creating offline versions.

Why might sharing an existing design, like the CITI training, prompt clients and learners to focus on incremental improvements?

Are these incremental improvements likely to result in a design that meets the learning needs?

Having asked for their participation, what are possible consequences of ignoring their ideas?

How could Jeff and Paloma have made better use of their time with Mr. Yazzie and the learners?

Designers who engage with stakeholders must also pay attention to **power dynamics** (Kim et al., 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 unfamiliar cultures. 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, such as whether they need support with typical tasks like email, word processing, file management, and so forth, or more specific tasks, like using privacy settings on social media to reduce an abuser's access to information about these women. Equally important, the designer needs to know about contextual needs, like transportation, child care, and learning disabilities, that if not taken into account in the design process could result in a solution that fails to meet learning needs. In order to gather such information, the instructional designer should consider carefully the situations in which learners will feel safe sharing. A focus group coordinated by someone the women trust might be better than holding one-on-one interviews. The instructional designer could supplement the focus group with a survey or comment cards to collect ideas anonymously.

LIDT in the World: Lesson #4 for ID

With a focus on understanding human need, design thinking and agile methods should also draw our attention to inclusivity, diversity, justice, and participant safety.

Example: Jeff, a white man, and Paloma, a Latina, both with graduate degrees, recognize that their experiences differ from the tribal members they are designing for. They acknowledge that a long history of oppression and injustice will likely make stakeholders cautious about sharing their thoughts and feelings. Because they don't trust their own precedent, they seek out information about Indigenous and decolonizing instructional design (DeLorme, 2018) and consult with Mr. Yazzie about the appropriateness of using a **talking circle** to gather stakeholder feedback. Mr. Yazzie is supportive because he has observed other outsiders take this approach. However, he advises them to allow him to identify a tribal member to lead the circle.

Learning Check

Which statement is most accurate regarding benefits and challenges designers encounter in agile and human centered design methods?

- [ ] While stakeholders feedback ensures the design will meet the needs, it is more work overall.
- [ ] Power dynamics can prevent stakeholders from engaging in the design process. By mitigating the impacts of power dynamics, designers are liklier to get honest feedback.
- [ ] Stakeholders typically intuitively understand that sketches and low fidelity prototypes are intentionally drafty, so there is no need to set expectations about such representations.

Design Thinking in ID Practice

To understand how design thinking might play out in different instructional design methods, let's consider another case with the following four 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
- Agile design proceeds iteratively, using low fidelity, rapid prototyping to get feedback from stakeholders early and often
- 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 four 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 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—thinking, "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 Agile used the budget to visit three different sites overseen by the state agency. They shared a low fidelity prototype with multiple stakeholders at the first site. In doing so, they realized they had misunderstood key aspects of the problem from one small but critical stakeholder group. They revised both their framing of the problem and their idea about the solution significantly and shared a revised prototype with stakeholders at the remaining sites. They submitted documentation of this process with their revised prototype. In their work, Team Agile prioritized iteration and diversity of point of views. They committed to treating their solution ideas as highly tentative, but gave stakeholders something new and different to react to. This strategy helped the team reframe the problem, but could have failed had they only sought feedback on improvements, rather than further understanding of the problem. They used design thinking to reframe their understanding of the problem, and this led them to iterate on their solution. Design researchers describe this as a co-evolutionary process, in which changes to the problem framing affect the solution, and changes to the solution affect the framing (Dorst & Cross, 2001).

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 4). For instance, designers may not have easy access to stakeholders, and large projects may make agile approaches unwieldy to carry out (Turk et al., 2002).

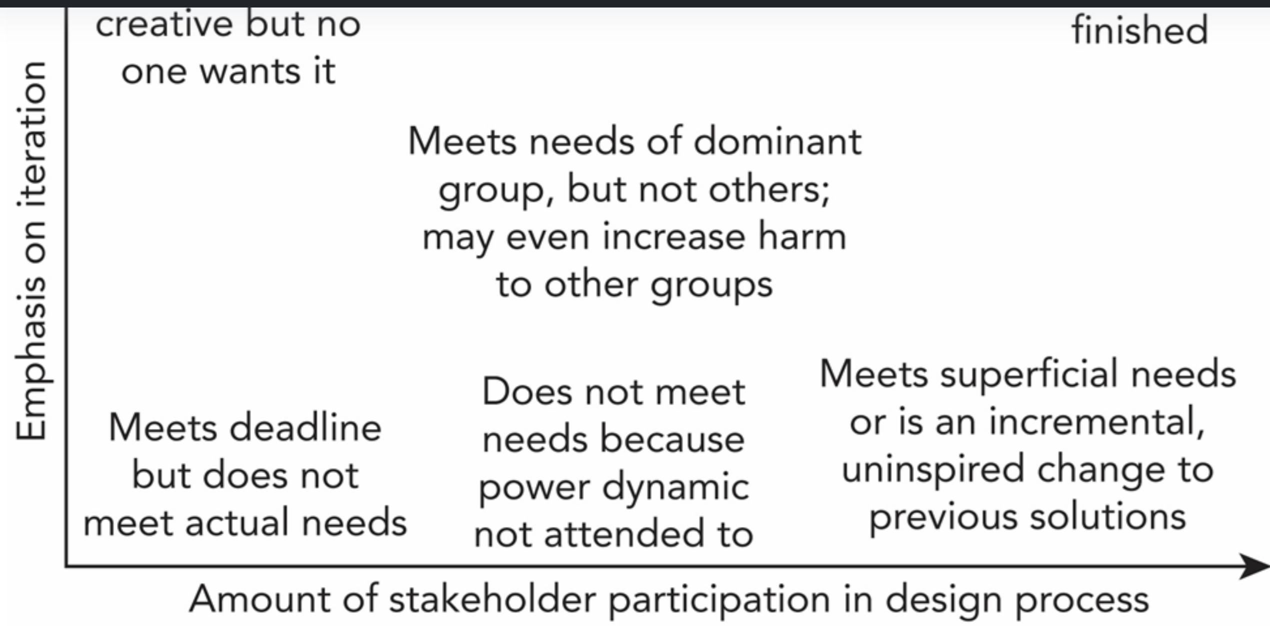


Figure 4. Risks and pitfalls associated with different levels of stakeholder participation and iteration

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 as a set of methods, 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 (Figure 2). 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, a practice that is central 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 can 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, Pólya's "How to Solve it" from 1945 to Stanford's d.school representation of design thinking (Table 2). While Pólya 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 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 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 contextualized to the particular process and as occurring in iterative or overlapping ways (Carmel-Gilfilen & Portillo, 2010; Dolata et al., 2017; Lande et al., 2012; Razzouk & Shute, 2012).

Pólya, 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

Table 2. Similarities between "How to Solve it" and a representation of design thinking

My second concern is that, as a field, we tend 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, agile methods 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. Methods like agile design 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 agile and 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 agile, human-centered work. For instance, I developed the *Wrong Theory Design Protocol* (http://www.vanessasvihla.org/wrong-theory-protocol.html) (Svihla & Kachelmeier, 2022) 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.

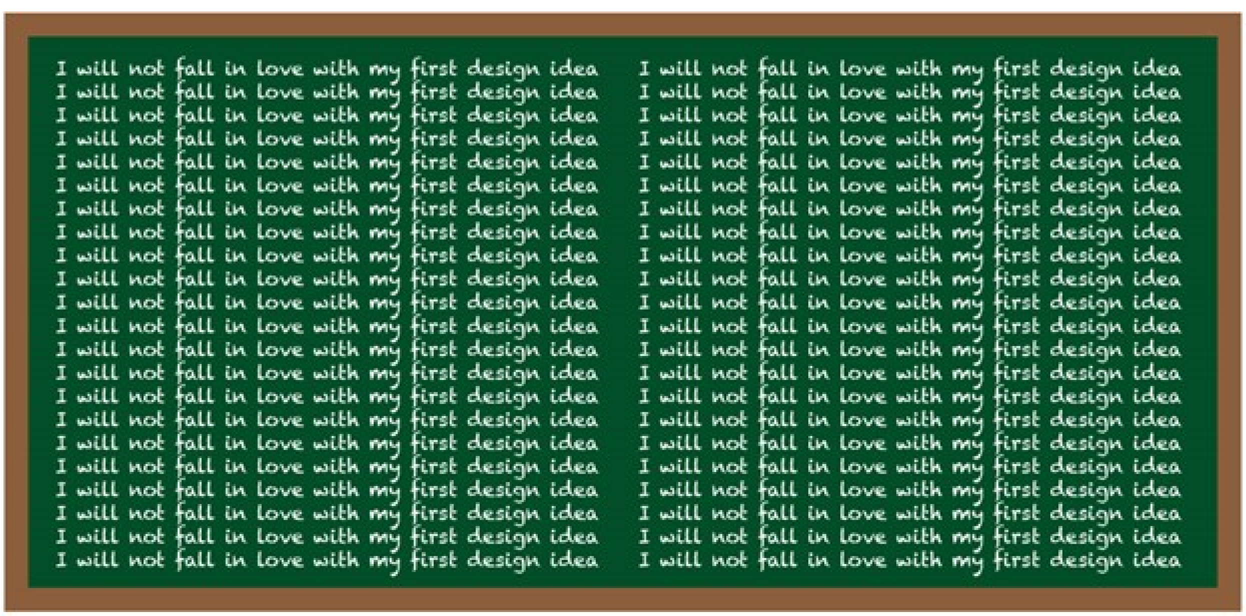
I encourage novice instructional designers, as they ponder the various ID models, practices and methods available to them, to be suspicious of any that render design work tidy and linear. If, in the midst of designing, you feel muddy and uncertain, unsure how to proceed, you are likely exactly where 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 diligently 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, the 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.



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.

Want to know more about the **Design Research** field so you can contribute or locate resources?

The Design Society publishes several relevant journals:

- Design Science
- CoDesign: International Journal of CoCreation in Design and the Arts
- International Journal of Design Creativity and Innovation
- Journal of Design Research

The Design Research Society (DRS) has conferences and discussion forums.

There are other prominent journals in the design research field:

- Design Studies, 1979-2023 (Note: In July 2023, the journal editors resigned in protest over changes made by the publisher that threatened the quality; the DRS has plans to develop a new journal)
- Design Issues
- The Design Journal
- She Ji: The Journal of Design, Economics, and Innovation
- Design and Culture

Sign up for monthly emails from Design Research News to find out about conferences, calls for special issues, and job announcements.

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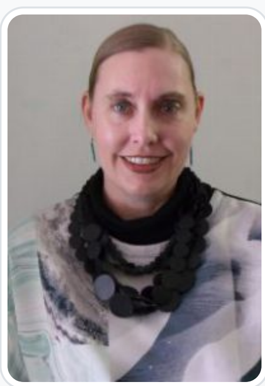
[1] For those interested in learning more, refer to the journal, *Design Studies*, and the professional organization, *Design Research Society*. Note that this is not a reference to educational researchers who do design-based research, which is sometimes, confusingly, referred to as "design research."

[2] Waterfall might also be used when designing a large, expensive system that cannot be tested and iterated on as a whole and when subsystems cannot easily or effectively be prototyped.



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Access it online or download it at https://edtechbooks.org/foundations_of_learn/dt_and_agile.

Human Performance Technology for Instructional Designers

Jill E. Stefaniak & Lauren Bagdy

Instructional Design | Technology | Performance | Instructional Designers | Human Performance Technology

The overarching goal for instructional designers is to enhance learning and performance outcomes, often achieved through needs assessments, learner analyses, and the development of targeted instructional materials. This chapter delves into the foundational principles of HP and differentiates between HPT and instructional design. The role of performance analysis is explored, focusing on organizational, environmental, and cause analyses to identify performance gaps and root causes. The role of non-instructional interventions, such as organizational design, job analysis, and feedback systems to support infrastructure are discussed. Recommendations for integrating HPT principles into instructional design through a systems approach are also provided.

The goal for all instructional designers is to facilitate learning and improve performance regardless of learning environments and assigned tasks. When working within professional organizations particularly, the goal is often to develop interventions that yield measurable outcomes in improving employee performance. This may be accomplished through conducting needs assessments and learner analyses, designing and developing instructional materials to address a gap in performance, validating instructional materials, developing evaluation instruments to measure the impact of learning, and conducting evaluations to determine to what extent the instructional materials have met their intended use.

Depending on their level of involvement in implementing change within their organization, instructional designers may need to apply concepts from the field of human performance technology. By definition, "human performance technology (HPT) is the study and ethical practice of improving productivity in organizations by designing and developing effective interventions that are results-oriented, comprehensive, and systemic" (Pershing, 2006, p. 6). The purpose of this chapter is to provide an overview for how instructional designers can integrate aspects of human performance technology into their instructional design activities. We differentiate between human performance technology and instructional design and provide examples of HPT applications in the real world. We conclude with an overview of professional resources available related to the topic of human performance technology.

Differentiating Between Human Performance Technology and Instructional Design

Human performance technology emerged in the 1960s with publications and research promoting systematic processes for improving performance gaining traction in the 1970s. The foundations of human performance technology are performance, Mager and Pipe's (1970) early introduction of measurable learning objectives, and Harless' (1973) approach to systematic instruction in the workplace. All of these contributions were grounded in behaviorism and sought to create a systematic approach to measuring employee performance in the workplace. While these concepts can be applied to school settings, the majority of research exploring the application of human performance technology strategies has been predominant in workplace environments.

When differentiating between human performance technology and instructional design, HPT focuses on applying systematic and systemic processes throughout a system to improve performance.

Emphasis is placed on analyzing performance at multiple levels within an organization and understanding what processes are needed for the organization to work most effectively. Systemic solutions take into account how the various functions of an organization interact and align with one another. Through organizational analyses, performance technologists are able to identify gaps in performance and create systematic solutions (Burner, 2010).

While instruction may be one of the strategies created as a result of a performance analysis, it is often coupled with other non-instructional strategies. Depending on an instructional designer's role in a project or organization, they may not be heavily involved in conducting performance assessments. When given the opportunity, it is good practice to understand how performance is being assessed within the organization in order to align the instructional solutions with other solutions and strategies.

While human performance technology and instructional design have two different emphases, they do share four commonalities: (1) evidence-based practices, (2) goals, standards, and codes of ethics, (3) systemic and systematic processes, and (4) formative, summative, confirmative evaluations (Foshay et al., 2014). Table 1 provides an overview of how these four commonalities are applied in human performance technology and instructional design.

Commonalities	Human Performance Technology	Instructional Design
Evidence-based practices	Organizational analyses are conducted to collect data from multiple sources to evaluate workplace performance.	Emphasis is placed on learner assessment to ensure instruction has been successful.
Goals, standards, and codes of ethics	ISPI and ATD are two professional organizations that have created workplace standards and professional certification programs.	AECT and ATD are two professional organizations that have created standards for learning and performance.
Systematic and systemic processes	Systematic frameworks have been designed to conduct needs assessments and other performance analyses throughout various levels of an organization.	Systematic instructional design models have been designed to guide the design of instruction for a variety of contexts.
Formative, summative, and confirmative evaluations	Multiple evaluation methods are utilized to measure workplace performance throughout the organization.	Multiple assessments are conducted throughout the design phase of instruction as well as afterwards to

Commonalities	Technology	Instructional Design
		ensure the instructional solutions have been successful.

Table 1. Four commonalities shared across human performance technology and instructional design

The Role of Systems in Instructional Design Practice

Instructional designers understand that anytime they are designing, they are operating within a system. Many of our instructional design models, for example, promote a systematic process and take into account a variety of elements that must be considered for design (Dick et al., 2009; Merrill, 2002; Smith & Ragan, 2005). Similarly, human performance technology originates from behavioral psychology but also general systems theory. "General systems theory refers to one way of viewing our environment" (Richey et al., 2011, p. 11). Through this theoretical lens, instructional designers or performance technologists must take into account the whole environment and organization in which they are working.

In general terms, a "system is a set of objects together with relationships between the objects and between their attributes" (Hall & Fagen, 1975, p. 52). Systems can be open or closed (Bertalanffy, 1968). Open systems operate in a manner where they rely on other systems or can be modified based on actions occurring outside of a system. Closed systems are contained and can demonstrate resistance to changes or actions occurring outside the system in order to keep their value (Richey et al., 2011). Examples of systems could include the instructional design or training department within a larger organization. While the department is a system, it is also viewed as a subsystem functioning within something much larger. In addition, those receiving human performance training also work within systems. For example, an instructional designer may be asked to provide training based on values espoused by the CEO, but which may conflict with culture within an individual department in the organization. Other times, they may be asked to identify other instructional solutions to address performance gaps identified in a needs assessment. Or they may seek to improve employees' performance in one area, when that performance depends on the success of another department in the organization—something outside of the employees' control. Thus, seeking to improve organizational performance requires a broader understanding of the organization than is sometimes typical in instructional design practices.

Systems thinking impacts instructional design practices by promoting systematic and systemic processes over narrower solutions. A systems view has three characteristics:

1. "It is holistic.
2. It focuses primarily on the interactions among the elements rather than the elements themselves.
3. It views systems as "nested" with larger systems made up of smaller ones" (Foshay et al., 2014, p. 42).

These characteristics affect instruction design practices in a variety of ways. Designers must take the holistic nature of the system and consider the effects on learning from all elements that exist within the system. Not only does this consider the specific instructional design tasks that learners are currently completing, but also various layers of the organization including the people, politics, organizational culture, and resources—in other words, the inputs and outputs that are driving the development and implementation of a project (Rummler & Brache, 2013). Regardless of their role on a project, the instructional designer must be aware of all the various components within their system and how it affects the instruction they create. For example, an instructional designer may be asked by senior leadership of an organization to develop health and safety training for employees working on the frontline of a manufacturing plant. It would be advantageous to understand the unique tasks and nuances associated with the frontline work responsibilities to ensure they are developing training that will be beneficial to the employees. Another example where it would be important for an instructional designer to be aware of an organization's system or subsystems would be if they were asked to design instruction for a company that has multiple locations across the country or world. The instructional designer should

Think About It!

Think about an organization that is familiar to you. What is its purpose? Who are the people that belong to that organization? What are the functions of that organization? How do the various people and functions interact?

In addition, considering that the fundamental goals of instructional design are to facilitate learning and improve performance, the instructional designer working within organizations should strive to create design solutions that promote sustainability. As stated by the second system characteristic, it is important to not only be aware of the various elements within a system, but also develop an understanding of how they interact with each other. The instructional designer should be aware of how their work may influence or affect, positively or negatively, other aspects of the organization. For example, if an organization is preparing to launch training on a new organizational philosophy, how will that be perceived by other departments or divisions within the organization? If an organization is changing their training methods from instructor-led formats to primarily online learning formats, what considerations must the instructional design team be aware of to ensure a smooth transition?

LIDT in the World

Emma is a principal at a public middle school. Teacher turnover has steadily increased over the last three years at Emma's school. After reviewing personnel files, Emma found that most teachers who left were in their first or second year of teaching. Given that most of the teachers who left Emma's school were new teachers, what factors might have contributed to teacher turnover? What other systemic factors could Emma consider?

Does the organization have the infrastructure to support online learning for the entire organization? Is the information technology department equipped with uploading resources and managing any technological challenges that may arise over time? Does the current face to face training provide opportunities for relationship-building that may not seem critical to the learning, but are important to the health and performance of the organization? If so, how can this be accounted for online? These are examples of some questions an instructional designer may ask in order to take a broader view of their instruction besides just whether it achieves learning outcomes.

Performance Analysis

Regardless of context or industry, all instructional design projects fulfill one of three needs within organizations: (1) addressing a problem; (2) embracing quality improvement initiatives; and (3) developing new opportunities for growth (Pershing, 2006). The instructional designer must be able to validate project needs by effectively completing a performance analysis to understand the contextual factors contributing to performance problems. This allows the instructional designer to appropriately identify and design solutions that will address the need in the organization—what is often called the performance gap or opportunity.

The purpose of performance analysis is to assess the desired performance state of an organization and compare it to the actual performance state (Burner, 2010; Rummler, 2006). If any differences exist, it is important for the performance

Performance analysis can occur in multiple ways, focusing on the organization as a whole or one specific unit or function. Organizational analysis consists of “an examination of the components that strategic plans are made of. This phase analyzes the organization’s vision, mission, values, goals, strategies and critical business issues” (Van Tiem et al., 2012, p. 133). Items that are examined in close detail when conducting an organizational analysis include organizational structure, centrally controlled systems, corporate strategies, key policies, business values, and corporate culture (Tosti & Jackson, 1997). All of these can impact the sustainability of instructional design projects either positively or negatively.

An environmental analysis not only dissects individual performance and organizational performance, it also expands to assess the impact that performance may have outside the system. Rothwell (2005) proposed a tiered environmental analysis that explores performance through four lenses: workers, work, workplace, and world. The worker level dissects the knowledge, skills, and attitudes required of the employee (or performer) to complete the tasks. It assesses the skill sets that an organization’s workforce possesses. The work lens examines the workflow and procedures; how the work moves through the organizational system. The workplace lens takes into account the organizational infrastructure that is in place to support the work and workers. Examples of items taken into consideration at this phase include checking to see if an organization’s strategic plan informs the daily work practices, the resources provided to support work functions throughout the organization, and tools that employees are equipped with to complete their work (Van Tiem et al., 2012). World analysis expands even further to consider performance outside of the organization, in the marketplace or society. For example, an organization might consider the societal benefits of their products or services.

While instructional designers do not have to be experts in organizational design and performance analysis, they should be fluent in these practices to understand how various types of performance analyses may influence their work. Whether an analysis is limited to individual performance, organizational performance, or environmental performance, they all seek to understand the degree to which elements within the system are interacting with one another. These analyses vary in terms of scalability and goals. Interactions may involve elements of one subsystem of an organization or multiple subsystems (layers) within an organization. For example, an instructional design program would be considered a subsystem of a department with multiple programs or majors. The department would be another system that would fall under a college, and a university would be composed of multiple colleges, each representing a subsystem within a larger system.

Cause Analysis

A large part of human performance technology is analyzing organizational systems and work environments to improve performance. While performance analysis helps to identify performance gaps occurring in an organization, it is important to identify the causes that are contributing to those performance gaps. The goal of cause analysis is to identify the root causes of performance gaps and identify appropriate sustainable solutions.

While conducting a cause analysis, a performance technologist will consider the severity of the problems or performance gaps, examine what types of environmental supports are currently in place (i.e. training, resources for employees) and skill sets of employees (Gilbert, 1978). The performance technologist engages in troubleshooting by examining the problem from multiple viewpoints to determine what is contributing to the performance deficiencies (Chevalier, 2003).

Non-instructional Interventions

Once a performance technologist has identified the performance gaps and opportunities, they create interventions to improve performance. “Interventions are deliberate, conscious acts that facilitate change in performance” (Van Tiem et al., 2012, p. 195). Interventions can be classified as either instructional or non-instructional. As mentioned in the non-instructional interventions are often needed to create a supportive infrastructure. Considering politics within an organization and promoting an organizational culture that is valued by all departments and individuals within the system and carried out in processes and services are examples of infrastructural support needed for an organization (or system) to be successful. While there are a variety of different strategies that may be carried out to promote stability within an organization, the non-instructional strategies most commonly seen by instructional designers include job, analysis, organizational design, communication planning, feedback systems, and knowledge management. Table 2 provides examples of how non- instructional strategies may benefit the instructional design process.

Non-Instructional Strategies	Benefit to the Instructional Design Process
Job analysis	Up to date job descriptions with complete task analyses will provide a detailed account for performing tasks conveyed in training.
Organizational design	A plan that outlines the organizational infrastructure of a company. Details are provided to demonstrate how different units interact and function with one another in the organization.
Communication planning	Plans that detail how new initiatives or information is communicated to employees. Examples may include listervs, performance reviews, and employee feedback.
Feedback systems	Detailed plans to provide employees feedback on their work performance. This information may be used to identify individual training needs and opportunities for promotion.
Knowledge management	Installation of learning management systems to track learning initiatives throughout the organization. Electronic performance support systems are used to provide just-in-time resources to employees.

Table 2. Non-instructional strategies

Organizational design and job analysis are two non-instructional interventions that instructional designers should be especially familiar with especially, if they are involved with projects that will result in large scale changes within an organization. They should have a solid understanding of the various functions and departments within the organization and the interactions that take place among them. Organizational design involves the process of identifying the necessary organizational structure to support workflow processes and procedures (Burton et al., 2015). Examples include distinguishing the roles and responsibilities to be carried out by individual departments or work units, determining whether an organization will have multiple levels of management or a more decentralized approach to leadership, and how these departments work together in the larger system.

Job analyses are another area that can affect long term implications of instructional interventions. A job analysis is the process of dissecting the knowledge, skills, and abilities required to carry out job functions listed under a job description (Fine & Getkate, 2014). Oftentimes, a task analysis is conducted to gain a better understanding of the minute details of the job in order to identify what needs to be conveyed through training (Jonassen et al., 1999). If job analyses are outdated or have never been conducted, there is a very good chance that there will be a misalignment between the instructional materials and performance expectations, thus defeating the purpose of training.

performance improvement by providing performers the necessary information to modify performance accordingly" (Ross & Stefaniak, 2018, p. 8). Gilbert's (1978) Behavioral Engineering Model is a commonly referenced feedback analysis tool used by practitioners to assess performance and provide feedback as it captures data not only at the performer level but also at the organizational level. This helps managers and supervisors determine the degree of alignment between various elements in the organization impacting performance (Marker, 2007).

The most recognizable non-instructional interventions may be electronic performance support systems (EPSSs) and knowledge management systems. These are structures put in place to support the training and performance functions of an organization. Oftentimes EPSSs are used as a hub to house training and supports for an employee. Examples extend beyond e-learning modules to also include job aids, policies and procedures, informative tools or applications, and other just-in-time supports that an employee may need to complete a task. Knowledge management systems serve as a repository to provide task-structuring support as well as guidance and tracking of learning activities assigned or provided to employees (Van Tiem et al., 2012).

Other examples of supportive systems could also include communities of practice and social forums where employees can seek out resources on an as needed basis. Communities of practice are used to bring employees or individuals together who perform similar tasks or have shared common interests (Davies et al., 2017; Wenger, 2000; Wenger et al., 2002). When selecting an intervention, it is important to select something that is going to solve the problem or address a particular need of the organization. Gathering commitment from leadership to implement the intervention and securing buy-in from other members of the organization that the intervention will work is also very important (Rummler & Brache, 2013; Spitzer, 1992; Van Tiem et al., 2012).

LIDT in the World

Ilona is the Training and Development Manager for a Fortune 500 medical informatics company. In her role, she leads a team of instructional designers that provide training and resource materials for their customers. The company is finalizing a new mobile technology product that they intend to launch in the next six months.

The majority of training materials have been designed for on-site instructor-led tutorials as health care organizations implement the new software package. Ilona's director of strategic projects has asked Ilona to create a plan for implementing instructor-led and asynchronous training that can be accessed on a mobile platform. What should Ilona consider as she maps out her plan for her team?

Whether the intervention to improve performance is instructional or non-instructional, Spitzer (1992) identified 11 criteria for determining whether an intervention is successful. Table 3 shows these criteria and provides examples of questions instructional designers should ask when selecting or designing interventions.

Spitzer's (1992) 11 Criteria	Questions to Ask
Design should be based on a comprehensive understanding of the situation.	• Will the intervention align with the performance gaps and opportunities identified by the cause analysis?

Interventions should be carefully targeted.	Will the intervention target... • The right people, • In the right setting, • At the right time?
An intervention should have a sponsor.	• What individual or groups within the organization will champion this intervention?
Interventions should be designed with a team approach.	• Will stakeholders be involved in designing this intervention? • Will the intervention consider the expertise of other individuals within the organization?
Intervention design should be cost-sensitive	• Will the intervention be the most cost-effective option? • Will all costs (finances, time, labor-force, etc.) be considered?
Interventions should be designed on the basis of comprehensive, prioritized requirements, based on what is most important to both the individual and the organization.	• Will there be alignment between the intervention and the priorities of the organization and stakeholders at various levels?
A variety of intervention options should be investigated because the creation of a new intervention can be costly.	• Will various intervention options be considered before a decision is made?
Interventions should be sufficiently powerful.	• What will be the short-term effectiveness of the intervention? • What will be the long-term effectiveness of the intervention?
Interventions should be sustainable.	• How will this intervention be embedded in the organizational culture over time?
Interventions should be designed with viability of development and implementations in mind.	• What human and organizational resources will support this intervention throughout implementation and over time?
Interventions should be designed using an iterative approach.	• What formative strategies will be used to evaluate the intervention? • How many revisions will be necessary?

Table 3. Examples of questions to ask when selecting or designing interventions

Inclusive Design

One particular challenge in the field of learning, design, and technology is that not all instructional designers are aware of the impact that HPT strategies can have on their design work. Not all instructional design training programs incorporate human performance technology coursework. Oftentimes, the extent that instructional design students may be introduced to needs assessment and evaluation does not extend beyond the learner analysis and an evaluative assessment at the end of an e-learning module.

HPT strategies can be used to help instructional designers support and promote inclusive design. If an instructional designer adheres to Spitzer's (1992) criteria for designing a performance intervention, they will develop a sufficient understanding of the situation and be able to prioritize their design practices accordingly.

To date, researchers have been to look at how HPT can be leveraged to support instructional design through the adoption of an organizational justice lens (Giacumo et al., 2021). By applying this lens on typical activities that occur in HPT (e.g., cause analysis, needs assessment, environmental analysis, organizational analysis, intervention selection and design, and evaluation), instructional designers are positioned to address issues such as fairness, equity, and ethical behavior in different contexts (Cropanzano & Stein, 2009; Stefaniak & Pinckney-Lewis, in press).

The processes of collecting and analyzing data to understand situations warranting instructional design support is fundamental in HPT practices. For several decades, strategies have been offered to provide recommendations for how best to approach and account for the layers and complexities inherent in more organizations. It is also important that individuals responsible for collecting data are collecting appropriate data that provides sufficient information pertaining to the cultural needs of their audience (Asino & Giacumo, 2019).

In an effort to triangulate data sources that capture and discrepancies within and amongst different cultures and populations that may exist with the system (organization) being examined, Peters and Giacumo (2020) proffer guidelines to support cross-cultural data collection. They recommend that individuals responsible for data gathering demonstrate respect for cultural beliefs, allow for the addition of time to gather information and understand the situation, build trust with members of the population, and take a participatory approach to include members of the population in the process. These cross-cultural HPT practices can extend to all facets of instructional design; thus promoting inclusive design environments where the learners have a significant role in the interventions being designed to support their needs.

Conclusion

While it is not necessary for instructional designers to engage in human performance technology, they may find themselves frequently in their careers working more like performance technologists than they originally supposed they would. In addition, those that use human performance technology thinking may be better positioned to design sustainable solutions in whatever their organization or system. Human performance technology offers a systems view that allows for the instructional designer to consider their design decisions and actions. By recognizing the systemic implications of their actions, they may be more inclined to implement needs assessment and evaluation processes to ensure they are addressing organizational constraints while adding value. With the growing emphasis of design thinking in the field of instructional design, we, as a field, are becoming more open to learning about how other design fields can influence our practice (i.e., graphic design, architecture, and engineering), and human performance, as another design field in its own right, is one more discipline that can improve how we do our work as instructional designers.

There are a variety of resources available for instructional designers who are interested in learning more about how they can utilize concepts of human performance technology in their daily practice. This section provides an overview of journals and important books related to the field.

Recommended Readings

Compared to other disciplines, the field of human performance technology is considered a relatively young field dating back to the early 1960s. The following is a list of books that may be of interest to individuals who are interested in learning more about human performance technology:

- Arrington, T. L., Moore, A. L., Steele, K., & Klein, J. D. (2022). The value of human performance improvement in instructional design and technology. In J. Stefaniak & R. Reese (Eds.), *The instructional design trainer's guide: Authentic practices and considerations for mentoring ID and ed tech professionals* (pp. 161-169). Routledge.
- Giacumo, L. A., & Asino, T. I. (2022). Preparing instructional designers to apply human performance technology in global context. In J. Stefaniak & R. Reese (Eds.), *The instructional design trainer's guide: Authentic practices and considerations for mentoring ID and ed tech professionals* (pp. 170-179). Routledge.
- Gilbert, T. F. (1978). *Human competence: Engineering worthy performance*. McGraw-Hill.
- Moseley, J. L., & Dessinger, J. C. (2010). *Handbook of improving performance in the workplace. Volume 3: Measurement and evaluation.* Pfeiffer.
- Pershing, J. A. (2006). *Handbook of human performance technology* (3rd ed.). Pfeiffer.
- Rossett, A. (1999). *First things fast: A handbook for performance analysis*. Pfeiffer.
- Rummler, G. A., & Brache, A. P. (2013). *Improving performance: How to manage the white space on the organization chart* (3rd ed.). Jossey-Bass.
- Silber, K.H., & Foshay, W.R. (2010). *Handbook of improving performance in the workplace*. *Volume 1: Instructional design and training delivery*. Pfeiffer.
- Stefaniak, J. (Ed.). (2015). *Cases on human performance improvement technologies*. IGI Global.
- Stefaniak, J. (2020). *Needs assessment for learning and performance: Theory, process, and practice*. Routledge.
- Stefaniak, J., Giacumo, L. A., & Villachica, S. (2022). Preparing instructional designers to scale needs assessment. In J. Stefaniak & R. Reese (Eds.), *The instructional design trainer's guide: Authentic practices and considerations for mentoring ID and ed tech professionals* (pp. 147-160). Routledge.
- Van Tiem, D., Moseley, J. L., & Dessinger, J. C. (2012). *Fundamentals of performance improvement: A guide to improving people, process, and performance* (3rd ed.). Pfeiffer.
- Watkins, R., & Leigh, D. (2010). *Handbook of improving performance in the workplace. Volume 2: Selecting and implementing performance interventions*. Pfeiffer.

Journals

While a number of instructional design journals will publish articles on trends related to the performance improvement, the following is a list of academic journals focused specifically on the mission of human performance technology:

- *Performance Improvement Quarterly* is a peer-reviewed scholarly journal published by the International Society for Performance Improvement.
- *Human Resource Development Quarterly* is a peer-reviewed scholarly journal published byJohn Wiley & Sons, Inc.
- *International Journal of Training and Development* is a peer-reviewed scholarly journal published by John Wiley & Sons, Inc.
- *Journal of Applied Instructional Design* is a peer-reviewed scholarly journal published by the Association for Educational Communications and Technology.
- *Journal of Workplace Learning* is a peer-reviewed scholarly journal published by Emerald, HR, Learning and Organizational Studies eJournal Collection.
- *TD (Training + Development)* is a monthly magazine published by the Association for Talent Development.

Additional Reading

Another useful chapter on performance technology is available in *The Foundations of Instructional Technology*, available at https://edtechbooks.org/-cx

Stefaniak, J. (2018). Performance technology. In R.E. West (Ed.), *Foundations of learning and instructional design technology: The past, present, and future of learning and instructional design technology*. EdTech Books. https://edtechbooks.org/lidtfoundations/performance_technology

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Bertalanffy, L. (1968). *General systems theory: Foundations, development, applications*. George Braziller.

Burner, K. J. (2010). From performance analysis to training needs assessment. In K. H. Silber & W. R. Foshay (Eds.), *Handbook of improving performance in the workplace: Instructional design and training delivery* (vol. 1, pp. 144–183). Pfeiffer.

Burton, R. M., Obel, B., & Håkonsson, D. D. (2015). *Organizational design: A step-by-step approach*. Cambridge University Press.

Chevalier, R. (2003). Updating the behavior engineering model. *Performance Improvement*, *42*(5), 8-14. https://doi.org/10.1002/pfi.4930420504

Cropanzano, R., & Stein, J. H. (2009). Organizational justice and behavioral ethics: Promises and prospects. *Business Ethics Quarterly*, *19*(2), 193–233. https://doi.org/10.5840/beq200919211

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Gamification and the Way It Can be Used to Influence Learning

Keith Heggart & Claire Seldon

Gamification | Educational Games | Motivation

This chapter presents an engaging discussion of the way that gamification and learning technology have developed over recent years, as well as examining some of the theoretical contestations in the field, mapping out avenues for future research and development, and providing clear advice for designers considering adopting gamified approaches. The chapter begins by defining the game and recognizing that gaming and gamification both have a long history. It notes that gamification is distinct from games, and uses Kapp's (2012) discussion of the elements of gamification to discuss this. From that point, a conversation is developed about the need to design gamification in such a way so that is fit for its intended purpose. This leads into a discussion about how various learning theories, including behaviourism, and motivation theories, relate to gamification design. It notes the distinct advantages that have been lent to the development and adoption of gamification via mobile technology, and especially internet enabled devices. It will also recognize that some of the promises of gamification, especially as it relates to learning and instructional design, have failed to materialize. The chapter concludes with advice for designers to consider as they design their own gamification, including how they might leverage the most value on gamified resources. The chapter makes significant use of authentic examples and case studies drawn from a range of different industries and areas, thus ensuring that students of all backgrounds are able to access the material and apply it to their own experience.

Defining a Game

It should be no surprise that people love playing games and that they have done so for a very long time. For example, archaeologists have found chess sets that might be more than 1500 years old. Go (a Chinese abstract strategy game where players try to capture territory on a game board) is much older—dating back to 2000 BCE. For many, games of any form are a distraction from everyday life and are often dismissed as nothing more than that; however, that ignores the potential for learning that takes place in games. We, as learning designers and educators, need to be mindful of these opportunities, especially as **gamification** is a buzzword in education and training today.

It is easy to be distracted by new and innovative ideas. One of our challenges as educators is to look at these ideas through a critical lens and consider whether these new ideas are viable, sustainable, and actually contribute to learning—or whether they are educational flim-flam destined to go the way of interactive whiteboards!

So, what is a game, and how is that it to gamification? There are many definitions of what a game is, given the diverse forms and contexts in which games are played. Salen and Zimmerman (2003, p. 5) proposed the following: "A game is a

While this definition is a good fit for many board games, or even sporting games, it does not necessarily harmonize with other definitions. What about those games where there is little player involvement, such as the so-called idle genre (for an example, see Raid: Shadow Legends)? Modern interpretations of games need a more measured definition. One game designer defined a game as "a system in which players engage in an abstract challenge, defined by rules, **interactivity**, and **feedback**, that results in a quantifiable outcome often eliciting an emotional reaction" (Koster, 2003, p. 12). This is a much more comprehensive definition that includes a few new ideas, such as the emotional reaction that games produce.

Karl Kapp (2012) examined the **elements** that comprised both definitions (Salen and Zimmerman's, and Koster's) and created a new, workable definition. He said,

> *Together these disparate elements combine to make an event that is larger than the individual elements. A player gets caught up in playing a game because the instant feedback and constant interaction are related to the challenge of the game, which is defined by the rules, which all work within the system to provoke an emotional reaction and, finally, result in a quantifiable outcome within an abstract version of a larger system. (p. 9)*

Each of these elements of games in Kapp's framework are explained below (see Figure 1).

Figure 1. The Elements of Games

Defining What Gamification Is and Is Not

Using Kapp's (2012) elements of games, it is now possible to consider what gamification means in the context of learning. Kapp suggested that gamification involves using elements traditionally thought of as being part of games, or elements that are fun, to promote learning and engagement. He defined gamification as "using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems" (2012, p. 10). We will explore these elements in the next section.

Kapp (and others) are also firm about what gamification is not. This is important because being aware of some of these ideas will help us more critically determine which educational technology integrations are likely to be successful and which are not. Kapp argued that gamification is not just the implementation of badges, points, and rewards. While these implementations are elements or **mechanics** of gamification, they alone are not sufficient for true gamification–nor is gamification a trivialization of learning.

The debate about whether game-based learning is the same as gamification is a point of some contention. Serious games are described as complete experiences that use game mechanics and game thinking to educate individuals. On the other hand, gamification — the use of game mechanics to engage learners — is often seen as more limited. Gamification allows for meaningful learning in a range of contexts. The effectiveness of this learning and the application of gamification depends on embracing all the elements of gamification, not just the simple ones such as badges and rewards. These elements, such as storytelling, have much in common with those of serious games. Thus, the distinction between serious learning and the more effective applications of gamification is largely meaningless.

The field of game-based learning is a bit older (in terms of research) than gamification. One of the key researchers in the field has been James Paul Gee, who identified 16 principles of good game-based learning in 2013. He wrote mostly about video games, but many of the elements he identified as being central to game-based learning are also elements of gamification. For the purposes of our discussion, we will consider them to be essentially the same thing. These elements are incorporated into the discussion below (see Figure 2).

Another point to consider is that gamification is not new. We know that war games have been used to train soldiers since the 7th century. Similar games-based learning approaches are still used in military academies around the world settings can be seen as an example of gamification.

Finally, Kapp (2012) indicated that gamification is neither perfect for every learning situation, nor easy to create. Good processes of gamification are time and resource intensive. Creating a learning activity that is both enjoyable and instructional is no easy task.

Elements of Gamification

We have probably all played games that we have found to be intensely interesting—almost becoming addicted to them, returning to them over and over again because we just want "one more go!" This can be the hallmark of a well-made game (although that, of course, depends on what you mean by "well made"). The elements that contribute to the making of that game are also important to designing a satisfactory gamified learning experience. These elements are presented in Figure 2 (adapted from Kapp, 2012).

Figure 2. The elements of gamification.

Some examples of these elements in action are presented in Table 1.

Elements of gamification	Example learning activity
Rules	Natural selection simulation This learning resource uses game-like mechanics to create a simulation of an ecosystem. Students can change the rules of the system and observe the outcome just like they do when playing a video game such as Minecraft.
Aesthetics	Fire and Evacuation VR Safety Training This video of a VR Fire safety training module shows how leveraging aesthetics such as full 360 vision, sound, and interactivity from games creates an engaging and immersive experience.
Conflict, competition, or cooperation	Communication puzzle In this activity, learners must work collaboratively, communicate, and problem solve to complete the activity.

Table 1. Examples of gamification

Try this simple gamification strategy.

1. Open the last multiple-choice quiz you created or completed.
2. Use this spinner to select an element of game to use.
3. Use this spinner to find out what tool you will use to apply your element of game.
4. Create a different version of the quiz by using the element of game and design tool.

Notes

- At first glance, some of these combinations of tools and elements may seem to be incompatible, but they are just an opportunity to stretch your creativity. For example, if you were assigned the game element of 'random' and the tool of 'branching scenario', you could create an assessment where the learner is randomly assigned different responses in a scenario, asked to explain whether these are the right or wrong choice in that situation, and instructed to justify their answer.

Ensuring Gamification Is Fit for Purpose

Not all gamification is created equal. As discussed earlier, gamification can be reduced to the trivial. For example, a learning designer can add points, badges, and/or multiple-choice questions to some presentation slides they turned into a video. They might even rank participant's scores on a leader board and claim the learning activity has been gamified. Ultimately, this will be a transient and unsatisfactory experience. It does technically meet the definition of being "gamified," as it incorporates several of the elements discussed above, and it may be slightly more engaging to some users, but it fails because it does not combine all, or most, of the elements of gamification into an event that is larger than its individual parts.

Choosing which activities to gamify and how to gamify them is a key part of **learning design**. Competitive elements of games such as scoring, recognizing winners and losers, or providing a league table can be motivating or engaging to certain types of learners but strongly de-motivating to others—particularly low-ability or low-interest learners. Similarly, adding a scenario to your learning activity may be very interesting to learners, but if your learning activity is one that must be repeated regularly, the story will rapidly become stale and demotivating.

A different pitfall that designers often fall into is the trap of seeking **engagement** over learning. A gamified learning activity can be fun to learners. In fact, usage statistics and feedback may tell you that your learners are engaged and motivated by the activity. However, if the assessment shows no appreciable improvement in learning or change in behavior, then the learning activity has not been a success. Good, gamified learning experiences should improve engagement—but not at the cost of learning.

Another concern that must be addressed when gamifying a learning activity is the lack of equity and accessibility. For example, a virtual reality experience could be wonderfully engaging to your learners but may be inaccessible and inequitable to learners with a range of disabilities. Equally, a gamified activity that requires an able body will exclude many adult learners in a workplace setting and should be chosen with caution.

Ideally, any application of gamification to a learning activity will begin with thoughtful consideration of your learners and their context to ensure that you are making choices that are fit for the intended learning objective. Table 2 showcases some poor examples of gamification.

Too competitive	Kahoot is a very popular cooperative online quiz software. Kahoot! tournaments and similar tools are used by large companies to train and gather data on their employees. While this approach is touted as giving the company lots of useful data and a fun way to train large groups of employees, there is no consideration for the employees who may be alienated by this kind of competitive approach.
Engagement without learning	The Reading Eggs program is a very popular program designed to help children learn to read. Watch this video The key selling point in this video is how engaged the children are. However, in a classroom, teachers may see students rushing through their readings in order to earn points to be able to play games. The design of this program places emphasis on the rapid completion of reading tasks instead of children developing an intrinsic interest in reading.
Inaccessible	Gamification in learning design is not always about learning a skill or concept—it can be about changing behavior. This example of gamification is inaccessible to everyone who is not able bodied. If your learners cannot access the learning experience or activity you are offering, your design will be less successful.

Table 2. Poor Examples of Gamification (LIDT in the World)

Scenario-based learning is often an excellent tool of gamification, but just like the examples given above, it can fail if applied poorly.

Cathy Moore is an internationally recognized training designer who follows a specific approach to scenario-based learning. Her useful website includes a number of examples of scenarios to help you understand how to use or, in this case, not use her scenario-based learning approach.

- Complete the scenario Classroom management by Cathy Moore. Consider how these elements are present in the scenario:
  - feedback
  - storytelling/ engagement
  - problem solving
  - learning outcomes
- Can you think of a situation where this kind of scenario would be highly effective? When could it be a ineffective?

Gamification and Learning

One of the main criticisms of gamification is that, in most forms, it uses limited behaviorist theories to inform teaching and learning practices. While this concern might be the case when regarding the use of rewards and some forms of feedback, this mindset fundamentally misunderstands the wider applications of gamification and ignores the way other theories of learning have informed the development of gamified principles and approaches to learning. In this section, the links between gamification and some key ideas relating to learning and instruction are examined.

Conditioning

The ideas of conditioning (from the behaviorist approach to learning) are present in many forms of gamification—most often in the form of operant conditioning, where players are rewarded for demonstrating a particular behavior. This reward reinforces the behavior and increases the probably that it will be demonstrated again. The most effective mechanism for this is, somewhat counter-intuitively, a **variable interval schedule**, where a player is rewarded after demonstrating the behavior a certain number of times but on an uneven schedule that cannot be predicted.

Motivation

A key concept of gamified learning is encouraging **motivation**. The argument is that gamified learning is more effective because the learner is more motivated to complete the learning. This motivation comes because they are more engaged and are having fun. However, there are two different kinds of motivation, and good gamified models make use of both. The first type of motivation is extrinsic motivation—the motivation that comes from outside the learner and is often developed through rewards and punishments. The second type of motivation is intrinsic motivation, which is when a person undertakes an activity for its own sake, the feelings of enjoyment, learning, and accomplishment they receive from that activity. Kapp (2012) explained,

> *When people are intrinsically motivated, they tend to be more aware of a wide range of phenomena, while giving careful attention to complexities, inconsistencies, novel events, and unexpected possibilities. They need time and freedom to make choices, to gather and process information, and to have an appreciation of well-finished and integrated products, all of which may lead to a greater depth of learning and more*

A good method of thinking about motivation is through John Keller's ARCS model (2009). Keller explained that motivation has four main characteristics:

Attention: Good learning must gain the attention of the learners to pique their interest in the content. There are different kinds of attention (or arousal). Perceptual arousal means gaining attention through specific relatable examples, incongruity or surprise. Inquiry arousal involves stimulating curiosity by presenting a question that the learner is interested in solving. Variability in delivery method is important too, as it can be used to hold the learner's attention.

Relevance: There are three different methods of ensuring relevancy: goal orientation, which means orienting the learner to the importance of achieving the goal and explaining how it will help in the future; familiarity, which is related to linking new knowledge to existing knowledge; and modelling the learning of new knowledge.

Confidence: If learners are confident that they can learn the material, they tend to be more motivated.

Satisfaction: If learners are satisfied with the experience and believe that the learning has value, they will perceive the experience as being worthy of continuing the effort.

Distributed Practice

An element of gamification related to cognitivist theories of learning is the idea of distributed practice. This element has different names. Sometimes, it is called “spaced learning” or “spaced practice.” It is the idea that learning is more efficient if it is spread over multiple shorter sessions, rather than in one long session. Distributed practice helps learners remember information over long periods of time because the spacing prompts deeper processing of the learned material.

Social Constructivism

Social constructivist theories of learning often refer to Vygotsky’s Zone of Proximal Development (1978). This is the idea that we learn best when the learning is pitched at the right level. If it is too easy, we don't learn. If it is too hard, we often struggle or give up. Scaffolding is a pedagogical approach that is used to assist in structuring the learning to ensure that learners receive the appropriate level of support in the Zone of Proximal Development. Scaffolding is like the use of levels in games and gamified learning. As Kapp (2012) stated,

> *Scaffolding and the use of levels in games provide educational advantages but also maintain interest in the game as a player moves from level to level having different experiences and achieving success as he or she progresses toward the ultimate goal. The levels usually become more difficult and challenging as the players move toward the end of the game, and the skills they exhibit at the final level would not be possible without the experience of playing the preceding levels. (p. 67)*

Learn More About Social Learning Theory

To learn more about Social Learning Theory, we recommend reading another chapter from this textbook titled Sociocultural Perspectives on Learning by Allman, Casto, and Polly.

Social Learning Theory

Finally, Albert Bandura's social learning theories (1977) are sometimes present in gamification too, often in the form of cognitive apprenticeships and modelling. Modelling is the process by which people learn to behave through observing, desired behavior through modelling.

Advice for Using Gamification Effectively

As stated earlier, gamification is popular in many settings. However, this can sometimes work against educators, as learners might have had previous bad experiences with gamification. The overuse of some elements of gamification and poor gamification design has led to a level of mistrust in learners, subject matter experts, and content owners. Because of this mistrust, they are resistant when educators suggest gamification of a specific learning activity. Understanding good gamification and how it is different from what has gone before will help educators make a better case for these design approaches.

When poor quality examples of gamification are reviewed, the following elements of game design are often over-represented:

- conflict, cooperation, competition
- levels
- reward structure
- goals
- abstractions
- rules

There is a reason these elements are commonly overused, as they are cheaper and easier to apply to learning activities. They also link back to the discussion about creating activities that are suitable for learners and their contexts, as well as the idea of the elements being used to create something that is greater than the sum of its parts. Many of these elements, when used on their own, create activities that are overly competitive, lead to short-term engagement without learning, or are inaccessible to a variety of learners.

In contrast, the list of underused elements is shorter. It contains all the elements that are more difficult to apply, and yet lead to richer, more robust learning activities.

- feedback
- storytelling
- aesthetics
- replay or do-over opportunities
- time (when used as a motivator or distributed as a finite resource)

Not all elements of gamification can be considered equal. In fact, some elements are more impactful than others.

Figure 3 presents a framework developed by Seldon and Kolber (2017) about the relative importance of various gamification elements. For example, while rewards will provide slight gamification benefits, the strongest benefits and most transformational changes come from introducing strong storytelling and elements of discovery to the learning. It is not that rewards, competition, rules and so on are not useful in gamification. Rather, on their own and without higher order elements, the lower order elements risk alienating learners, driving engagement without actual learning, or simply being inaccessible to a reasonable percentage of your learners.

Figure 3. Change and Gamification

To gamify effectively, educators should start with a purposeful approach to these elements and choose them based on the specific learning outcome required as well as the strength, weaknesses, and contexts of the learners.

An Example of Effective Gamification

To see these elements in play, you may view the following example of a gamified learning resource. It is a VR experience of a bushwalk in the endangered Cumberland Plains woodland.

First, note that this resource is not a game. It is a virtual learning experience designed to provide information to school students who are 5–16 years old. It could have been created solely as an educational webpage with images and text about plants and animals, but the designer added elements of gamification to create a more fulfilling learning experience.

The resource displayed above has the elements of aesthetics, feedback and discovery, replay or do-over, and time (See Figure 2). As a learner moves through the space, they are able to explore a high-quality image with surround sound in an immersive way. The interaction icons are small and do not crowd the viewing space. Also, the map in the top right-hand corner helps to orientate the learner in the virtual environment.

The learner makes choices about where they visit and what they look at by selecting question marks to learn about the space and by using arrows to move around. Each question mark gives the learner feedback about what plants, animals, insects, and hazards they might find in that ecosystem. The question mark was chosen and used deliberately to increase the learner's motivation, attention, sense of discovery, and sense of choice. If the icons had been chosen to represent what was located at that point (e.g., a plant, animal, or insect), learners might only select what they think they are interested in instead of discovering all the different and interesting parts of a functioning ecosystem.

The ability for a learner to move through the walk as many times as they want, or even jump to a specific location using the map, gives them the opportunity to explore at their own pace. This feature also ensures they feel safe and confident to revisit places and information as many times as they like rather than pushing them through a linear experience.

This chapter introduced the concept of gamification, explored its relationship to games themselves, and discussed how the elements of gamification relate to the mechanics of games. It also briefly considered the history of games as tools for learning and noted that gamification is not something that must rely upon technology in order to be effective. This chapter also explored how gamification relates to some of the common theories about learning.

More importantly, this chapter also discussed which of the elements of gamification are most effective for learning. The notions of story, discovery, choice, and problem solving are harder to implement; however, but they are far more likely to produce meaningful learning outcomes than simpler elements such as rewards and competition. In order to demonstrate ways in which these more complex elements might be utilized, a number of examples from various contexts were discussed.

LIDT in the World

Academic integrity is an important topic at every university but is also the kind of boring mandatory training that students avoid or think they already know all about. It is therefore a learning situation that is ripe for the application of gamification.

1. Play through the scenario.
2. How has the designer used the following elements of gamification well?
    1. Feedback
    2. Storytelling
    3. Aesthetics
    4. Replay or do-over
    5. Time
3. How would you improve this example if you had an unlimited budget?

Think About It!

Encouraging a learner to discover something for themselves, rather than simply telling them a key information or guiding them through the steps of a skill, is a key part of constructivist pedagogy. This example of gamification turns away from the traditional short video and quiz format. Instead, it challenges high school students to discover the key parts of computational thinking and develop their own working definitions.

1. Complete the learning task.
2. Evaluate how this approach is different from watching a short video about computational thinking.
3. Explain how the gamification approach in the Learning Check above is more difficult to apply.
4. Imagine that you need to pitch or sell a gamified learning activity to your manager or supervisor. What talking points should you prepare to help explain why simplistic approaches of design are not always the best approach to gamification in instructional design?

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Designing for Creative Learning Environments

Putting Pedagogical Principles into Action

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Innovation | Instructional Design | Creativity | Learning | learning environments

In this chapter, we discuss fundamental principles that define a creative learning environment and how these can be integrated into pedagogical design. Utilizing research, a creative environment instrument, and diverse learning settings as a springboard, we emphasize the link between a learning environment's design and how it nurtures creativity. We propose the use of the SCALE (Support for Creativity in a Learning Environment) instrument (Richardson & Mishra, 2018) as a frame for understanding and evaluating the characteristics of creative learning environments. Using the SCALE's constructs—characteristics of the environment, learning climate, and learner engagement—as benchmarks, we consider how these offer criteria to build into the design of learning environments. We examine the theoretical underpinnings of creativity, creative environments, and learning, identifying gaps in classroom research that the SCALE instrument can bridge. This chapter discusses applications of these principles across various environments, including online and blended spaces, acknowledging that different environments present distinctive affordances, opportunities, constraints, and possibilities. Our implications take a future-oriented perspective on online creative learning environment design in both research and practice.

Creativity is one of the most coveted qualities of thinking, (Lewis, 2009) bringing social, emotional, cognitive, and professional benefits (Sternberg, 2006). While education has increasingly framed creativity as a key element of teaching and learning, this rhetoric has rarely been realized in formal learning settings, partly due to traditional school limitations. In schools, the steady march of standardized testing restricts teachers' and students' creativity. Even in higher education, traditional structures and assumptions still permeate learning settings and designs. Creativity is not a discrete subject matter to be taught, memorized, or drilled—rather, it develops when the learning environment is deliberately designed to encourage and nurture it. Most of the attention on classroom creativity has focused on pedagogical practices or curricula. Teachers' roles in designing learning environments to support creative expression are often overlooked. This gap becomes starker when we consider the design of online/virtual learning environments, where even less scholarship exists on the design of creative spaces.

In this chapter, we delve into the fundamental principles that define a creative learning environment and how these can be integrated into pedagogical design. Utilizing research, a creative environment instrument, and diverse learning settings as a springboard, we underscore the pivotal link between a learning environment's design and the nurturing of creativity. We propose the use of the SCALE (Support for Creativity in a Learning Environment) instrument (Richardson & Mishra, 2018) as a frame for understanding and evaluating the characteristics of creative learning environments. Using environments. We examine the theoretical underpinnings of creativity, creative environments, and learning, identifying gaps in classroom research that the SCALE instrument can bridge. Then, we share applications of these principles across various environments, including online and blended spaces, acknowledging that different environments present distinctive affordances, opportunities, constraints, and possibilities. Our implications take a future-oriented perspective on online creative learning environment design in both research and practice.

Theoretical Foundations

Creativity: The Myths and Realities

Creativity is often defined as the process of creating ideas, artifacts, processes, and solutions, that are novel and effective (Cropley, 2003); or, as Runco and Jaeger (2012) articulated as “original” and “effective” in their standard definition. This two-part definition is deceptively simple. The very notion of creativity intimidates many people, as it is often seen as only available to the special or gifted. But, this view of creativity, as only for a select few, is problematic. According to Starko (2013), learning is integral to the creative process, and Guilford (1950) argued that creativity is a form of learning. Creative learning goes beyond academic knowledge and skills to help address the ever-evolving challenges of a changing world. It emphasizes learning creatively and applying knowledge in uncertain contexts (Beghetto, 2021), rejecting the notion of one correct answer. Allowing for uncertainty cultivates creative identities that embrace the complexity of creative processes (Craft et al., 2007).

This complexity can be daunting. When faced with creative thinking or problem-solving challenges, people often hesitate to self-identify as “creative” or are uncomfortable engaging in intellectual risk-taking and open-endedness (Weisberg, 2006). The inherent uncertainty and open-endedness of creative work can be emotionally and mentally taxing, requiring environments that are psychologically safe and supportive as well as dynamic and interesting.

The hesitancy that many feel about identifying as “creative” may relate to how creativity has historically been mythologized as an inherent trait, rather than a developed habit of mind or approach to the world (Cropley, 2016). For thousands of years, creativity has been seen as enigmatic, with Plato once attributing it to the influences of “the muse” (Rothenberg & Hausman, 1976). This myth contrasts with views of many creativity researchers today, who see it as an ability that may grow, flex, and expand through intentional development. Yet, popular myth still views creativity as innate —impervious to development or augmentation (Henriksen et al., 2017). Despite rhetoric about the importance of fostering creativity, most education systems still default to an instrumentalist view of teaching and learning. Prevailing policy tends to constrain or offer no support for teacher creativity, leaving many people uncertain about their individual creative potential. By viewing teachers as empowered designers of creative learning environments, rather than enactors of pre-set content, we might create the conditions for creativity to thrive in education (Benedek et al., 2021)—especially in the design of online learning environments, which are sometimes seen as more remote, removed, and less creative. However, we need to be aware of conditions that support learner creativity—e.g., what does creativity research suggest about creative learning environments?

Creative Environments

Creative environment refers to how a particular context or setting facilitates or influences creativity (Richardson & Mishra, 2018). This includes the psychological, pedagogical, and physical factors of a formal learning environment (in-person or online) or non-traditional learning spaces like museums or gardens (Jindal-Snape et al., 2013). Considering the architecture of an environment, we are influenced by Latour’s (2005) actor-network-theory (ANT), Gibson’s affordance theory (1979), and Dirkin and Mishra’s (2010) idea of “zone of possibility.” Though closely aligned, these frameworks differ subtly in emphasis. ANT suggests that all elements within a network, including non-human entities like the physical environment or technology, play an active role in shaping interactions and outcomes. Gibson’s affordance theory emphasizes the interaction between the possibilities an environment offers (i.e., its “affordances”), achievable within a given context or set of conditions. Each of these theories or approaches is neutral regarding the nature of the "space," whether physical, online, or blended. The key is that the architecture of the environment can facilitate or hinder communication, collaboration, exploration, and innovation, influencing the quality and nature of learning and creative outcomes.

Creative environments support the pursuit of interests and passions, engage students in co-creation/collaboration, value students' ideas, and embrace mistakes as a part of learning (Chan & Yuen, 2014). Curiosity-driven activities like exploring new media technologies, fantasy play, outdoor activities, model making, building, planning, and engaging in other design tasks can also foster creativity. Creative environments benefit students in many ways, including increasing personal achievement, GPAs, reasoning abilities, confidence, resilience, motivation, engagement, critical thinking, and problem-solving skills (Jindal-Snape et al., 2013). Such environments promote cooperation and encourage students to take reasonable risks and learn from mistakes. A learning environment is a community, and the values embodied within that community influence members' behaviors. Values, such as those that support creativity, can be operationalized and embedded within explicit roles, norms, and designed elements of a community. Learning designers, teachers, and students have a part to play in supporting or constraining creativity (Peppler & Solomou, 2011).

The role of the environment encompasses the physical space, interpersonal relationships, and the availability of resources and support (Beghetto & Kaufman, 2014). But, despite the growing interest in creativity research, creativity assessment tools have often overlooked the impact of environments, focusing instead on personality factors or psychological elements, which teachers have less influence over. For instance, in a review of creativity instruments, Henriksen et al. (2015) found that only 3% of existing creativity instruments measured creative environments, which is surprisingly low considering the environment's influence on creativity (Beghetto & Kaufman, 2014). Moreover, less than 20% of the already small portion of creative environment measures were specifically designed for K-12 students. Speaking to this gap, Richardson and Mishra (2018) designed a tool known as the SCALE, which identifies and evaluates the elements of creativity within learning environments. This tool has become a highly cited and widely used measure for assessing creative learning environments, offering a structure of constructs that pinpoint creative environment characteristics that teachers and learning designers can focus on to support creativity (Cullingford, 2007; Cheng, 2019; Hamid & Kamarudin, 2021; Huang, 2020; Jaatinen & Lindfors, 2019; Katz-Buonincontro & Anderson, 2020; Ovbiagbonhia et al., 2019). Since practitioners can benefit from clear principles or a frame to guide their efforts in the design of creative learning spaces, we outline key principles from the SCALE. From there, we consider how they might be applied to more varied learning settings.

Framing the Principles of Creative Learning Environments: The SCALE

What is the SCALE?

The Support for Creativity in a Learning Environment (SCALE) is a practical tool that assists education professionals in designing creative learning environments by identifying and measuring aspects of the physical environment, learning climate, and learner engagement (Richardson & Mishra, 2018). The SCALE tool consists of 14 items related to the (a) physical space and available resources and materials (4 items), (b) classroom atmosphere and relationships (4 items), and (c) tasks and activities that students are engaged in (6 items) (see Table 1). These items are rated on a four-point Likert scale from "no evidence" (0) to "high evidence" (3).

Although the SCALE instrument was developed in the context of K-12 education, we believe the underlying principles apply across contexts and learner ages—i.e., in-person, online and blended; and for learners in K-12, higher education, and adult education spaces. Context and setting clearly matter, but we believe that these principles are adaptable and flexible. Although their instantiations may vary across settings and contexts, the core ideas are transferable and applicable beyond K-12. These broader principles hold true, even while playing out differently in a 4th grade math class the core ideas provide a valuable foundation for teachers and learning designers to create, build on, and contextualize environments that support creativity.

SCALE Components	
Physical Environment:	• A variety of resources/supplies are available and accessible to students. • Examples of student work appear in the space. • A variety of workstations or areas are available to students. • The furniture allows for multiple arrangements and configurations.
Learning Climate:	• Students are involved in discussions among themselves, with or without the teacher, that deepen their understanding. • The students are caring, respectful, and value differences. • The teacher is a facilitator, co-learner, explorer, or inquirer with students. • Mistakes, risk-taking, and novel ideas are valued or encouraged.
Learner Engagement:	• Students are involved in tasks that are open-ended and/or involve choice. • Students are involved in activities that may include inquiry, project-based learning, or interdisciplinary tasks. • Students use multiple perspectives/viewpoints/ways of knowing or various modes of investigation/problem solving. • Students demonstrate interest in or enthusiasm for the activity beyond being “on task.” • Students spend time developing ideas for deeper understanding and/or reflecting on their learning. • Students work at their own pace and/or time is used flexibly.

SCALE ComponentsTable 1. SCALE Tool Components and Rating Scale
Note. From “Learning environments that support student creativity: Developing the SCALE,” by C. Richardson and P. Mishra, 2018, *Thinking Skills and Creativity*, 27. Copyright 2017 by Elsevier Ltd.

Key Ideas Supporting the SCALE Principles

The SCALE tool aims to assist teachers and administrators in identifying, measuring, and adjusting learning environmental variables that directly impact creativity as well as individuality, independence, and risk-taking (Lilly & Bramwell-Rejskind, 2004).

resources, sensory variables, space configurations, and class size" (Warner & Myers, 2009, p. 30). One of the environmental variables emphasizes the need to make a variety of resources available and accessible, including tools and materials to experiment with ideas and information to creatively solve problems (Peterson & Harrison, 2005). For instance, hyper-content textbooks—which connect content in books to online learning resources through links, barcodes, and augmented reality—have been used to enrich learning experiences and facilitate differences in learning characteristics (Surahman et al., 2021). Also, furniture designs should be psychologically appealing and provide a sense of comfort and safety. Space configurations should be flexible with areas for students to move around and communicate (Warner & Myers, 2009). For example, classrooms have been redesigned to enable active communication and interaction among students, with wheeled lecterns and chairs, round tables, and LCD screens connected to docking systems on tables (Park & Choi, 2014). Additionally, decorations, such as displays of student work, may prompt creativity and lead to new ideas by offering opportunities for reflection and metacognitive thinking (Eckhoff, 2019; Warner & Myers, 2009).

Learn More About Designing Physical Environments that Support Creativity

Wold Architects and Engineers. (2019, May 24). *Innovative learning spaces for the next generation: Centerview Elementary School* [Video]. YouTube. https://www.youtube.com/watch?v=uUisTKQFDho

[Watch on YouTube]

The second component of the SCALE tool consists of four items that identify and measure aspects of learning climates. These items focus on the influence that classroom atmosphere and teacher-student/student-student relationships have on creativity. Students need opportunities to explore and express ideas in learning climates that encourage "mistakes, risk-taking, innovation, and uniqueness, along with a certain amount of mess, noise, and freedom" (Edwards & Springate, 1995, p. 4). In these climates, teachers can become powerful aids in fostering creativity by exploring alongside students while facilitating meaningful activities with open-ended discussions (Craft, 2001; Edwards & Springate, 1995). For example, in STEM classrooms, teachers have designed and implemented problem-based

(Gillies, 2006), teachers can encourage students to be caring, respectful, and appreciative of differences by (a) making them feel worthy and loved, (b) showing respect for their ideas, and (c) searching for connections between different ideas and ways of knowing (Craft, 2001; Esquivel, 1995). For instance, teachers can promote critical thinking and enhanced engagement in whole-class discussions on controversial questions by prompting reciprocal interactions and respectful exploration of differences (Henriksen et al., 2022).

Learn More About Designing Learning Climates that Encourage Risk-taking and Creativity

TEDx Talks. (2018, June 1). *Take Beautiful Risks|Ron Beghetto|TEDxManchesterHighSchool* [Video]. YouTube. https://www.youtube.com/watch?v=toIJHDxx99A

[Watch on YouTube]

The third component of the SCALE tool consists of six items that identify and measure aspects of learner engagement. With a focus on the design of tasks that students are involved in, these items examine pedagogical practices, techniques, and methods that can be used to support creativity. As learning is a fundamentally social activity, teachers need to utilize constructivist-based pedagogical practices that enable students to frame and generate meaning with others (Dawson & McWilliam, 2008). Research on creativity in early childhood education has demonstrated that students benefit from long-term, open-ended projects that integrate different subject areas and lead to exploration (Edwards & Springate, 1995). For instance, in STEAM classrooms, teachers have used project-based learning processes to guide students through conducting in-depth research on real-world issues and drawing on information from multiple disciplines to brainstorm possible solutions (Henriksen et al., 2019).

In project-based learning processes, creativity can be supported by giving students more choices regarding what problems they will solve and how much time they will be given to complete work. This support may increase interest, engagement, and learning (Craft, 2001; Greenberg, 1992; Patall et al., 2010). For instance, virtual labs have been

2017). Further, the Creative Problem-Solving method (an active learning process embodying collaborative inquiry concepts within a constructivist paradigm) has been used to foster ingenuity and creativity and enhance motivation. This method utilizes critical reflection, critical thinking, and exploration of possible perspectives and solutions (Samson, 2015). Craft (2001) noted various ways to foster creativity in classrooms—viewing practices, techniques, and methods as an adaptable toolbox to craft each learning environment.

Learn More About Designing Tasks to Increase Learner Engagement

Edutopia. (2016, January 27). *STEAM + project-based learning: Real solutions from driving questions* [Video]. YouTube. https://www.youtube.com/watch?v=H7LHsL0iB_w

[Watch on YouTube]

The SCALE tool was designed to assess student creativity in learning environments and guide teachers in supporting and facilitating creativity (Richardson & Mishra, 2018). Its principles have been applied to diverse learning environments, including teacher education, online education, and STEAM programs (de la Peña et al., 2021; Ozkan & Topsakal, 2021; Wahyudi & Winanto, 2018). The SCALE tool has also been used to better understand ways to enhance creativity-fostering practices with emerging technologies (e.g., virtual/augmented reality, 3D design software) (Bereczki & Kárpáti, 2021; Chen et al., 2022). We propose key implications that can transfer to online environments while also supporting creativity within those same environments.

Implications for Practice

The SCALE is not just a measurement tool. It also embodies, in its structure, a set of principles that can help design environments that support creativity—these principles could be used from a pedagogical design standpoint to shape creative learning environments, both in physical and online/blended spaces. That said, we must recognize that instrument (Physical Environment, Learning Climate, and Learner Engagement) and discuss how teachers and learning designers might factor these into online and blended learning.

Physical Environment

The meaning of the "physical environment" changes when we consider online and blended learning spaces. One might argue that online and blended spaces offer greater flexibility to designers since they are relatively unconstrained by the geography of space, the materiality of objects, and maybe even the laws of physics. This gives designers of online/blended systems more flexibility to create a "conceptual" playground for students to engage with each other and with ideas. Yet, designers of online and blended environments are often constrained by capabilities of current technological systems and contextual factors outside of their control, such as the students' physical surroundings, possible distractions, and disruptions. Thus, online and blended setups may be freeing in some respects and limiting in others. An additional constraint may also be the instructor or learning designers' inability to imagine possibilities and opportunities in existing technologies. For instance, they may seek to replicate existing processes/structures of in-person learning that may not transfer effectively to technologically mediated contexts. This was evident when teachers were forced to teach online during the pandemic. There was a strong urge to replicate conventional structures instead of opening the classroom to the lived world of students and engaging in more project-based learning experiences and innovative practices.

The underlying principle of adaptability and configurability could be translated into the design of online and blended learning environments, creating digital spaces that allow multiple arrangements and configurations to suit diverse needs and preferences. Yet, many existing online learning tools/platforms or modes offer limited adaptable features and opportunities to completely redesign spaces or rethink assumptions. Ideally, platforms could allow users (i.e., not just learning designers but also teachers and students) to rethink and play with layouts in ways that align with their own preferences or needs, including flexible organization of resources and adjustment of accessibility features.

One of the benefits of online or blended learning environments is that students can easily be given a wide array of readily accessible digital resources and supplies. The goal is to include elements that allow a wider range of creative experimentation, help students appreciate the achievements of peers, and make the learning environment a space for fostering collaboration and improvement. A few suggestions in this regard include:

- utilizing diverse digital resources (e.g., software applications, digital libraries, and creative tools) to give students creative options to explore and experiment;
- offering different areas, discussion spaces, or online workspaces that cater to different modes of creativity; and
- seeking opportunities for students to share their digital work within learning spaces and, potentially, externally with others in the community and the wider world (e.g., creating blogs, videos, portfolio websites, or public digital articles)

Learning Climate

A learning climate that supports creativity depends on the nature of the relationship between teachers and students. This relationship cannot be based on power and fear but should instead be based on trust and respect. The norms of learning spaces should emphasize that the creative process can be messy and nonlinear, and mistakes and failures are to be expected. Teachers and students must be present—physically, cognitively, and emotionally. In this, online and blended spaces have a fundamental disadvantage. Online tools often do not afford the kind of social presence that being in a physical space with other people provides. Online and blended spaces lack the breadth and depth of communication modalities that physical presence provides, which in turn deepens social and emotional distance between participants. Individuals in learning communities need ways to convey their social and emotional selves as authentic beings engaged in shared tasks.

- providing opportunities for the affective aspect of learning to emerge through meaningful discussions and prompts
- using video tools to help enhance social presence—e.g., online office hours, video announcements/messages, or video conferenced meetings (though the mere utilization of video as a communication medium is rarely enough)
- establishing norms for respectful and empathetic communication where difference and play are encouraged and valued
- ensuring students realize it is okay to take risks, explore unconventional solutions, and think divergently—without punishment for mistakes
- experimenting with formative activities (e.g., ungrading or providing multiple opportunities to generate solutions)

Learner Engagement

Social presence is as important to learner engagement as it is to classroom climate. Assuming that the instructor is focused on enhancing and supporting the learner presence, the next thing to factor in is the design of the tasks and activities. Students are autonomous agents who drive their own learning—they want to learn *with* rather than be taught *to* (or *at*). Thus, student choice becomes important in designing learning environments that support creativity. This often takes the shape of open-ended tasks where students have some autonomy in selecting the tasks (or aspects of tasks) and the ways they would like to approach them. Engaging students in inquiry-based, project-based, and interdisciplinary activities promotes their creativity, encouraging them to delve deeper, make connections, and generate innovative solutions. Students who engage in activities that encourage a deep dive into a topic, exploring connections across disciplines and developing their own questions and hypotheses, become genuinely interested and are more likely to invest in their creativity and produce meaningful and innovative work.

One advantage of online and blended learning environments is the flexibility that lets students work at their own pace and manage their time effectively during more in-depth projects. Online settings allow students to structure their workflow and pace themselves, with the (possible) ability to customize deadlines to meet individual needs. That said, there must be a balance between structure and flexibility, providing clear expectations that allow students to plan and manage their learning. Several ways teachers can factor these ideas into their teaching include the following:

- designing projects, challenges, and problem-solving activities that allow students to explore different possibilities and leverage their strengths
- embracing multidisciplinary approaches, letting students apply their creativity to real-world problems, deep investigations, and innovative solutions
- showing genuine interest and enthusiasm through activities that tap into students' passions through self-directed projects
- integrating multimedia elements, increasing opportunities for students to pursue projects related to their interests
- providing time for idea development, reflection, and flexible pacing to enhance students' understanding, connections, and insights

Conclusion

We tend to think of teaching and learning as processes that take place in the minds of students, teachers, and ourselves. Thus, we often think about educational design in terms of how pedagogy influences learning as a mental process. Certainly, cognition is central to learning, but it is important to also consider how human thoughts and behaviors are influenced and driven by the environments we create; and environments are inherently a human construction. At some level, the human environment is "made up," in that it is constructed by people for a purpose and thus can be remade or shaped differently to fulfill different purposes—like learner creativity. Environments can be changed, shifted, redesigned, recreated, and reimagined.

Consider How Education is Designed and Could Be Redesigned

TED Talks. (2023, June 9). *How to Design a School for the Future|Punya Mishra|TED* [Video]. YouTube. https://www.youtube.com/watch?v=YYRI164Y-_M

Watch on YouTube

In doing design or redesign work, learning designers need thoughtful principles framed by a sense of the environmental factors that influence learning and creativity. This is where we suggest the application of an environmental frame, such as the principles found in the SCALE instrument, to guide the design and construction of creative learning environments from a comprehensive physical/virtual, cognitive, behavioral, and perceptual lens. One of the ultimate goals of education is to prepare students for the future, which is inherently uncertain and requires creativity. In that sense, building creative learning spaces is one of the most important tasks we can undertake toward that fundamental creative purpose of teaching and learning.

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Learning Experience Design

Matthew Schmidt, Yvonne Earnshaw, Andrew A. Tawfik, & Isa Jahnke

This chapter elucidates on learning experience design (LXD), a philosophical approach to instructional that draws from various perspectives including human-computer interaction and design thinking. LXD aims to guide the design and development of digital learning technologies, emphasizing on creating highly usable and satisfying digital learning experiences. The chapter outlines specific human-centered design techniques, their goals, and the ideal stage of application during the design and development of digital learning experiences.

Author's Note

This chapter is a companion to the chapter entitled *Evaluation Methods for Learning Experience Design*, also available in this volume.

Various theories and models have been published that guide the design and development of digital learning technologies. While these approaches can be useful for promoting cognitive or affective learning outcomes, user-centered design methods and processes from the field of human-computer interaction can also be of value to those in the learning/instructional design and technology community. In this chapter, we present user-centered design techniques and processes derived from human-computer interaction, human-centered computing, user experience design, and design thinking. These techniques can lead to highly usable and satisfying digital learning experiences. We begin with foundational theories particularly relevant to the field of learning experience design. We then outline specific, human-centered design techniques that can be applied during the design and development of digital learning experiences. The descriptions of these techniques include both the goals of the techniques, as well as the ideal stage in which to apply them.

Introduction

Educators and learners are increasingly reliant on digital tools to facilitate learning. However, educators and learners often use technology in ways that are different than developers originally intended (Straub, 2017). For instance, educators may be challenged with trying to determine how to assess student learning within their learning management system (LMS), so they use a different tool than the one provided in the LMS and then copy/paste the results. Or they might spend time determining workarounds to administer lesson plans because the LMS does not directly support a particular pedagogical approach or learning strategy. From the perspective of learners, experiencing the challenges of navigating an interface or finding homework details might result in frustration or even missed assignments. When an interface is not easy to use, users tend to develop alternative paths to complete a task to accomplish a learning goal.

of the software development team failing to consider the user (or in this case, the learner) sufficiently in the design process. This extends to the field of learning/instructional design and technology (collectively LIDT) and can create barriers to effective instruction (Jou et al., 2016; Rodríguez et al., 2017).

The principles of human-computer interaction (HCI) and **user-centered design (UCD)** have implications for the design of learning experiences in digital environments. While the field of LIDT has focused historically on theories that guide learning design (e.g., **scaffolding**, **sociocultural theory**), less emphasis has been placed on learning technology design from the view of HCI and UCD (Okumuş et al., 2016). Increasingly, **user experience design (UXD)** and usability research are being accepted as particularly useful in supporting positive, enjoyable, or memorable learning experiences. This has emerged as a focus area in the field of LIDT and is referred to as ***learning experience design***. Adoption of such techniques occurred alongside the field differentiating *instructional design* (Mor & Craft, 2012) from ***learning design*** (Saçak et al., 2022). At the same time, usability and user experience methods emerged from the field of software engineering (Hassenzahl, 2013), and practitioners of learning design began adopting these methods in their own design practice (Kilgore, 2016). Hence, the term *learning experience designer* was born (Georgiou & Ioannou, 2021; Harrati et al., 2016; Korkmaz, 2018; Minichiello et al., 2018) to describe designers engaging in the practice of **learning experience design** (LXD; Schmidt & Huang, 2022).

LXD is a relatively novel phenomenon in the field of LIDT. We recently published an edited volume titled *Learner and User Experience Research: An Introduction for the Field of Learning Design & Technology* (Schmidt et al., 2020). In our introduction to this book, we identified three areas in need of further articulation. Firstly, there is little agreement in terminology within our discipline. Secondly, LXD as an emerging area of research and practice has made neither substantial nor sufficient connections to the theoretical foundations of LIDT. Thirdly, although learning designers are applying methods and processes of UCD in their design contexts, there are as of yet no guidelines for this in LIDT. Since publishing this edited volume, some progress has been made in terms of defining LXD (as discussed in the following paragraph). However, progress elaborating theoretical foundations of LXD remains limited. In this chapter, we approach this issue by situating LXD within theories of cognitive load, distributed cognition, and activity theory. Finally, guidance regarding design techniques and evaluation methods for aspiring learning experience designers has yet to emerge. The current chapter (and its companion chapter in this volume, titled *Evaluation Methods for Learning Experience Design*) speaks to this need, focusing primarily on design techniques for learning experience designers.

Learn More About Learner and User Experience Research

To learn more about learner and user experience research in the field of LIDT, we recommend the open access edited volume *Learner and User Experience Research: An Introduction for the Field of Learning Design & Technology*, provided here in EdTech Books!

Schmidt, M., Tawfik, A. A., Jahnke, I., & Earnshaw, Y. (2020). *Learner and User Experience Research: An Introduction for the Field of Learning Design & Technology*. EdTech Books. https://edtechbooks.org/ux

Learning experience design (LXD) is defined as “a human-centric, theoretically-grounded, and socioculturally sensitive approach to learning design, intended to propel learners towards identified learning goals, and informed by UXD methods” (Schmidt & Huang, 2022, p. 151). LXD is concerned with learners’ interactions with the learning environment, as well as with their interactions with the learning space (Tawfik et al., 2022). Importantly, the term LXD does not suggest that learning or experiences themselves can be designed or engineered, but instead that opportunities *for* learning can be designed so that positive and enjoyable learning experiences can happen. The practice

(a) the technological dimension, which includes learner-computer interaction with a given learning technology;

(b) the pedagogical dimension, which includes learner interaction with designed materials, instructions, activities, assessments, etc.; and

(c) the sociocultural dimension, which includes digitally-mediated social relationships, digital communication, and online social presence (Jahnke et al., 2020; Marell-Olsson & Jahnke, 2019), as detailed in Figure 1.

Learn More

For further details, we recommend reading Schmidt and Huang's (2022), *Defining Learning Experience Design: Voices from the Field of Learning Design & Technology* here:

https://link.springer.com/article/10.1007/s11528-021-00656-y

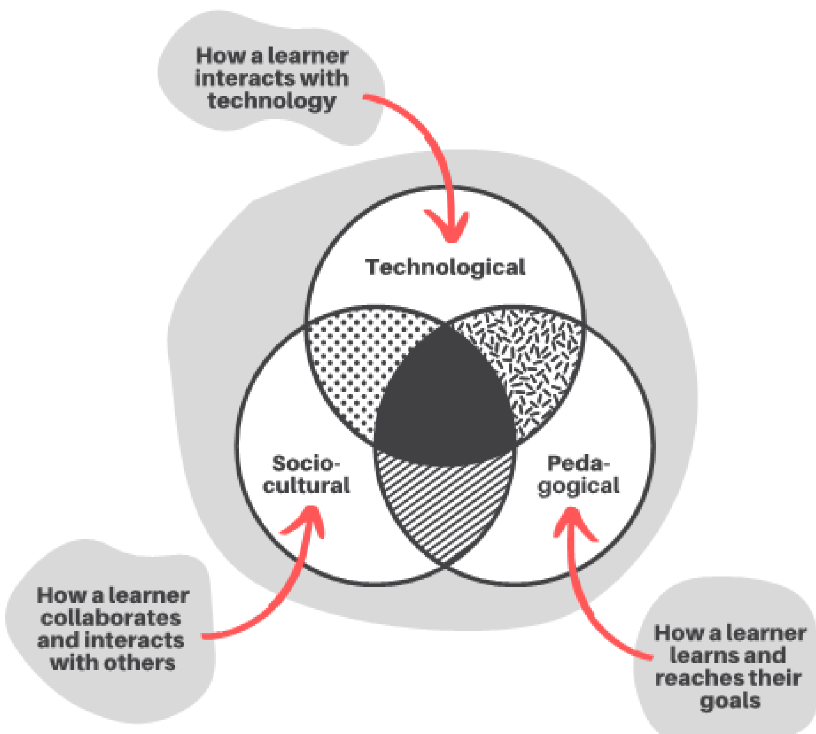


Figure 1. Technological, socio-cultural, and pedagogical dimensions of learning experience design.

What is LXD? Is it the new ID? Is it UX for e-learning? Earnshaw and colleagues (2021) seek to provide clarity around these questions in their blog post *Understanding the complexity of Learning Experience Design* here: https://medium.com/ux-of-edtech/understanding-the-complexity-of-learning-experience-design-a5010086c6ee

Summarize your thoughts in a paragraph or two as you reflect on how these questions were addressed in the blog post.

Learning Check

(True/False) Learning experience design is the same as instructional design.

- [ ] True
- [ ] False

Learning experience design is a multidimensional construct that considers the following dimensions (select all that apply):

- [ ] Sociocultural
- [ ] Technological
- [ ] Theoretical
- [ ] Pedagogical

Theoretical Foundations

Usability and HCI principles are often situated in established theories such as **cognitive load theory**, **distributed cognition**, and **activity theory**. LIDT is a sibling of these disciplines; hence, these theories also have ramifications for the design and development of learning technologies. In the following sections, we discuss each theory and the importance for conceptualizing UCD, usability, and UX from the LIDT perspective.

Human-Computer Interaction

Understanding how educators and learners interact with learning technologies is key to avoiding and remediating design flaws. HCI seeks to understand the interaction between technology and the people who use it from multiple perspectives (Rogers, 2012)—two of which are user experience (UX) and **usability**. UX describes the broader context of technology usage in terms of "a person's perceptions and responses that result from the use or anticipated use of a technology is. More specifically, usability describes how easy or difficult it is for users to interact with a user interface in the manner intended by the software developer (Nielsen, 2012). Highly usable user interfaces are easy for users to become familiar with, efficiently support users achieving their goals, and are easy to remember. From the perspective of learning design, these design factors are used strategically to focus cognitive resources primarily on the task of learning.

Learn More about Usability in LXD

For details on usability in the field of LXD, we recommend reading Jahnke et al. (2021), *Sociotechnical-pedagogical Usability* at:

https://edtechbooks.org/ux/sociotechnical_pedagogical_usability

Cognitive Load Theory

Cognitive load theory (CLT) contends that learning is predicated on effective cognitive processing; however, an individual only has a limited number of resources needed to process the information (Mayer & Moreno, 2003; Paas & Ayres, 2014). The three categories of CLT include: (a) intrinsic load, (b) extraneous load, and (c) germane load (Sweller et al., 1998) (see Figure 2).

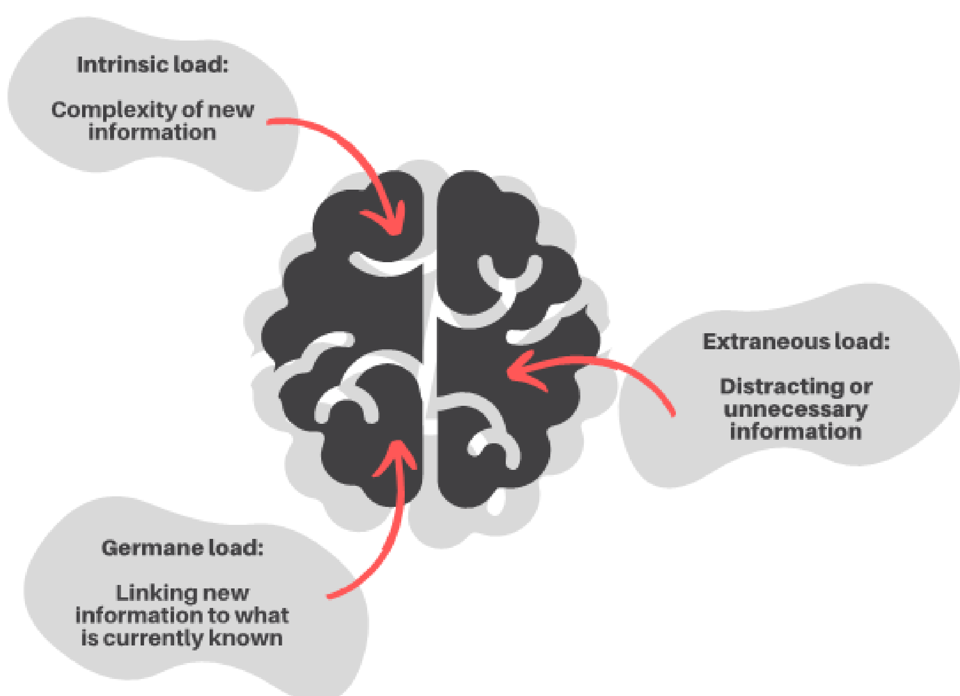


Figure 2. The three categories of cognitive load.

Secondly, **extraneous load** includes the elements that are not essential for learning but are still present for learners to process (Korbach et al., 2017). Thirdly, **germane load** describes the relevant load imposed by the effective instructional/learning design of learning materials (hereafter referred to simply as learning design). Germane cognitive load is therefore relevant to **schema** construction as information is incorporated into **long-term memory** (Paas et al., 2003; Sweller et al., 1998; van Merriënboer & Ayres, 2005). It is important to note that the elements of CLT are additive, meaning that if learning is to occur, the total load cannot exceed available **working memory** resources (Paas et al., 2003).

Extraneous load is of particular importance for UCD. Extraneous cognitive load can be directly manipulated by a designer (van Merriënboer & Ayres, 2005) through improved usability. When an interface is not designed with usability in mind, the extraneous cognitive load is increased, which impedes meaningful learning. From a learning design perspective, poor usability might result in extraneous cognitive load in many forms. For instance, a poor navigation structure in an online course might require the learner to extend extra effort to click through the learning modules to find relevant information. Further, when an instructor uses unfamiliar terms in digital learning materials that do not align with a learner's mental model or the different web pages in a learning module are not consistently designed, the learner must exert additional effort toward understanding the materials. Another example of extraneous cognitive load is when a learner does not know how to progress in a digital learning environment, resulting in an interruption of learning flow. Although there are many other examples, each depicts how poor usability taxes finite cognitive resources. Creating highly usable digital environments for learning can help reduce extraneous cognitive load and allow mental resources to remain focused on germane cognitive load for building schemas (Sweller et al., 1998).

Distributed Cognition and Activity Theory

While CLT helps describe the individual experience of user actions and interactions, other theories and models focus on broader conceptualizations of HCI. Among the most prominent are **distributed cognition** and **activity theory**, which take into account the social context of learning and introduce the role of collaboration between various individuals. Distributed cognition suggests that knowledge is present both within the mind of an individual and across artifacts (Hollan et al., 2000). The theory focuses on the understanding of the coordination "among individuals and artifacts, that is, to understand how individual agents align and share within a distributed process" (Nardi, 1996, p. 39). From the perspective of LIDT, individual agents (e.g., learners, instructors) operate within a **distributed process** of learning, as facilitated by various artifacts (such as content, messages, and media). The distributed process of learning is mediated by intentional interaction and communication with learning technologies (e.g., learning management systems, web conferencing platforms) in pursuit of learning objectives (Boland et al., 1994; Vasiliou et al., 2014). For example, two learners collaborating on a pair of programming problems might write pseudo-code and input comments into a text editor. In this case, distributed cognition is evident in collaborating on the programming problem and by conceptualizing various solutions mentally but also by using a tool (the text editor) to extend their memory. Cognition in this case is distributed between people and tools; distributed cognition, therefore, would focus on the function of the tool within the broader learning context (Michaelian & Sutton, 2013). In contrast with the more narrow perspective of CLT that considers the degree to which a specific learner's limited cognitive resources are affected when interacting with a technology system, distributed cognition adopts a broader cognitive, social, and organizational perspective (Rogers & Ellis, 1994).

Activity theory, on the other hand, is a systems-based, **ecological framework** that that shares some similarities with distributed cognition but distinguishes itself in its specific focus on activity and the dynamic interaction of actors, artifacts, and **sociocultural** factors within an interconnected system. Given its ecological lens, activity theory can be a useful framework for describing and understanding how a variety of factors can influence human activity. Central to activity theory is the concept of **mediation**. In activity theory, activity is mediated by tools, also called artifacts (Kaptelinin, 1996). From a technological perspective, the concept of tools is often in reference to digital tools or software. These technological tools mediate human activity within a goal-directed hierarchy of (a) activities, (b) actions, and (c) operations (Jonassen & Rohrer-Murphy, 1999). Firstly, activities describe the top-level objectives and fulfillment processes that group members complete (Engeström, 2000). However, operations do not maintain their own goals but are rather the unconscious adjustment of actions to the situation at hand (Kaptelinin et al., 1999). Engström's (2000) sociocultural activity theory framework is commonly depicted as an interconnected system in the shape of a triangle, as depicted in Figure 3.

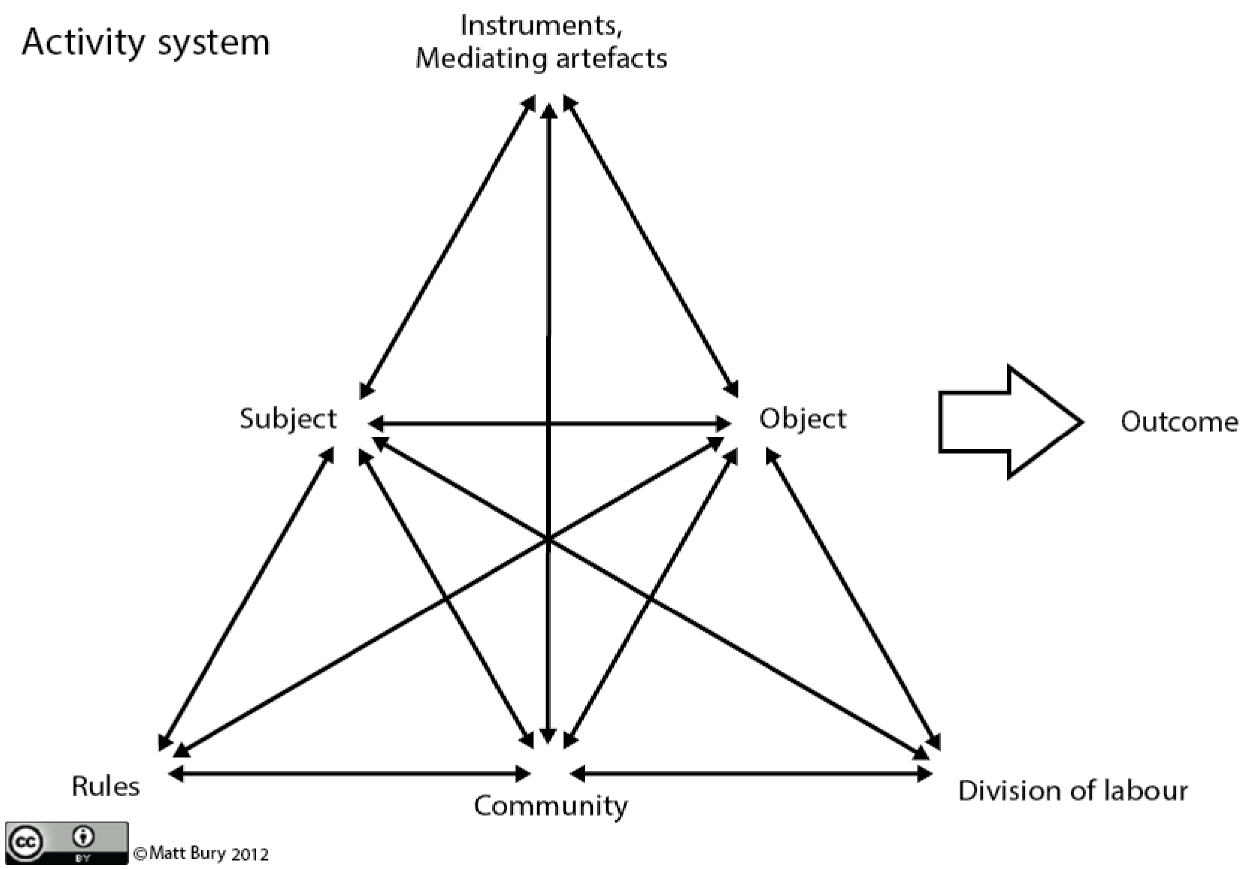
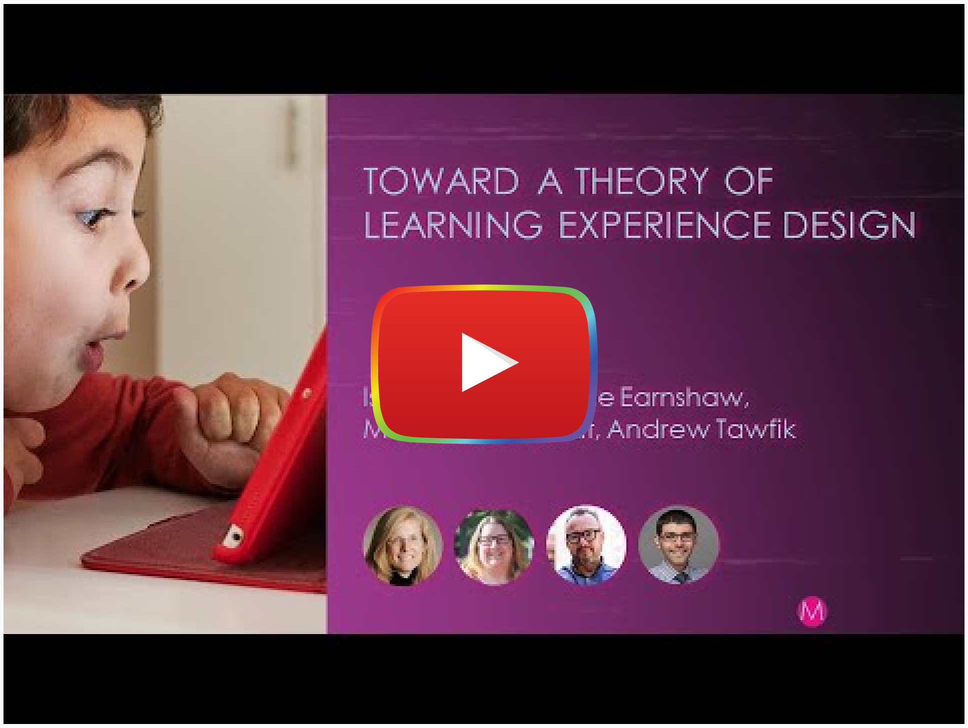


Figure 3. Activity system diagram. Adapted from "Activity Theory as a Framework for Analyzing and Redesigning Work," by Y. Engeström, 2000, *Ergonomics*, *43*(7), p. 962.

Activity theory is especially helpful for LXD because it provides a framework to understand how objectives are completed within a learning context. Nardi (1996) highlights the centrality to activity theory of mediation via tools/artifacts. These artifacts are created by individuals to control their own behavior and can manifest in the form of instruments, languages, or technology. Each carries a particular culture and history that stretches across time and space (Kaptelinin et al., 1999) and serves to represent ways in which others have solved similar problems. As applied to learning contexts, activity theory suggests that tools not only mediate the learning experience but that learning processes are often altered to accommodate the new tools (Jonassen & Rohrer-Murphy, 1999).

This belief in the role tools play in learning processes and experiences underscores the importance of considering the influence of novel learning technologies (e.g., LMSs, educational video games) from within a broader context of social activity when implemented by schools and/or organizations (Ackerman, 2000). The technological tools instituted in a particular workgroup should not radically change work processes but should present solutions on the basis of needs, constraints, history, etc. of that workgroup (Barab et al., 2002; Yamagata-Lynch et al., 2015). As learning is increasingly collaborative through technology (particularly online learning), activity theory and distributed cognition can provide important insights for learning designers into the broader sociocultural aspects of HCI.

For details on theoretical perspectives that influence LXD, the authors of this chapter created a video (10 minutes) on *Toward a Theory of Learning Experience Design*.



Watch on YouTube

Matthew S. (2021, December 15). Toward a Theory of Learning Experience Design. [Video]. YouTube. https://www.youtube.com/watch?v=FYTouzHwKt0&t=1s

What did you learn from this video that was new?

How would like you encorporate what you learned into your own designs?

Learning experience design is situated in established theories such as the following (select all that apply):

- [ ] Cognitive load theory
- [ ] Attribution theory
- [ ] Activity theory
- [ ] Distributed cognition

Learning Experience Design Techniques

The brief overview of theoretical foundations provided in the previous sections highlights how theories of cognition and human activity in sociocultural contexts can be useful in the design of digital learning experiences. However, the question remains as to how one designs highly usable, engaging, and effective digital learning experiences on the basis of these theories. Answering this question is difficult because these theories are not **prescriptive**. Specific guidance for how they can be applied is lacking, meaning that how best to design theoretically inspired, highly usable, and pleasing learning environments is ultimately the prerogative of the designer. **Iterative design approaches** can be useful for confronting this challenge.

While the field of LIDT has recently begun to shift its focus to more iterative design and user-driven development models, there is a need to more intentionally bridge learning design and user experience design approaches to support effective, efficient, and satisfying learning experiences in digital environments. To this end, a number of existing learning design methods can be used or adapted to fit iterative approaches. For example, identifying learning needs has long been the focus of a front-end analysis. **Ideation** and prototyping are frequently used methods from UX design, and **rapid prototyping** (see Tripp & Bichelmeyer, 1990) is a typical design process. In addition, evaluation in learning design has a rich history of formative and summative methods. By applying these specific design methods within iterative design processes, learning experience designers can advance their designs in such a way that they can focus not only on intended learning outcomes but also on the learning experience and usability of their designs.

In the following sections, LXD techniques are considered for incorporation into one's learning design processes through (1) identifying user needs, (2) project **requirements gathering**, and (3) **prototyping**.

Developing Project Requirements Based on Learners' Needs

One potential pitfall of any design process is when designers create systems based on assumptions of what users want. Only after designers have begun to understand the user should they begin to identify what capabilities or conditions a system must be able to support to meet the identified needs. These capabilities or conditions are known as "requirements." The process a designer undertakes to identify these requirements is known as "requirements gathering." Generally, requirements gathering involves gathering and analyzing user data (e.g., surveys, **focus groups**, interviews, observations) and assessing user needs (Sleezer et al., 2014).

In the field of LIDT, assessing learner needs often begins with identification of a gap (the need) between actual performance and optimal performance (Rossett, 1987; Rossett & Sheldon, 2001). Needs and performance can then be alone is insufficient to design highly usable and satisfying learning environments. Further detail is needed regarding the specific context of use for a given tool or system. Context is defined by the learners (and others who will use the tool or system such as administrators or instructors), the tasks (what will learners do with the tool or system), and the environment (the local context in which learners use the tool or system).

Based on identified learner needs, a set of requirements is generated to define what system capabilities must be developed to meet those needs. Requirements are not just obtained for one set of learners, but for all learner types and **personas** (including instructors and administrators) that might utilize the system. Data-based requirements help learning designers avoid the pitfall of applying ready-made solutions to assumed learner needs, but instead position the learner and learner needs centrally in the design process, allowing for creation of design guidelines targeting an array of various learner needs.

Requirements based on learner data are therefore more promising in supporting a positive learning experience. However, given the iterative nature of UXD, requirements might change as a design evolves. Shifts in requirements vary depending on design, associated evaluation outcomes, and contextual considerations. Two methods commonly used in UXD for establishing requirements are persona and scenario development. Personas provide a detailed description of a fictional user whose characteristics represent a specific user group—thus helping designers approach design based on the perspective of the user. Meanwhile scenarios situate the learner in an authentic context by presenting narratives that describe user activity in an informal story format (Carroll, 2000).

Learn More About Activity Theory and Learning Experience Design

Schmidt and Tawfik (2022) provide examples of how activity theory can be used to inform learning experience design in their article *Activity Theory as a Lens for Developing and Applying Personas and Scenarios in Learning Experience Design.* You can read the article here:

https://edtechbooks.org/jaid_11_1/activity_theory_as_a

Prototyping Digital Learning Experiences

Gathering data and designing and developing digital learning experiences is an iterative process. Based on personas and identified requirements, an initial prototype of the user interface or the online learning environment will be created. Prototyping is central to learning experience design practice and tends to follow a trajectory of development over time from low fidelity to high fidelity (Walker et al., 2002). **Fidelity** refers to the degree of precision, attention to detail, and functionality of a prototype. A LXD designer progresses in prototype levels towards greater and higher fidelity, testing each prototype with learners. Examples of the range of prototyping encouraged include:

prototype.

- **Medium-fidelity prototypes**, such as wireframes, that visually convey structure but lack the functionality and visual elements of high-fidelity prototypes. **Wireframing** commonly occurs early in the design process after paper prototyping and allows designers to focus on things that paper prototyping does not, such as layout of content. These prototypes are typically evaluated through testing/feedback with small groups of target learners.
- **High-fidelity prototypes**, which can include non-functional "dummy" graphical mockups of interfaces and interfaces with limited functionality that allow for more refined user evaluation with target learners or can represent a full manifestation of a design. These can be evaluated through field testing, **heuristic evaluation** using established heuristic guidelines, and learner feedback from usage tests.

Typically, lower fidelity prototypes do not take much time to develop, and higher fidelity prototypes take longer because prototypes become more difficult to change as more details and features are added. Prototyping is a crucial skill for all learning experience designers, including those who create online courses by arranging various content, media, and interactive experiences to those who develop educational software such as educational video games or mobile apps.

LIDT in the World

For further information, we recommend the AECT Design & Development Webinar (56 minutes) on *Agile Project Management for Instructional Designers*:

Watch on YouTube

AECT Design and Development. (2022, February 22). AECT D&D Webinar - Agile Project Management for Instructional Designers. [Video]. YouTube. https://www.youtube.com/watch?v=hm_pMeXs0xs

How does agile methodology differ from traditional instructional design project management approaches?

For further information on paper prototyping, refer to Snyder (2003) and the following link:

https://www.usability.gov/how-to-and-tools/methods/prototyping.html

To reiterate, the goal of UCD is to approach systems development from the perspective of the end-user. Using tools such as personas and prototypes, the learning design process becomes iterative, dynamic, and more responsive to learner needs. Learning designers often use these tools in conjunction with a variety of evaluation methods to better align prototype interface designs with learners' mental models, thereby reducing cognitive load and improving usability.

Conclusion

As digital tools for learning have gained in popularity, there is a rich body of literature that has focused on designing learning experiences with and through these tools. Indeed, a variety of principles and theories (e.g., cognitive load theory, distributed cognition, activity theory) provide valuable insight to situate the learning design process. In this chapter, we have illustrated how the fields of HCI and UX intersect with the field of LIDT and have provided specific examples of how theories from within and outside the field of LIDT influence learning experience design. Moreover, we have provided a brief description of iterative design processes that can be employed to advance usable and pleasing learning designs. A design approach that connects the principles of UXD and HCI with theories and processes of LXD can help ensure that digital environments for learning are constructed to support learners' achievement of their learning goals in ways that are effective, efficient, and satisfying.

Think About It!

LXD focuses on the three dimensions: sociocultural, technical and pedagogical. What will happen to your design if you neglect one of the three dimensions?

You want to design a mobile microlearning unit. Starting with requirements gathering, what type of data would you collect and analyze to understand more about the learner? How would you iterate on the design?

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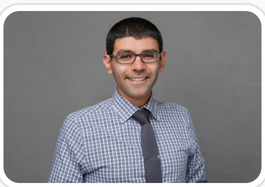

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Evaluation Methods for Learning Experience Design

Matthew Schmidt, Yvonne Earnshaw, Andrew A. Tawfik, & Isa Jahnke

This chapter addresses the methodological vacuum in evaluating LXD practices. It elucidates common evaluation methods for LXD, providing a structured approach amidst the existing challenges in terminology, theoretical foundation, and method-application from user experience design (UXD) in learning design contexts. This chapter aims to bridge the gap by offering methodological guidance, thus fostering a more robust framework for evaluating LXD initiatives.

Author's Note

This chapter is a companion to the chapter entitled *Learning Experience Design*, also available in this volume.

Learning experience design (LXD) is being practiced as a modern manifestation of learning design at an increasing rate (Schmidt & Huang, 2022; Schmidt & Tawfik, 2022). However, given the recency of LXD, a range of challenges present themselves when learning designers desire to apply LXD in their own design practice. Of these, Schmidt and colleagues (2020) identified three major, troublesome issues: (a) there is little agreement in terminology (i.e., what is it?), (b) no substantial efforts have been made to connect LXD practice with the theoretical foundations of learning design and technology (i.e., how does it work?), and (c) there are no guidelines for applying methods and processes derived from user experience design (UXD) in learning design contexts (i.e., how do you do it?). In response to the lack of methodological guidance in this area, the current chapter seeks to introduce evaluation methods that are commonly used for LXD.

Learning experience design has been characterized as encompassing two broad forms of interaction: (a) interaction with the learning space and (b) interaction with the learning environment, which Tawfik and colleagues (2022) describe as follows:

> *[Interaction with the learning environment is] focused on UX elements and includes learner's utility of the technology in terms of customization, expectation of content placement, functionality of component parts, interface terms aligned with existing mental models, and navigation. Interaction with the learning space describes how the student perceives the interface elements, including engagement with the modality of content, dynamic interaction, perceived value of technology features to support learning, and scaffolding. Rather than see these as mutually exclusive, [they represent a] confluence of these design constructs. (p. 331)*

interaction, that is, how learners actually use a digital learning technology product or service. However, learning designers cannot know a priori how learners will actually interact with a product (Gregg et al., 2020). Therefore, evaluation methods are critical to explore not only learners' perceptions of **prototypes** and fully developed products, but also to gain insight into learners' needs, preferences, and values related to envisioned products. In the following sections, we present various evaluation methods that are commonly used in UXD and usability research, as well as recommendations for when these evaluation methods are most appropriate.

Learn More About LXD and UXD Research in LIDT

To learn more about learner and user experience research in the field of LIDT, we recommend the open access edited volume *Learner and user experience research: An introduction for the field of learning design & technology*, provided here in EdTech Books!

Schmidt, M., Tawfik, A. A., Jahnke, I., & Earnshaw, Y. (2020). *Learner and user experience research: An introduction for the field of learning design & technology*. EdTech Books. https://edtechbooks.org/ux

Evaluation Methods

In LXD, knowing when and under what conditions to apply evaluation methodologies is a challenge. In the following sections, several evaluation methodologies commonly used in LXD are described, with descriptions of how these evaluation methodologies can be used in a learning design context. These can be applied during various phases across the learning design and development process (i.e., **front-end analysis**, low fidelity to high-fidelity prototyping). While a case can be made that any of the approaches can be applied to a given design phase, some evaluation methodologies are more appropriate to the overall learning experience, while others focus more on usability. Table 1 provides an overview of methods, the associated design phases in which they can most optimally be implemented, and their associated data sources.

Method	Design phase				Data source
		Prototyping			
	Front-end analysis	Paper (low fidelity)	Wireframe (medium fidelity)	Functional (high fidelity)	
Ethnography	x				Single user or users
Focus groups	x	x			Group of users
Card sorting	x	x			Single user, multiple users, or group fo users
Cognitive walkthrough		x	x	x	Expert
Heuristic evaluation		x	x	x	Experts
A/B testing		x	x	x	Multiple users
Think-aloud		x	x	x	Multiple users
EEG/Eye Tracking				x	Multiple users
Analytics				x	Multiple users

Ethnography

A method that is used early in the front-end analysis phase, especially for requirements gathering, is **ethnography**. Ethnography is a qualitative research method in which a researcher studies people in their native setting (not in a lab or controlled setting). During data collection, the researcher observes the group, gathers artifacts, records notes, and performs interviews. In this phase, the researcher is focused on unobtrusive observations to fully understand the phenomenon in situ. For example, in an ethnographic interview, the researcher might ask open-ended questions but would ensure that the questions were not **leading**. The researcher would note the difference between what the user is doing versus what the user is saying and take care not to introduce their own bias. Although this method has its roots in the field of cultural anthropology, **UCD**-focused ethnography can support thinking about design from activity theory and **distributed cognition** perspectives (Nardi, 1996). This allows the researcher to gather information about the users, their work environment, their culture, and how they interact with the device or website in context (Nardi, 1997). This information is particularly valuable when writing user personas and **scenarios**. Ethnography is also useful if the researcher cannot conduct user testing on systems or larger equipment due to size or security restrictions.

A specific example of how ethnography can be applied in learning design is in the development of learner personas. Representative learners can be recruited for key informant interviews with the purpose of gathering specific data on what a learner says, thinks, does, and feels, as well as what difficulties or notable accomplishments they describe. The number of participants needed depends on the particular design context but does not need to be large. Indeed, learning designers can glean critical insights from just a few participants, and there is little question that even small numbers of participants is better than none. For example, to develop online learning resources for parents of children with traumatic brain injuries, a learning designer might interview two or three parents and ask them to relay what their typical day looks like, tell a story about a particular challenge they have encountered with parenting their child, or describe how they use online resources to find information about traumatic brain injuries. The interviews could then be transcribed, and the learning designer could use a variety of analysis techniques to categorize the interview data thematically. This information from thematic categories could then be generalized into the development of learner personas that are illustrative of themes derived from the key informant interviews.

Learn More About Conducting Thematic Analysis

For information on how to conduct a thematic analysis on interviews, refer to Mortensen (2020).

Learning Check

(True/False) Ethnography can be used to gather information about users' work environment and culture.

- [ ] True
- [ ] False

Focus groups are often used during the front-end analysis phase. Rather than the researcher going into the field to study a larger group as is done in ethnography, a small group of participants (n = 5–10) are recruited based on shared characteristics. Focus group sessions are led by a skilled moderator who uses a semi-structured set of questions. For instance, a moderator might ask what challenges a user faces at work (i.e., **actuals vs. optimals gap**), suggestions for how to resolve them, and provide feedback on present technologies. The participants are then asked to discuss their thoughts on products or concepts that the moderator/group of learning designers propose. The moderator may also present a low-fidelity prototype to the prospective user and ask for feedback. The role of the researcher in a focus group is to ensure that no single person dominates the conversation in order to hear everyone's opinions, preferences, and reactions. This helps to determine what users want and keeps the conversation on track. It is preferred to have multiple focus group sessions to ensure various perspectives are heard in case a conversation gets side-tracked. Analyzing data from a focus group can be as simple as providing a short summary with a few illustrative quotes for each session. The length of the sessions (typically 1–2 hours) may include some extraneous information, so it is best to keep the report simple.

For example, a learning designer developing an undergraduate-level introduction to nuclear engineering course invited a group of nuclear engineers, radiation protection technicians, and undergraduate-level nuclear engineering students to participate in a focus group. Before meeting with the focus group, the learning designer created a semi-structured set of questions to guide the session. These questions focused on issues such as the following: the upcoming challenge of an aging workforce on the brink of retirement and with no immediate replacements, the stigma of nuclear power, and the perceived difficulty of pursuing a career in nuclear engineering that the designer had gleaned from discussions with SMEs and from a document analysis. These issues were then explored with the focus group participants during a focus group session, with the designer acting as a facilitator. Sticky notes were used to document key ideas and posted around the room. Participants were asked to use sticky notes to provide brief responses to facilitator questions. The facilitator then asked the participants to find the sticky notes posted on the walls that best aligned with the responses they had provided and post their sticky notes near those sticky notes. These groups of notes were then reviewed by the participant groups, refined, and then named. The entire process took two hours. These categorized groups of sticky notes served as the foundation for the content units in the online course, covering topics like the application of nuclear medicine in cancer diagnosis and treatment, as well as the use of irradiation to extend the shelf life of food.

Learning Check

(True/False) Analyzing data from a focus group should involve providing a detailed report with extensive quotes for each session.

- ☐ True
- ☐ False

Card Sorting

Aligning designs with users' **mental models** is important for effective UX design. A method used to achieve this is **card sorting**. Card sorting is used during **front-end analysis** and paper prototyping. Card sorting is commonly used in

Card sorting can be conducted physically using tools like index cards and sticky notes or it can be conducted electronically. It can involve a single participant or a group of participants. With a single participant, they group content (individual index cards) into categories, allowing the researcher to evaluate the information architecture or navigation structure of a website. For example, a participant might organize “Phone Number” and “Address” cards together. When a set of cards is placed together by multiple participants, this suggests to the designer distinct pages that can be created (e.g., a “Contact Us” page). When card sorting with a group of participants instead of just one person, the same method is employed, but the group negotiates how they will sort content into categories. How participants arrange cards provides insight into mental models and how they group content.

No-cost tools like Lloyd Rieber’s (2017) Q Sort (http://lrieber.coe.uga.edu/qsort/index.html) can be used for card sorting.

There are two types of card sorting methods: open and closed. In an open card sort, a participant or group of participants will first group content (menu labels on separate notecards) into piles and then name the category. Participants can also place the notecards in an “I don’t know” pile if the menu label is not clear or may not belong to a designated pile of cards. In a closed card sort, the categories will be pre-defined by the researcher. It is recommended to start with an open card sort and then follow-up with a closed card sort (Wood & Wood, 2008). As the arrangement of participants are compared, the designer designs a new prototype where the menu information and other features align with how the participants organize the information within their mind.

Learn More About Card Sorting Best Practices

For card sorting best practices, refer to “Card sort analysis best practices” (Righi et al., 2013).

Card sorting is particularly useful for learning designers who are creating courses in learning management systems. After identifying the various units, content categories, content sections, and so on, the learning designer can write what they identified on cards (or use other methods discussed above), present them to a SME, course instructor, or student, and ask them to arrange the cards into what they perceive to be the most logical sequence or organization. This approach can be particularly informative when comparing how instructors feel a course should be organized with how a learner feels a course should be organized, which can sometimes be quite different. Findings can then be used to inform the organization of the online course and potential navigational structures that are important to LXD.

What is the main difference between open card sorting and closed card sorting?

- Open card sorting allows participants to create their own categories, while closed card sorting provides predefined categories.
- Open card sorting involves using digital tools, while closed card sorting uses physical index cards.
- Open card sorting is conducted with a group of participants, while closed card sorting is done individually.
- Open card sorting requires paid technology tools, while closed card sorting can be performed using low-cost or no-cost tools.

Cognitive Walkthroughs

Cognitive walkthroughs (CW) can be used during all prototyping phases. CW is a hands-on inspection method in which an evaluator (not a user) evaluates the interface by walking through a series of realistic tasks (Lewis & Wharton, 1997). CW is not a user test based on data from users, but instead is based on the evaluator's judgments.

During a CW, a UX or LXD expert evaluates specific tasks and considers the user's mental processes while completing those tasks. For example, an evaluator might be given the following task: Recently you have been experiencing a technical problem with software on your laptop and you have been unable to find a solution to your problem online. Locate the place where you would go to send a request for assistance to the Customer Service Center. The evaluator then identifies the correct paths to complete the task but does not make a prediction as to what a user will actually do. In order to assist designers, the evaluator also provides reasons for making errors (Wharton et al., 1994). The feedback received during the course of the CW provides insight into various aspects of the user experience including

- first impressions of the interface,
- how easy it is for the user to determine the correct course of action,
- whether the organization of the tools or functions matches the ways that users think of their work,
- how well the application flow matches user expectations,
- whether the terminology used in the application is familiar to users, and
- whether all data needed for a task is present on screen.

CW is particularly valuable when working in teams that consist of senior and junior learning experience designers. Junior learning experience designers can develop prototype learning designs (e.g., learning modules, screencasts, infographics), which can then be presented to the senior designer to perform a cognitive walkthrough. For example, a junior designer creates a series of five videos and sequences them in the LMS logically so as to provide sufficient information for a learner to correctly answer a set of corresponding informal assessment questions (e.g., a knowledge check). The junior designer then presents this to the senior designer with the following scenario: "You don't know the answer to the third question in the knowledge check, so you decide to review what you learned to find the answer." The senior designer then maps out the most efficient path to complete this task but finds that videos cannot be easily scrubbed by moving the playhead rapidly across the timeline. Instead, the playhead resets to the beginning of the video when it is moved. The senior designer explains to the junior designer that learners would have to completely rewatch each video to find the correct answer. The junior designer then has specific feedback that can be used to improve the learning experience for this learning module.

Heuristic Evaluation

Heuristic evaluation is an inspection method that does not involve working directly with the user. In a heuristic evaluation, it is recommended that at least two evaluators work independently to review the design of an interface against a predetermined set of usability principles (heuristics) before communicating their findings. Ideally, each evaluator will work through the interface at least twice: once for an overview of the interface and the second time to focus on specific interface elements (Nielsen, 1994). The evaluators then meet and reconcile their findings. This method can be used during any phase of the prototyping cycle.

Many heuristic lists exist that are commonly used in heuristic evaluations. The most well-known heuristic checklist was developed over 25 years ago by Jakob Nielsen and Rolf Molich (1990). This list was later simplified and reduced to 10 heuristics which were derived from 249 identified usability problems (Nielsen, 1994). In the field of LIDT, researchers have embraced and extended Nielsen's 10 heuristics to make them more applicable to the evaluation of eLearning systems (Mehlenbacher et al., 2005; Reeves et al., 2002). Not all heuristics are applicable in all evaluation scenarios, so UX designers tend to pull from existing lists to create customized heuristic lists that are most applicable and appropriate to their local context, as do LX designers.

Nielsen's 10 Heuristics

1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognize, diagnose, and recover from errors
10. Help and documentation

Mehlenbacher et al. (2005) task-oriented usability heuristics for web -based instruction design and evaluation.

https://docs.google.com/spreadsheets/d/1cmqopfqgc-ejhCCBtvEkVLkWn86UOcKi/

An approach that bears similarities with a heuristic evaluation is the **expert review**. In an expert review, the expert is knowledgeable about usability principles and has worked directly with users in the past. Expert reviewers do not always use a set of heuristics, but instead they may produce a document that details the overall issues, ranks them in order of severity, and then provides recommendations on how to mitigate the issues. This more informal approach allows for more flexibility than using a heuristic list. As is the case with the heuristic evaluation, multiple experts should be involved and data from all experts should be aggregated. This is because expert review is particularly vulnerable to the expert's implicit biases. Different experts will have different perspectives and therefore will uncover different issues. Involving multiple experts helps ensure that implicit bias is minimized and that problems are not overlooked.

For learning designers developing online courses, established quality metrics such as Quality Matters (QM) can be used for guiding heuristic evaluations (Zimmerman et al., 2020). QM provides evaluation rubrics for certified evaluators to assess the degree to which an online course meets QM standards. The aggregate QM score can then be used as a quality benchmark for that course. However, when applied in the context of a heuristic evaluation, the QM materials should only be used to evaluate prototypes for making improvements—not for establishing a quality benchmark for a finalized course. A QM-guided heuristic evaluation performed by a skilled evaluator can provide tremendously valuable insights along the dimensions of learning experience that are outlined above. These can serve as the basis for subsequent design refinements to an online course. These insights, in turn, promote a more positive learning experience.

Learn More About Heuristics

For details on heuristics, we recommend reading Jahnke et al. (2021)'s article titled "Advancing sociotechnical-pedagogical (STP) heuristics for the usability evaluation of online courses for adult learners," https://olj.onlinelearningconsortium.org/index.php/olj/article/view/2439

Learning Check

Select the most appropriate response to complete the following statement: Usability testing and Nielsen's heuristics are for . . .

- [ ] Testing the user's ability to effectively and efficiently complete a task
- [ ] Evaluating the user's interaction with the digital technology, product, or service

A/B testing or **split-testing** compares two versions of a user interface; because of the nature of this method, all three prototyping phases can be employed at the same time. The different interface versions might utilize different screen elements (such as the color or size of a button), typefaces, textbox placements, or overall general layouts. During A/B testing, it is important that the two versions are tested at the same time by the same user. For instance, Version A can be a control and Version B should only have one variable that is different (e.g., navigation structure). A randomized assignment, in which some participants receive Version A first and then Version B (versus receiving Version B and then Version A), should be used.

LIDT in the World

Learning experience designers do not frequently have access to large numbers of learners for A/B testing, and therefore need to consider how to adapt this approach to specific design contexts. For example, a design team building a **case library** for a case-based learning environment is struggling with the design of the cases themselves. One learning experience designer has created a set of cases that highlight the central theme of the different cases (i.e., constant responsibilities, preparatory activities, recruitment, training, and the selection process); however, the chosen texts are fairly text heavy. Another learning experience designer has taken a different design approach and created a comic book layout for the cases, which has visual appeal. However, the central theme of the cases is not emphasized. The design team asks six students to review the designs. Three students review the more thematically focused cases and three review the comic book cases. The students are then asked to create a concept map that shows the central themes of the cases and how those themes are connected. The design team learns that students who used the thematically focused cases spent much less time reviewing the cases, and their concept maps show a very shallow understanding of the topic—although, they did appropriately identify thematic areas of the cases (i.e., constant responsibilities, recruitment, etc.). The students who used the comic book cases spent more time reviewing the cases. Their concept maps are richer and show a more nuanced understanding of the topic but are missing the specific names of the thematic areas (although they describe the areas in their own words). With this information, the team decides to continue to iterate prototypes of the comic book design while focusing on better emphasizing the central themes within those cases. On this basis, a potentially more effective learning experience was uncovered.

Learn More About A/B Testing

To learn more about A/B Testing, we recommend reading Kimmons (2021).

Think-Aloud User Study

Unlike A/B testing, a **think-aloud** study is only used during the functional prototyping phase. According to Jakob Nielsen (1993), "thinking aloud may be the single most valuable usability engineering method" (p. 195). In a think-aloud user study, a single participant is tested at any given time. The participant narrates what he or she is doing, feeling, and thinking while looking at a prototype (or fully functional system) or completing a task. This method can seem unnatural for participants, so it is important for the researcher to encourage the participant to continue verbalizing throughout a study session.

To view an example of a think-aloud usability study, we recommend the video (24 minutes) from Peachpit TV (2010) on *Rocket Surgery Made Easy by Steve Krug: Usability Demo*.

Krug (n.d.) also provides useful scripts that are freely available for you to download and adjust.

A great deal of valuable data can come from a think-aloud user study (Krug, 2009). Sometimes participants will mention things they like or dislike about a user interface. This is important to capture because their opinions may not be discovered in other methods. However, the researcher needs to also be cautious about changing an interface based on a single comment.

Users do not necessarily have to think aloud while they are using the system. The retrospective think aloud is an alternative approach that allows a participant to review the recorded testing session and talk to the researcher about what he or she was thinking during the process. This approach can provide additional helpful information, although it may be difficult for some participants to remember what they were thinking after some time. Hence, it is important to conduct retrospective think aloud user testing as soon after a recorded testing session as possible.

Learn More About Conducting Think-Aloud User Testing

For a primer on how to conduct think-aloud user testing, refer to the U.S. government's online resources for usability at https://www.usability.gov (U.S. Dept. of Health and Human Services, n.d.)

Think-aloud testing does not test the user but the interaction of the user with the technology, product, or service. It is the most widely used method of usability evaluation in practice, including in the field of LIDT. Indeed, usability testing has long been recognized as a useful evaluation method in the design of interactive learning systems (cf. Reeves & Hedberg, 2003). Increasingly, usability testing is gaining acceptance in LIDT as a viable and valuable evaluation method for informing research related to advanced or novel learning technologies, for which existing research is neither substantial nor sufficient, such as 360-video based virtual reality (Schmidt et al., 2019) or digital badging (Stefaniak & Carey, 2019). Given the limited resources provided to learning designers, think aloud user testing is particularly attractive because it can be conducted with relatively small numbers of participants (5–12 users depending on the complexity of the system) and with open source or free-to-use tools.

LIDT in the World

Learn how learning designers apply think-aloud techniques in the AECT Design & Development Webinar (58 minutes) on "Think-Aloud Methods: Just-in-Time & Systematic Methods to Improve Course Design" by Gregg et al. (2022). https://edtechbooks.org/dd_chronicles/lxd_tao

Further details can be found in the chapter "Think-Aloud Observations to Improve Online Course Design: A Case Example and "How-to" Guide" by Gregg et al. (2020).

When is the best time for a think-aloud user study to be conducted in the design and development process?

- [ ] During the initial brainstorming phase.
- [ ] Only during A/B testing.
- [ ] Primarily during the functional prototyping phase.
- [ ] At any phase of the design process.

Eye-Tracking

Similar to the think-aloud user study, **eye-tracking** is an evaluation method that involves the user during the functional prototype phase. Eye-tracking is a psychophysiological method used to measure a participant's physical gaze behavior in responses to stimuli. Instead of relying on self-reported information from a user, these types of methods look at direct, objective measurements in the form of gaze behavior. Eye-tracking measures saccades (eye movements from one point to another) and fixations (areas where the participant stops to gaze at something). These saccades and fixations can be used to create heat maps and gaze plots, as shown in Figures 1–3, or for more sophisticated statistical analysis.

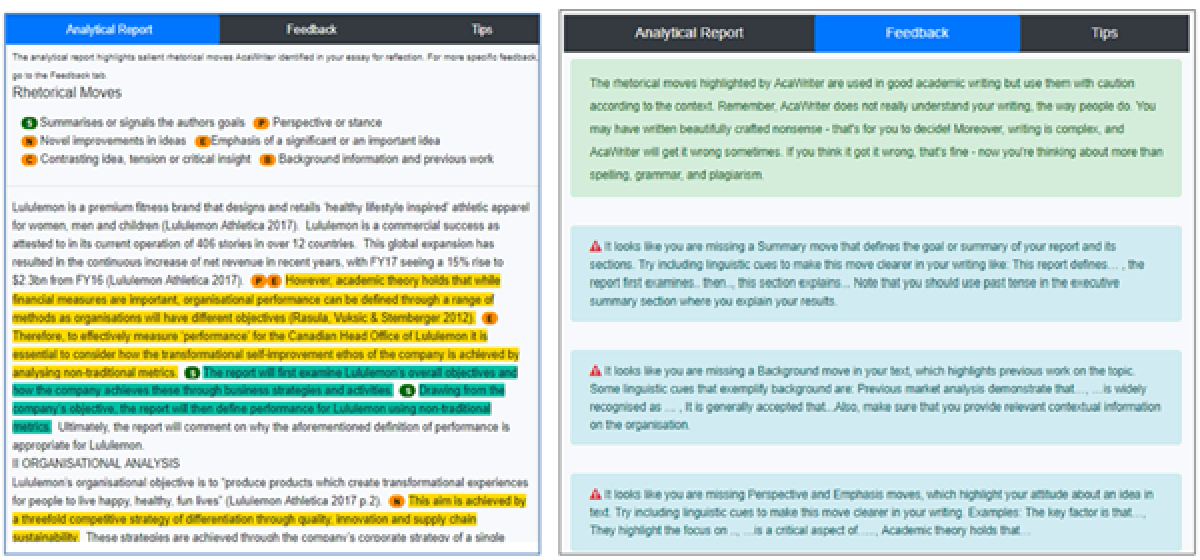

Figure 1. Heat map of a functional prototype's interface designed to help learners with Type 1 Diabetes learn to better manage their insulin adherence; here, eye fixations are shown with red indicating longer dwell time and green indicating shorter dwell time. Photo courtesy of the Advanced Learning Technologies Studio at the University of Florida. Used with permission.

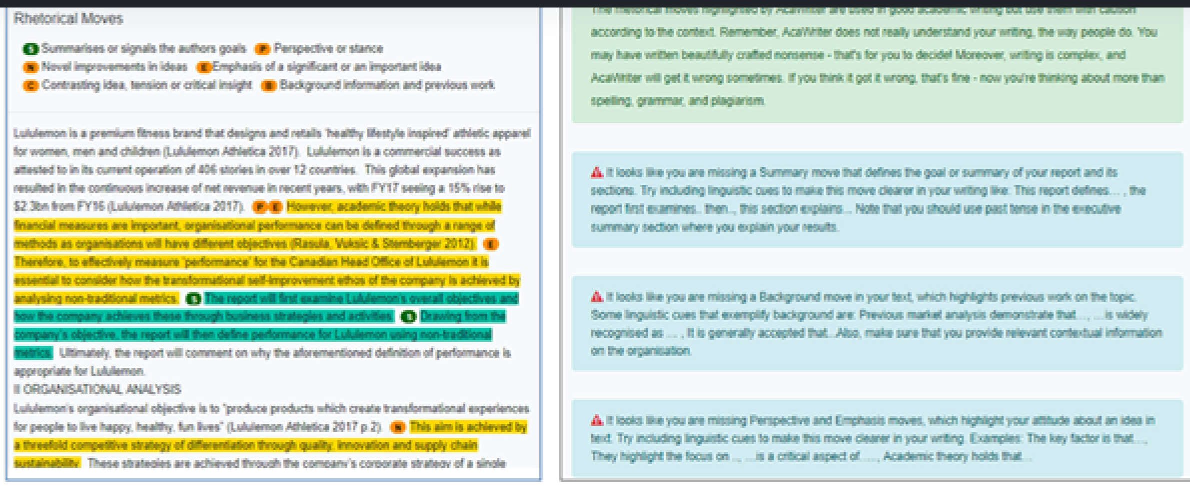

Figure 2. Heat map of a three-dimensional interface showing eye fixations and saccades in real-time, with yellow indicating longer dwell time and red indicating shorter dwell time. Adapted from "The best way to predict the future is to create it: Introducing the holodeck mixed-reality teaching and learning environment," by M. Schmidt, J., Kevan, P. McKimmy, and S. Fabel, 2013, *Proceedings of the 2013 International Convention of the Association for Educational Communications and Technology*, Anaheim, CA. Reprinted with permission.

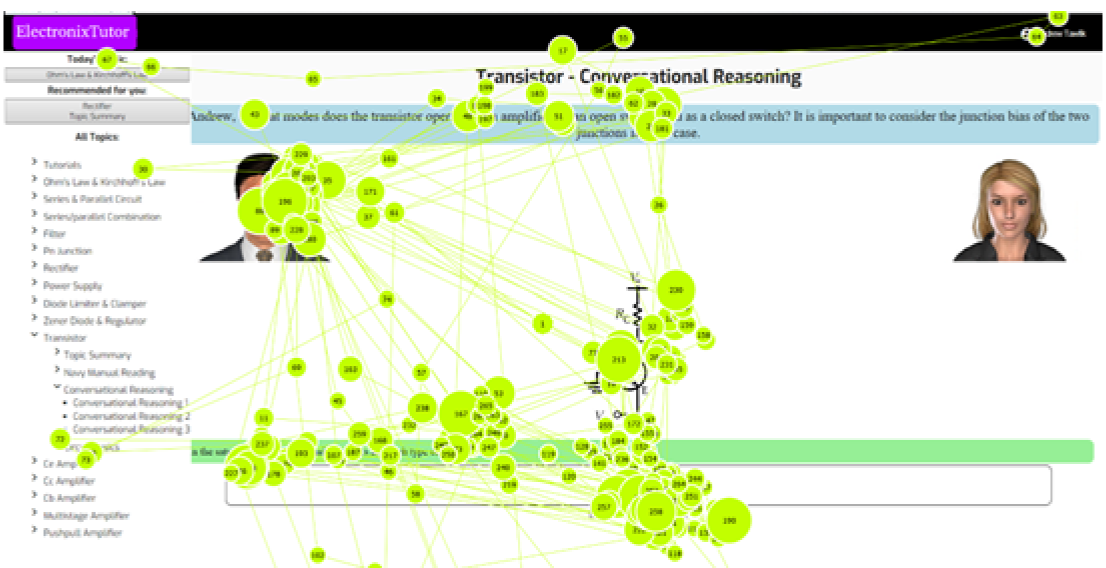

Figure 3. Gaze plot of a learner engaged with the ElectronixTutor learning environment adapted from Tawfik et al. (2022). Photo courtesy of the Instructional Design Studio at the University of Memphis. Used with permission.

LIDT in the World

Conley et al. (2020) used eye-tracking to examine two different layouts (functional and chronological) in Blackboard in their article "Examining course layouts in Blackboard: Using eye-tracking to evaluate usability in a learning management system," https://doi.org/10.1080/10447318.2019.1644841

Another psychophysiological method used to directly observe participant behavior is **electroencephalogy (EEG)**. EEG measures participant responses to stimuli in the form of electrical activity in the brain. An EEG records changes in the brain's electrical signals in real-time. A participant wears a skull cap (Figure 4) with tiny electrodes attached to it. While viewing a prototype, EEG data such as illustrated in Figure 5 can show when a participant is frustrated or confused with the user interface (Romano Bergstrom et al., 2014).

From the perspective of learning design, eye tracking and EEG-based user testing are typically reserved for very large training programs (i.e., for large corporations like Apple or Facebook) or for learning designs that are more focused on research than on practical application. It is not very common for small learning design teams to have access to EEG and eye tracking resources. Nonetheless, these approaches can serve as a way to understand when learners find something important, distracting, disturbing, etc., thereby informing learning designers of factors that can impact extraneous cognitive load, arousal, stress, and other factors relevant to learning and cognition. A disadvantage of this type of data, for example, is that it might not be clear why a learner was fixated on a search box, why a learner showed evidence of stress when viewing a flower, or if a fixation on a 3D model of an isotope suggests learner interest or confusion. In these situations, a retrospective think-aloud can be beneficial. After the eye-tracking data have been collected, the learning designer can sit down with a participant and review the eye-tracking data while asking about eye movements and particular focus areas.

Figure 4. A research study participant wears an EEG while viewing an interface. Photo courtesy of the Neuroscience Applications for Learning (NeurAL Lab) at the University of Florida's Institute for Advanced Learning Technologies (IALT). Used with permission.

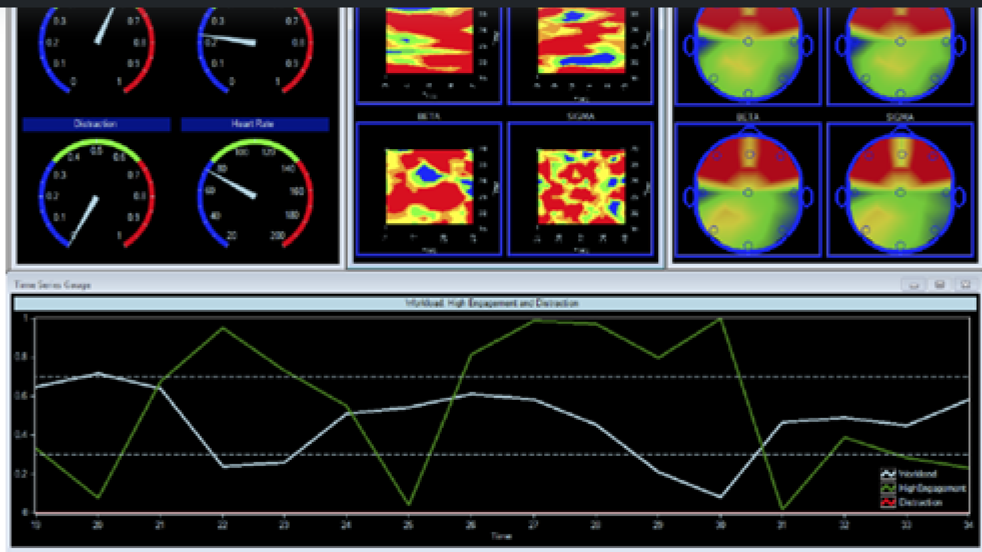

Figure 5. Output from an EEG device in a data dashboard displaying a variety of psychophysiological measures (e.g., workload, engagement, distraction, heart rate). Photo courtesy of the Neuroscience Applications for Learning (NeurAL Lab) at the University of Florida's Institute for Advanced Learning Technologies (IALT). Used with permission.

Analytics

A type of evaluation method that is gaining significant traction in the field of learning design due to advances in machine learning and data science is **analytics** (e.g., learning analytics). Analytics are typically collected automatically in the background while a user is interfacing with a system and sometimes without the user even being aware the data is being collected. An example of analytics data is a clickstream analysis in which the participants' clicks are captured while browsing the web or using a software application (see Figure 6). This information can be beneficial because it can show the researcher the path the participant was taking while navigating a system. Typically, these data need to be triangulated with other data sources to paint a broader picture.

Student Information System	Learning Environment	Research Instruments	Multimodal	Sc
• demographics • timetables • enrolment • attendance • previous assessment results	• trace data • simulation data • assessment data • social interaction • content interaction • intelligent tutoring systems • educational context data	• surveys • questionnaires • interviews • focus groups • observations	• video • audio • gesture • gaze • psychophysiological data • EEGs • fMRI	• Tw • Ins • Fa • blc

Figure 6. An example of a clickstream, showing users' paths through a system. Adapted from "Transforming a problem-based case library through learning analytics and gaming principles: An educational design research project," by M. Schmidt and A. Tawfik, 2017, *Interdisciplinary Journal of Problem-Based Learning*. Reprinted with permission.

Increasingly, learning analytics and data dashboards such as LMSs, video conferencing suites, video hosting providers, and more are being incorporated into the tools of the learning design trade. Indeed, the massive collection of learners' personal usage data has become so ubiquitous that it is taken for granted. However, analytics and data dashboards remain novel tools that learning designers do not necessarily have the training to use for making data-based decisions for improving learning designs. That said, data dashboards are maturing quickly. Less than a decade ago, only the most elite learning designers could incorporate learning analytics and data dashboards into their designs, whereas today these tools are built-in to most tools. Clearly, these tools have enormous potential in the field of LIDT; for example, these tools could be beneficial for creating personalized learning environments, providing individualized feedback, improving motivation, and so-on. With advances in machine learning and artificial intelligence (AI), learning analytics hold great promise. However, privacy concerns, questions of who owns and controls learner data, and other issues remain. Learning designers are encouraged to carefully review the data usage agreements of the software used for developing and deploying digital environments for learning. LXD considers the entire experience of the learner when using a technology, which includes their experiences with the collection of personal data. Carefully safeguarding this data and using it judiciously is paramount for a positive learning experience.

What is one of the primary benefits of analytics data, such as clickstream analysis, in the context of learning design?

- Analytics data can replace the need for user testing.
- Analytics data are collected manually by users during their interactions.
- Analytics data provide insights into the path participants take while navigating a system.
- Analytics data are typically used as the sole source of information for decision-making.

Evaluating the Educational Impact of Digital Learning Experiences

A range of evaluation techniques can be used to evaluate the educational impact of digital learning experiences, including pre/posttests and **concept maps**. Pre/posttests help answer the question of whether the learning design is effective. Pre/poststests are performed with an identical set of measurement items before and after the learning design. In the pretest, the learner's knowledge is captured as baseline, and in the posttest, the difference between the pre- and posttest scores indicates the level of learning growth. This technique is quick and easy to apply; however, it is limited in that it typically is only able to measure lower-order learning outcomes such as memorization/recall. For more intricate higher-order learning objectives, such as synthesis and problem-solving, alternative methods prove more suitable. These may include collaborative design, simulation tasks, or more advanced pre/posttest designs that extend beyond mere information recall. For example, concept mapping allows learners to represent their understanding of concepts using **line-and-node visualizations** (Borrego et al., 2009). A concept mapping task might ask learners to map out all of the things they know about a particular content area (i.e., different kinds of poems, how the animal kingdom is classified, etc.). This is done both before and after the learning experience, after which researchers can compare the differences.

Learn More About Evaluating the Educational Impact of Digital Learning Experiences

For further details, we suggest two case studies of learning experience design that give practical insights into iterative development and testing of the LXD including effectiveness, efficiency and appealing:

Lee et al. (2021), "Mobile microlearning design and effects on learning efficacy and learner experience," https://doi.org/10.1007/s11423-020-09931-w

Li et al. (2021), "Digital learning experience design and research of a self-paced online course for risk-based inspection of food imports," https://doi.org/10.1016/j.foodcont.2021.108698

In this chapter, we have provided examples of commonly used evaluation methodologies that can be employed to advance usable and pleasing learning designs, along with illustrative examples of how these methods can be used in practice. A design approach that connects the evaluation methods of UX and HCI with LXD can help ensure that digital environments for learning are constructed to support learners' achievement of their learning goals in ways that are effective, efficient, and satisfying.

Think About It!

1. In your role as a learning experience designer, reflect on a project you are currently involved in. How can you strategically combine different evaluation methods discussed in this chapter to maximize the effectiveness of your evaluation process for this project? Explain your rationale for selecting specific evaluation methods and their potential synergies.
2. In the context of the evaluation methods discussed in this chapter, how might you adapt and combine different evaluation approaches to gain a deeper understanding of the impact of a learning design? Consider the potential challenges and benefits of combining quantitative and qualitative data, user testing, and analytics in your evaluation process.
3. Evaluating learning experiences often involves collecting and analyzing user data. What ethical considerations should learning designers and evaluators keep in mind when working with user data for evaluation purposes? How can you ensure that the collection and use of data respect the privacy and rights of learners while still providing valuable insights?

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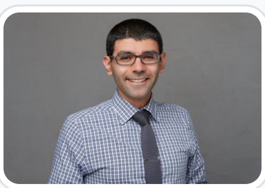

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How Do We Solve a Problem Like Media and Methods?

Peter C. Honebein & Charles M. Reigeluth

Media | instructional methods | instructional framework theory | instructional priorities | research to prove | research to improve | Culture of Instructional Design | confounded variables

Media and instructional methods have had a problematic history in the instructional design field. In the 1990s, the "media vs. methods" debate exploded across influential issues of journals, including Educational Technology Research and Development, led by thinkers such as Richard Clark and Robert Kozma. This chapter discusses this historical debate and its insights, and updates it for our time, providing examples of how many designers still struggle with focusing on the media of a design, over the instructional methods.

Imagine that you are an instructional designer who needs to teach whitewater-river rafters how to tie a knot, specifically a double fisherman's knot (Wikipedia, 2022). The *designer* instructional objective (Reigeluth & An, 2021) for the task is as follows:

> *Given two, 2-foot or greater lengths of rope, tie a double fisherman's knot from memory. Knot must be tied in less than 20 seconds and must be appropriately dressed.*

For the content, you are primarily teaching a rote procedure, with a few concepts like "knot" and "dressed" (Bloom, 1956; Merrill, 1983). You engage a subject-matter expert to show you how to tie the knot and explain what "dressed" means. You take photographs of the procedure.

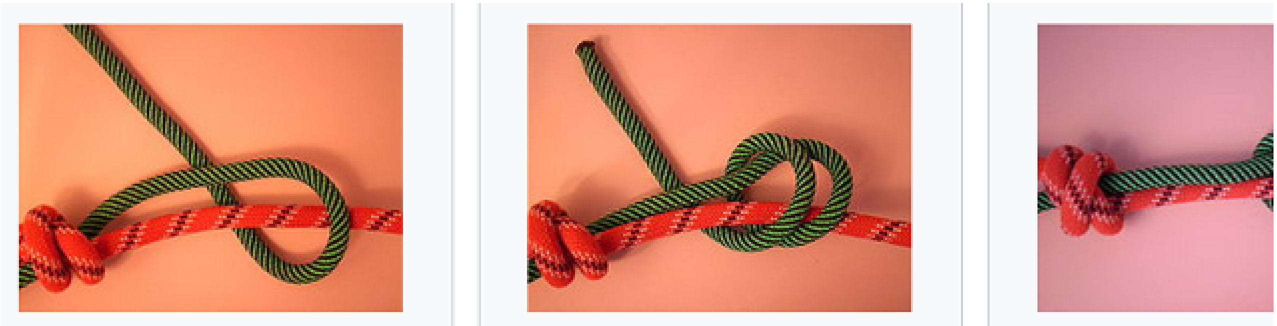

Figure 1. Photo sequence for tying a double fisherman's knot. (Wikipedia public domain photo credit: Markus Bärlocher)

You then add words beneath each image, like "Step 1, Step 2," and so on, that explain what the learner should do with the rope for each of the steps.

Heinich, Molenda, and Russell (1989). The photos and text communicate the message: in this case, the subject-matter content. Yet, these photos and text alone do not enable a learner to master the specified instructional objective. Think about it: from memory (which means the learner cannot look at the photos or words when performing the task), do you think a learner could tie this knot to meet the standard specified in the instructional objective on the first try?

It is very likely that the learner could not. Why? Because a medium only carries the *message* to the learner. For the learner to *learn* the message (specified by the instructional objective), the message must contain *instructional methods, specific features* that facilitate actual learning (Reigeluth & Carr-Chellman, 2009; Reigeluth & Keller, 2009). Instructional methods have a hierarchical classification that includes *instructional approaches*, *instructional components*, and *sequencing* of both content and instructional components.

For example, for a physical task like knot tying, we recommend the approach of *hands-on learning*, which is characterized by "mastery of skills through activity and direct experience", i.e., actually trying to tie the knot (Reigeluth & Keller, 2009). We further recommend that this instructional approach be customized by using the well-researched, primary instructional components of tell (generality), show (example), and do (practice with feedback) (Merrill, Reigeluth & Faust, 1979). As a rote procedure, the practice should involve repetitive memorization of how to tie the knot (called drill and practice) and automatization (learning to tie it quickly without really thinking about it). The sequence should involve simultaneous telling and showing, followed by doing with immediate feedback.

To summarize the key terminology described in the example above:

- Media include words, diagrams, pictures, narration, motion pictures (videos), computers/smartphones, and real objects (like rope) that transport messages (content).
- Instructional methods include hands-on learning, instructional games, instructional simulations, tell, show, do, feedback, and easy-to-difficult sequencing.

Classify the following examples as either **Media** or **Instructional Method**:

YouTube Video

- [ ] Media
- [ ] Instructional Method

Demonstration

- [ ] Media
- [ ] Instructional Method

Closed-captioning

- [ ] Media
- [ ] Instructional Method

Analogy

- [ ] Media
- [ ] Instructional Method

Authentic task

- [ ] Media
- [ ] Instructional Method

Exhibit in a museum

- [ ] Media
- [ ] Instructional Method

Podcast

- [ ] Instructional Method

Teamwork

- [ ] Media
- [ ] Instructional Method

Flight simulator

- [ ] Media
- [ ] Instructional Method

Zoom Meeting

- [ ] Media
- [ ] Instructional Method

(Explanations for answers can be found at the end of the chapter.)

However, media and instructional methods have had a problematic history in the instructional design field. Simply stated, the problem is that designers and researchers often attribute the learning effectiveness (mastery of the instructional objective) of their design to media when it is really due to instructional methods. This problem was first noticed in the 1960s with media comparison studies (Clark, 1983), but received even more significant attention when computer-based instruction (CBI) gained popularity in the 1980s. Clark (1985) was an early researcher who challenged the media mindset that was evolving:

> *The result of the analysis strongly suggests that achievement gains found in these CBI studies are overestimated and are actually due to the uncontrolled but robust instructional methods embedded in CBI treatments. It is argued that these [instructional] methods may be delivered by other media [methods] with achievement gains comparable to those reported for computers (p. 1).*

The purpose of this chapter is to bring you up-to-speed on this topic so you can advise current or future clients, managers, and other stakeholders about its implications for instructional design. If you plan to base your instructional designs on research, or conduct your own research, this chapter will help you understand appropriate research for media and instructional methods. We start by introducing you to *effectiveness*, *efficiency*, and *appeal*, three key measures for judging the success of instruction (Reigeluth & Carr-Chellman, 2009). Next, we chronologically summarize various perspectives about media and instructional methods between 1980 and the present. We conclude with ideas for both research and practice, focusing on the value of *research-to-improve* versus *research-to-prove* and "Culture Five" design principles.

Instructional designers, teachers, clients, parents, and a host of other instructional stakeholders want to know how well a learning experience works. To measure this, the instructional design field focuses on three measures embedded in the instructional theory framework: *effectiveness*, *efficiency*, and *appeal* (Honebein & Reigeluth, 2021; Reigeluth & Carr-Chellman, 2009).

Effectiveness measures learner mastery of an instructional objective, which is also known as student achievement (Reigeluth, 1983). An example of an effectiveness measure is a test, which is typically an objective measure. Another example is a rubric, which is usually a subjective measure.

Efficiency measures the time, effort, and costs put in by teachers, learners, and other stakeholders to deliver and complete a learning experience (Reigeluth, 1983). An example is the number of hours a learner puts in to master an instructional objective. Another example is the cost of instructional materials that deliver the learning experience.

Appeal measures how well learners, teachers, and other stakeholders enjoy the learning experience, especially in terms of media and instructional methods. An example is having students answer a survey question like, "I would recommend this course to others." Another example is an evaluator interviewing teachers about their experiences teaching a learning experience. These appeal measures are synonymous with Merrill's (2009) terminology of "engaging" and the first level of the Kirkpatrick-Katzell model, "reaction" (Katzell, 1952; Kirkpatrick, 1956, 1959).

Effectiveness, efficiency, and appeal form what is called an "Iron Triangle" (Honebein & Honebein, 2015; Honebein & Reigeluth, 2021). The iron triangle represents sacrifices a designer must make during the design process. The left side of Figure 2 is what the designer initially desires, where the double fisherman's knot instruction balances all three outcomes. However, during development, the designer experiences various situational issues and constraints that impact the design. This forces the designer to sacrifice—or "trade-off"—media, instructional methods, or both in their design. This effect is illustrated on the right side of Figure 2. For example, learner feedback favors keeping the hands-on learning instructional method because it boosts effectiveness. Learner feedback also advises the designer to sacrifice efficiency by using a more expensive and more time-consuming media—video— rather than still photographs to increase appeal (for example, see https://www.youtube.com/watch?v=9glfeKvEuyo).

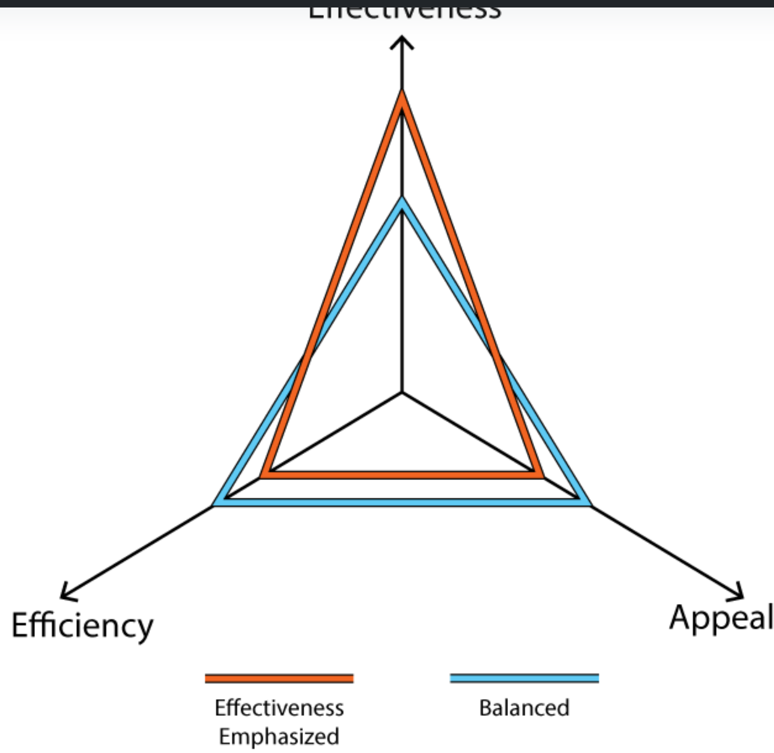

Figure 2. The Instructional Design Iron Triangle depicts the three outcomes (or constraints) associated with instructional methods: effectiveness, efficiency, and appeal. The blue triangle shows equal priority for the three outcomes. The orange triangle shows priority for effectiveness, which requires some sacrifice in efficiency and appeal.

Many designers believe that media only affects two of the three effectiveness-efficiency-appeal measures:

- Instructional methods influence (and therefore require measurement of) all three outcomes: effectiveness, efficiency, and appeal (Clark, 1994).
- Media, on the other hand, influence (and therefore require measurement of) just two outcomes: efficiency and appeal.

As the two authors were finalizing this manuscript, Reigeluth threw out this idea:

"I think video can improve effectiveness by showing the actual motions (an affordance of the video medium) for teaching a task that entails movement. Do you think we should acknowledge that affordances of media can, for some kinds of content (perhaps using a motion medium for a motion task or a sound medium for a sound task), influence effectiveness?"

Honebein was skeptical, reiterating that it is the message and instructional method that drive effectiveness. He responded: "Video without a message is essentially a blank screen, thus how can it, alone, be effective?"

Reigeluth then replied that perhaps some messages can be communicated more effectively through one medium than another, just like different kinds of goods (like livestock versus gasoline) can be delivered more effectively by one kind of truck than another.

What do you think? Could a media "affordance", like motion or sound, influence effectiveness?

Why are media likely limited to efficiency and appeal? Clark (1994) wrote, "When learning gains [effectiveness] are found, we attribute them to the delivery medium, not to the active ingredient in instruction [instructional methods]. When learning gains are absent, we assume we have chosen the wrong mix of media" (p. 27). What Clark is saying is that since media are not the active ingredient for effectiveness, it is impossible for a medium to claim it delivers learning effectiveness (mastery of the instructional objective). What a medium can claim is that it contributes to making learning more efficient and appealing.[1]

What if we give a learner with no knot-tying experience a photograph of a completed double fisherman's knot (Figure 3) and some rope? All the learner has is media, the photo and realia. If the learner is able tie the knot, wouldn't it prove that media has learning effectiveness qualities? Why don't you try it out with your husband, wife, boyfriend, girlfriend, or some random person off the street.

Figure 3. An appropriately-dressed double fisherman's knot. Could you tie this knot based solely on this photograph? Could you do it in 20 seconds or less on the first try? (Wikipedia public domain photo credit: Malta, https://commons.wikimedia.org/wiki/File:N%C5%93ud_de_p%C3%AAcheur_double_serr%C3%A9.jpg, no changes made).

Let's explore this thought experiment: the photograph (*media*) communicates the *message* (the end-state of a properly dressed double fisherman's knot). The *message* is embedded in an instructional method, likely *self-paced hands-on learning* and/or *discovery-based learning* (Reigeluth & Keller, 2009). These types of instructional methods require learners to apply their own experience and knowledge to figure out the solution. In other words, it is the learner who invents or appropriates these, and perhaps other instructional methods to master the task based upon their experience—probably similar to what the person who originally invented the double fisherman's knot did when inventing the knot.

Instructional designers and researchers should always collect data for all three outcomes: effectiveness, efficiency, and appeal. Honebein and Reigeluth (2021) advised that:

> *Without data for effectiveness, efficiency, and appeal, it is difficult to know when an instructional medium or method is preferable compared to another, given that different priorities are valued by different stakeholders in different situations. This is a huge gap in our field's research practice (p. 17).*

To summarize, the three primary measures for evaluating learning experiences are effectiveness, efficiency, and appeal. Instructional methods enable measurement of all three outcomes. Media enable measurement of two outcomes, efficiency and appeal. The Instructional Design Iron Triangle guides how designers make trade-offs and sacrifices in their designs, which can then be measured by always collecting data about effectiveness, efficiency, and appeal. So, as a designer, it is important that you understand the priorities for effectiveness, efficiency, and appeal in your particular project.

A Cold Bucket of Water: The Great Media vs. Instructional Method Debates

Generally, each new medium seems to attract its own set of advocates who make claims for improved learning and stimulate research questions which are similar to those asked about the previously popular medium. Most of the radio research approaches suggested in the 1950s (e.g., Hovland, Lumsdaine, & Sheffield, 1949) were very similar to those employed by the television movement of the 1960s (e.g., Schramm, 1977) and to the more recent reports of the computer-assisted instruction studies of the 1970s and 1980s (e.g., Dixon & Judd, 1977). Clark (1983), p. 447

Macintosh IIcx, copies of Hypercard, Supercard, and Macromedia Director (which were the latest and greatest multimedia software development tools of that time to create computer-based learning experiences), and a vision to prove the efficacy of computer-based instruction over all other mediums. He was one of those advocates Clark described.

Read and Reflect

Given that you are likely new to the instructional design field, you are probably an advocate for some new kind of instructional media. Gibbons (2003) interprets this type of behavior as "centrisims." New designers tend to start out media-centric, then evolve to embrace message, strategy, and model centrisms. Newcomers go through this process because media technologies attract people, like you, to the instructional design field. What media technology are you an advocate for? How do you think you will evolve across Gibbon's "centrisims"?

The first author's dreams of glory started to moderate in a class taught by the second author, who introduced the idea that situation drives methods. Another media-focused class clarified the difference between media and instructional methods, and how they interact. And a third hypermedia class re-imagined the relationship between media and instructional methods via a constructivist perspective. Somewhere in the massive amount of reading for each of these classes was the Clark (1983) paper, an excerpt of which we included at the start of this section. Clark's paper was a paradigm shift. It shattered the first author's dream. Attempting to prove the efficacy of computer-based instruction now seemed to be a complete waste of time.

After publication of the 1983 paper, Clark's follow-up papers on this topic (Clark, 1984, 1985, 1986) appear to be rebuttals and elaborations to other academics. Clark had touched a nerve in the instructional design community, especially Clark's (1983) analogy that referred to media as being "mere vehicles that deliver instruction" (p. 445), leading Ross (1994) to refer to media as "delivery trucks" (p. 1). For example, Petkovich and Tennyson (1984, 1985) challenged Clark's ideas about the relationship between media and methods, specifically from an encoding perspective. Clark's rebuttal suggested, among other ideas, that any media research should focus on "delivery issues (cost, efficiency, equity, and access)" (p. 240).

Hannifin (1986) (and, later, Driscoll & Dick, 1999), on the other hand, opined that the small size of the instructional design field, combined with tenure and promotion processes, created conditions for "quick and dirty publications" (p. 14) that are mostly experimental and focused only on learning outcomes (effectiveness). In this context, Hannifin cautioned academics to heed Clark's (1983) ideas about the primary suspect: confounded, comparative media research. Ross and Morrison (1989) added the comment that media "…does not directly affect learning, [yet media] serves as influential moderating variables" (p. 29-30).

Kozma (1991), in his first rebuttal to Clark (1983), agreed with the idea that traditional experimental designs involving media that focused on cued recall measures were confounded and therefore not useful. However, Kozma pressed on to provide media research examples that were supposedly unconfounded in his view. These included four studies that focused on comprehension and learning with text and pictures (similar to our knot-tying example above).

The Stone & Glock (1981) research study is particularly instructive in understanding the relationship between media and instructional methods. It also shows how to identify potential experimental research methodology flaws that contribute to media/instructional method confounding and poor instructional designs.

The study was straight-forward: subjects in three different groups were asked to assemble a hand-truck. All groups received hand-truck parts. All groups received a job aid (assembly instructions) in three different media forms:

- Group 1 received just text.
- Group 2 received text and illustrations.
- Group 3 received just illustrations.

The result was that text and illustration produced “significantly more accurate performance” (p. 1). Or did it? We argue that the causes for this performance were (a) the instructional methods, and (b) the amount of time spent using those instructional methods.

The Method section of the study neglected to mention differences in instructional methods across treatment groups. The researchers described details of the media—the text and illustrations. However, the researchers mentioned nothing about the instructional methods. To discover what instructional methods were present, we carefully read the study’s methods and procedure. This enabled us to reverse-engineer the likely instructional objectives (which the researchers didn’t specify, but should have):

- *From memory and given 10 types of hand-truck parts, name each part with 100% accuracy*.
- *Given hand-truck parts and job aids, assemble the hand-truck with 100% accuracy.*

Based on the instructional objectives and the research procedure, we deduced the likely instructional methods. First, we applied Merrill’s (1983) Component Display Theory, specifically its primary presentation forms, to analyze the situation.

- Group 1 used *generalities* (G), an instructional method category that describes *concepts*, *procedures*, and *principles* in the form of *text*.
- Group 3 used *instances* (E), an instructional method category that includes *examples* in the form of illustrations.
- Group 2 included both *generalities* and *instances* (G+E).

These instructional method differences represent the confounding. The researchers should have identified them in the Method section.

Second, we used Reigeluth and Keller (2009) and Reigeluth (1999) to name the likely instructional methods: *presentation, practice*, *hands-on learning*, *easy-to-difficult sequencing*, and *procedural sequencing*. The researchers did not specify these instructional methods in the Method section, and it is unclear how subjects applied these methods.

Another criticism is that researchers used inadequate *outcome measures*. The researchers:

Group 3 (illustration only).
    - Did not collect *total time to complete the task* data for all three groups. This is an important outcome measure for instructional method selection.
- Did not collect *appeal*

The efficiency data suggests the presence of *time-on-task confounding*. Group 2 had significantly fewer errors than Groups 1 and 3. However, Group 2 spent 375.24 seconds looking at the job aid (309 seconds for text; 66.24 seconds for illustration), while Group 3 spent 160.33 seconds looking at just the illustration job aid. The difference was 214.91 seconds (researchers did not collect time data for Group 1). Could the performance difference be only that Group 2 spent a lot more time *learning* than the other groups?

Perhaps Kozma's choice of Stone and Glock (1981) and other studies were potentially more confounded than originally thought. This example demonstrates just how tenuous experimental research can be in terms of media /instructional-method confounding, inadequate outcome measures, and time-on-task confounding.

A few years after Kozma (1991) published his first response to Clark's (1983) paper, Ross (1994) organized a special issue in *Educational Technology Research and Development* (*ETR&D*) spearheaded by two papers, one from Kozma (1994) and one from Clark (1994). This became known as the "Clark/Kozma debate". This debate included perspectives by reviewers of Kozma's paper (Jonassen, Campbell, & Davidson, 1994; Morrison, 1994; Reiser, 1994; Shrock, 1994), as well as an overall synthesis by Tennyson (1994).

There was no definitive agreement on whether media could influence learning. Tennyson's (1994) scorecard essentially showed a 3/3 tie. However, within Kozma's and several other contributors' papers, an interesting theme emerged, that of media having complex properties, such that a learning experience might be considered a complex system (Honebein & Reigeluth, 2020). As Tennyson wrote, "learning is a complex phenomenon, requiring the interaction of many variables including the learner and environmental factors" (p. 16). Shrock (1994) picked up on this, suggesting research methods that "would allow the investigation of complex, simultaneous variables" (p. 52). Reiser (1994) cited Ullmer (1994) to explain that "traditional experimental research methods and their attendant controlling mechanisms may fail to fully assess the complex effects that modern multimedia systems may have on learners" (p. 48). Jonassen et. al (1994) got very specific about the complex systems association:

> *When we consider the role of media, we should realize that [media] vehicles are not "mere." They are complex entities with multiple sets of affordances that are predicated on the perceptions of users and the context in which they are used (p. 38).*

Researcher and designer perspectives on the 1994 Clark/Kozma debates have persisted over the years since 1994. Lockee, Burton, and Cross (1999) reported the rise of distance education media comparison studies, calling media comparison studies in this context "inappropriate" (p. 1). Kozma (2000), as a commentator for several articles in a special *ETR&D* issue, wrote that "as both Richey (1998) and Discroll and Dick (1999) point out, the messy, uncontrolled context of real-world educational technology R&D demands alternative research methodologies. Traditional experimental designs often are not able to accommodate the complexity of these real-world situations" (p. 10).

Richey (2000) responded to Kozma's comments in a "yes…, and…" way, suggesting that "other views of the field describe a more complex enterprise with a more complex knowledge base" (p. 16). Richey continued to differentiate the needs in K-12 environments compared to the needs in corporate environments, where many instructional designers work. Richey wrote, "[Corporate practitioners'] primary concern is not technology-based delivery, nor is it even learning. Instead, they are typically concerned with organizational problem solving" (p. 17). This idea is somewhat supported when Nathan and Robinson (2001) wrote that "media and method, while separable in theory, cannot be separated in practice" (p. 84). Surry and Ensminger (2001) suggested using other research methods for media research, such as intra-medium studies

> *We believe that after 22 years it is time to reframe the original debate to ask, not if, but how media affects learning. We agree that media comparison studies are inherently flawed and support the argument that we must identify research designs that will provide answers to this question in significantly less time (p. 30).*

Fast forward to 2019. Between 2005 and 2018, not much was written or said about the relationship between media and instructional methods. However, Sickel (2019), observing the significant rise of new media, suggested that technical pedagogical and content knowledge (TPACK) could be a "modern framework for teaching with technology" (p. 157). This led to reinforce the idea that "methods take advantage of media attributes" and "media enable certain methods" (p. 161).

Yet Kozma's statement that "traditional experiments often are not able to accommodate the complexity of these real-world situations" (p. 10) had led the instructional design field to new and more accepted research methods that, instead of trying to prove, focused on trying to improve. These research-to-improve methods (Honebein & Reigeluth, 2021, 2020; Reigeluth & An, 2009) recognized that learning experiences were a complex system where media and instructional methods and other elements exist as systemic components. These components provide value when stakeholders (learners, designers, clients, etc.) say they do. Such research methods include action research (Efron & Ravid, 2020; Stringer, 2008; Stringer & Aragon, 2021), design experiments (Cobb et al. 2003), design-based research (Barab & Squire, 2004; Collins et al., 2004; Design-Based Research Collective, 2003; Wang & Hannafin, 2005), evaluation research (Phillips et al., 2012), and formative research (Reigeluth & An, 2009; Reigeluth & Frick, 1999).

Research-to-Prove or Research-to-Improve?

Around 2017, Honebein & Reigeluth (2020) noticed a concerning trend: it seemed that there was a rise in experimental, media comparison-type studies in various instructional design journals. They further investigated the phenomenon by reviewing comparative research papers in *ETR&D* between 1980 and 2019. Thirty-nine papers from *ETR&D* met their criteria (Study 1). Another forty-one papers focused on flipped instruction from non-*ETR&D* journals also met the criteria (Study 2) (Al-Samarraie et al. (2019).

The results showed a significant rise of experimental, research-to-prove papers. These papers appeared to (a) confound media and instructional methods, (b) not include sufficient information about the instructional objective, (c) omit one or more of the effectiveness, efficiency, and appeal outcomes, and (d) not report whether or not the researchers conducted formative evaluation. The results also showed a significant rise in comparative studies between 2010 and 2019 (Figure 4):

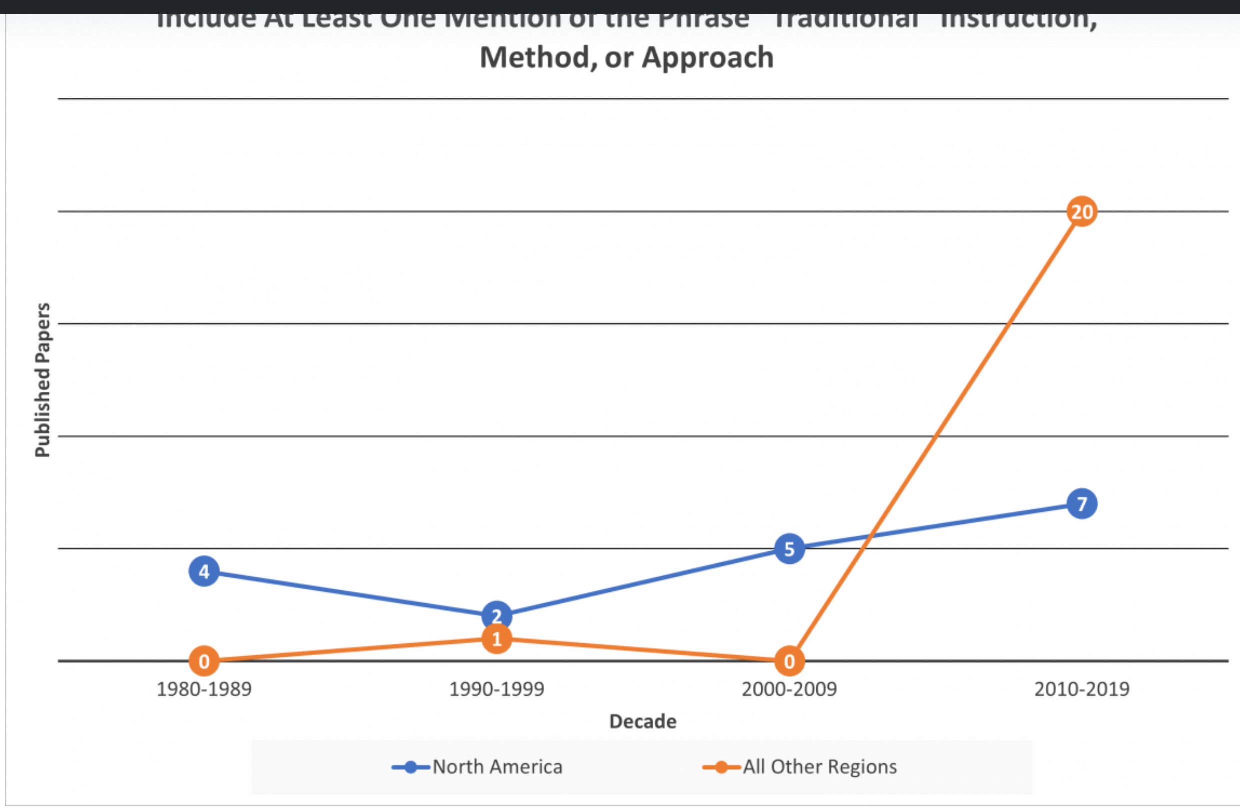

Figure 4. Distribution of published articles comparing North America with all other regions. The number of articles published from non-North American regions increased substantially between 2010 and 2019.

In Study 1, the 2010 to 2019 rise in research-to-prove journal articles was attributed to non-North American sources (75%), primarily from China (41%). This increase of non-North American journal articles was likely caused by a change in *ETR&D* editorial policies around 2008 which, according to Spector (2017), "encouraged more international contributions from outside North America" (p. 1416). In Study 2, North American sources (63%) were the primary contributor of research-to-prove journal articles. Honebein and Reigeluth (2021) summarized the situation this way:

> *The studies introduce significant confounding variables involving the mixture of instructional methods and media. The instructional design field has vigorously debated these issues (see Clark, 1983, 1994; Kozma, 1994, 2000; Tennyson, 1994). By eliminating the comparison group (traditional learning experience) and focusing on research to improve, a researcher eliminates the problem of confounding variables (p. 18).*

What Should Future Instructional Designers and Researchers Take Away from This Chapter?

The Clark/Kozma debates have a lot to unpack, in terms of how such ideas impact and provide guidance to future practitioners and researchers. Here we provide some advice for how you should think about applying media and instructional methods in your coursework, professional work, or research work.

    - Suggest that learning effectiveness is improved by the media, when in fact it is improved by the instructional method.
    - Influence practitioners to choose media that likely won't work for their situation.
    - Represent quick and dirty publications that are intentionally or unintendedly meant to pad a researcher's portfolio for promotion, salary increase, and tenure. In other words, the paper benefits the author, not the reader.
2. When designing a learning experience, follow the processes associated with the instructional theory framework (Honebein & Reigeluth, 2020, 2021) (Figure 5). This framework helps you systematically and logically synthesize possible media and instructional method options that fit your specific instructional-design situation.

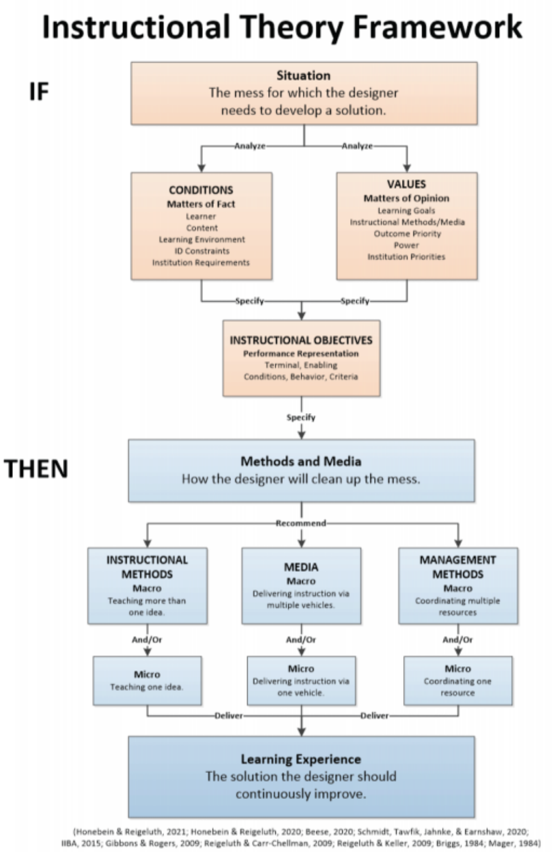

Figure 5. A revised version of the instructional theory framework.

3. Think of a learning experience as a systemic, complex system (Honebein & Reigeluth, 2021, 2020). Formative evaluation or research-to-improve is your best option for determining whether or not your learning experience (which likely blends media and instructional methods in interesting ways) meets the needs of your stakeholders in your particular situation. For these types of evaluation/research, you must collect effectiveness, efficiency, and appeal data. With this data, you will be able to advise your team, manager, or clients about the benefits and pitfalls of a learning experience.

Kozma (2000), in what was likely his last paper about the media versus instructional method debate, planted a seed where he called for building a "Fifth Culture" of instructional design practice—the Forth Culture was put forth by Leslie Briggs in 1984 (Briggs, 1984). In Kozma's Fifth Culture, designers and researchers embed themselves within their client's world, as co-designers or "co-producers" (Honebein & Cammarano, 1995, p. 5), where designers learn to "understand their [client's] needs, goals, problems, issues, and practices" (Kozma, 2000, p. 13). By doing this, it

Summary of Kozma's (2000) Fifth Culture Principles:

1. Embed research designs in the "real world" and embed ourselves in the contexts of our client base. Deeply understand our clients' needs, goals, problems, and issues, and embed these, in turn, into our theories, research, and practices.
2. Shift the focus of our work from the design of instruction to the design of learning environments. Learning outcomes are owned by the learners. Learners set the objectives for learning, not the designers.
3. Understand that the relationship between media, design, and learning should be the unique contribution of our field to knowledge in education. This understanding is the base of our practice, our theory, and our research.

Summary of Honebein and Reigeluth's (2021) additions to Kozma's (2000) Fifth Culture ideas:

1. Accurately specify the desired learning outcomes based upon the conditions and values of the situation elicited from stakeholders, and supply requirements and instructional objectives that include conditions, behaviors, and criteria, along with assessments that align with the situation.
2. Describe students' real learning experiences in detail, including improvements suggested by data, made over time.
3. Describe how learning experiences are systematically designed and formatively evaluated, using good design judgment, prior to conducting research or evaluation.
4. Make sure that tests and data really measure effectiveness, efficiency, and appeal. (p. 17)

Footnotes

[1] Perhaps there is an exception when a particular medium's affordances match a particular feature of the content, as in the affordance of sound for teaching musical chords, pictures for teaching colors and hues, and motion for teaching dance moves.

YouTube Video: Videos, moving pictures, etc. are media.

Demonstration: Demonstration is an instructional method that one can deliver through various media.

Closed-captioning: Closed-captioning is a medium that converts narration to text.

Analogy: Analogy is an instructional method that one can deliver through various media.

Authentic task: Authentic task is an instructional method that one can deliver through various media.

Exhibit in a museum: An exhibit is a medium that illustrates a phenomenon, like a skeleton of a dinosaur.

Podcast: Podcast is a medium that delivers narrated messages that may be enhanced by other media, such as music, sound effects, ambient sounds, and multiple narrators.

Teamwork: Teamwork is an instructional method that one can deliver through various media (i.e., in person or by phone).

Flight simulator: Flight simulator is a medium, as it includes realia (the controls and instruments for flying a plane).

Zoom Meeting: Zoom meeting is a medium, as it enables the presentation of voice, text, graphics, photos, and videos.

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United States National Educational Technology Plan

Technology can be a powerful tool to reimagine learning experiences. Technology-enabled learning allows learners to tap resources and expertise anywhere in the world. Because of this, promoting effective implementation of technology is a key focus of the U.S. and other governments. This chapter provides an abridgment of part of the U.S. National Educational Technology Plan, a guiding document for educational technology initiatives throughout the United States.

Editor's Note

The following are sections 1 and 2 from the National Educational Technology Plan, published by the Office of Educational Technology in the United States Department of Education. The full document is available at https://tech.ed.gov/netp/

The references follow each section, as they do in the original OET report.

Section 1: Engaging and Empowering Learning Through Technology

Goal: All learners will have engaging and empowering learning experiences in both formal and informal settings that prepare them to be active, creative, knowledgeable, and ethical participants in our globally connected society.

To be successful in our daily lives and in a global workforce, Americans need pathways to acquire expertise and form meaningful connections to peers and mentors. This journey begins with a base of knowledge and abilities that can be augmented and enhanced throughout our lives. Fortunately, advances in learning sciences have provided new insights into how people learn.1 Technology can be a powerful tool to reimagine learning experiences on the basis of those insights.

Historically, a learner's educational opportunities have been limited by the resources found within the walls of a school. Technology-enabled learning allows learners to tap resources and expertise anywhere in the world, starting with their own communities. For example:

- Learners struggling with planning for college and careers can access high-quality online mentoring and advising programs where resources or geography present challenges to obtaining sufficient face-to-face mentoring.
- With mobile data collection tools and online collaboration platforms, students in a remote geographic area studying local phenomena can collaborate with peers doing similar work anywhere in the world.
- A school with connectivity but without robust science facilities can offer its students virtual chemistry, biology, anatomy, and physics labs—offering students learning experiences that approach those of peers with better resources.
- Students engaged in creative writing, music, or media production can publish their work to a broad global audience regardless of where they go to school.
- Technology-enabled learning environments allow less experienced learners to access and participate in specialized communities of practice, graduating to more complex activities and deeper participation as they gain the experience needed to become expert members of the community.2

These opportunities expand growth possibilities for all students while affording historically disadvantaged students greater equity of access to high-quality learning materials, expertise, personalized learning, and tools for planning for future education.3, 4 Such opportunities also can support increased capacity for educators to create blended learning opportunities for their students, rethinking when, where, and how students complete different components of a learning experience.

Personalized Learning

Personalized learning refers to instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Learning objectives, instructional approaches, and instructional content (and its sequencing) all may vary based on learner needs. In addition, learning activities are meaningful and relevant to learners, driven by their interests, and often self-initiated.

Blended Learning

In a blended learning environment, learning occurs online and in person, augmenting and supporting teacher practice. This approach often allows students to have some control over time, place, path, or pace of learning. In many blended learning models, students spend some of their face-to-face time with the teacher in a large group, some face-to-face time with a teacher or tutor in a small group, and some time learning with and from peers. Blended learning often benefits from a reconfiguration of the physical learning space to facilitate learning activities, providing a variety of technology-enabled learning zones optimized for collaboration, informal learning, and individual-focused study.

Agency in Learning

Learners with agency can “intentionally make things happen by [their] actions,” and “agency enables people to play a part in their self-development, adaptation, and self-renewal with changing times.”6 To build this capacity, learners should have the opportunity to make meaningful choices about their learning, and they need practice at doing so effectively. Learners who successfully develop this ability lay the foundation for lifelong, self-directed learning.

What People Need to Learn

To remain globally competitive and develop engaged citizens, our schools should weave 21st century competencies and expertise throughout the learning experience. These include the development of critical thinking, complex problem solving, collaboration, and adding multimedia communication into the teaching of traditional academic subjects.5 In addition, learners should have the opportunity to develop a sense of agency in their learning and the belief that they are capable of succeeding in school.

navigation through tasks such as forming relationships and solving everyday problems. They also include development of self-awareness, control of impulsivity, executive function, working cooperatively, and caring about oneself and others.

Building Non-cognitive Competencies: Providing Opportunities for Practice

Interacting with peers, handling conflicts, resolving disputes, or persisting through a challenging problem are all experiences that are important to academic success.

Digital games can allow students to try out varied responses and roles and gauge the outcomes without fear of negative consequences.28 Accumulating evidence suggests that virtual environments and games can help increase empathy, self-awareness, emotional regulation, social awareness, cooperation, and problem solving while decreasing the number of behavior referrals and in-school suspensions.29

Games such as Ripple Effects and The Social Express use virtual environments, storytelling, and interactive experiences to assess a student's social skill competencies and provide opportunities to practice. Other apps help bridge the gap between the virtual environment and the real world by providing just-in-time supports for emotional regulation and conflict resolution. A number of apps are available to help students name and identify how they are feeling, express their emotions, and receive targeted suggestions or strategies for self-regulation. Examples include Breathe, Think, Do with Sesame; Smiling Mind; Stop, Breathe & Think; Touch and Learn—Emotions; and Digital Problem Solver.

Fostering Growth Mindset: Technology-based Program to Fuel Student Achievement

A key part of non-cognitive development is fostering a growth mindset about learning. Growth mindset is the understanding that abilities can be developed through effort and practice and leads to increased motivation and achievement. The U.S. Department of Education has funded several growth mindset–related projects, including a grant to develop and evaluate SchoolKit, a suite of resources developed to teach growth mindset quickly and efficiently in schools.

Jill Balzer, a middle school principal in Killeen, Texas, has seen success from using SchoolKit in her school. Balzer spoke with an eighth grader who achieved academic distinction for the first time in five years after using the using the program. "When I asked him what the difference was," recalled Balzer, "he said that now he understood that even though learning was not always going to come easy to him it didn't mean he was stupid, it just meant he needed to work harder on that subject."

District of Columbia Public Schools also have made the SchoolKit available to all middle schools. Principal Dawn Clemens of Stuart-Hobson Middle School saw increases in reading scores for their seventh-grade students after using the program. "With middle-schoolers, there are always excuses," Clemens said. "But this shifts the language to be about payoff from effort, rather than 'the test was too hard' or 'the teacher doesn't like me.'"

Increased connectivity also increases the importance of teaching learners how to become responsible digital citizens. We need to guide the development of competencies to use technology in ways that are meaningful, productive, respectful, and safe. For example, helping students learn to use proper online etiquette, recognize how their personal information may be collected and used online, and leverage access to a global community to improve the world around them can help prepare them for successfully navigating life in a connected world. Mastering these skills requires a basic understanding of the technology tools and the ability to make increasingly sound judgments about the use of them in learning and daily life. For the development of digital citizenship, educators can turn to resources such as Common Sense Education's digital citizenship curriculum or the student technology standardsfrom the International Society for Technology in Education (ISTE).

Learning principles transcend specific technologies. However, when carefully designed and thoughtfully applied, technology has the potential to accelerate, amplify, and expand the impact of powerful principles of learning. Because the process of learning is not directly observable, the study of learning often produces models and conclusions that evolve across time. The recommendations in this plan are based on current assumptions and theories of how people learn even while education researchers, learning scientists, and educators continue to work toward a deeper understanding.

The NETP focuses on how technology can help learners unlock the power of some of the most potent learning principles discovered to date. For example, we know that technology can help learners think about an idea in more than one way and in more than one context, reflect on what is learned, and adjust understanding accordingly. Technology also can help capture learners' attention by tapping into their interests and passions. It can help us align *how* we learn with *what* we learn.

Following are five ways technology can improve and enhance learning, both in formal learning and in informal settings. Each is accompanied by examples of transformational learning in action.

1. **Technology can enable personalized learning or experiences that are more engaging and relevant.** Mindful of the learning objectives, educators might design learning experiences that allow students in a class to choose from a menu of learning experiences—writing essays, producing media, building websites, collaborating with experts across the globe in data collection—assessed via a common rubric to demonstrate their learning. Such technology-enabled learning experiences can be more engaging and relevant to learners.

Scaling Up Personalized Learning: Massachusetts' Innovation Schools Create Multiple Pathways to Learning

As part of Massachusetts' Achievement Gap Act of 2010, funding was set aside to give schools the opportunity to implement innovative strategies to improve learning. Through this legislation, educators can create Innovation Schools that can operate with increased flexibility in key areas such as schedule, curriculum, instruction, and professional development.

As of 2015, there were 54 approved Innovation Schools and Academies in 26 school districts across Massachusetts. Some schools implemented a science, technology, engineering, and mathematics (STEM) or STEM-plus-arts model, and others implemented a combination of one or more of the following educational models: multiple pathways, early college, dual-language immersion, or expanded learning time.

Students in a Safety and Public Service Academy combine rigorous college-style coursework available in a variety of formats (in class, online, blended learning, off-site for internships and job shadows) in areas such as forensics, computer science, criminal law, crisis management, psychology, and video production. Students at the Arts Academy may combine their coursework with off-site learning opportunities at local universities, combining high-tech design skills and knowledge of the creative arts to prepare them for post-secondary education and a career in the arts.

Pentucket Regional School District's program has scaled their innovation approach to every elementary school in the district. Their approach is centered on student choice and the use of opportunities for learning that extend beyond the classroom walls. Through the redesign of the school day and year, students engage in hands-on experiential learning with in-class lessons; online and blended coursework; and off-campus academic opportunities, internships, and apprenticeships.

than writing a research report to be read only by her biology teacher and a small group of classmates, a student might publish her findings online where she receives feedback from researchers and other members of communities of practice around the country. In an attempt to understand the construction of persuasive arguments, another student might draft, produce, and share a public service announcement via online video streaming sites, asking his audience for constructive feedback every step of the way.

Project-based Learning

Project-based learning takes place in the context of authentic problems, continues across time, and brings in knowledge from many subjects. Project-based learning, if properly implemented and supported, helps students develop 21st century skills, including creativity, collaboration, and leadership, and engages them in complex, real-world challenges that help them meet expectations for critical thinking.

Engaged Creation: Exploratorium Creates a Massive Open Online Course (MOOC) for Exploring Circuits and Electricity

In the summer of 2015, the Exploratorium in San Francisco launched its first MOOC, working with Coursera, called Tinkering Fundamentals to inspire STEM-rich tinkering; introduce a set of high-quality activities that could be replicated easily in the classroom; and foster robust discussions of the learning.

The six-week course included a blend of hands-on activities, short videos of five to eight minutes each, an active discussion forum, live Web chats, social media, and other resources. Each week the videos highlighted an introduction to a new tinkering activity, the learning goals, and tips for facilitation; step-by-step instructions for how to build and support others to build the tinkering contraption; classroom video and interviews with teachers about classroom implementation and student learning; profiles of artists; and comments by learning experts. Reflective prompts generated extensive conversation in the discussion forums.

To facilitate these online activities, the Exploratorium integrated multiple platforms, including Coursera and live video streaming tools. Instructors used these online platforms and spaces to reflect on the week's activities and forum posts and to provide real-time feedback to participants. In videoconferences, the instructors positioned themselves as questioners rather than as experts, enhancing a strong sense of camaraderie and collaborative exploration.

The Exploratorium used a social media aggregator to showcase photos and videos of participants' tinkering creations, underscoring the hands-on and material nature of the work of the MOOC. The course attracted more than 7,000 participants from 150 countries, of whom approximately 4,400 were active participants, resulting in more than 66,000 video views and 6,700 forum posts. For more information, visit the Exploratorium and Coursera on the Web.

Building Projects for Real Audiences: National Parks Service Deepens Engagement Through Technology

Journey Through Hallowed Ground is a partnership project of the National Park Service that encourages students to create rich connections to history through project-based learning, specifically making videos about their visits to historical sites. The students take the roles of writers, actors, directors, producers, costume designers, music directors, editors, and filmmakers with the support of professional video editors. The videos allow the students to speak about history in their own words as well as share their knowledge with their peers. In addition to learning about history, participating in the projects also teaches students to refine their skills of leadership and teamwork. All videos become official material of the National Park Service and are licensed openly for use by other students and teachers around the world.

classrooms from all over the world to come together through literacy. One book is chosen, and participating classrooms have six weeks in which teachers read the book aloud to students and then connect their classrooms to other participants across the world. Although the book is the same for each student, the interpretation, thoughts, and connections are different. This setting helps support learners through the shared experience of reading and builds a perception of learners as existing within a world of readers. The shared experience of connecting globally to read can lead to deeper understanding of not only the literature but also of their peers with whom students are learning.

Upskilling Adult Learners: at Peer-to-peer University (p2pu), Everyone is a Teacher and a Learner

P2PU and the Chicago Public Library (CPL) have partnered to pilot Learning Circles—lightly facilitated study groups for adult learners taking online courses together at their local library. In spring 2015, the partnership ran a pilot program in two CPL branches, facilitating in-person study groups around a number of free, online courses. The pilot program has expanded to 10 CPL branches in fall 2015, with the ultimate goal of developing an open-source, off-the-shelf solution that can be deployed by other public libraries, allowing all libraries and their communities to harness the potential of blended learning for little to no expertise or cost.

Meeting once a week in two-hour sessions, a non-content expert librarian helps facilitate a peer-learning environment, with the goal that after six weeks the Learning Circles become self-sustainable. P2PU has designed a number of software tools and guidelines to help onboard learners and facilitators, easing administrative burdens and integrating deeper learning principles into existing online learning content. Initial results suggest that students in Learning Circles have far higher retention than do students in most online courses, participants acquire non-cognitive skills often absent from pure online learning environments, and a diverse audience is participating. By working with libraries and building in additional learning support, P2PU also is able to reach first-time online learners, many of whom do not have a post-secondary degree.

P2PU measures success in terms of both the progress of individual learners and the viability of the model. In addition to the number of branches involved, cost per user, and number of learners, attributes such as retention, returning to additional Learning Circles, advancing from the role of learner to that of facilitator, and transitioning from Learning Circles into other fields (formal education, new job) are all other factors that contribute to success. Furthermore, P2PU designs for and measures academic mindsets (community, self-efficacy, growth mindsets, relevance) as a proxy for learner success.

Helping Parents Navigate a Technological World: a Resource for Making Informed Technology Decisions

Family Time With Apps: A Guide to Using Apps With Your Kids is an interactive resource for parents seeking to select and use apps in the most effective ways with their children.33 The guide informs parents of the variety of ways that apps can support children's healthy development and family learning, communication, and connection with eight strategies. These strategies are playing games together, reading together every day, creating media projects, preparing for new experiences, connecting with distant family, exploring the outside world, making travel more fun, and creating a predictable routine. Tips on how to find the best apps to meet a child's particular needs and an explanation of how and why to use apps together also are included.

The guide references specific apps, which connect parents with the resources to select appropriate apps for their children. This online community is connected with various app stores and gives parents a menu for app selection on the basis of learning topic, age, connectivity, and device capability. Information also is included that describes exactly what other elements are attached to each app—for example, privacy settings, information collection, advertisements allowed, related apps, and so on.

Choice Foundation, have gone through a rigorous, multi-tiered evaluation process. The committee looks for apps that help children grow socially, intellectually, emotionally, and ethically while inspiring creativity and imagination and connecting parents and children.

4. **Technology can help learners pursue passions and personal interests.**A student who learns Spanish to read the works of Gabriel García Márquez in the original language and a student who collects data and creates visualizations of wind patterns in the San Francisco Bay in anticipation of a sailing trip are learning skills that are of unique interest to them. This ability to learn topics of personal interest teaches students to practice exploration and research that can help instill a mindset of lifelong learning.

Leveraging the Power of Networks: Cultivating Connections Between Schools and Community Institutions

Cities of LRNG helps close the opportunity gap by connecting young people with a wide range of learning opportunities throughout their cities. The program makes learning activities from hundreds of community organizations easily discoverable to youth and their families on a single online platform.

Each LRNG city has a website where partner organizations can make their offerings visible. Young people receive recommended activities on the basis of their personal passions. For example, in Chicago through the local Chicago Cities of Learning initiative, more than 120 organizations have provided a collective 4,500 engaging learning opportunities for tens of thousands of young people in all areas of the city through the platform.

As students participate in learning activities, they earn digital badges that showcase their skills and achievements. These digital badges signify mastery of a skill—for example, coding, games, design, or fashion—giving out-of-school learning greater currency by documenting and archiving learning wherever it occurs. Each time a young person earns a badge, he or she is recommended additional learning experiences and invited to broaden or deepen skills to propel him or her along academic, civic, or career trajectories. Because digital badges contain in-depth information about each individual's learning experiences, schools and potential employers can gain a comprehensive view of each person's interests and competencies.

Hive Learning Networks, a project of the Mozilla Foundation, organize and support city-based, peer-to-peer professional development networks and champion connected learning, digital skills, and Web literacy in youth-serving organizations in urban centers around the world. Using a laboratory approach and catalytic funding model, Hive re-imagines learning as interest based and empowers learners through collaboration with peer educators, youth, technology experts, and entrepreneurs.

Similar to Cities of LRNG, Hive networks are made up of community-based organizations, including libraries; museums; schools; after-school programs; and individuals, such as educators, designers, and artists. Hive participants work together to create learning opportunities for youth within and beyond the confines of traditional classroom experiences, design innovative practices and tools that leverage digital literacy skills for greater impact, and advance their own professional development.

The Hive model supports three levels of engagement:

2. **Learning Communities.**Community organizers with an interest in Hive's core principles come together in regular meet-ups and events to explore how to apply connected learning tools and practices. Learning communities are in seven cities in the United States, Canada, and India.
3. **Learning Networks.**With an operational budget and staff, Hive Learning Networks commit to promoting innovative, open-source learning models in partnership with a community's civic and cultural organizations, businesses, entrepreneurs, educators, and learners. Learning Networks are in New York, Chicago, and Pittsburgh.

For more information about Hive Learning Networks, visit Hive on the Web.

5. **Technology access when equitable can help close the digital divide and make transformative learning opportunities available to all learners.**An adult learner with limited physical access to continuing education can upskill by taking advantage of online programs to earn new certifications and can accomplish these goals regardless of location.

Building Equal Experiences: Black Girls Code (bgc) Informs and Inspires

Introducing girls of color to technology at an early age is one key to unlocking opportunities that mostly have eluded this underserved group. BGC, founded in 2001 by Kimberly Bryant, an electrical engineer, aims to "increase the number of women of color in the digital space by empowering girls of color to become innovators in STEM subjects, leaders in their communities, and builders of their own futures through exposure to computer science and technology."

Through a combination of workshops and field trips, BGC gives girls of color a chance to learn computer programming and connects them to role models in the technology space. BGC also hosts events and workshops across the country designed to help girls develop a wide range of other skills such as ideation, teamwork, and presenting while exploring social justice issues and engaging in creating solutions to those issues through technology. One example of such an event occurred at DeVry University where 100 girls between the ages of 7 and 17 learned how to build a webpage in a day. Tech industry volunteers led sessions in how to code using HTML, change the look and formatting of webpages using CCS, and design a basic Web structure. The girls developed webpages that integrated text, images, videos, and music, according to their interests and creativity. Toward the end of the day, participants presented their websites to cheering parents, volunteers, and other attendees. Between 10 and 12 similar events by BGC are held in Oakland each year.

BGC is headquartered in San Francisco, and BGC chapters are located in Chicago; Detroit; Memphis; New York; Oakland; Raleigh; and Washington, D.C., with more in development.

Creating for Accessibility: Hello Navi for the Visually Impaired

When Maggie Bolado, a teacher at Resaca Middle School in Los Fresnos, Texas, was approached about the unique challenge of helping a visually impaired student navigate the school's campus, she had not imagined the innovation that was about to happen. Bolado helped guide a group of seventh- and eighth-grade students to develop an app to navigate the school grounds called Hello Navi. Working mostly during extracurricular time, the students learned bracket coding via online tutorials that enabled them to develop the app. As they learned to program, they also were developing problem-solving skills and becoming more detail oriented.

When the app was made available for download, requests came in to tailor the app to the needs of other particular users, including one parent who wanted to know how to make it work for her two-year-old child. The students participated in a developers' forum to go through requests and questions on the app and problem-solve challenges and issues together. The students also interpreted various data sets, tracking the number of times the app was downloaded and monitoring the number of total potential users, making possible an improved next iteration of the app.

Although these examples help provide understanding of the current state of educational technologies, it is also important to note the research being done on early stage educational technology and how this research might be applied more widely in the future to learning.

As part of their work in cyberlearning, the National Science Foundation (NSF) is researching opportunities offered by integrating emerging technologies with advances in the learning sciences. Following are examples of the projects being funded by the NSF as part of this effort:

Increased use of games and simulations to give students the experience of working together on a project without leaving their classrooms. Students are involved actively in a situation that feels urgent and must decide what to measure and how to analyze data in order to solve a challenging problem. Examples include RoomQuake, in which an entire classroom becomes a scaled-down simulation of an earthquake. As speakers play the sounds of an earthquake, the students can take readings on simulated seismographs at different locations in the room, inspect an emerging fault line, and stretch twine to identify the epicenter. Another example is Robot-Assisted Language Learning in Education (RALL-E), in which students learning Mandarin converse with a robot that exhibits a range of facial expressions and gestures, coupled with language dialogue software. Such robots will allow students to engage in a social role-playing experience with a new language without the usual anxieties of speaking a new language. The RALL-E also encourages cultural awareness while encouraging good use of language skills and building student confidence through practice.

New ways to connect physical and virtual interaction with learning technologies that bridge the tangible and the abstract. For example, the In Touch With Molecules project has students manipulate a physical ball-and-stick model of a molecule such as hemoglobin, while a camera senses the model and visualizes it with related scientific phenomena, such as the energy field around the molecule. Students' tangible engagement with a physical model is connected to more abstract, conceptual models, supporting students' growth of understanding. Toward a similar goal, elementary school students sketch pictures of mathematical situations by using a pen on a tablet surface with representational tools and freehand sketching, much as they would on paper. Unlike with paper, they easily copy, move, group, and transform their pictures and representations in ways that help them to express what they are learning about mathematics. These can be shared with the teacher, and, via artificial intelligence, the computer can help the teacher see patterns in the sketches and support the teacher's using student expression as a powerful instructional resource.

Interactive three-dimensional imaging software, such as zSpace, is creating potentially transformational learning experiences. With three-dimensional glasses and a stylus, students are able to work with a wide range of images from the layers of the earth to the human heart. The zSpace program's noble failure feature allows students constructing a motor or building a battery to make mistakes and retry, learning throughout the process. Although the content and curriculum are supplied, teachers can customize and tailor lesson plans to fit the needs of their classes. This type of versatile technology allows students to work with objects schools typically would not be able to afford, providing a richer, more engaging learning experience.

Augmented reality (AR) as a new way of investigating our context and history In the Cyberlearning: Transforming Education EXP project, researchers are addressing how and for what purposes AR technologies can be used to support the learning of critical inquiry strategies and processes. The question is being explored in the context of history education and the Summarizing, Contextualizing, Inferring, Monitoring, and Corroborating (SCIM-C) framework developed for historical inquiry education. A combined hardware and software platform is being built to support SCIM-C pedagogy. Students use a mobile device with AR to augment their "field" experience at a local historical site. In addition to experiencing the site as it exists, AR technology allows students to view and experience the site from several social perspectives and to view its structure and uses across several time periods. Research focuses on the potential of AR technology in inquiry-based fieldwork for disciplines in which analysis of change across time is important to promote understanding of how very small changes across long periods of time may add up to very large changes.

The Schools and Libraries Universal Service Support Program, commonly known as E-rate, is a source of federal funding for Internet connectivity for U.S. schools and libraries. Created by Congress in 1996, E-rate provides schools and libraries with discounted Internet service based on need. The program was modernized in 2014 to allow schools to prioritize funding high-speed wireless connectivity in schools. For more information about E-rate, visit the website of the Federal Communications Commission (FCC).

Across these examples, we see that learning is not contained within screens or classrooms and that technology can enrich how students engage in the world around them.

To see additional examples of cyberlearning, visit The Center for Innovative Research in CyberLearning.

Bringing Equity to Learning Through Technology

Closing the Digital Use Divide

Traditionally, the digital divide in education referred to schools and communities in which access to devices and Internet connectivity were either unavailable or unaffordable. Although there is still much work to be done, great progress has been made providing connectivity and device access. The modernization of the federal E-rate program has made billions of dollars available to provide high-speed wireless access in schools across the country.

However, we have to be cognizant of a new digital divide—the disparity between students who use technology to create, design, build, explore, and collaborate and those who simply use technology to consume media passively.

On its own, access to connectivity and devices does not guarantee access to engaging educational experiences or a quality education. Without thoughtful intervention and attention to the way technology is used for learning, the digital use divide could grow even as access to technology in schools increases.

Providing Technology Accessibility for All Learners

Learning experiences enabled by technology should be accessible for all learners, including those with special needs. Supports to make learning accessible should be built into learning software and hardware by default. The approach of including accessibility features from the beginning of the development process, also known as *universal design*, is a concept well established in the field of architecture. Modern public buildings include features such as ramps, automatic doors, or braille on signs to make them accessible by everyone. In the same way, features such as text-to-speech, speech-to-text, enlarged font sizes, color contrast, dictionaries, and glossaries should be built into educational hardware and software to make learning accessible to everyone.

Three main principles drive application of universal design for learning (UDL):

1. **Provide multiple means of representation so that students can approach information in more than one way.** Examples include digital books, specialized software and websites, and screen readers that include features such as text-to-speech, changeable color contrast, alterable text size, or selection of different reading levels.
2. **Provide multiple means of expression so that all students can demonstrate and express what they know.** Examples include providing options in how they express their learning, where appropriate, which can include options such as writing, online concept mapping, or speech-to-text programs.
3. **Provide multiple means of engagement to stimulate interest in and motivation for learning.** Examples include providing options among several different learning activities or content for a particular competency or skill and providing opportunities for increased collaboration or scaffolding.

with the needs of each student. They also can expand communication with mentors, peers, and colleagues through social media tools. Digital tools also can make it possible to modify content, such as raising or lowering the complexity level of a text or changing the presentation rate.

At a higher level of engagement, digital tools such as games, websites, and digital books can be designed to meet the needs of a range of learners, from novices to experts. Learners with little understanding might approach the experience first as a novice and then move up to an intermediate level as they gain more knowledge and skills. One example is McGill University's The Brain from Top to Bottom. The site includes options to engage with the content as a beginner, intermediate, or advanced learner and adjusts the learning activities accordingly.

To help in the selection of appropriate universally designed products and tools, the National Center on Universal Design for Learning has developed a resource linking each guideline to information about digital supports that can help a teacher put UDL into practice.

Reaching All Learners: Tools for UDL

Developed with support from the U.S. Department of Education, the tools listed here were designed to help educators implement UDL principles into classroom practice and make learning activities more accessible:

- Nimble Assessment Systems developed Nimble Tools, to deliver standard versions of assessment instruments that are tailored with embedded accommodation tools to meet the specific needs of students with disabilities. Some examples of the accommodation tools include a keyboard with custom keyboard overlays, the capacity of the system to read text aloud for students, an on-screen avatar presenting questions in American Sign Language (ASL) or Signed English, and the magnification of text and images for students with visual impairments.
- The Information Research Corporation developed eTouchSciences, an integrated software and hardware assistive technology platform to support STEM learning among middle school students with (or without) visual impairments. The product includes a haptic sensing controller device to provide real-time tactile, visual, and audio feedback. See video.
- Filament Games developed the Game-enhanced Interactive Life Sciencesuite of learning games to introduce middle school students to key scientific concepts and practices in the life sciences. These games, aligned to UDL, provide students with multiple means of representation, expression, and engagement and provide assistive features such as in-game glossaries and optional voice-over for all in-game text. See video.
- Institute for Disabilities Research and Training developed the myASL Quizmakerto provide Web-based assessments for deaf or hard of hearing students who use ASL. This product provides automatic ASL graphic and video translations for students; enables teachers to create customized tests, exams, and quizzes that are scored automatically; and provides teacher reports with grades and corrected quizzes. See video.

Design in Practice: Indiana School District Adopts Udl for All Instruction for All Students

Bartholomew Consolidated School Corporation is a public school district in Columbus, Indiana, serving approximately 12,000 students. The student population consists of 13 percent in special education, 50 percent receive free or reduced-price lunch, and more than 54 languages are spoken. UDL has been helpful as a decision-making tool in the deployment of technologies such as computers and other networked devices. The UDL guidelines help educators determine what strategies, accessible technologies, and teaching methods will enable all students to achieve lesson goals.

In one instance, a social studies teacher held an online discussion during a presidential debate. Realizing that some students were not taking part in class discussions, the teacher used technology to provide multiple means of representation, expression, and engagement. Some students who were reluctant to speak up in a face-to-face setting felt safe to do so online, becoming engaged participants in the class discussion.

tests has increased.

Physical Spaces and Technology-enabled Learning

Blended learning and other models of learning enabled by technology require educators to rethink how they organize physical spaces to facilitate best collaborative learning using digital tools. Considerations include the following:

- Are the design and layout of the physical space dynamic and flexible enough to facilitate the technology-enabled learning models and practices selected? Can a space in which an educator delivers whole-class instruction also be shifted to facilitate individual online practice and research?
- Do the physical spaces align in their ability to facilitate individual and collaborative work? When practices such as project-based learning require students to be working together with multiple devices for research and presentation building, is the space as useful as when individual learners need time and space to connect with information and experts online for personalized learning?
- Can the physical spaces and tools be shaped to provide multiple contexts and learning experiences such as Wi-Fi access for outdoor classrooms? Are library spaces able to become laboratories? Can a space used as a history lecture hall for one class become a maker space for engineering the next period?

For more information and tools for aligning physical spaces, visit the Centre for Effective Learning Environments and the Clayton Christensen Institute's Blended Learning Universe.

Innovation From the Ground Up: Denver School for Science and Technology (dsst) Uses Space to Promote Student Achievement

The DSST is an innovative high school located in Stapleton, Colorado, a redeveloped neighborhood near downtown Denver. Behind the bright colors and unique geometry of spaces at DSST lies a relationship to the way academic subjects are taught and community is formed at the high school. The school is designed to be flexible and aims to support student achievement through the design of its physical spaces.

The school features a series of gathering spaces that can be used for various academic and social purposes throughout the day. The largest of the gathering areas, near the school's entrance, is where the school's daily morning meeting for both students and faculty is held. Student and faculty announcements, skits, and other community functions are all encouraged in this communal setting.

Each of the three academic pods also includes informal spaces for gathering, studying, and socializing. These academic clusters are linked by a galleria, or large open hallway, that is lined with skylights and also serves as a gathering place for students and faculty members.

DSST has demonstrated results in the academic achievement of its students and in its attendance record. In 2005, the school's founding Grade 9 class was the highest scoring Grade 9 class in Denver in mathematics and the second highest scoring class in reading and writing. DSST was also the only Denver high school to earn a significant growth rating on the Colorado Student Assessment Program test scores from one year to the next. Student attendance at the school is typically about 96 percent.

Recommendations

States, districts, and post-secondary institutions should develop and implement learning resources that embody the flexibility and power of technology to create equitable and accessible learning ecosystems that make learning possible everywhere and all the time for all students. Whether creating learning resources internally, drawing on opportunities.

States, districts, and post-secondary institutions should develop and implement learning resources that use technology to embody design principles from the learning sciences. Educational systems have access to cutting-edge learning sciences research. To make better use of the existing body of research literature, however, educators and researchers will need to work together to determine the most useful dissemination methods for easy incorporation and synthesis of research findings into teachers' instructional practices.

States, districts, and post-secondary institutions should take inventory of and align all learning technology resources to intended educational outcomes. Using this inventory, they should document all possible learner pathways to expertise, such as combinations of formal and informal learning, blended learning, and distance learning. Without thoughtful accounting of the available tools and resources within formal and informal learning spaces within a community, matching learners to high-quality pathways to expertise is left to chance. Such an undertaking will require increased capacity within organizations that have never considered such a mapping of educational pathways. To aid in these efforts, networks such as LRNG, the Hive Learning Networks, and education innovation clusters can serve as models for cross-stakeholder collaboration in the interest of best using existing resources to present learners with pathways to learning and expertise.

Education stakeholders should develop a born accessible standard of learning resource design to help educators select and evaluate learning resources for accessibility and equity of learning experience. Born accessible is a play on the term born digital and is used to convey the idea that materials that are born digital also can and should be born accessible. If producers adopt current industry standards for producing educational materials, materials will be accessible out of the box. Using the principles and research-base of UD and UDL, this standard would serve as a commonly accepted framework and language around design for accessibility and offer guidance to vendors and third-party technology developers in interactions with states, districts, and institutions of higher education.

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Section 2: Teaching With Technology

Goal: Educators will be supported by technology that connects them to people, data, content, resources, expertise, and learning experiences that can empower and inspire them to provide more effective teaching for all learners.

Technology offers the opportunity for teachers to become more collaborative and extend learning beyond the classroom. Educators can create learning communities composed of students; fellow educators in schools, museums, libraries, and after-school programs; experts in various disciplines around the world; members of community organizations; and families. This enhanced collaboration, enabled by technology offers access to instructional materials as well as the resources and tools to create, manage, and assess their quality and usefulness.

To enact this vision, schools need to support teachers in accessing needed technology and in learning how to use it effectively. Although research indicates that teachers have the biggest impact on student learning out of all other school-level factors, we cannot expect individual educators to assume full responsibility for bringing technology-based learning experiences into schools. They need continuous, just-in-time support that includes professional development, mentors, and informal collaborations. In fact, more than two thirds of teachers say they would like more technology in their classrooms, and roughly half say that lack of training is one of the biggest barriers to incorporating technology into their teaching.

Institutions responsible for pre-service and in-service professional development for educators should focus explicitly on ensuring all educators are capable of selecting, evaluating, and using appropriate technologies and resources to create experiences that advance student engagement and learning. They also should pay special care to make certain that educators understand the privacy and security concerns associated with technology. This goal cannot be achieved without incorporating technology-based learning into the programs themselves.

For many teacher preparation institutions, state offices of education, and school districts, the transition to technology-enabled preparation and professional development will entail rethinking instructional approaches and techniques, tools,

Roles and Practices of Educators in Technology-supported Learning

Technology can empower educators to become co-learners with their students by building new experiences for deeper exploration of content. This enhanced learning experience embodies John Dewey's notion of creating "more mature learners." Side-by-side, students and teachers can become engineers of collaboration, designers of learning experiences, leaders, guides, and catalysts of change. Following are some descriptions of these educator roles and examples of how technology can play an integral part.

Authentic Learning

Authentic learning experiences are those that place learners in the context of real-world experiences and challenges.

Educators can collaborate far beyond the walls of their schools. Through technology, educators are no longer restricted to collaborating only with other educators in their schools. They now can connect with other educators and experts across their communities or around the world to expand their perspectives and create opportunities for student learning. They can connect with community organizations specializing in real-world concerns to design learning experiences that allow students to explore local needs and priorities. All of these elements make classroom learning more relevant and authentic.

In addition, by using tools such as videoconferencing, online chats, and social media sites, educators, from large urban to small rural districts, can connect and collaborate with experts and peers from around the world to form online professional learning communities.

Building Communities for Educators: International Education and Resource Network (iearn) Fosters Global Collaborative Teaching and Learning

Through technology, educators can create global communities of practice that enable their students to collaborate with students around the world. Technology enables collaborative teaching regardless of geographic location, as demonstrated by the global nature of the Solar Cooking Project organized by earth and environmental science teacher Kathy Bosiak.

Bosiak teaches at Lincolnton High School in Lincolnton, North Carolina, and is a contributing educator for iEARN, a nonprofit organization made up of more than 30,000 schools and youth organizations in more than 140 countries. iEARN offers technology-enabled resources that enable teachers and students around the world to collaborate on educational projects, all designed and facilitated by teachers and students to fit their curriculum, classroom needs, and schedules.

In addition to its student programs, iEARN offers professional face-to-face workshops for teachers that combine technology and continued engagement through virtual networks and online professional learning opportunities. The workshops focus on the skills needed to engage in Internet-based collaborative learning projects, including peer review, team building, joining regional and international learning communities, and developing project-based curricula that integrate national education standards.

Educators can design highly engaging and relevant learning experiences through technology. Educators have nearly limitless opportunities to select and apply technology in ways that connect with the interests of their students and achieve their learning goals. For example, a classroom teacher beginning a new unit on fractions might choose to have his students play a learning game such as Factor Samurai, Wuzzit Trouble, or Sushi Monster as a way to introduce the

To create an engaging and relevant lesson that requires students to use content knowledge and critical thinking skills, an educator might ask students to solve a community problem by using technology. Students may create an online community forum, public presentation, or call to action related to their proposed solution. They can use social networking platforms to gather information and suggestions of resources from their contacts. Students can draft and present their work by using animated presentation software or through multimedia formats such as videos and blogs. This work can be shared in virtual discussions with content experts and stored in online learning portfolios.

A school without access to science labs or equipment can use virtual simulations to offer learners those experiences that are currently unavailable because of limited resources. In addition, these simulations are safe places for students to learn and practice effective processes before they conduct research in the field. Just as technology can enhance science learning for schools lacking equipment, it can enable deep learning once students are in the field as well. Students can collect data for their own use via mobile devices and probes and sync their findings with those of collaborators and researchers anywhere in the world to create large, authentic data sets for study.

Educators can lead the evaluation and implementations of new technologies for learning. Lower price points for learning technologies make it easier for educators to pilot new technologies and approaches before attempting a school-wide adoption. These educators also can lead and model practices around evaluating new tools for privacy and security risks, as well as compliance with federal privacy regulations. (For more on these regulations, see Section 5: Infrastructure). Teacher-leaders with a broad understanding of their own educational technology needs, as well as those of students and colleagues, can design short pilot studies that impact a small number of students to ensure the chosen technology and the implementation approach have the desired outcomes. This allows schools to gain experience with and confidence in these technologies before committing entire schools or districts to purchases and use.

Teacher-leaders and those with experience supporting learning with technology can work with administrators to determine how to share their learning with other teachers. They also can provide support to their peers by answering questions and modeling practical uses of technology to support learning.

Evaluating Technology Through Rapid-cycle Technology Evaluations

As schools continue to invest heavily in education technology, there is a pressing need to generate evidence about the effectiveness of these investments and also to develop evaluation tools that developers and practitioners can use to conduct their own evaluations that take less time and incur lower costs than do traditional evaluations. The U.S. Department of Education is funding a rapid cycle technology evaluation project that will design research approaches for evaluating apps, platforms, and tools; conduct pilots and disseminate the resulting short reports; and create an interactive guide and implementation support tools for conducting rapid cycle technology evaluations to be used by schools, districts, developers, and researchers.

Rapid cycle technology evaluations will help provide results in a timely manner so that evidence of effectiveness is available to school and district leaders when they need to make purchasing decisions.

Teach to Lead: Developing Teachers as Leaders

Teach to Lead, a joint program of the National Board for Professional Teaching Standards, ASCD, and the U.S. Department of Education, aims to advance student outcomes by expanding opportunities for teacher leadership, particularly opportunities that allow teachers to stay in the classroom. With the help of supporting organizations, Teach to Lead provides a platform for teacher-leaders and allies across the country (and around the world) to create and expand on their ideas.

Teach to Lead participants are invested personally in the development of their teacher leadership action plans because the ideas are their own. Participants identify a current problem within their school, district, or community and develop a theory of action to solve that problem. Since its inception in March 2014, Teach to Lead has engaged more than 3,000 organizations to strengthen their teacher leadership ideas, share resources, and develop the skills necessary to make their projects a reality.

Marcia Hudson and Serena Stock, teacher-leaders at Avondale Elementary School in Michigan, identified a need for teacher-led professional development at their school and created a module for teachers to collect and analyze student outcome data to drive new professional development opportunities. The teachers now are holding engagement meetings with teacher-leaders to develop and fund professional development and data collection further.

Chris Todd teaches at Windsor High School in Connecticut and is a Teacher-Leader-in-Residence for the Connecticut State Department of Education. Chris's team is developing the Connecticut Educator Network, a database of teacher-leaders who are readily available to advise on policy development. The group intends to provide training and policy briefings to continue to hone the teachers' leadership skills.

Educators can be guides, facilitators, and motivators of learners. The information available to educators through high-speed Internet means teachers do not have to be content experts across all possible subjects. By understanding how to help students access online information, engage in simulations of real-world events, and use technology to document their world, educators can help their students examine problems and think deeply about their learning. Using digital tools, they can help students create spaces to experiment, iterate, and take intellectual risks with all of the information they need at their fingertips. Teachers also can take advantage of these spaces for themselves as they navigate new understandings of teaching that move beyond a focus on what they teach to a much broader menu of how students can learn and show what they know.

Educators can help students make connections across subject areas and decide on the best tools for collecting and showcasing learning through activities such as contributing to online forums, producing webinars, or publishing their findings to relevant websites. These teachers can advise students on how to build an online learning portfolio to demonstrate their learning progression. Within these portfolios, students can catalog resources that they can review and share as they move into deeper and more complex thinking about a particular issue. With such portfolios, learners will be able to transition through their education careers with robust examples of their learning histories as well as evidence of what they know and are able to do. These become compelling records of achievement as they apply for entrance into career and technical education institutions, community colleges, and four-year colleges and universities or for employment.

Deepening Student Understanding: Using Interactive Video to Improve Learning

Reflective teachers can search for new ways for their students to engage with technology effectively, especially when students are not optimizing their learning experiences. Every year at Crocker Middle School, Ryan Carroll would ask his sixth-grade world history students to watch a variety of online videos for homework. He found that no matter how entertaining or interesting the videos were, his students were not retaining much of the information being presented, and often they were confused about key concepts. After learning about Zaption, a teaching tool funded by the U.S. Department of Education, Carroll realized his students could get more out of the videos he assigned. Using Zaption's interactive video platform, he added images, text, drawings, and questions to clarify tricky concepts and check for understanding as students watched the video.

Zaption's analytics allow educators to review individual student responses and class-wide engagement data quickly, giving greater insight on how students are mastering key concepts as they watch and enabling teachers to address misconceptions quickly.

Educators can be co-learners with students and peers. The availability of technology-based learning tools gives educators a chance be co-learners alongside their students and peers. Although educators should not be expected to know everything there is to know in their disciplines, they should be expected to model how to leverage available tools

Co-learning in the Classroom: Teacher User Groups Provide Peer Learning for Adult Education Educators

Recognizing the power of virtual peer learning, the U.S. Department of Education's Office of Career, Technical, and Adult Education has funded projects that have established teacher user groups to explore the introduction of openly licensed educational resources into adult education. This model of professional development recognizes that virtual peer learning can support teachers to change their practice and provide leadership and growth opportunities. The small groups of far-flung teachers work with a group moderator to identify, use, and review openly licensed resources in mathematics, science, and English language arts.

Reviews referenced the embedded evaluation criteria in OER Commons, a repository of open educational resources (OER) that can be used or reused freely at no cost and that align to the College- and Career-Readiness mathematics and language arts and Next Generation Science Standards. They also included practice tips for teaching the content to adult learners. The reviews are posted on OER Commons and tagged as *Adult Basic Education* or *Adult English for Speakers of Other Languages* to facilitate the discovery by other teachers of these high-quality, standards-aligned teaching and learning materials.

Learning Out Loud Online: Jennie Magiera, District Chief Technology Officer and Classroom Teacher

Planning a lesson on how elevation and other environmental influences affect the boiling point of water, Jennie Magiera realized that many of the students in her fourth-grade class in Cook County, Illinois, had never seen a mountain. So Magiera reached out to her network of fellow educators through social media to find a teacher in a mountainous area of the country interested in working with her on the lesson.

Soon, Magiera and a teacher in Denver were collaborating on a lesson plan. Using tablets and online videoconferencing, the students in Denver showed Magiera's students the mountains that they could see outside of their classrooms every day. After a discussion of elevation, the two teachers engaged their students in a competition to see which class could boil water faster. By interacting with students in the other class, Magiera's students became engaged more deeply in the project, which led them to develop a richer understanding of ecosystems and environments than they might have otherwise.

Educators can become catalysts to serve the underserved. Technology provides a new opportunity for traditionally underserved populations to have equitable access to high-quality educational experiences. When connectivity and access are uneven, the digital divide in education is widened, undermining the positive aspects of learning with technology.

All students deserve equal access to (1) the Internet, high-quality content, and devices when they need them and (2) educators skilled at teaching in a technology-enabled learning environment. When this occurs, it increases the likelihood that learners have personalized learning experiences, choice in tools and activities, and access to adaptive assessments that identify their individual abilities, needs, and interests.

Connected Educators: Exemplars

Technology can transform learning when used by teachers who know how to create engaging and effective learning experiences for their students. In 2014, a group of educators collaborated on a report entitled, Teaching in the Connected Learning Classroom. Not a how-to guide or a set of discrete tools, it draws together narratives from a group of educators within the National Writing Project who are working to implement and refine practices around technology-

Producing Student Films With Online Audiences: Katie Mckay: Lights, Camera, Social Action!

In Katie McKay's diverse, fourth-grade transitional bilingual class, encouraging her students to work together on a project helped them build literacy skills while simultaneously giving them the opportunity to pursue culturally relevant questions related to equity.

McKay recognized that her students were searching for the language to talk about complicated issues of race, gender, power, and equity. To address the competing priorities of preparing her students for the state test and providing them with authentic opportunities to develop as readers and writers, McKay started a project-based unit on the history of discrimination in the United States.

Students worked in heterogeneously mixed groups to develop comic strips that eventually were turned into two videos, one showing micro-aggressions students commonly see today and one about the history of discrimination in the United States. The movie on micro-aggressions portrayed current scenarios that included characters who acted as agents of change, bravely and respectfully defending the rights of others.

According to McKay, students who previously were disengaged found themselves drawn into the classroom community in meaningful and engaging ways. While reflecting on this unit, McKay wrote:

> *We were not only working to promote tolerance and appreciation for diversity in our community. We also were resisting an oppressive educational context. In the midst of the pressure to perform on tests that were isolating and divisive, we united in collaborative work that required critical thinking and troubleshooting. In a climate that valued silence, antiquated skills, and high-stakes testing, we engaged in peer-connected learning that highlighted 21st century skills and made an impact on our community.*

Just-in-time Learning: Janelle Bence: How Do I Teach What I Do Not Know?

Texas teacher Janelle Bence was looking for new ways to engage and challenge her students, the majority of whom are English language learners from low-income families. After observing her students' motivation to persist through game challenges, she wondered if games held a key to getting them similarly engaged in classwork. After attending a session on gaming at a National Writing Project Annual Meeting, Bence was inspired to incorporate gaming into her classroom. She did not know anything about gaming and so, as is the case for many teachers seeking to bridge the gap between students' social interests and academic subjects, she had to figure out how to teach what she did not know.

Bence started by reading a book about using video games to teach literacy. As she read, she shared her ideas and questions on her blog and talked to other educators, game designers, and systems thinkers. Through these collaborations, she decided that by creating games, her students would be required to become informed experts in the content of the game as well as to become powerful storytellers.

As she explored games as a way to make academic tasks more engaging and accessible for her students, Bence found it was important to take advantage of professional learning and peer networks, take risks by moving from a passive consumer of knowledge to actually trying the tasks that she planned to use with students, and put herself in her students' shoes.

Bence shared that "finding a way to connect to students and their passions—by investigating what makes them tick and bridging [those passions] to academic tasks—educators are modeling risks that encourage the same behavior in their learners."

Aware of the popularity of video games among his students, and as a longtime fan of video games himself, teacher Jason Sellers decided to use gaming to develop his 10th-grade students' ability to use descriptive imagery in their writing. Specifically, Sellers introduced his students to text-based video games. Unlike graphics-based games in which users can view graphics and maneuver through the game by using controller buttons, text-based games require players to read descriptions and maneuver by typing commands such as go north or unlock the door with a key. Sellers decided his students could practice using descriptive imagery by developing their own text-based games.

Using tutorials and other resources found on Playfic, an interactive fiction online community, Sellers created lessons that allowed students to play and eventually create interactive fiction games. Prior to the creation of the games, Sellers's class analyzed several essays that skillfully used descriptive imagery, such as David Foster Wallace's *A Ticket to the Fair*, and composed short pieces of descriptive writing about their favorite locations in San Francisco.

Students then transferred their newly honed descriptive storytelling skills to the development of an entertaining text-based game. Because Sellers's students wanted to develop games their peers would want to play, they focused on ways to make their games more appealing, including, as Sellers described, "using familiar settings (local or popular culture), familiar characters (fellow students or popular culture), and tricky puzzles."

According to Sellers, this project allowed students to work through problems collaboratively with peers from their classroom and the Playfic online community and motivated them to move beyond basic requirements to create projects worthy of entering competitions.

Rethinking Teacher Preparation

Teachers need to leave their teacher preparation programs with a solid understanding of how to use technology to support learning. Effective use of technology is not an optional add-on or a skill that we simply can expect teachers to pick up once they get into the classroom. Teachers need to know how to use technology to realize each state's learning standards from day one. Most states have adopted and are implementing college- and career-ready standards to ensure that their students graduate high school with the knowledge and skills necessary to succeed.

For states that have voluntarily adopted the Common Core State Standards, there are more than 100 direct mentions of technology expectations, and similar expectations exist in states adopting other college- and career-ready standards. Many federal, state, and district leaders have made significant investments in providing infrastructure and devices to schools. Without a well-prepared and empowered teaching force, our country will not experience the full benefits of those investments for transformative learning.

Schools should be able to rely on teacher preparation programs to ensure that new teachers come to them prepared to use technology in meaningful ways. No new teacher exiting a preparation program should require remediation by his or her hiring school or district. Instead, every new teacher should be prepared to model how to select and use the most appropriate apps and tools to support learning and evaluate these tools against basic privacy and security standards. It is inaccurate to assume that because pre-service teachers are tech savvy in their personal lives they will understand how to use technology effectively to support learning without specific training and practice. This expertise does not come through the completion of one educational technology course separate from other methods courses but through the inclusion of experiences with educational technology in all courses modeled by the faculty in teacher preparation programs.

Aligning Education With Technology Standards: University of Michigan

Pre-service teachers at the University of Michigan School of Education are experiencing the kind of learning with technology their students will one day know. The curriculum addresses each of the five ISTE Standards for Teachers21 and aligns with skills from the Partnership for 21st Century Skills. Each standard also has related course projects graders that is based on Next Generation Science Standards and to design and teach a lesson that uses technology and meets the needs of their learners as part of their student teaching placement.

Preparing to Teach in Technology-enabled Environments: Saint Leo University

A 2006 survey of Saint Leo University teacher preparation program alumni showed satisfaction with their preparation with one notable exception—technology in the classroom. As a result, the education department established a long-term goal of making technology innovation a keystone of its program. Saint Leo faculty redesigned their program on the basis of the Technological Pedagogical and Content Knowledge model, in which pre-service teachers learned to blend content, pedagogical, and technological knowledge in their PK–12 instruction.

Faculty developed their expertise with different technologies so that every course models the use of technology to support teaching and learning. The school built an education technology lab where teacher candidates can practice using devices, apps, and other digital learning resources. Students regularly reflect on their experience using technology to increase effectiveness and efficiency as well as its value in the learning process.

Perhaps most notably, Saint Leo ensures all pre-service teachers have basic technologies available at their student teaching placements. Each pre-service teacher is given a digital backpack with a tablet, portable projector, speakers, and a portable interactive whiteboard. A student response system is also available for pre-service teachers to use in their field placements.

Advancing Knowledge and Practice of Assistive Technologies for New Teachers: Illinois State University

Illinois State University's Department of Special Education is one of the largest special education training programs in the nation. Recognizing the value of assistive technology in meeting the needs of each student, the special education teacher preparation program at the University includes an extensive emphasis on selection and use of assistive technologies.

Classroom learning is brought to life through ongoing clinical and field-based experiences in schools and at the university's Special Education Assistive Technology Center. The center provides hands-on experiences to pre-service teachers enrolled in the special education programs at Illinois as well as opportunities for teachers, school administrators, family members, and businesses to learn about assistive technologies. Furthermore, faculty work in partnership with a variety of public, private, and residential schools to enhance student field experiences and provide opportunities for students to work with learners with a range of disabilities and in a variety of settings, including rural, urban, and suburban areas.

Building Digital Literacy in Teaching: University of Rhode Island (uri)

A critical aspect of ensuring that young Americans learn appropriate digital literacy skills is equipping educators at all levels with the same skills. To that end, URI offers a graduate certificate in digital literacy for graduate students, classroom teachers, librarians, and college faculty. By targeting a broad audience to participate in the program, URI is expanding the number of educators with the professional capacity to help students to learn, access, analyze, create, reflect, and take action using digital tools, texts, and technologies in all aspects of their lives.

During the program, students are introduced to key theories of digital literacy in inquiry-driven learning and given time to experiment with and explore a wide range of digital texts, tools, and technologies. In collaboration with a partner, they create a project-based instructional unit that enables them to demonstrate their digital skills in the context of an authentic learning situation. Throughout the program, students participate in hands-on, minds-on learning experiences;

In its evaluation of the program, URI has found that participants experienced a dramatic increase in digital skills associated with implementing project-based learning with digital media and technology. Their understanding of digital literacy also shifted to focus more on inquiry, collaboration, and creativity.

Fostering Ongoing Professional Learning

The same imperatives for teacher preparation apply to ongoing professional learning. Professional learning and development programs should transition to support and develop educators' identities as fluent users of technology; creative and collaborative problem solvers; and adaptive, socially aware experts throughout their careers. Programs also should address challenges when it comes to using technology learning: ongoing professional development should be job embedded and available just in time.

Increasing Online Professional Learning: Connected Educator Month Builds Collaboration Across the Country

Connected Educator Month, part of the U.S. Department of Education's Connected Educators project, began with a monthlong online conference that included a centralized guiding structure, kickoff and closing events, engagement resources, and an open calendar to which organizations of all types could submit professional learning events and activities. Educators used these resources and the calendar to create their own professional development plan for the month. Available activities included webinars, Twitter chats, forum discussions, and actively moderated blog discussions based on personal learning needs and interests.

In the first year, more than 170 organizations provided more than 450 events and activities, with educators completing an estimated 90,000 hours of professional learning across the month. More than 4 million people followed the #ce12 hashtag on Twitter, generating 1.4 million impressions per day.

Now led by partner organizations from the original Connected Educators project—American Institutes for Research (AIR), Grunwald Associates LLC, and Powerful Learning Practice—Connected Educator Month features more than 800 organizations and has provided more than 1,000 events and activities. Australia, New Zealand, and Norway hosted their own iterations of Connected Educator Month, and educators in more than 125 countries participated in some way.

Putting Learning in Teachers' Hands: Denver Public Schools Personalizes Professional Development

In 2014, 80 teachers from 45 schools engaged in the pilot year of Project Cam Opener, an initiative of the Personalized Professional Learning team in Denver Public Schools. Now in its second year with 425 teachers and leaders, Project Cam Opener allows educators to record their teaching with customized video toolkits and share those videos for self-reflection and feedback within an online community of practice.

In the program's pilot year, the first 80 teachers recorded hundreds of videos using tools such as Swivls, iPads, high-definition webcams, and microphones. The videos were uploaded to private YouTube channels and shared via a Google+ community for feedback. For many of these teachers, it was the first time that they had seen the teaching practices of other teachers in their district. The videos sparked daily conversations and sharing of ideas.

Three measures are used to determine the effectiveness of Project Cam Opener: engagement, retention, and observation. In the first end-of-year survey, 90 percent of respondents said that taking part in Project Cam Opener made them more engaged in their own professional learning and growth. In addition, not a single teacher from the pilot group left Denver Public Schools after their year with Project Cam Opener (the overall district rate of turnover is 20 percent). Although teacher observation scores are harder to attribute to this project specifically, the growth of this cohort of

Micro-credentialing Teacher Learning: Kettle Moraine Introduces Teacher-led Professional Learning

Kettle Moraine School District in Wisconsin is creating a professional learning environment in which practicing teachers can be the masters and architects of their own learning. Using the Digital Promise educator micro-credentialing framework as a guide (for more information on Digital Promise's micro-credentialing work, see Section 4: Leadership), teachers in the district take a technology proficiency self-assessment, which they use as a baseline for their personal professional growth. The teachers then work by themselves and in collaborative teams to develop specific professional learning goals aligned to district strategic goals, which they submit to district leadership for approval.

Once these goals are approved, the teachers establish measurable benchmarks against which they can assess their progress. Both the goals and benchmarks are mapped to specific competencies, which, in turn, are tied to micro-credentials that can be earned once teachers have demonstrated mastery. Demonstrations of mastery include specific samples of their work, personal reflections, classroom artifacts, and student work and reflections, which are submitted via Google Forms to a committee of 7 to 10 teachers who review them and award micro-credentials.

Currently, 49 staff members are working to earn a micro-credential for personalized learning, which requires them to conduct their own background research and engage in regularly scheduled Twitter chats as well as blogging, networking, and other forms of self-guided learning using technology. Many also have begun to engage with teachers across the country, allowing them to give and receive ideas, resources, and support.

Embracing the Unconference: Going to Edcamp

An educator attending an Edcamp event engages in a professional learning experience vastly different from traditional professional development. Sessions are built on the interests and needs of the people who attend and are created on the day by using a cloud-based collaborative application that is open to all (including those unable to participate in person). Each teacher chooses which sessions to attend on the basis of individual interests or needs.

Because using technology in learning effectively is one of the challenges facing teachers, sessions frequently are organized around sharing practices and overcoming common challenges when improving practices around the use of technology. Teachers collaborate to overcome challenges together, often making connections that lead beyond the single session or day, as partnerships are formed to engage their students with each other. The shared documents created at these events become an archive and resource for whoever attended, in person or virtually.

The first Edcamp was organized in Philadelphia by a group of local educators interested in new unconference (self-organizing) approaches to a conference for professional learning. The model took off, and five years later there have been more than 750 Edcamps all organized by local educators. The enormous popularity of the format has led to the formation of the Edcamp Foundation, a nonprofit organization that will formalize much of the ad hoc support that has been provided to Edcamp organizers until now.

Recommendations

Provide pre-service and in-service educators with professional learning experiences powered by technology to increase their digital literacy and enable them to create compelling learning activities that improve learning and teaching, assessment, and instructional practices. To make this goal a reality, teacher preparation programs, school systems, state and local policymakers, and educators should come together in the interest of designing pre- and in-service professional learning opportunities that are aligned specifically with technology expectations outlined within state standards and that are reflective of the increased connectivity of and access to devices in schools. Technology

Use technology to provide all learners with online access to effective teaching and better learning opportunities with options in places where they are not otherwise available. This goal will require leveraging partner organizations and building institutional and teacher capacity to take advantage of free and openly licensed educational content such as that indexed on LearningRegistry.org. Adequate connectivity will increase equitable access to resources, instruction, expertise, and learning pathways regardless of learners' geography, socio-economic status, or other factors that historically may have put them at an educational disadvantage.

Develop a teaching force skilled in online and blended instruction. Our education system continues to see a marked increase in online learning opportunities and blended learning models in traditional schools. To meet the need this represents better, institutions of higher education, school districts, classroom educators, and researchers need to come together to ensure practitioners have access to current information regarding research-supported practices and an understanding of the best use of emerging online technologies to support learning in online and blended spaces.

Develop a common set of technology competency expectations for university professors and candidates exiting teacher preparation programs for teaching in technologically enabled schools and post-secondary education institutions. There should be no uncertainty of whether a learner entering a PK–12 classroom or college lecture hall will encounter a teacher or instructor fully capable of taking advantage of technology to transform learning. Accrediting institutions, advocacy organizations, state policymakers, administrators, and educators have to collaborate on a set of clear and common expectations and credentialing regarding educators' abilities to design and implement technology-enabled learning environments effectively.

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Access it online or download it at https://edtechbooks.org/foundations_of_learn/us_national_ed_tech_plan.

Distance Learning

Standards, Perspectives, and Best Practices of Online Education

Florence Martin & Beth Oyarzun

Online learning has continued to increase in the last decade across higher education and K-12 education. Covid-19 forced many instructors and teachers globally to teach and learn online. Research in online learning has been conducted at micro and macro levels. This chapter explores several research trends in distance learning in order to assess the state of distance learning and provide recommendations for designers.

Online learning has continued to increase in the last decade across higher education and K-12 education (NCES, 2021). Covid-19 forced many instructors and teachers globally to teach and learn online. Research in online learning has been conducted at micro and macro levels. Micro level research has been conducted at the course or individual case study level, investigating variables such as effective instructional strategies or demographic profiles of successful learners in these environments. Macro level research has been conducted at the national or global levels, investigating access to education via free online courses such as Massively Open Online Courses—otherwise known as MOOCs—and examining global standards for online learning.

This chapter explores several research trends in order to assess the state of online learning and identify opportunities for future research. In order to better understand the research trends, definitions are presented first, followed by quality standards for online learning courses and the summary of programs developed by professional organizations. Student, faculty, and administrator perspectives of online learning research are reviewed in addition to best practices in design and facilitation in online learning. Best practices regarding faculty and learner support, as well as inclusive and equitable online learning, are also discussed. Finally, the chapter concludes with a list of academic journals dedicated to online learning research.

Definitions of Delivery Methods

In this section, we briefly define the various terms involved with online delivery methods (Table 1).

Asynchronous online learning	A course course where most of the content is delivA courseered online and students can participate in the online course from anywhere and anytime. There are no real-time online or face-to-face meetings.
Synchronous online learning	A course where most of the content is delivered online and students can participate in courses from anywhere. There are real-time online meetings and students login

Asynchronous online learning	online course from anywhere and anytime. There are no real-time online or face-to-face meetings.
	from anywhere—but at the same time—to participate in the course.
Bichronous online learning	A course that blends both asynchronous and synchronous online learning; students can participate in 'anytime, anywhere' learning during the asynchronous parts of the course but then participate in real-time activities for the synchronous sessions.
MOOC	These are Massive Open Online Courses where an unlimited number of students can access the open-source content free of cost.
Blended/Hybrid	A course with a combination of face-to-face and online delivery with a substantial portion of the course delivered online.
Blended Synchronous	A combination of face-to-face and synchronously online students in the course.
Hyflex	A flexible method providing students the option to attend class in person or online, asynchronously or synchronously.

Table 1. Definition of Online Delivery Methods

Distance education and online learning are terms that are often used interchangeably. However, online learning and its components is encompassed within distance education, which contains two components that are not representative of online learning: correspondence courses and satellite campuses. Figure 1 is a visual representation of the delivery methods of distance education.

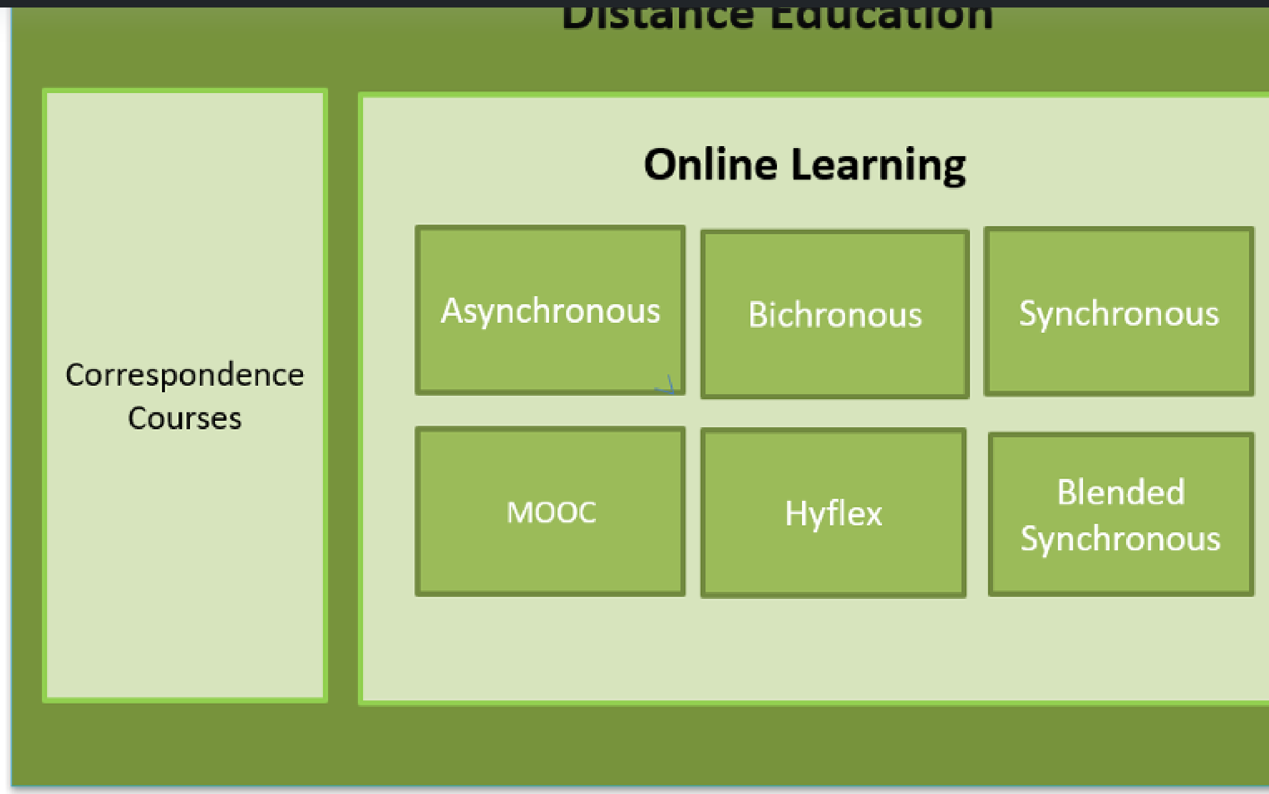

Figure 1. Online Learning and Delivery Methods

Standards and Frameworks for Online Learning

Various standards and frameworks have been established and made available for instructors and administrators to use when designing and implementing online learning. Shelton (2011) reviewed 13 paradigms for evaluating online learning and suggested a strong need for a common method for assessing the quality of online education programs. Shelton found that the institutional commitment, support, and leadership theme was frequently seen in these standards. At least 10 of the standards included institutional commitment, support, and leadership theme as a primary indicator of quality. Teaching and Learning was the second most-cited theme for indicating quality.

Daniel and Uvalic-Trumbic (2013), in their review of quality online learning standards, list institutional support (vision, planning, and infrastructure), course development, teaching and learning (instruction), course structure, student support, faculty support, technology, evaluation, student assessment and examination security as elements essential for quality online learning. They also add that to assure quality online learning in higher education, the most essential requirement is the institutional vision, commitment, leadership, and sound planning.

Martin, Polly et al. (2017) reviewed twelve different global standards for online learning found that the number of standards varied in these documents from 17 to 184 (Table 2). While instructional analysis, design, and development (N=164), student attributes, support, and satisfaction (N=115), and institutional Mission, structure, and support (N=102) were the top categories, course facilitation, implementation, and dissemination (N=40), policies and planning (N=33), and faculty support and satisfaction (N=27) were rated the lowest three.

Standard Name	Year	Sponsor	Number of Sections	Number of Standards
Quality on the Line: Benchmarks for Success	2000	Institute for Higher Ed Policy,	7	24

Standard Name	Year	Sponsor	Sections	Number of Standards
in Internet Based Distance Education		supported by NEA and Blackboard		
Open eQuality Learning Standards (Canada), http://www.eife-l.org/publications/quality/oeqls/intro	2004	Canada	4	25
Online Learning Consortium (formerly Sloan-C) Quality Score Card	2005	OLC Consortium	8	75
Blackboard Exemplary Rubric	2000	Blackboard	4	17
Quality Matters	2015, 5th edition	Quality Matters	8	45
CHEA Institute for Research and study of accreditation and Quality Assurance	2002 revision 1	Council for Higher Education Accreditation	7	7
NADEOSA (South Africa)	2005 revision of 1996 document		13	184
ACODE (The Australasian Council on Open, Distance and e-learning)	2014	Australasian Council on Open, Distance and e-learning	8	64
AAOU (Asian Association of Open Universities)	no date	Asian Association of Open Universities	10	54
ECBCheck	2012		13	46
UNIQUe	2011		10	71
International Organization for Standardization (ISO)	2005		7	38

Table 2. *Standard Details (Name, Year, Sponsor, Number of Sections and Number of Standards).* Used with permission from Martin et al. (2017)

These three analyses of the quality standards and frameworks over time echo similar results of study showing that institutional factors such as vision, support, and planning are important indicators of quality online learning.

Research

Several researchers have examined student, faculty, and organization or administrator-focused research on online learning. In the following section, we have categorized research studies on key online learning topics based on these perspectives.

Student Perspective

In Table 3, we summarize the key aspects of student-focused topics studied on online learning including benefits and challenges.

Student Perspective	***Example Research Studies***
Readiness	Joosten & Cusatis (2020); Martin et al. (2020); Ranganathan et al. (2021); Wei & Chou (2020)
Self-Regulation and Motivation	Chiu et al. (2021); Landrum (2020); Su et al. (2018)
Flexibility and Convenience	Schwartzman (2007); Leasure, Davis, & Thievon (2000); Petrides (2002); Schrum (2002); Poole (2000), Karaman (2011)
Online discussion helps in providing thoughtful/supporting responses	Meyer (2003), Petrides (2002), Vonderwell (2003)
Belongingness in Online Learning Community	Lapointe & Reisette (2008); Peacock et al. (2020); Peterson et al. (2018)
Interaction and engagement	Martin, Parker & Deale (2012); Kaufmann et al., 2020; Martin & Bolliger, 2018
Lack of immediacy	Petrides (2002); Vonderwell (2003)
Lack of sense of community/ feeling isolated	Lack of sense of community/ feeling isolated
Equity, Inclusion and Diversity	Chandler et al. (2021); Fussell et al. (2021); Sublett (2022)

Table 3. Student Perspective

Faculty Perspective

In Table 4, we summarize faculty-focused research on online learning including benefits and challenges.

Faculty Perspective	***Example Research Studies***
Readiness	Cuitri & Mena, 2020; Dimaculangan et al. (2021); Martin et al. (2019)
Flexibility and Convenience	Hiltz et al. (2010); Luongo (2018)
Accessibility	Dolamore (2021); Guilbaud et al. (2021); Nambiar (2020)

Technological difficulties	Bolliger and Wasilik (2009), Lieblein (2000), Hunt et al. (2014)
Workload issues	Bolliger and Wasilik (2009), Mandernach et al. (2013)
Institutional Support	Gaytan (2015), Martin and Parker (2014), Kumar et al. (2022)
Mentoring and Supervision	Byrnes et al. (2019); Kumar & Johnson (2019); Pollard & Kumar (2021)

Table 4. Faculty Perceptive

Organization Perspective

In Table 5, we summarize the key aspects of organization or administrator-focused research on online learning including benefits and challenges.

Organization Perspective	Example Research Studies
Advocacy for online education, staying informed and learning about online education, collaborating with faculty, procedural changes, changes in schemas and roles	Garza (2009)
Securing the necessary resources, developing the organizational structures, influencing organizational culture	Barefield & Mayer (2013)
Sufficient resources for training, technology, and course design/development	Alexander (2015)
Local, state, federal laws, digital divide, technology diffusion, student income	Palvia et al. (2018)
Evaluation of Online Teaching	Lowenthal et al. (2015); Reyes-Fournier et al. (2020); Schwanenberger et al. (2021)

Table 5. Organization Perspective

Best Practices for Online Teaching

Martin and Kumar (2021) categorized barriers into institutional, technology and technical, pedagogical, and interpersonal barriers. Research in online teaching has tried to address these issues by focusing on course design, course engagement, course facilitation, learner and instructor support, and inclusion and equity.

In this video (https://www.youtube.com/watch?v=jobEenvgqv0), Dr. Florence Martin discusses several best practices to teach online.

Course Design

Lister (2014) conducted an analysis of online learning literature to identify patterns and themes for the design of online courses. Four themes emerged: course structure, content presentation, collaboration and interaction, and timely community and discourse, pedagogy, assessment, and content. Recommendations identified included structuring courses, developing student-centered interactive learning activities, building collaboration through group projects, incorporating frequent assessments and strategies for equitable scoring such as rubrics, and providing sufficient detail and solicit student feedback.

Jaggers (2016) developed a course design rubric that assessed organization/orientation, objectives/assessments, interpersonal interaction, and the use of technology for their effects on student achievement. The results showed that well organized courses with specific objectives were more desirable but may not have an impact on student achievement. However, the quality of interpersonal interaction within the courses positively correlated with student grades. The following sections explore research in course design trends in more depth.

Instructors may have various levels of control over the design of the course structure depending on organizational philosophies. Lee et al. (2012) defined three approaches to faculty control of course structure: fully autonomous, basic guidelines, and highly specified. When faculty have less control of their course design, the courses are designed by the institution with instructors serving more as facilitators. Regardless of the amount of faculty control, there are basic elements to course structure that research has shown to be effective, such as a having a consistent course structure throughout the course (Swan, 2001).

Gamification and the use of games, virtual worlds, and simulations have also gained traction in the online learning research. Gamification is defined as the application of game design elements, such as digital badges, in non-game contexts. Hamari et al. (2014) conducted a literature review of gamification studies and found that gamification can have positive effects, but those effects depended on the context in which the strategies were implemented and the audience. For example, in the context of applying gamification in an educational setting, learners experienced increased motivation and engagement. However, some negative outcomes were also identified such as increased levels of competition. Applying the same gamification strategies in such as health and exercise increased levels of competition may not be considered a negative outcome. Similarly, the different qualities of the users may also have effects on levels if motivation and engagements. Merchant et al. (2014) conducted a meta-analysis to examine the effects of games, virtual worlds, and simulations as instructional methods. The results showed that students had higher learning gains with games over virtual worlds and simulations. Clark et al. (2016) found similar results when investigating the literature for effects of games on learning outcomes. The effectiveness of the content delivery method depends on the effectiveness of the design of the instruction and the suitability method for the context of instruction.

Assessment affects how learners approach learning and the content as well as how learners engage with one another and the instructor (Kolomitro & MacKenzie, 2017). Students access course content based upon the belief that the course will help them learn and have better outcomes (Murray et al., 2012). Therefore, the design of online assessments should promote active learning and ensure that success depends on retaining course content. Martin and Ndoye (2016) examined learner-centered assessment in online learning and how instructors can use learning analytics to improve the design and delivery of instruction to make it more meaningful. They demonstrate several data analytic techniques that instructors can apply to provide feedback to students and to make informed data driven decisions during instruction as opposed to after the instruction. Applying such techniques can increase retention of online students.

Martin et al. (2021) identified the Online Course Design Elements (OCDE) based on six areas that can guide design in online courses:

- overview
- content presentation
- assessment and evaluation
- interaction and communication
- assessment and evaluation
- support

Course Engagement

Transactional distance theory defined the feeling of isolation or psychological distance that online learners often experience (Moore, 1989). To lesson transactional distance, Moore defined three types of interaction: (a) learner-to-learner, (b) learner-to-instructor, and (c) learner-to-content to guide faculty to create quality distance education experiences. Bernard et al. (2009) conducted a meta-analysis on 74 distance education studies on the effects of Moore's three types of interaction and found support for their importance for achievement.

The Community of Inquiry framework built upon these types of interaction and defined a quality education experience for an online learner in terms of three overlapping presences: cognitive, social, and teaching (Garrison et al., 1999). This framework provides guidelines for faculty and designers to create meaningful interactive learning experiences that increase the level of social interaction. However, the Community of Inquiry framework's ability to create deep and meaningful learning experiences has come into question due to much of the research using self-reporting, achievement, and perception measures (Rourke and Kanuka, 2009; Annand, 2011). Community-building in online classes has received more attention in recent years. Social presence refers to "the strength of the social relationships and emotional connection among the members of a class or learning community" (Rubin, 2013, p. 119). On an individual level, social presence refers to how involved and engaged each individual student is in the community and their motivation and drive to share, interact, and learn from others. On a community level, social presence refers to the shared sense of belonging of the students in the classroom. Teachers can influence social presence by designing group assignments, creating discussion forums, rewarding community building behaviors, and modeling openness and sharing (Rubin, 2013). Teacher presence refers to designing learning experiences, guiding and leading students' work, providing feedback and facilitating interaction and community-building (Rubin, 2013).

Another research lens used to address online learner isolation is learner engagement. Engagement in any learning is important. However, in online learning, engagement is essential because online learners have fewer chances to interact with each other, the instructor, and the institution. Redmond et al. (2018) used a constant comparative method to establish a conceptual framework of online engagement. The framework identifies five key elements for online engagement to guide research in this area: social engagement, cognitive engagement, behavioral engagement, collaborative engagement, and emotional engagement.

Dixon (2010) created and validated a scale to measure online learner engagement. The instrument was used to survey 186 online learners from six different campuses. Results showed that multiple communication channels or meaningful and multiple ways of interaction may result in higher learner engagement. However, more research should be conducted to validate these results.

Research on all of these frameworks echo the importance of collaborative or cooperative learning to increase interaction. Borokhovski et al. (2012) conducted a follow-up study to the Bernard (2009) meta-analysis investigating the investigating the effects of cooperative online learning on achievement and found no significant difference in achievement between students who completed the assignment individually or cooperatively. However, more experimental research is needed to validate the effects of collaborative learning and to identify effective methods of online collaborative learning.

Course Engagement

Bolliger and Martin (2021) designed Online Engagement Strategies Questionnaire (OESQ) and validated it with students and instructors. Based on the exploratory factor analysis, four engagement constructs emerged which are critical in online courses. These include:

- peer engagement
- multimodal engagement
- instructor engagement
- self-directed engagement

Course Facilitation

Muilenburg and Berge (2007) identified several issues related to online learning implementation from the student perspective, including course materials that are not always delivered on time, instructors not knowing how to teach online, lack of timely feedback, and lack of access to the instructor. Three of these issues deal specifically with instructor immediacy or responsiveness. Bodie and Michel (2014) conducted an experimental study manipulating immediacy strategies for 576 participants in an introductory psychology course. Results revealed that learners in the high immediacy group showed greater learning gains and retention. Martin, Wang et al. (2017) investigated the effects of 12 different facilitation strategies on instructor presence, connection, learning, and engagement. They found that students perceived timely responses to questions and feedback on assignments from instructors helpful. It was also noted that instructors' use of video aided in building a connection with the instructor. Timeliness and immediacy are common themes in the research. Again, more experimental research should be conducted to identify specific strategies for faculty.

In addition, Oncu and Cankir (2011) identified four main research goals for course design and implementation to address achievement, engagement, and retention issues in online learning. The four goals are: (a) learner engagement & collaboration; (b) effective facilitation; (c) assessment techniques; and (d) designing faculty development. They further recommended experimental research be conducted to identify effective practices in these areas. Thus, there are many frameworks and principles for effective design and implementation of online learning but still a lack of research validating many of these ideas or providing effective cases.

Martin et al. (2018) identified facilitation strategies for online course categorized as *Pedagogical, Social, Managerial, Technical*. Based on this study, online students perceived the following:

- Instructors' timely response to questions/feedback on assignments were helpful.
- Video-based introduction was helpful in building instructor connection.
- Instructors' response to reflections helped establish connection with instructor.

Faculty and Learner Support

Faculty Support

Several universities that offer online courses are providing online course planning and development support and technology support to their faculty along with institutional support.

Online teaching can be very demanding on faculty. One study found that online teaching demanded 14% more time than traditional teaching and fluctuated considerably during times of advising and assessment (Tomei, 2006). With the spread on online teaching practices in higher education, many academic staff are faced with technological and pedagogical demands that require skills they don't necessarily possess (Weaver et al., 2008). The quality of online programs depends upon the pedagogical practices of online teachers; therefore, faculty support in online programs is very important (Baran & Correia, 2014).

Some believe that the success of online teaching depends upon the support of faculty on three main levels: teaching, community, and organization (Baran & Correia, 2014). The teaching level includes assistance with technology, pedagogy and content through workshops, training programs, and one-on-one assistance. The challenge here is often the fact that academic staff find it hard to adapt to changes in their teaching or allow someone else to tell them how to teach, therefore individuals who design online programs need to first establish themselves as experts and be viewed as such by faculty (Weaver et al., 2008).

The community level includes collegial learning groups, peer support programs, peer observation, peer evaluation and mentoring programs. Some have highlighted the importance of creating a supportive community for online instructors who often feel isolated (Eib & Miller, 2006). Building learning communities and communities of practice for online teachers as well as providing opportunities for students and online faculty helps combat feelings of isolation (Eib & Miller, 2006; Top, 2012).

The institutional level of support consists of rewards and recognition and the promotion of a positive organizational culture towards online education (Baran & Correia, 2014). Institutional support is seen as supremely important (Baran & Correia, 2014; Weaver et al., 2008). On one hand, if the Deans and Department Heads do not support online teaching, the faculty who do may feel marginalized, unsupported within their discipline, and isolated. On the other hand, if upper management adopts online teaching and pushes for too many changes too quickly, planned implementation and adequate training can be grossly neglected, resulting in dissatisfaction among academic staff (Weaver et al., 2008).

Learner Support

Online education is supported by technology-assisted methods of communication, instruction, and assessment. The methods of communication in online learning are very important since feedback given to students depends on them. For some students, synchronous communication helps with receiving direct feedback, whereas for others, asynchronous communication methods allow for more control on the part of the students to process feedback and respond at their own pace (Gold, 2004). Some have stressed the importance of not simply creating online interaction but rather developing high-quality, technology-assisted communication to promote student outcomes (Gold, 2004).

sense of community to be positive aspects of online learning (El Mansour & Mupinga, 2007).

Technology characteristics in online learning are important considerations. Some have suggested that interface design, function, and medium richness play a key role in student satisfaction. The medium should accommodate both synchronous and asynchronous communication and the interface should be appealing, well structured, easy to use, allow for different mediums such as text, graphics, audio and video messages, and have the capability of providing prompt feedback to students (Volery & Lord, 2000). Ice et al. (2010), Merry and Orsmond (2007) and Philips and Wells (2007) found that students responded positively to audio feedback.

Within the context of learner support, providing accommodations and support for students with disabilities is also an important consideration in online education. In particular, for students with cognitive impairments, navigating an online course can be particularly challenging, as existing platforms typically do not support such learners (Grabinger et al., 2008).

Instructor Support

Kumar et al. (2022) developed the Online Instructor Support Survey (OISS) consisting of five sections that are various supports that online instructors need for effective online teaching:

- Technology and technical support
- Pedagogical (Course Development and Teaching) support
- Online Education Academic Support Services
- Institutional Policies for Online Education
- Online Instructor Recognition, Rewards, and Incentives

Inclusive and Equitable Online Learning

When creating online courses, it is essential to create inclusive and equitable online content to meet the needs of diverse learners. The online course can be made more inclusive and equitable through various aspects of online teaching and learning, such as (a) online instructor self-awareness and commitment to inclusive and equitable online teaching, (b) getting to know the online learners, (c) designing the course, and (d) during course facilitation and evaluation.

Instructor self-awareness. Some of the strategies that the instructor can use includes reflecting on the students and their needs; examining your own assumptions about student behavior; including a Diversity, Equity, and Inclusion statement in the syllabus; and reviewing the syllabus to identify changes, such as course policies that need to be updated, to make it equitable.

Getting to know the online learners. Some of the strategies the instructors can use include surveying the students at the beginning of the semester to understand student needs and their readiness, ensuring all students have access to the devices they need as well as reliable internet for online learning, advocating for students who have greater needs and fewer resources, and supporting students who need specialized instruction and services (e.g., students with disabilities and English language learners).

Course Design. During course design, some of the strategies instructors can use to make the course inclusive and equitable include creating a welcoming online environment, including materials that are accessible to all learners,

Course Facilitation and Evaluation. During course facilitation and evaluation, some of the strategies instructors can use to make the course inclusive and equitable include ensuring equitable participation in asynchronous and synchronous discussions, recording lectures and virtual meetings so that students who are unable to attend can view it later, being available to support students through virtual office hours and providing timely response to questions, providing opportunities for students to engage in smaller group settings, grading anonymously to reduce bias, and collecting feedback anonymously from students for course improvement.

Additional Resources

Table 7 includes a list of journals that publishes research focusing on online learning and distance education.

American Journal of Distance Education	https://www.tandfonline.com/journals/hajd20
Distance Education	https://www.tandfonline.com/journals/cdie20
Distance Education: An International Journal	https://teachonline.ca/tools-trends/journals/distance-education-international-journal
Distance Learning	https://www.infoagepub.com/distance-learning.html
European Journal of Open and Distance Learning (EURDL)	http://www.eurodl.org/
International Journal of Instructional Technology & Distance Learning	http://www.itdl.org/index.htm
International Journal on E-Learning	http://www.aace.org/pubs/ijel/default.htm
International Journal of E-Learning and Distance Education	http://www.ijede.ca/index.php/jde/index
International Journal of Online Pedagogy and Course Design	http://www.igi-global.com/journal/international-journal-online-pedagogy-course/1183
International Review of Research in Open and Distance Learning (IRRODL)	http://www.irrodl.org/
Journal of Interactive Online Learning	http://www.ncolr.org/jiol/
Journal of Online Learning Research	https://www.learntechlib.org/j/JOLR/
Online Journal of Distance Learning Administration	http://www.westga.edu/~distance/ojdla/browsearticles.php
Online Learning Journal	https://onlinelearningconsortium.org/read/online-learning-journal/
Open Learning: The Journal of Open and Distance Learning	https://www.tandfonline.com/journals/copl20
Quarterly Review of Distance Education	https://www.infoagepub.com/Quarterly-Review-of-Distance-Education.html

The Journal of Distance Education (Formerly the Journal of Distance Education)	https://www.learntechlib.org/j/JDE/
Turkish Online Journal of Distance Education	http://tojde.anadolu.edu.tr/index.htm

Table 7. Journals focusing on Online Learning and Distance Education

Learning Check

A course that blends both asynchronous and synchronous online learning, and where students can participate in anytime, anywhere learning is called: (Select one answer)

- [ ] Hyflex
- [ ] Blended
- [ ] Bichronous
- [ ] MOOC

Which of the following are important aspects of online teaching? (Check all that apply)

- [ ] Course design
- [ ] Course facilitation
- [ ] Course engagement
- [ ] Inclusion and Equity

Editor's Note

To read more on this topic, see the chapter titled "Distance Learning" published in the first edition of this textbook.

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How Learning Analytics Can Inform Learning and Instructional Design

Lisa-Angelique Lim & Keith Heggart

Learning and instructional designers are increasingly required to make use of various forms of data and analytics in order to design, implement and evaluate interventions. This is largely due to the increase in data available to learning designers and learning analysts due the update of digital technologies as part of learning and training. This chapter examines the historical development of what has become known as learning analytics, defining the field and considering various models of learning analytics, including the process model with its focus on student learning. The chapter then explores the ways that learning analytics might be effectively connected to the field of learning design, and provides a number of examples of applications of this, including learning analytics dashboards, tailored messaging and feedback systems and writing analytics. Examples of these different applications are also presented and discussed. Finally, the chapter concludes with a consideration for he challenges and future directions for learning analytics.

Introduction

P. W. Anderson (1972) famously wrote that more is not just more—more is sometimes both quantitatively and qualitatively different. This is especially true in the case of data, and what is often known as "**big data**," which is central to the study of **learning analytics**. This chapter discusses the relationship between big data and learning analytics and, more importantly, what that means for learning designers and other educators. It will examine what learning analytics is, some of the advantages it offers and the challenges it faces, and what learning designers need to know to make use of it in their design work.

Making Sense of Data

One consequence of the increased use of digital technologies in education is that users now generate significantly more data than in the past. Often, this data is a kind of "digital exhaust"—something that learners do not even realize they are creating. Nevertheless, that data is generated, and researchers, academics, and businesses gather it and attempt to make sense of it. However, understanding how to use the data to improve **learning outcomes** is not easily done; This led to the development of the field of learning analytics (LA).

A Short History of Learning Analytics

Many of the tools, techniques, and data sources used in learning analytics are new, but the field itself has a long history. Since the early days of behaviorism, psychologists and educational researchers have discussed Computer-Aided Instruction (CAI), Computer-Assisted Teaching (CAT) and Intelligent Tutoring Systems (ITS)—all movements where Artificial Intelligence (AI) has been central. The key point, however, is that technology is beginning to make possible

Figure 1. A brief history of learning analytics

Defining Learning Analytics

The following definition was proposed at the first International Learning Analytics and Knowledge Conference (Siemens & Long, 2011):

> *"Learning analytics is the measurement, collection, analysis, and reporting of data about learners and their contexts, for the purposes of understanding and optimising learning and the environments in which it occurs."*

This definition is one that has been taken from the broader data analytics field and has become known as Business Intelligence (BI). The purpose of data analytics is the development of what is called "actionable intelligence." This means the data analysis is not undertaken solely for the sake of research, but rather to be able to make better decisions about what to do to reach specific outcomes. That idea is present in the definition of learning analytics as presented above, with its emphasis on "optimising learning and the environments in which it occurs." A more comprehensive definition is presented in the Consolidated Model of Learning Analytics (Gašević et al., 2016). This model (Figure 2) combines design, theory, and data science, and argues that learning analytics rests in the nexus of all of these.

Figure 2. The consolidated model of learning analytics

How Does Learning Analytics Work?

Learning analytics is best understood as a cyclical, iterative process. This section will examine the learning analytics cycle in detail, including a discussion about the kinds of data, **algorithms**, and modelling employed in learning analytics.

Process Models of Learning Analytics: It is All About the Learning

In the formative years of learning analytics as a discipline, researchers proposed models and frameworks to facilitate a better understanding of the processes involved in data-informed educational decision-making. One example of an earlier documented process for LA is provided by Campbell and Oblinger (2007, in Clow, 2012). To gain actionable intelligence into institutional data regarding retention and success, they defined a five-step process: capture, report, predict, act, and refine. Because academic analytics involves decision-making based on institutional data (Campbell et al., 2007), Campbell and Oblinger's (2007, in Clow, 2012) model focused on statistics and modelling of big data.

As learning analytics began to draw greater attention, new frameworks and models were defined. Chatti et al. (2012) proposed a 3-stage reference model focusing on how data are involved in the process, namely: (a) data are collected and pre-processed; (b) the results of pre-processing are transformed via analytics and actions such as prediction or data-mining; and (c) improvement of the analysis process through post-processing, for example, by gathering new data or refining existing data, or adapting the analysis. Their model addressed four key questions: what (data), who (target of analysis), why (purpose of analysis), and how (how analysis is performed). The three-stage model provided a useful framework to understand the emerging trends in the early years of the discipline. Chatti et al. (2012) mapped the literature available at the time against this framework. They identified that most of the work around learning analytics at that time was purposed for intelligent tutoring systems or researchers and system designers, focusing on classification and prediction techniques. In contrast to Chatti et al.'s (2012) data-centric model, Clow (2012) aligned his model (see Figure 4) to that of Campbell and Oblinger's (2007, in Clow, 2012). Through this choice of alignment, Clow proposed a four-stage LA cycle emphasising learners and learning in the process. This cycle includes the following four aspects that explain how (a) Learners in any learning setting (b) generate data either by virtue of their demographics or through their learning activities and academic performance; (c) these data are transformed into metrics(e.g., indicators of progress, comparisons against benchmarks or peers) via analytics; (d) metrics inform interventions such as learning

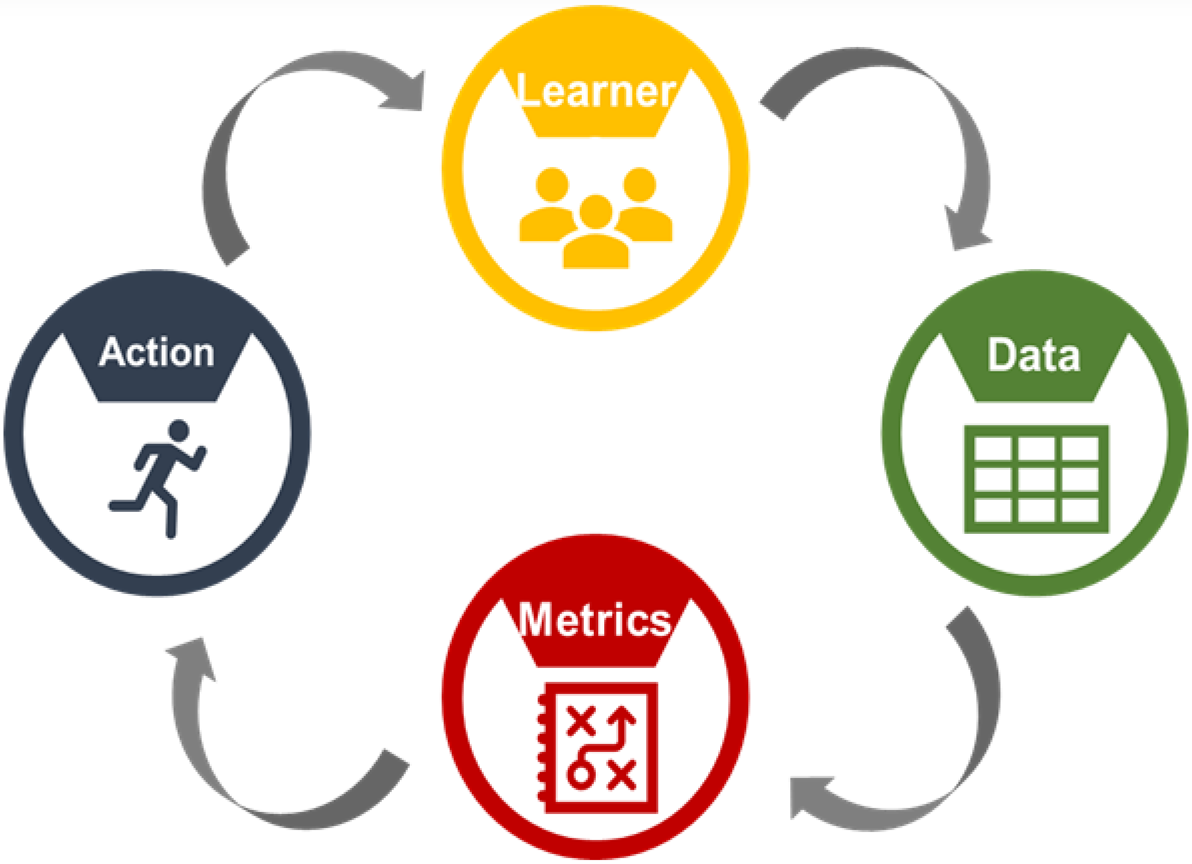


Figure 3. The Learning Analytics Cycle (based on Clow, 2012)

Other models have emerged in the literature to improve upon predecessors and focus more on making sense of learner data. For example, Verbert et al. (2013) proposed a learning analytics process model that focuses on processes around the sensemaking of learning analytics. However, in our view, Clow's (2012) model is useful for educators and learning designers who have control over the teaching context, as the process cycle highlights the need for LA interventions "to close the feedback loop" (p. 134) for students through actionable insights. This theme of closing the feedback loop continues to be significant when considering the effectiveness of LA interventions today. Throughout the rest of this chapter, you will see concrete examples of how this framework can be implemented in teaching and learning design.

Think About It!

As an educator:

- What information do you usually rely on to know whether your students are learning?
- How do you use this information to help your students?
- How might you use data from your students' interactions with the course's learning tasks and resources to inform your learning design?

Regardless of which LA process or model is subscribed to, a central concern of LA is data. So, what kinds of data can be collected about learners? The reality is that there are almost limitless amounts of data available. The challenge lies

> *A wide range of data is generated by the learners and stored in online and blended teaching and learning environments. Data is collected from explicit learners' activities, such as completing assignments and taking exams, and from tacit actions, including online social interactions, extracurricular activities, posts on discussion forums, and other activities that are not directly assessed as part of the learner's educational progress.*

Some examples are included below (Figure 4).

Where can we find the data?

Student Information System	Learning Environment	Research Instruments	Multimodal	Social Media	Other Data
• demographics • timetables • enrolment • attendance • previous assessment results	• trace data • simulation data • assessment data • social interaction • content interaction • intelligent tutoring systems • educational context data	• surveys • questionnaires • interviews • focus groups • observations	• video • audio • gesture • gaze • psychophysiological data • EEGs • fMRI	• Twitter • Instagram • Facebook • blogs	• library attendance • library helpdesk request • loan reports

Figure 4. Sources of data

This learner-generated data is used to assess learning progress, predict learning performance, detect and identify potentially harmful behaviors, and act upon the findings. In addition to measuring student performance, it can also be used to help us understand the effectiveness of our learning design, as will be described in the next section.

Connecting Learning Analytics with Learning Design

This section will explore various learning analytics that can be employed in order to assist students in reaching intended learning outcomes. It will take the form of practical case studies and discussions about the benefits of the different learning analytics approaches and will then explain the current areas and focus of learning analytics research. Learning analytics interventions can take any forms, including feedback or personalized study support. To do this, the interventions draw on information about the learner's activity or performance that is available from university systems or that the learner provides through self-reporting mechanisms.

Learning analytics dashboards: Visualising learning

Dashboards are perhaps the most frequently mentioned intervention associated with learning analytics and are garnering strong interest from developmental researchers Learning analytics dashboards (LADs) are visual displays of learners' information and/or progress with digital learning technologies. The dashboard's aim is to present the most important information to a range of educational stakeholders in a single display (Schwendimann et al., 2017). These systems are fully automated, in that data are transformed into meaningful metrics by preset algorithms and deployed at scale. LADs differ from *institutional dashboards*, which are designed from the perspective of academic analytics, and draw on a wide range of data captured across university systems, providing information on key performance indicators such as student enrollment patterns, retention rates, and faculty and staff employment information.

Institutional dashboards as described above draw on big data and can present useful information for the university to make decisions at an administrative level. However, when it comes to closing the feedback loop for learning (cf. Figure

One of the earliest and most famous LADs in the field—also referred to as the “poster-child of LA” – was Purdue University’s Course Signals (Arnold & Pistilli, 2012), an early-alert system that employed predictive algorithms on data from students’ academic background, current performance, and ongoing progress to identify students who are at risk of dropping out or failing a subject. The results of the algorithms were presented visually, in the form of “traffic lights” to signal the likelihood of success, with green indicating a high likelihood that the learner will succeed in the course; orange indicating the presence of issues impeding success; and red flagging students who are at high risk of failing in a course. The signals are presented to students as feedback on their progress, as well as to course instructors, who can then intervene in a timely way through emails or face-to-face consultation.

Other notable LAD research has been documented by researchers around the globe. Notably, a group from *Katholieke Universiteit* (KU) Leuven in Belgium, led by Katrien Verbert (e.g., Verbert et al., 2013; Broos et al., 2018), have been actively involved in developing LADs. However, comparatively few of these developments have made their way into actual teaching and learning settings. In a recent example, Li et al. (2021) described how instructors used an instructor-facing LAD at one institution in the United States (see case-in-point below).

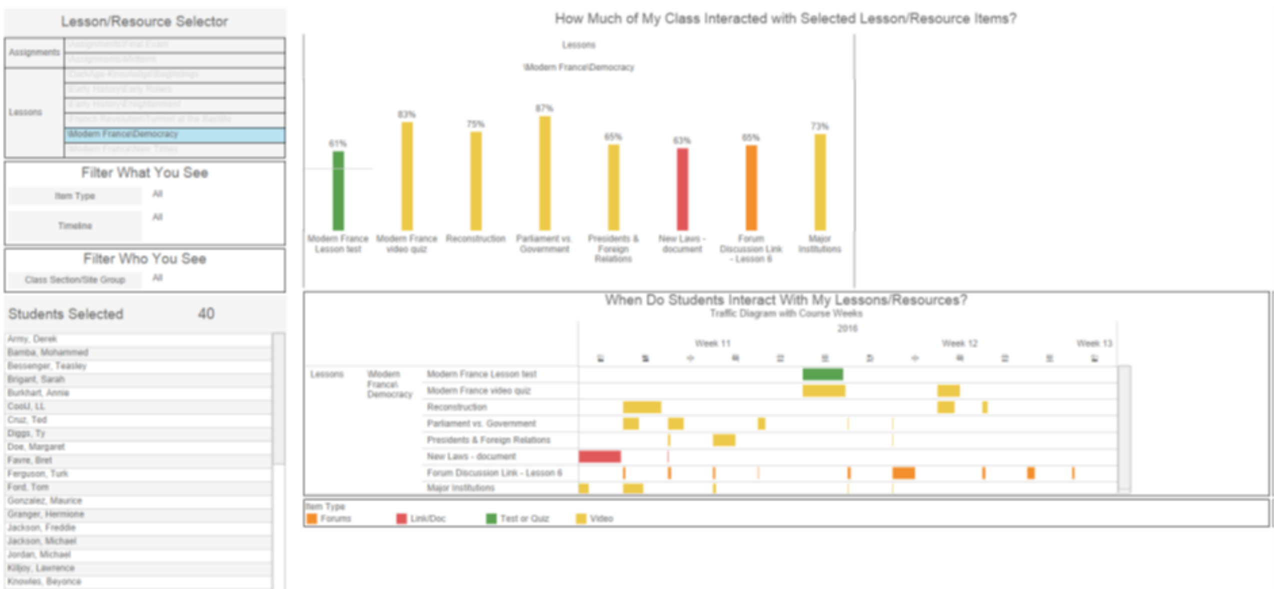


Figure 5. An example of an instructor-facing LAD (Source: Li et al., 2021, p.346. Image used with permission)

LADs have tended to draw on LMS activity data, which is not surprising as these data are readily available and automatically cached in learning platforms. However, advances in **information and communication technologies (ICTs)** as well as in **data mining** have resulted in a greater range of data reporting and **visualizations** afforded by LADs. For example, some recently developed LADs use **multimodal data** to provide feedback to educators and learners about learners’ emotions during learning (e.g., Ez-Zaouia, Tabard, & Lavoué, 2020) and collaborative activity (e.g., Martinez-Maldonado et al., 2021).

With learning increasingly shifting to online or blended modes, the LMS has become a feature of most learning environments. Major LMS vendors such as Canvas and Blackboard now include dashboard features for students and instructors (See Figure 6). Accordingly, Williamson and Kizilcec (2022) noted that “the dashboard feature in LMS likely exposed millions of students and instructors to LADs” (p. 260).

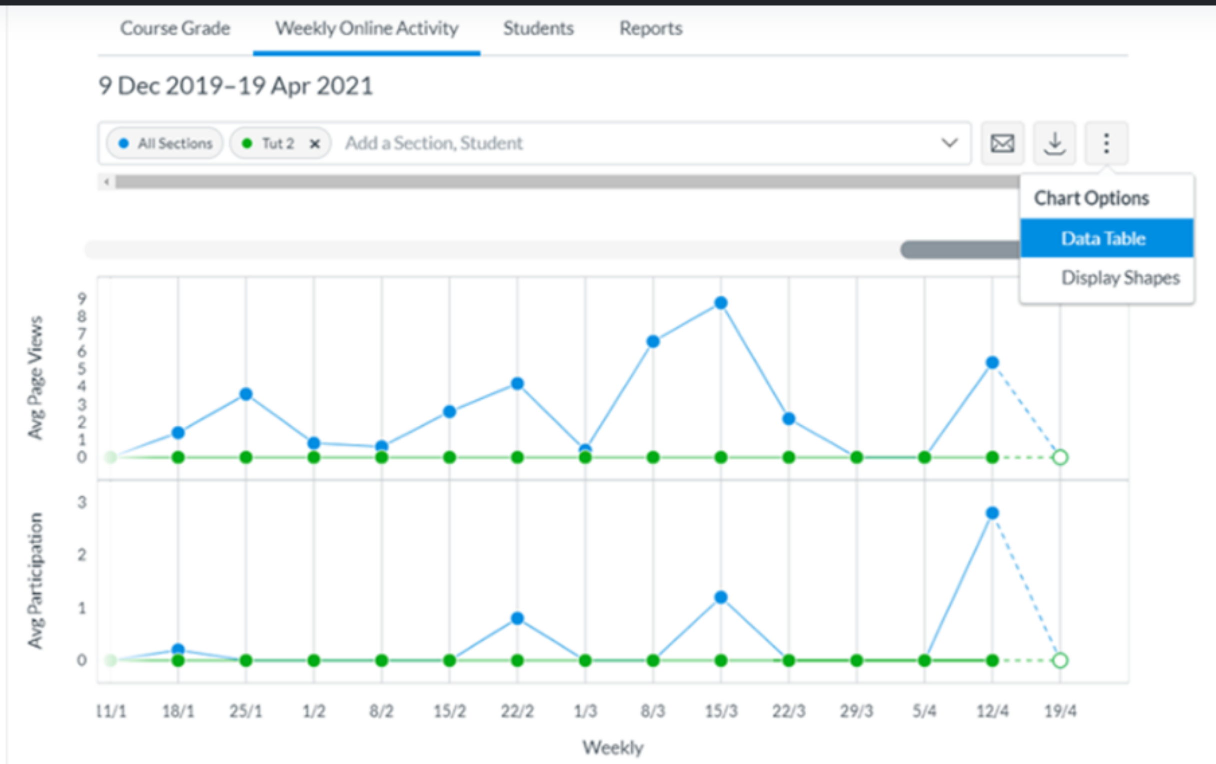


Figure 6. An example of an instructor-facing LAD generated by the Canvas Learning Management System used at the University of Technology Sydney (Source: https://lx.uts.edu.au/collections/building-your-canvas-course/resources/canvas-new-analytics/. Image used with permission)

Recall the Think About It! exercise posed earlier. Consider how you might use data from your students' interactions, with learning tasks and resources in your course, to inform your learning design. LADs offer such information at a glance. So, how do instructors use this information in their own contexts? Gleaning actionable intelligence from student activity and performance information in LADs involves a sense-making process. Li et al. (2021) studied how instructors from different disciplines at a large private University in the United States made sense of a teacher-facing LAD at the institution. The LAD (see Figure 5) had been part of the institution's **learning management system** for a few years, and offered the following views for instructors:

- Timestamped data showing the extent to which students had accessed course materials
- Frequency with which students employed key words in discussion forum posts or assignments
- Interactions with video resources
- Assessment performance

From their analysis of interview data with instructors who used the LAD, the researchers identified three categories of questions to which instructors sought answers when interrogating the visualizations. Most typically, instructors approached the LAD with *goal-oriented questions*—seeking information regarding how students were interacting with course resources, and therefore, the extent to which course objectives were being met. Importantly, some instructors also applied their knowledge about their student cohort (e.g., if they were mature students) as an additional layer of insight to inform how they talked to students about course objectives. Secondly, instructors approached the LAD with *problem-oriented questions*—seeking explanations for notable issues such as students' poor performance, for instance, by examining their learning behaviours. Thirdly, instructors approached the LAD with *instructional modification questions*—making informed decisions about teaching, for example, to maximize limited class time by focusing instruction if data showed poor grasp of certain topics.

Despite their pervasiveness, LADs have come under heavy criticism as automated feedback systems. A key criticism is that, because these visualization tools are designed to scale across students and contexts, they tend to be a one-size-fits-all solution (Teasley, 2017). As noted above, LADs tend to draw on data collected from students' activity in the LMS. The way students engage with different activities—discussion forums, readings, practice exercises and other resources—is a function of learning design. Given the contextual nature of these interactions, information presented in LADs, especially those that run on **predictive analytics**, face the issue of trustworthiness.

A second criticism has to do with the communication of information: While the visualisations may be very advanced and aesthetically pleasing, most are still passive displays of feedback reporting (Jivet et al., 2021). Feedback is a **dialogic process**, requiring learners to make sense of the information presented, manage unproductive emotions, and then take action in order to improve learning or performance (Carless & Boud, 2018). As such, LADs need to be carefully designed to foster dialogic feedback processes.

Related to this, a third criticism is that many LADs are limited in their ability to offer actionable advice to learners, which is another important principle of effective feedback communication., Because of the highly visual nature of the reports, learners may need help interpreting the information. Inaccurate or unhelpful interpretation of the information could negatively impact a learner's motivation to learn (e.g., Lim et al., 2019). In fact, research examining the impact of LADs indicates that the way information is presented on LADs can have detrimental effects on students who are at risk of failing (Aguilar, 2018; Lonn, Aguilar, & Teasley, 2015).

A final criticism of LADs has to do with the increasing concern regarding equity in learning analytics. With most LADs relying on single algorithms to report on students' progress or to predict performance, there is a danger of "algorithmic bias," disadvantaging underrepresented groups (Williamson & Kizilcec, 2023). As contemporary more experience with academic environments.

In summary, LADs are a ubiquitous intervention in digital learning environments, due in large part to the abundance of data readily cached in LMS platforms. However, while these fully automated feedback interventions can be aesthetically pleasing and easy to scale, most fall short of delivering on some of the principles of effective feedback and are limited in their ability to address issues of equity.

Think About It!

Have you come across LADs in your own teaching? To what extent do you make use of these visualisations to understand your students? Do you find these tools helpful or unhelpful?

Tailored Messaging and Feedback Systems: "Systems That Care"

As noted above, LADs are fully automated learning analytics feedback systems that deliver personalized feedback to learners with the aim of supporting monitoring and self-regulated learning. We also took note of some of the criticisms associated with such systems, which are designed to be administered at scale. We now turn to another class of feedback interventions that are not fully automated but are instead designed with a "human in the loop" in the learning analytics process. This means that humans intervene in the application of the system. The following interventions may be considered as "systems that care," in du Boulay's (2010) terms. This is because they are directed at learners' motivation, metacognition, and affect.

These human-involved systems are currently adopted "in the wild"—in higher education settings by educators around the world. These systems allow educators to control certain features—also known as *parameters*—in accordance with their context and learning design. Depending on the tool, these parameters may include one or more of the following:

- the kind(s) of data which is the basis for feedback at specific points in time
- the rules and conditions for defining subgroups for personalization
- the content of the message that educators want to convey to students
- the scheduling of personalized feedback or other tailored support messages

This contextualization is important, as learning design significantly influences students' engagement and success (Gašević et al., 2016). What follows are three examples of these semi-automated learning analytics feedback systems that have been featured in the literature: the Student Relationship Engagement System (SRES), OnTask, and ECoach. These systems are discussed as they are known for their implementation in higher education courses.

The Student Relationship Engagement System (SRES) and OnTask

SRES (Liu et al., 2017) and OnTask (Pardo et al., 2018) are described together here, as they share a few similarities in the way they allow for educators to make decisions regarding personalized, data-informed feedback and support, using "teacher intelligence and small (but meaningful) data" (Arthars et al., 2020, p. 229). A noteworthy point about both systems is that they were developed by educators who understood the challenges that fellow-educators face in wanting to personalize support and feedback to large cohorts of students. These tools were designed to facilitate educators' personalized support of students in a timely manner in their courses.

institutional systems. In addition, educators can upload additional data from other sources. This might include: attendance data from synchronous or face-to-face classes; performance on formative quizzes; or surveys that capture student academic variables such as program of study, current motivation, or learning challenges. Self-report surveys may be especially important for further personalization of support or communication. At the simplest level, at the start of the semester, instructors may ask students if they have a preferred name that differs from their official record that the instructor can use that for all subsequent communications.

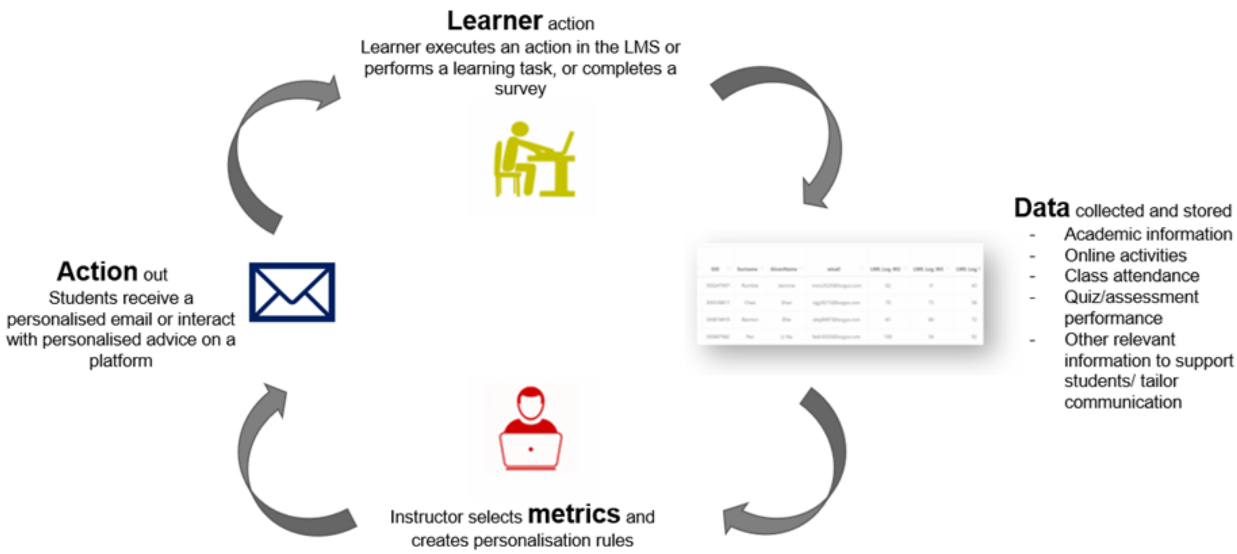


Figure 7. The learning analytics cycle with a human in the loop

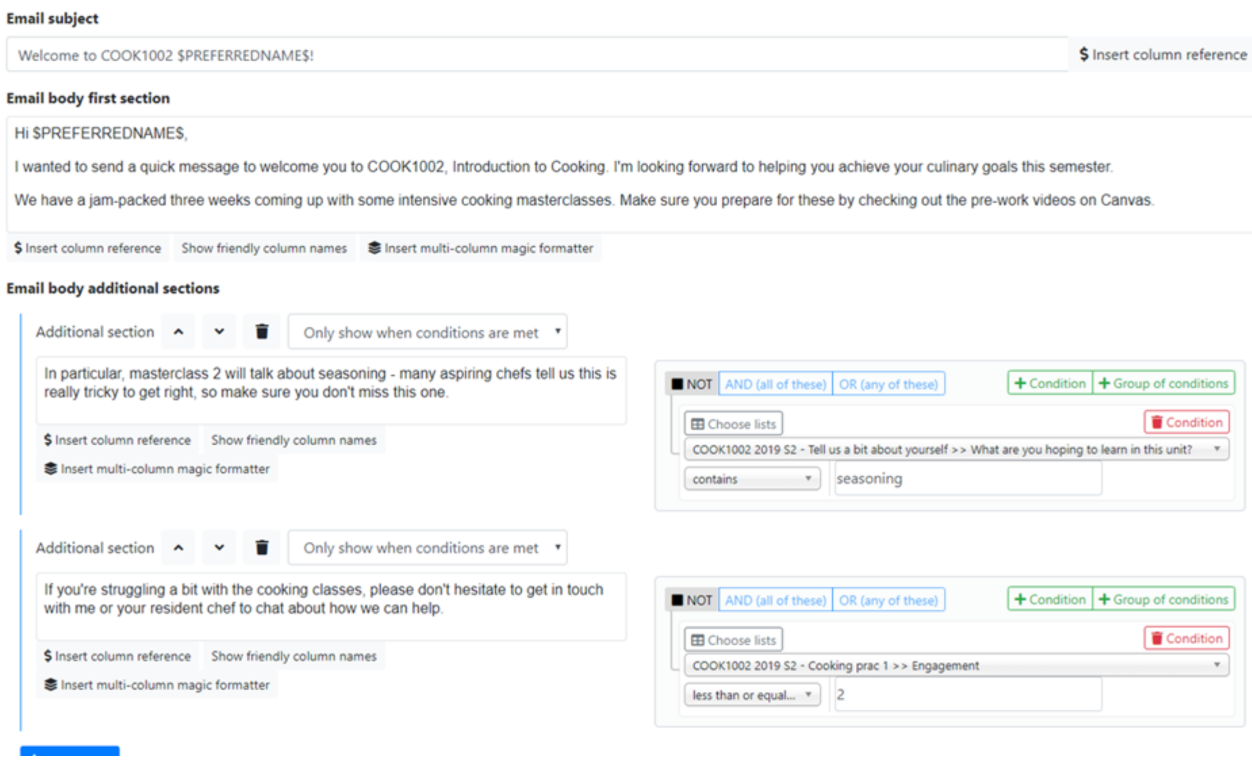
Interviews with instructors using the SRES to communicate with their students on a first-name basis reported that the emphasis on using a preferred name helped the instructors engage personally with their students and to show their care. As students progress through the semester, instructors can deploy timely surveys to tap into how students are feeling about their current learning—for example, by asking them about "muddiest points" of the week. The instructors then possess the resources to personalize communication based on students' responses. Following this, the instructor can then segment students based on the data, and design supportive messages for personalized feedback, nudges, or advice to each student based on their progress or attitudes over the course of their study.

While these systems are still fairly new, empirical evidence that documents their impact has recently emerged. For example, results from studies with OnTask have been promising, showing positive impact on students' motivation (Lim et al., 2021), self-regulated learning (Matcha et al., 2019), and academic performance (Pardo et al., 2019; Lim et al., 2021). In these studies, performance and learning management system activity data were collected from courses where instructors employed OnTask for personalized feedback; the data were compared between cohorts who experienced personalized feedback and those who had not.

Additionally, studies exploring data on course satisfaction indicate that personalizing feedback in this way enhanced the course experience for students (Pardo et al., 2019). Through interview studies, it was also found that students experienced greater feelings of support and belonging in their courses (e.g., Lim et al., 2021). Importantly, students noted that the fact that personalized feedback was communicated from the instructor played an important motivational role in their continued efforts to learn in the course.

Research on educators' perspectives with SRES also serves as a rich source of information to understand how these key stakeholders engage with learning analytics feedback tools in actual teaching settings (as opposed to laboratory settings, which tends to be the case for new technologies), the challenges they face, and how to facilitate wider adoption of such tools (Arthars & Liu, 2020; Blumenstein et al., 2019). For example, Arthars and Liu (2020) described automation of the data collection process became possible. This automation then allowed instructors to generate metrics for personalized feedback on engagement data such as quizzes; it also allowed them to communicate this feedback through emails.

While sharing some similarities with OnTask, the SRES—being an earlier development—has advanced to a more mature, “multifunctional system” (Arthars et al., 2020). This new system offers additional features for interactions with feedback, such as the affordances of students’ self-reflection on instructor, dialogic, and peer feedback (see Figure 8 for an illustration). As students write their self-reflections, their inputs can be the next cycle of personalized feedback (see Figure 8). It is also possible for instructors to upload data in real time; these data include tutorial attendance data, students’ lab results, or marks based on rubrics in oral examinations. This has allowed instructors to greatly reduce the time it takes to provide feedback on **assessment**. To date, the SRES has been widely adopted at the University of Sydney by instructors who want to engage personally with their students (see Arthars et al., 2020 for an in-depth perspective of how and why instructors adopted SRES at the institution).



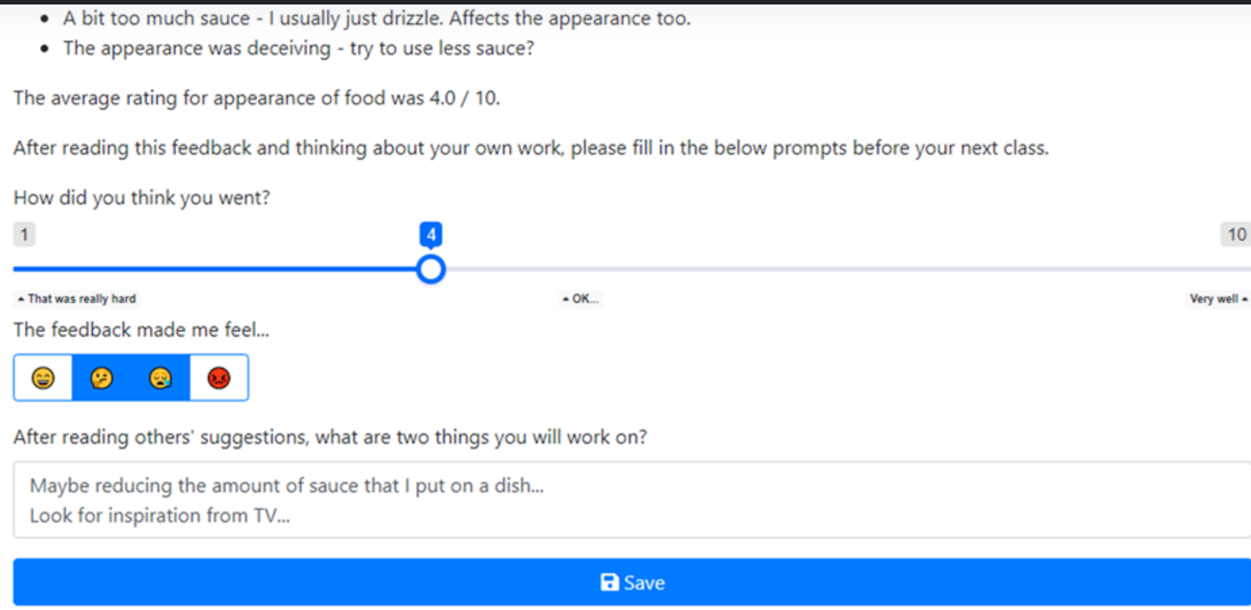


Figure 8. The SRES interface. (Top) Email editor with elements for personalization. (Bottom) Feedback message showing instructor and peer feedback, and dialogue for feedback response. (Source: Arthars et al., 2020. Images used with permission)

Both OnTask (https://www.ontasklearning.org/) and SRES (https://sres.io/) are open source tools, meaning that they are available for anyone to use—what may be needed is to ensure the tool meets institutional requirements with regards to data **privacy** and security (if you are interested, read the paper by Buckingham Shum (2023) when seeking to embed learning analytics technologies within the institution).

ECoach

ECoach is a platform that leverages data to offer personalized learning support to students, offering them a personal "coach" through the students' own personalized portal. The platform was designed as a motivational coaching system for students in large, introductory STEM courses to enhance motivation and ultimately foster academic success. Managed at the University of Michigan since 2014 (Huberth et al., 2015; Wright et al., 2014), this platform is relatively mature, having undergone several iterations of design based upon ongoing research.

The platform hosts a range of features to prompt students' metacognition and reflection, and employs messages personalized to students' activity data in the course LMS, as well as to information gathered from self-report surveys. The features in the platform were gradually added over time as part of the platform's development and include tailored messages, exam playbooks, exam reflections, a grade calculator, and an interactive to-do list (see Matz et al., 2021 for details). Some of these surveys are preset, and based on existing instruments on study habits such as the Motivated Strategies for Learning Questionnaire, MSLQ (Pintrich & de Groot, 1990). The pre-set surveys ask students about their goals for the course or their study habits; other surveys can be designed by instructors and deployed to students through the system so that advice or feedback can be tailored to students based on their response data.

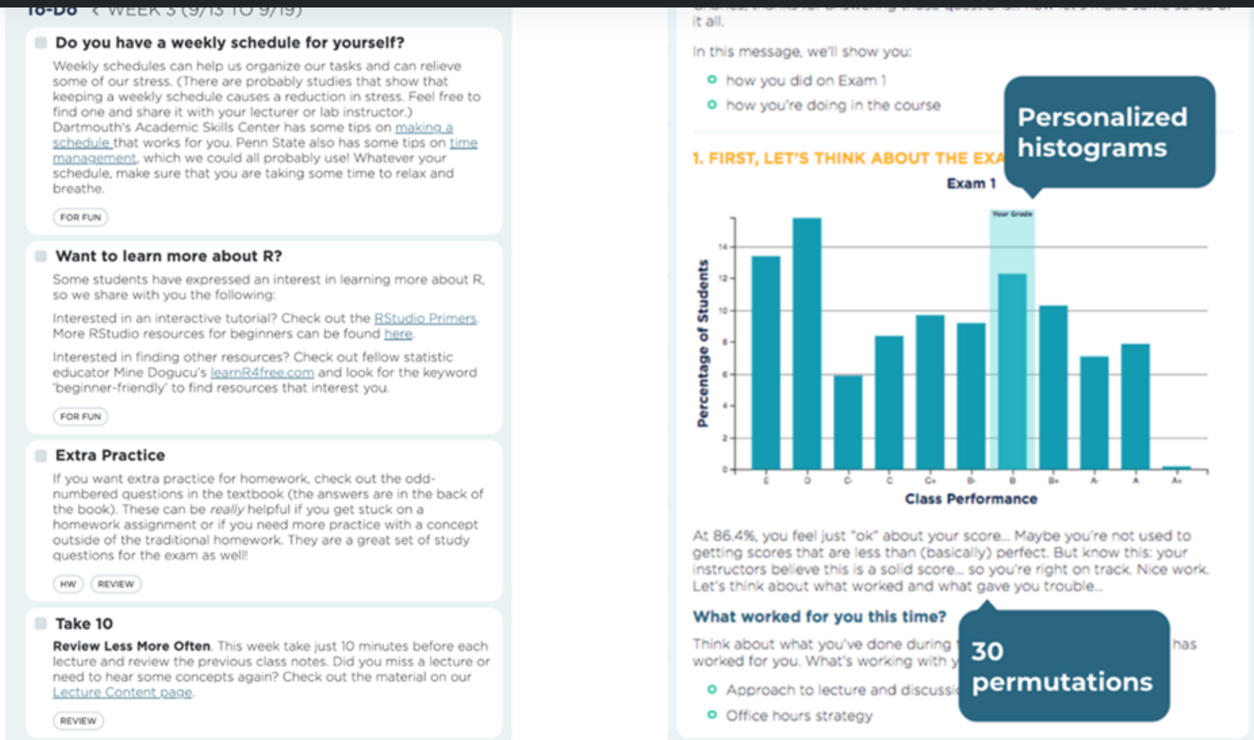


Figure 9. The ECoach platform from the students' perspective. (Left) A To-Do list tuned to the curriculum, prompting student reflection and action. (Right) a tailored post-exam reflection message integrating student self-report data about how they regarded their grade, and eliciting reflection on study habits. For details see https://ai.umich.edu/software-applications/ecoach Images used with permission.

A notable difference between ECoach and the OnTask and SRES systems, as described above, is how instructors work with the system. Instructors work directly with the OnTask and SRES platforms to select data and create rules for—as well as write—personalized messages to motivate students and nudge productive study behaviours. In the case of ECoach, a team of behavioral scientists consults with instructors to customize the platform for their course—this becomes the "coach" for students.

Study on Personalized Feedback

Educators can align learning analytics with learning design through personalized feedback. Here is one example: The setting was a course in the Engineering and IT discipline that employed a flipped learning design. This was a large course enrolled by close to 600 students. As is typical of flipped learning designs, students were required to complete preparatory tasks prior to the weekly lecture. The preparatory work consisted of watching a topic video and answering related questions, as well as completing a short series of practice exercises. The preparatory work was designed to support students' mastery of the weekly topics.

Because the educator wanted to increase students' engagement with the preparatory work and provide personalized feedback on the mastery of the weekly topic, they utilized the OnTask system to generate formative feedback after the preparatory work was due. This meant that students received feedback on their progress with the tasks as well as on their performance. Evaluations of this personalized feedback design found that, overall, students acquired a regular pattern of study that involved preparation and review. They also performed better when the educator included actionable study advice along with performance feedback. Importantly, the way that the personalized, data-informed feedback was designed reinforced the rationale of the flipped learning design. This is a powerful example of the impact on students' learning when learning analytics is aligned with learning design. For more details about this case study, refer to Pardo et al. (2019) and Lim et al. (2021).

Think About It!

How much do you know about your students? If you were to give them a survey to find out more about them, what would you ask? How would you use this information to offer personalized advice or feedback?

Writing Analytics: Supporting Students' Academic Writing with Natural Language Processing

So far, we have discussed learning analytics interventions that draw on LMS activity data and, to some extent, student self-report data to personalize feedback and support. As mentioned earlier, quantitative data have tended to be the main type of data used in the field due to the affordances LMSs offer to automatically capture and harvest learners' activity data. However, textual data is also just as ubiquitous—readily available in forms such as written assessments, qualitative survey responses, and discussion forum comments. Furthermore, writing—in particular, academic writing—is a "key disciplinary skill" (Knight et al., 2020) that is a requisite for professions such as law and business, and certainly in most areas of research. However, teaching academic writing in higher education where enrollment is in the hundreds, is undoubtedly a challenge. This is because students need personalized feedback and guidance on their writing. Even so, with educators juggling teaching loads and administrative tasks, helping every student individually with their writing is nearly impossible. With this in mind, we now turn to another category of learning analytics interventions: writing analytics feedback.

Automated text analysis tools have been around for more than a decade now. These tools can be classified into one of three categories: automated essay scoring (AES), automated writing evaluation (AWE), and intelligent tutoring systems (ITS) (Conijn et al., 2022). In this chapter, only a very brief comparison among the three classes of tools is provided; for

ITSs have been in existence for years now. These are closed systems, meaning that they are fully automated with pre-set algorithms. They are standalone platforms, able to perform a range of functions with built-in affordances for interactivity. AES tools are intended to assist educators with summative assessment of students' writing; in other words, they focus on the written piece as an end product and evaluate this product according to pre-defined rules. Finally, AWEs are the newest systems, designed to provide personalized support and formative feedback on students' writing processes, rather than the final product, to help students improve in their writing.

Automated writing evaluation tools have emerged due to advancements in automated text analysis—particularly natural language processing techniques. One example of an AWE that has been featured in the literature is a tool called AcaWriter (see Knight et al., 2020). This tool sits on an online platform and provides automated feedback to students by highlighting the presence of "rhetorical moves" (Swales, 2004) that are critical in academic writing. AcaWriter is tuned through **machine learning** to detect "phrases and sentences that indicate . . . the writer's attitude or position in relation to . . . the text" (Knight et al., 2020, p.143). For example, rhetorical moves in analytical writing include: question move (i.e., raising a question or highlighting missing knowledge), background move (i.e., describing background knowledge or consensus about a topic), and emphasis move (i.e., emphasising significant, important ideas) (Swales, 2004). When students input their written drafts into the platform, they can obtain immediate feedback on their writing regarding the presence or absence of these moves; they can also receive actionable advice on how to improve the draft to make these moves more visible.

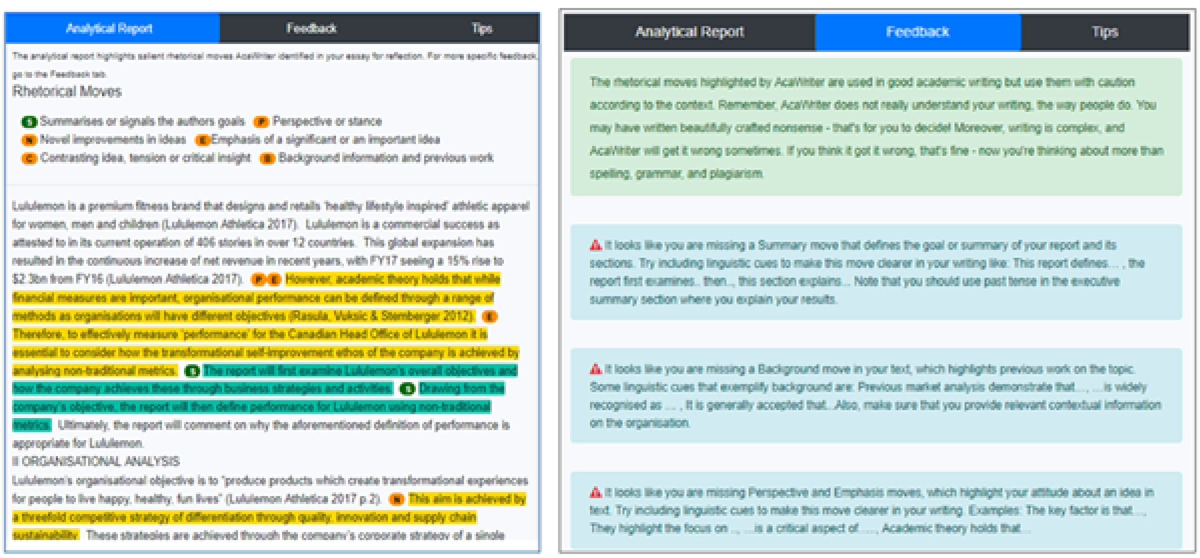


Figure 10. The AcaWriter web interface. (Left) Highlighting of sentences in which it detects academic 'rhetorical moves' (see legend). (Right) Feedback information for the author.

Analytics Tools—Where Learning Analytics Informs Learning Design

So far, we have described how learning design informs learning analytics interventions in context, but the reverse can also be true as learning analytics can inform learning design. We see this in the case study of the AWE tool, AcaWriter. In this case, researchers worked closely with the educator in a business course to ensure the learning design of the course and the feedback intervention were closely aligned. In this co-design, both parties worked together to tune AcaWriter feedback to the assessment rubric in order to facilitate students' sense-making of the tool's feedback and actionability. Even so, it was observed that not all students engaged deeply with the feedback from the AWE tool. Some/many made only surface changes in response to the feedback they received.

To encourage students' critical engagement with the feedback from AcaWriter, the researchers worked again with the educator to create "self-evaluation exercises" or SEE sheets that students were encouraged to complete as they used AcaWriter (see Figure 11). The SEE sheets comprised prompts for students to reflect on the feedback they obtained from AcaWriter. The purpose of the SEE sheets was not to enforce compliance with the feedback, but to encourage students to consider whether they agreed with their feedback or not. Students were also invited to annotate the feedback they downloaded from AcaWriter, as a way to develop their understanding of the feedback. The use of the SEE sheets resulted in an adaptation to learning design stimulated by the learning analytics intervention. Importantly, this was done in order to foster critical **student engagement** through personalized, writing feedback. You can read the full case study in Shibani et al. (2022).

1) Upload your draft report to **AcaWriter**

2) Download and print the PDF showing the AcaWriter feedback on your report

3) Print and review the **Acawriter feedback. Do you agree with the feedback given? Why/ Why not?**

4) On the printed copy of your report (that shows the AcaWriter Feedback), use highlighters and comments to add to the feedback by showing where your report use the following **rhetorical moves**. You should submit this report.

NOTE: AcaWriter will be able to identify most of these rhetorical moves, but not always! It is important to use your (honest) human judgement too.

Organisational analysis

Where does your report provide contextual information about the organisation's objectives, strategy, structure and activities?

Defining performance

Where does your report provide your **perspective [P]** about how to define performance or success for the organisation?

Where does your report **provide emphasis [E]** to highlight the most important aspects of performance for the organisation?

Justification of your definition of performance

Where does your report provide convincing, persuasive justifications for your definition of performance by proposing **novel [N] or critical insights, contrasting ideas or tension [C]**?

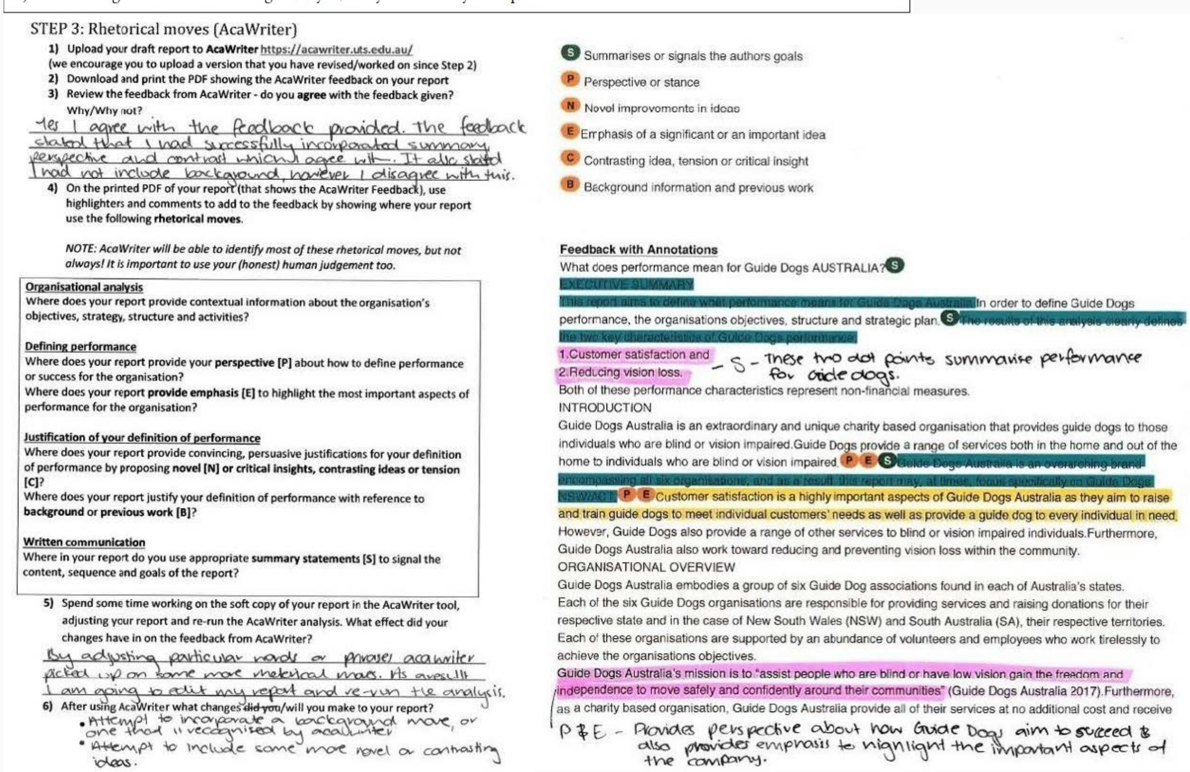
Where does your report justify your definition of performance with reference to **background information** or **previous work [B]**?

Written communication

Where in your report do you use appropriate **summary statements [S]** to signal the content, sequence and goals of the report?

5) Spend some time working on the soft copy of your report in the AcaWriter tool, adjusting your report and re-run the AcaWriter analysis. What effect did your changes have in on the feedback from AcaWriter?

6) After using Acawriter what changes did you/will you make to your report?



STEP 3: Rhetorical moves (AcaWriter)

1) Upload your draft report to **AcaWriter** https://acawriter.uts.edu.au/
(we encourage you to upload a version that you have revised/worked on since Step 2)
2) Download and print the PDF showing the AcaWriter feedback on your report
3) Review the feedback from AcaWriter - do you **agree** with the feedback given? Why/Why not?

Yes I agree with the feedback provided. the feedback stated that I had successfully incorporated summary, perspective and contrast which I agree with. It also stated I had not include background, however I disagree with this.

4) On the printed PDF of your report (that shows the AcaWriter Feedback), use highlighters and comments to add to the feedback by showing where your report use the following **rhetorical moves**.

NOTE: AcaWriter will be able to identify most of these rhetorical moves, but not always! It is important to use your (honest) human judgement too.

Organisational analysis
Where does your report provide contextual information about the organisation's objectives, strategy, structure and activities?

Defining performance
Where does your report provide your **perspective [P]** about how to define performance or success for the organisation?
Where does your report **provide emphasis [E]** to highlight the most important aspects of performance for the organisation?

Justification of your definition of performance
Where does your report provide convincing, persuasive justifications for your definition of performance by proposing **novel [N] or critical insights, contrasting ideas or tension [C]**?
Where does your report justify your definition of performance with reference to **background** or **previous work [B]**?

Written communication
Where in your report do you use appropriate **summary statements [S]** to signal the content, sequence and goals of the report?

5) Spend some time working on the soft copy of your report in the AcaWriter tool, adjusting your report and re-run the AcaWriter analysis. What effect did your changes have in on the feedback from AcaWriter?

By adjusting particular words or phrases acawriter picked up on some more rhetorical moves. As a result I am going to edit my report and re-run the analysis.

6) After using AcaWriter what changes ~~did you~~/will you make to your report?

- Attempt to incorporate a background move, or one that is recognised by acawriter
- Attempt to include some more novel or contrasting ideas.

S Summarises or signals the authors goals
P Perspective or stance
N Novel improvements in ideas
E Emphasis of a significant or an important idea
C Contrasting idea, tension or critical insight
B Background information and previous work

Feedback with Annotations

What does performance mean for Guide Dogs AUSTRALIA? S
EXECUTIVE SUMMARY
This report aims to define what performance means for Guide Dogs Australia. In order to define Guide Dogs performance, the organisations objectives, structure and strategic plan. S The results of this analysis clearly defines the two key characteristics of Guide Dogs performance.
1.Customer satisfaction and
2.Reducing vision loss.
– S – These two dot points summarise performance for Guide dogs.
Both of these performance characteristics represent non-financial measures.
INTRODUCTION
Guide Dogs Australia is an extraordinary and unique charity based organisation that provides guide dogs to those individuals who are blind or vision impaired.Guide Dogs provide a range of services both in the home and out of the home to individuals who are blind or vision impaired. P E S Guide Dogs Australia is an overarching brand encompassing all six organisations, and as a result, this report may, at times, focus specifically on Guide Dogs NSW/ACT. P E Customer satisfaction is a highly important aspects of Guide Dogs Australia as they aim to raise and train guide dogs to meet individual customers' needs as well as provide a guide dog to every individual in need. However, Guide Dogs also provide a range of other services to blind or vision impaired individuals.Furthermore, Guide Dogs Australia also work toward reducing and preventing vision loss within the community.
ORGANISATIONAL OVERVIEW
Guide Dogs Australia embodies a group of six Guide Dog associations found in each of Australia's states. Each of the six Guide Dogs organisations are responsible for providing services and raising donations for their respective state and in the case of New South Wales (NSW) and South Australia (SA), their respective territories. Each of these organisations are supported by an abundance of volunteers and employees who work tirelessly to achieve the organisations objectives.
Guide Dogs Australia's mission is to "assist people who are blind or have low vision gain the freedom and independence to move safely and confidently around their communities" (Guide Dogs Australia 2017).Furthermore, as a charity based organisation, Guide Dogs Australia provide all of their services at no additional cost and receive

P & E – Provides perspective about how Guide Dogs aim to succeed & also provides emphasis to highlight the important aspects of the company.

Figure 11. The AcaWriter self-evaluation exercise (SEE). (Top) SEE prompts for reflecting on AcaWriter feedback. (Bottom) Sample student response to SEE prompts on AcaWriter feedback. (Source: Shibani et al., 2022. Images used with permission)

Challenges and Future Directions for Learning Analytics

Over a little more than a decade, learning analytics as a field has grown with rising interest; technology development; and the creation of subfields such as multimodal analytics (Blikstein & Worsley, 2016), assessment analytics, and collaborative analytics. These subfields explore wider sources of data to inform interventions in support of student learning beyond the LMS.

A key challenge for the field is that of adoption. While there are a plethora of tools and systems, few have been actually adopted "in the wild,"—that is, by educators and institutions. In this chapter, we have presented three examples of systems that have seen adoption in actual teaching environments. Each of these systems harnesses either activity, performance, or textual data, to personalize feedback and support to students.

The reason for a lack of adoption is due to the challenges involved in deciding to procure and embed such tools within existing infrastructure (see Buckingham Shum, 2023, for an overview of the levels of conversations to be had in trying to embed learning analytics tools at a university). Furthermore, educators themselves are faced with challenges when considering to adopt data-informed tools. These challenges include the time investment required to learn how to work with the technology (Arthars & Liu, 2020), as well as the kinds of literacy that are required for effectively working with data (Buckingham Shum et al., 2023). This presents specific challenges for learning designers who are trying to incorporate learning analytics in their practice.

The low adoption of learning analytics within education makes measuring the impact of these data-driven interventions difficult —according to Viberg and Grönlund (2021), the field is in "desperate" need of showing impact at scale. To show this impact, educators and learning designers may need to return to fundamental skills around teacher feedback literacy and develop additional automated feedback competencies in order to effectively design data-informed, personalized feedback and support. Stakeholders need to develop an understanding of data that can inform about students' learning within learning design. They also need to enhance their ability to work with data to personalize feedback in a meaningful way. Combining this data literacy with knowledge of effective feedback will foster greater adoption of data-informed feedback systems in the wild.

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Dr Keith Heggart is an award-winning researcher with a focus on learning and instructional design, educational technology and civics and citizenship education. He is currently exploring the way that online learning platforms can assist in the formation of active citizenship amongst Australian youth. Keith is a former high school teacher, having worked as a school leader in Australia and overseas, in government and non-government sectors. In addition, he has worked as an Organiser for the Independent Education Union of Australia, and as an independent Learning Designer for a range of organisations.

Computer-Supported Collaborative Learning

Cindy Hmelo-Silver & Heisawn Jeong

Pedagogy Technology Collaboration Collaborative Learning CSCL Learning Sciences

Computer-Supported Collaborative Learning (CSCL) research has become pervasive in STEM (science, technology, engineering, and mathematics) education over the last several decades. Guided by sociocultural and social constructivist theories of learning, CSCL focuses on shared meaning making and is influenced by the three pillars of CSCL: enabling technologies, pedagogical designs, and modes of collaboration. This chapter identifies four different approaches or clusters to CSCL that involve different combinations of these pillars. Focusing on two of these clusters, this chapter (a) identifies robust themes in this field and (b) discusses the positive outcomes associated with these aspects of CSCL. Outcomes include learning gains, process improvements, and affective outcomes. Across clusters, results demonstrate that scaffolding and feedback in different combinations affect outcomes. Moreover, different combinations are used with learners at different ages and with different learning goals. Designing CSCL for different learning environments requires considering the complex system of learning environments that emerge from the interaction among contexts, learner characteristics, and learning activities.

Many contemporary theorists characterize learning as that which is fundamentally social rather than individual (Danish & Gresalfi, 2018). Advances in computer technologies have enabled diverse modes of collaboration and set the stage for **Computer-Supported Collaborative Learning (CSCL)**. CSCL refers to collaborative learning that is mediated in some way by computer technology (Stahl, Koschmann, & Suthers, 2014). It rests on three major pillars: the technologies that support and enable CSCL, the pedagogical designs that apply CSCL to learning, and the modes in which learners collaborate. In describing the goal of research in CSCL, Miyake (2007) argued that research and design of CSCL environment must take "collaboration seriously, and implements and evaluates technological support to materialize effective learning designs" (p. 248), addressing three key foundations of CSCL. Similarly, Roschelle, Bakia, Toyama, and Patton (2011) have argued that we need to understand the compound resources at play in complex learning environments. By looking at different combinations of CSCL design elements, we move closer to being able to understand how to design for CSCL in different contexts. This chapter considers how different combinations of these pillars affect the outcomes of CSCL research with a focus on science, technology, engineering, and mathematics (STEM) education, where much CSCL research has been conducted (Jeong, Hmelo-Silver, & Jo, 2019).

CSCL: An Overview

The pillars of CSCL are the technology, the **pedagogy**, and the mode of collaboration. CSCL environments may be synchronous, that is, with learners collaborating at the same time, or asynchronous, with learners collaborating at different times (Jeong et al., 2014). Synchronous collaboration can be at a distance (e.g., web conferences), or it can be face-to-face. An example of synchronous face-to-face CSCL is secondary school students discussing simulations in

Within CSCL, the focus is on learning through **technology-mediated collaboration** as a coordinated effort to build shared knowledge (Stahl et al., 2014). A broad range of theoretical perspectives can apply (Hmelo-Silver & Jeong, 2021). However, because a general constructivist **sociocultural** orientation or sociocultural framework accounts for the majority of CSCL research, we ground our discussion in these latter frameworks, as they have been the dominant **paradigms**.

This chapter adopts a broad view on technology, focusing on the **affordances** and supports rather than technical features that these technologies provide for collaborative learning. Jeong and Hmelo-Silver (2016) proposed seven affordances of CSCL for learning. Affordances here refer to the ways technology mediates learning in CSCL. CSCL technologies provide learners opportunities to (a) engage in a joint task, (b) communicate, (c) share resources, (d) engage in productive collaborative learning processes, (e) engage in **co-construction**, (f) monitor and regulate collaborative learning, and (g) find and build groups and communities. Different combinations of these functions can be used in CSCL designs to support a range of instructional designs and pedagogical approaches.

What are the three pillars of CSCL? (select all that apply)

- [ ] Enabling technologies
- [ ] Gamification
- [ ] Pedagogical designs
- [ ] Modes of collaboration

What is an example from this chapter of synchronous collaboration that occurs at a distance?

- [ ] In-class presentations
- [ ] Self-moderated learning modules
- [ ] Web conferences
- [ ] Discussion boards

What is an example from this chapter of synchronous collaboration that occurs face-to-face?

- [ ] Elementary school students posting self-introduction videos to a class discussion board while at home
- [ ] Secondary school students discussing simulations in their classrooms together
- [ ] Researchers participating in an online Zoom meeting (online video conference software) to discuss research methods
- [ ] Teaching assistants collaborate to create a test review while they are in different offices

How is asynchronous CSCL design different from synchronous CSCL design?

- [ ] Asynchronous CSCL design involves learners interacting in the same space
- [ ] Asynchronous CSCL design can involve learners interacting with learning material face-to-face
- [ ] Asynchronous CSCL design can involve learners across time

- encoding of informational details like time, space, and meaning of words
- visual representation of the relationship between ideas
- the input of information into the memory system
- learning through technology-mediated collaboration as a coordinated effort to build shared knowledge

Jeong and Hmelo-Silver (2016) proposed that technology can mediate learning through engagement in a joint task and engagement in co-construction. What are three of the five other ways technology mediates learning in CSCL? (select all that apply)

- Communication
- Sharing of resources
- Proliferation of ineffective learning practices
- Engagement in productive collaborative learning processes
- Promotion of in-person collaboration

Effects of CSCL on Learning

Recent meta-analyses suggest that CSCL has significant effects on student learning. Chen, Wang, Kirschner, and Tsai (2018) examined the role of collaboration, computer use, and overall CSCL environments on learning. They found overall moderate effects of CSCL on learning outcomes and social interaction, with large effects on group tasks. Vogel, Wecker, Kollar, and Fischer (2017) focused on **scaffolding** with CSCL **scripts**. They found small effects on knowledge gains and a moderate effect on collaboration skills. Scripts were particularly effective for learning domain knowledge when they prompted learners to engage in activities that built on the contribution of other group members or when they provided additional content-specific support. In a meta-analysis of CSCL in STEM domains, Jeong et al. (2019) found a similar overall moderate effect size. They did find, however, that effect sizes were affected by types of technology and pedagogy, education levels of learners, and modes of collaboration. For example, **representational tools** (e.g., simulations, modeling tools) were more effective in face-to-face than in asynchronous settings, as was **inquiry learning**. The use of scripts and discussion boards were more effective in asynchronous settings.

These syntheses suggest that CSCL is effective. However, these syntheses found that different factors moderated the effectiveness of these approaches. Jeong et al. (2019) drew from a larger corpus of CSCL research that was coded for types of technologies, pedagogies, and collaboration modes (c.f.,McKeown, Hmelo-Silver, Jeong, Hartley, Faulkner, & Emmanuel, 2017). They found that there was not just one CSCL but rather four unique clusters of CSCL designs:

- **Online Generative Inquiry**— asynchronous or face-to-face collaboration, inquiry and exploration or teacher-structured pedagogies, and sharing and co-construction technology.
- **Asynchronous Teacher-Structured Discussion**— asynchronous collaboration, discussion or teacher-structured pedagogies, and asynchronous communication technologies.
- **Synchronous Collaboration**—synchronous collaboration and communication technologies.

Here we focus on the first two inquiry-oriented clusters to show how CSCL has been used in different learning designs. This focus was selected because these were among the most commonly identified clusters and they provide a useful design contrast in considering how inquiry-oriented pedagogies are used with different technologies.

Learning Check

According to Jeong et al. (2019), what are two examples of how the effectiveness of teaching tools and pedagogies differ from face-to-face synchronous to asynchronous settings? (select all that apply)

- [ ] Representational tools and inquiry learning are more effective in face-to-face settings
- [ ] Scripts and discussion boards are more effective in asynchronous settings
- [ ] Representational tools and inquiry learning are more effective in asynchronous settings
- [ ] Scripts and discussion boards are more effective in face-to-face settings

Which of the four clusters of CSCL designs are discussed in this chapter? (select all that apply)

- [ ] Asynchronous teacher-structured discussion
- [ ] Online generative inquiry (OGI)
- [ ] Problem-based learning (PBL)
- [ ] Face-to-face collaborative inquiry with dynamic feedback (F2FCI)

Face-to-Face Collaborative Inquiry with Dynamic Feedback (F2FCI)

This cluster emphasizes face-to-face collaboration with inquiry and exploration pedagogies using dynamic technological tools such as simulations, games, and immersive technology. These provide feedback based on learner actions as well as rich contexts. In addition, a substantial number of the papers in this cluster also used sharing and co-construction tools. Within the cluster, the majority of papers were in K-12.

Learning under this type of CSCL led to significant learning gains, promoted student engagement, and supported positive process outcomes such as critical thinking and reasoning skills. These outcomes cut across quantitative and qualitative studies, disciplinary content, and education levels. K-12 math students improved their problem-solving skills (e.g., Roschelle, Rafanan, Estrella, Nussbaum, & Claro, 2010; Sao Pedro, Baker, & Rodrigo, 2014), conceptual understanding (Lai & White, 2012; Turcotte, 2012), and group collaboration (Chen et al., 2012). In physics, positive effects on learning gains were found in primary and secondary education (Turcotte, 2012; Echeverría et al., 2012, respectively). Primary students experienced positive learning gains and improved critical thinking skills from designing digital science games (Yang & Chang, 2013). Primary students who were guided either with awareness tools or scripts learned more about photosynthesis through a drawing task than students in a **control condition** (Gijlers et al., 2013).

F2FCI research also highlighted positive effects on student engagement and affective measures at multiple education levels. Primary students using handheld devices in an authentic outdoor learning task were enthusiastic and developed great interest in the assignment (Avraamidou, 2013). Secondary biology students who participated in a CSCL review game were more engaged than students in the control group who participated in traditional paper and pencil review sessions with CSCL support (Annetta, Minogue, Holmes & Cheng, 2009). Additionally, computer science secondary and tertiary students felt empowered in their own learning (Tsai, Tsai, & Hwang, 2012).

Furthermore, lessons using dynamic technologies with inquiry and exploration pedagogies promoted meaningful interactions between elementary students, which in turn led to greater learning outcomes (Lai & White, 2012). For example, students engaged in high quality interaction patterns which entailed discussing the problem, task delegation, and helping each other in turn complete more assignments correctly than students with poor communication and collaboration (Chen, Looi, Lin, Shao, & Chan, 2012).

Factors That Support Effectiveness

Overarching themes that emerged from this cluster are that both (a) pedagogies that support collaborative inquiry and (b) rich problem contexts that establish a joint task are needed to promote positive outcomes (e.g., Chiang, Yang, & Hwang, 2014; Kong, Yeung, & Wu, 2009; Lai & White, 2012). **Authentic problem contexts** can be set in games and simulations (e.g., Nelson & Ketelhut, 2008; Sinha et al., 2015). One way facilitators provided guided instruction was by giving assistance and feedback throughout collaborative inquiry, and by providing authentic problems for problem-based learning (e.g., Avraamidou, 2013).

Instructors provided guided instruction ranging from very open-ended to more highly-structured. For example, undergraduate and graduate students were given very open-ended guidelines as they engaged in mobile learning outside of the classroom (Tsai et al., 2012), whereas secondary-level students were provided more facilitation in a student-driven augmented reality game to help them learn electrostatics (Echeverría et al., 2012). Even greater structure was provided for primary students who were given systematic processes to follow as they engaged with inquiry learning to help them with knowledge sharing (Chiang et al., 2014). In a grade 5/6 study of Knowledge Forum, teacher and researcher questions were helpful in advancing student thinking (Turcotte, 2012).

Closely tied to the theme of guided inquiry is feedback (Hmelo-Silver et al., 2007). In studies with F2FCI with dynamic feedback, participants at a variety of educational levels received immediate feedback on a task or problem from facilitators (e.g., Kong et al., 2009;), peers (e.g., Lai & White, 2012), and/or software (e.g., Chen et al., 2012; Holmes, 2007; Roschelle et al., 2010). Software feedback could include direct hints or prompts or be more indirect in providing changes in the state of a simulation or game in response to learner actions (e.g., Eberbach & Hmelo-Silver, 2010). Teachers noted elementary student success with technology required active teacher feedback (Chiang et al., 2014; Kong et al, 2009).

Factors That Inhibit Effectiveness

Factors that may inhibit student learning and engagement are related to feedback. An example of the importance of informative feedback emerged from two studies with primary students and teachers. When teachers lack content provide consistent active feedback for each group (Chiang et al., 2014; Kong et al., 2009).

The lack of consistent, active feedback are pedagogical and technological concerns applicable at all educational levels. Technologies can be used to provide content feedback in such situations, but as Turcotte (2012) noted, just because technology provides affordances for particular kinds of activity such as elaborated explanations, learners do not always take advantage of those affordances.

Summary and Implications

In this cluster, there was a trend for students to be collaboratively engaged with authentic problems and their learning nurtured by guided instruction, feedback, and discussion. Together, these combinations were associated with significant learning gains, positive student engagement, meaningful interactions between students, and improved group collaboration and communication skills.

Simulation tools and augmented reality games allow students opportunities for practice, feedback, and revision as they collaboratively engage with disciplinary content and practices without the time or expense of physical tools. In this cluster, learning with authentic problems was supported by opportunities for guided inquiry and immediate feedback from the tools and discussion. Technology played a role in helping students to work in settings that are more authentic and have opportunities to directly test their ideas and solutions, with the tools providing dynamic feedback.The main difference between the higher education and K-12 school environments was the control retained by the instructor. When this design was used in higher education, students had greater autonomy than primary and secondary education students. Questions remain about how much information needs to be embedded in the technology and how to help teachers support their students.

Learning Check

What are the overarching themes present in the F2FCI cluster? (select all that apply)

- [ ] Pedagogies that support collaborative inquiry
- [ ] Use of open educational resources
- [ ] Amount of time spent engaging in informational gathering activities
- [ ] Rich problem contexts that establish a joint task are needed to promote positive outcomes

Why is feedback an important factor in F2FCI?

- [ ] Feedback will provide more opportunities for the students to solve problems independently
- [ ] An absence of feedback will leave students' questions unanswered
- [ ] An absence of feedback is proven to cause all students to experience detrimental levels of stress

What type of collaboration does F2FCI emphasize and what tools does it use?

What is an example of how a need for structure may vary from one group of learners to another in an F2FCI environment?

Online Generative Inquiry (OGI)

This cluster was primarily concerned with **integrated learning environments** (e.g., learning management systems) or online sharing and co-construction technologies (e.g., wikis). Asynchronous collaboration with inquiry and exploration pedagogies was a main focus, but collaboration and pedagogy were more varied than in some of the other clusters. By nature, integrated environments offered a variety of tools that could be used to collaborate asynchronously or in face-to-face environments. Most OGI research focused on higher education, suggesting connections between learner education level and collaboration types. Communication and discussion occurred through sharing/co-construction tools and integrated environments that allowed direct communication through built-in chat tools or discussion forums.

Outcomes

Research in this cluster primarily reported process gains as well as some learning gains. The positive process gains included metacognitive skills supported by a knowledge-building environment (Pifarre & Cobos, 2010) and improved reasoning and collaboration via e-learning environments or wikis (Huang, & Nakazawa, 2010). In an undergraduate statistics course, student report writing was completed individually or collectively via a wiki (Neumann & Hood, 2009). There were no differences in terms of final report quality, but students who collaborated within wikis were more engaged and had higher attendance than those who worked alone.

Learning gains in this cluster were not uniform. On one hand, collaborative use of a multimedia-enriched **concept map** produced greater short-and long-term retention scores than a control group that received regular instruction and worked on assignments individually (Marée et al., 2013). However, another study found no differences between the final grades of a group that collaborated through wikis and a group that worked independently with a word processor, despite positive engagement (Neumann & Hood, 2009). Here, some students reported dissatisfaction with using the technology, and task completion could be negatively affected by low group member participation. Mixed learning gains were reported in Krause, Stark, and Mandl (2009) in examining the role of adaptive feedback in an asynchronous statistics class. They found that feedback was beneficial for students with low prior knowledge but had no effect on students with high prior knowledge.

Factors That Support Effectiveness

In a wiki co-construction environment, students reported more interaction with peers than with their instructor, and that the instructor moved to more of a moderator role, allowing students to initiate interactions (Huang & Nakazawa, 2010). Students also noted the importance of receiving public feedback about revisions within the wiki where these could be discussed by group members. This feedback functioned as collaborative scaffolding and an anchor for their discussions. In using representational tools, Marée, van Bruggen and Jochems (2013 when there was less teacher guidance.

This OGI research also offered some promising implications about specific technologies and pedagogical practices. For example, in asynchronous discussion threads (i.e., a technology), particularly when students act as facilitators (i.e., a pedagogical practice), they need to understand different types of thread patterns and how questioning, summarizing, pointing, and resolving may affect discussion thread development and closure (Chan, Hew, & Cheung, 2009). Feedback, whether from instructors or peers, may promote more reflection--especially when it offers explanations (Krause et al., questioning and co-regulation.

Much of this research investigated how students used and perceived specific technology. These suggest that the use of collaborative group activities, instructors' timely feedback, and support materials embedded within an integrated system all related to student satisfaction with a variety of STEM related vocational e-learning courses (Inayat, ul Amin, Inayat, & Salim, 2013). When guided instruction and immediate feedback are integrated within these pedagogies and technologies, it can lead to improved student learning (Krause et al., 2009; Marée et al., 2013) and task completion (Hämäläinen, & Arvaja, 2009).

Although scripts might be effective for task completion, they do not necessarily avoid variability in collaboration processes among groups. In a study of university students engaging in **case-based learning**, Hämäläinen and Arvaja (2009) still found differences in collaborative activity with unequal participation or a dominant group member. This suggests that the structure from script may not be sufficient to promote uniformly productive collaboration.

Factors That Inhibit Effectiveness

Again, feedback was mentioned in relation to factors that inhibit effectiveness. Consistent with findings in other clusters, a lack of feedback can negatively affect students' learning outcomes (Krause et al., 2009). Meanwhile, too much feedback, or using facilitation techniques that resolve conflicts or summarize key points can lead to discussions closing prematurely (Chan et al., 2009). Without enough guidance regarding the importance of positive collaboration, students may have high task activity but not necessarily high-quality collaboration (Hämäläinen, & Arvaja, 2009).

Summary and Implications

Timely guidance from teachers and peers plays an important role in increasing student outcomes as well as favorable perceptions of the environment. The results for this cluster also highlighted the importance of keeping the guidance at an optimal level.

In contrast to F2FCI, communication was heavily mediated in this cluster. It made students' thinking visible in ways that a face-to-face classroom may not allow. Teachers can thus follow persistent threads of discussion along with the artifacts being created. This gives teachers opportunities for ongoing **formative assessment** and may also provide grist for student reflection on these ongoing interactions in ways that face-to-face discussions may not. This may be particularly important in higher education contexts with their larger class sizes that might otherwise offer few opportunities for discussion and feedback.

What is OGI primarily concerned with?

- [ ] Providing learning tools to groups of learners
- [ ] Promoting the adoption of cognitivist learning theories in teaching practices
- [ ] Integrated learning environments or online sharing in co-construction technologies
- [ ] Adoption of practices that integrate in-person context-based learning activities

What are the two primarily reported gains in OGI? (select all that apply)

- [ ] Systematic gains
- [ ] Proscriptive gains
- [ ] Process gains
- [ ] Learning gains

What did the study conducted by Hämäläinen and Arvaja (2009) suggest regarding scripting?

- [ ] Scripts may not be enough to promote uniformly productive collaboration
- [ ] A script reader's comprehension is essential to the improvement of learning gains
- [ ] Scripts are lesson guidelines that allow for flexibility in teaching
- [ ] Scripts are only recommended for teachers who feel comfortable with the material they are covering

Think About It!

How did OGI learning gains vary across different studies?

It is clear that the three pillars of CSCL—collaboration, technology, and pedagogy—are used in different combinations to design effective learning environments. However, we need to better understand how to design for the balance between developing appropriate structures and supporting student agency in ambitious learning practices promoted by CSCL (Glazewski & Hmelo-Silver, 2019). This is particularly important in being able to support diverse learners (Uttamchandani et al., 2020). We review this in the context of the major issues this chapter has identified.

First, feedback and support are themes that run through all the clusters, whether the feedback comes from the teacher, peers, or tools. Questions about feedback consider both timing and quality. Poorly timed feedback that does not address appropriate content, skills, or practices may impede learning. In designing effective CSCL, it is important to think about feedback and support as part of the CSCL system of technologies, pedagogies, and collaboration modes. It is important to consider which aspects of feedback and support should be fixed and part of the environment and which should be adaptive to the needs of the situation. Much dynamic feedback needs to come from teachers and peers. Not enough research has addressed ways to support high quality peer feedback (De Wever, Van Keer, Schellens, & Valcke, 2010). Research on scripts and roles may be one way to scaffold students to provide good quality feedback to their peers. To support teacher feedback, CSCL environments should provide mechanisms for teachers to monitor multiple groups, identify challenges that groups might face, and provide appropriate feedback and resources.

Second, certain technologies lend themselves better to particular **communication channels** and/or pedagogical goals. Dynamic representational tools are generally used in face-to-face environments as the F2FCI Cluster demonstrates. Rapid cycles of activity and engagement with such tools lend themselves to the immediacy of being in the same place at the same time. Additionally, the tools allow for **deictic referencing** as learners can easily point to phenomena on-screen and observe the gestures of others. Effect sizes were larger when dynamic representational tools were used in face-to-face settings (Jeong et al., 2019). Similarly, the use of sharing and co-construction tools dominated the OGI cluster. These tools may be more critical for online environments because learners' interaction channels are limited and thus need to be mediated by communication tools. When communicating and collaborating with these tools, learners need to be more explicit about their actions and contributions, which can provide opportunities for reflection, thus fostering knowledge co-construction .

Third, different learning environments are used for different learners**.** CSCL involving younger learners tends to involve face-to-face collaboration rather than online collaborations. Online collaboration requires dealing with a broader range of communication modalities and as such may be used for more mature learners. The trend seems to be for more structure and face-to-face collaboration for younger learners, perhaps due to the need for social presence in this population as they tend to be in the same physical space. In addition, technology tools can add to cognitive demands and pose increasing challenges for regulation that may be difficult for younger learners. However, these challenges are not unique to younger learners. Creating social presence and supporting self-regulated learning is challenging even for more mature learners in online environments.

What are the three major issues identified within this chapter? (select all that apply)

- Feedback
- Retention
- Assignment of technologies to different environments and pedagogies
- Learner and learning environment compatibility
- Language

True/False: CSCL provides a one-size-fits-all solution to collaborative learning.

- True
- False

Implications for LIDT

Considerations for Practice

Helping **stakeholders** become aware of the usefulness of CSCL is a first step in implementing **evidence-based practices**. This includes reporting on CSCL in practitioner venues publications. In addition, professional development training is important for instructors in order to effectively implement CSCL. Facilitating CSCL requires mastering the technology, tailoring it to tasks, and providing adequate scaffolds that can be differentiated for student skills and prior knowledge.

CSCL as a Complex System

It is critical to consider CSCL as a system of compound resources (Roschelle et al., 2011). There is no one-size-fits-all solution; how CSCL is used in different learning environments needs to be tailored to the particular level of the learners and the learning goals. Designers and teachers will need to consider how the collaboration modes, technology, and pedagogical choices fit together in ways that are more than the sum of their parts. A consideration of the seven CSCL affordances can help them to directly design efforts along with considering the learning contexts and educational goals.

While you watch this video, pay attention to how the technology is being used to facilitate collaboration:

[Watch on YouTube]

Write a paragraph or two reflecting on how the technology in this video reflects what you read in this chapter. Here are some questions you may want to think about:

- What are the benefits or drawbacks to implementing technology like this in the classroom?
- Is it sustainable? Why or why not?
- Do you think this technology would be received as well in classrooms with older learners?
- Can the assignment of this technology be flexible enough to fit in different pedagogies?
- Is the use of this technology compatible to a variety of learning environments?

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The Future of the Field is Not Design

Jason K. McDonald

The field of learning and instructional design and technology (LIDT) has an important contribution to offer towards what Beckwith (1988) called "the transformation of learners and . . . learning" (p. 18). However, in pursuit of this mission, we have become too fixated on being designers and applying the methods of design thinking. As valuable as design is, it's ultimately too narrow an approach to help us have the impact we desire because it overemphasizes the importance of the products and services we create. To be more influential, we need other approaches that focus our efforts on nurturing people's "intrinsic talents and capacities" that are ultimately outside of our ability to manage and control (Thomson, 2005, p. 158; see also Biesta, 2013). In this chapter I first describe how design's focus on creating and making misleads our understanding and application of important dimensions of our field. I then describe how we can cultivate an LIDT identity that is better suited for the aims we are pursuing. An LIDT-specific identity may include some methods from design thinking, but it will also encompass additional ways of improving the human condition. I end by calling on readers to consider what this important evolution for our field means for their personal practice.

We currently face a problem in the field of learning and instructional design and technology (LIDT). We have an important contribution to offer towards what Beckwith (1988) called "the transformation of learners and . . . learning" (p. 18). However, in pursuit of this mission, we have become too fixated on being designers and applying the methods of design thinking. As valuable as design has been for our field, it's ultimately too narrow an approach to help us have the impact we desire because it overemphasizes the importance of the products and services we create. To be more influential, we need approaches that focus our efforts on nurturing people's "intrinsic talents and capacities" that are ultimately outside of our ability to manage and control (Thomson, 2005, p. 158; see also Biesta, 2013). Tying ourselves to design will not accomplish this, so we need to cultivate an identity of our own—an identity centered on what Dunne (1997) called the character and dispositions of "practical judgment" (p. 160).

In this chapter I hope to make these issues clear. I start by describing how design's focus on creating and making misleads our understanding and application of important dimensions of our field, and so limits our impact. I then describe how we can cultivate an LIDT identity that is better suited for the aims we are pursuing. An LIDT-specific identity may include some methods from design thinking, but it will also encompass additional ways of improving the human condition, all centered in the character of practical judgment. I end by calling on readers to consider what this important evolution for our field means for their personal practice.

What is Misunderstood When LIDT is Defined as Design

The field of LIDT was drawn towards design thinking because it promised to help us create better learning products, strategies, services, and environments. Historically, the field relied on detailed processes for creating instruction that provided predictable, dependable results (e.g, Merrill et al., 1996). However, towards the close of the 20th century, it became clear that these processes were too rigid to be useful in many real-world settings (Rowland, 1992; Wedman & Tessmer, 1993). There were also questions about whether traditional instructional design processes, like Instructional design fields like architecture or industrial design (e.g., Boling & Gray, 2014; Hokanson & Gibbons, 2014; Lachheb & Abramenka-Lachheb, 2022; McDonald, 2011; Tracey, 2016). The claim was that embracing the way designers worked would "produce improvements in learning and performance far beyond those we are able to achieve today" (Boling & Smith, 2012, p. 363).

Design thinking did provide LIDT more flexibility, along with associated benefits such as a renewed emphasis on addressing the complexities found in every learning environment (Becker, 2007). But what did not change was the field's near-complete focus on creating learning products or services. This was because design is fundamentally about creating and making. Indeed, Nelson and Stolterman (2012) defined design as "the ability to imagine that-which-does-not-yet-exist [and] to make it appear in concrete form as a new, purposeful addition to the real world" (p. 12). And Archer et al. defined it as, "the conception and realization of new things . . . [through] planning, inventing, making, and doing" (as quoted in Cross, 2007, p. 16). This is the case even if LIDT professionals claim they have "moved beyond making artifacts," such as designing learning strategies, cultures, or relationships (cf. Lee, 2021, p. 497). To do this, they still tend to create some kind of object or operation (product or process) that is meant to have a discernible, concrete effect on the people using them (McDonald, 2021).

Design's emphasis on creation, however, threatens to distort our view of LIDT and its potential impact. To illustrate, consider what the effects have been of defining the field of teaching as also being a type of design (Henriksen & Richardson, 2017; Norton & Hathaway, 2015; Paniagua & Istance, 2018). Henriksen (2020) went so far as to claim that "teaching is *always* an act of design towards a learning purpose," because teachers create "engaging learning activities, effective assessment practices, and students' experience" (p. 294; emphasis added). On the surface, this seems to make sense. Teaching undeniably includes the activities Henriksen identified. And design methods often can help teachers do this kind of work well. However, as Biesta (2013, 2021) persuasively argued, there are many other dimensions of teaching that go beyond what teachers create. Teachers are role models. They manage the everyday, spontaneous events that just happen in a classroom. They counsel both students and parents. And they "call" students to live up to their full potential—not just through what they do but also through their relationships with those students (Biesta, 2021, p. 47).

These non-design dimensions of teaching are at least as definitive of teaching as creating materials or setting up conditions for students to learn. But they are not really *made* in the same way an object is made. Consider the important role teachers play in helping students believe in their own potential, especially when facing moments of self-doubt. Countless students have experienced the motivational effects of such encouragement. And it can sometimes be even more powerful than how caregivers (like parents) show confidence—given the unique fusing of care, expertise, and authority inherent in good teaching relationships. This is real teaching, as much as designing a lesson plan, and it can be life changing (Noddings, 2012). But it seems manipulative for a teacher to design situations where students experience doubt just so the teacher can show how much they care. Both common sense and research show that such Machiavellian tactics are damaging (Krause, 2012).

Biesta (2017, 2021) further argued that if teaching is primarily defined in terms of what teachers make, we can easily lose sight of its other dimensions. Thus, reducing teaching to design, because teachers sometimes make things, can ignore or dismiss as inconsequential other important teaching practices. At the extreme, this has led to both historical and contemporary attempts to replace teachers with designed learning products (Casas, 1997; Ovetz, 2021). Why hire a teacher who is likely a second-rate designer, when you can hire a trained learning designer instead? Or why not buy a curriculum that just "works" without a teacher at all? (cf. Heinich, 1995) Even without going to those lengths, when teaching is defined as something that can be made, there is a tendency to only recognize, evaluate, and reward what teachers make. And ultimately, this limits the scope of what is considered legitimate for teachers to do (Biesta, 2010). If the scholars cited earlier were asked, surely they would agree that the other dimensions of teaching identified above are important. But when they claim that teaching is defined by its activities of planning, making, and designing, the ultimate end is to eventually erase the possibility of doing anything other than plan, make, and design (Dreyfus, 2002; Thomson, 2005; Wrathall, 2019).

rather, that design is only one part of what it takes to accomplish our purpose of transforming learners and learning. They are an important part, to be sure. But, also like teaching, if what we design is viewed as our sole contribution, there will be dimensions of the field that we misunderstand. As one example, when LIDT is considered to be only a type of design, there is a tendency to consider learning to be the product we create, and students as the output of our design efforts (Gur & Wiley, 2007; Lee, 2021; McDonald, 2021). This, however, is an overly simplistic view of learning (Yanchar & Francis, 2022). Additionally, there are important dimensions of learning that are distorted if we attempt to design them, as much as if a teacher designs situations to manipulate how students feel about them. If we consider LIDT's purpose to be the design of learning, our tendency will be to "view learners in a similar manner as other makers view the material with which they work. Learners become matter to be mastered and shaped, and instructional strategies and techniques are the tools designers have to produce . . . learning" (McDonald, 2021, p. 47).

Further, just like important teaching practices are ignored when we overemphasize the materials or activities that teachers create, the scope and types of educational help LIDT can offer is limited when we define the field as a type of design. But given our historical emphasis on creation and design, we have spent very little effort considering what other contributions we could make. To understand the possibilities, we need to broaden our views of LIDT to encompass more than the creation of products and services.

LIDT's Future: Moving Beyond Design

What alternatives are available to us beyond creating, making, and designing? Designers suggest that whenever people seek to improve the human condition, by definition, they are designing (Nelson & Stolterman, 2012; Simon, 1996). However, a little reflection shows that this is not true. For example, doctors and nurses do not design a patient's health. They support the body as its own natural functions return itself to health. Similarly, a host of practices exist to improve ourselves and our world apart from design, including policy making, therapy, law, and—as discussed earlier—teaching. Proponents for design argue that, at least at times, such professionals are really designers even if they do not know it (Aakhus et al., 2018; Henriksen et al., 2020; Lachheb & Abramenka-Lachheb, 2022). But, as already discussed, when designers do this, it is an indication that they do not understand, or are simply dismissing, dimensions of these professions that do not involve making and creating. Of course, doctors, lawyers, and teachers sometimes make things. But what they make does not define them. They do many other things as well—things at least as definitive of their professions, if not more, than what they create. If we pay attention to those dimensions, we might learn new approaches for how LIDT can offer more, and better, contributions towards the transformation of learners and learning (see Beckwith, 1988).

In particular, we can pay attention to how these fields cultivate improvements to the human condition without managing, controlling, creating, or making. For instance, as discussed above, doctors and nurses do not actually make or create health. Instead, theirs is a *caring* profession. They rely on other forms of influence than designers rely upon with their making-oriented aims (Dunne, 1997). Sometimes this is no more than explaining the consequences of someone's current lifestyle to persuade him to live more healthily. Or, like teachers, sometimes it is by simply offering "a thoughtful glance, a soothing word, and other manifestations of caring and concern" (Arndt, 1992, p. 291). Since helping people learn also includes these kind of persuasive and caring dimensions, it seems that fields like medicine and nursing could provide insights for LIDT practice that design cannot. What might LIDT look like if we emphasized its caring dimensions as much as did doctors and nurses?

But simply importing practices from other fields (like nursing) is not enough (McDonald & Yanchar, 2020). There is something more fundamental that all these fields—including design—share that is important to help LIDT accomplish its purpose. At their core, all these fields share an assumption that instead of relying on methods and processes that attempt to define their response to every situation, the proper way to engage with the world's unpredictable and ever-changing circumstances are what Dunne (1997) called the dispositions of "practical judgment" (p. 160). Although practical judgment is difficult to define, Dunne summarized it as being when people are perceptive enough to recognize is doing the right thing “to the right person, to the right extent, at the right time, with the right aim, and in the right way” (p. 368). Since one of the original reasons for importing design thinking into LIDT was to correct our overemphasis on following rigid processes, it seems that we can better accomplish this goal by focusing on practical judgment directly, instead of tying ourselves to one field, design thinking, that attempts to create methods for enacting it.

In fact, as Dunne (1997) further emphasized, practical judgment is not merely an alternative, more flexible kind of process at all. Instead, it is a kind of character that people develop as they learn to respond to certain types of issues to which they were previously insensitive. Thus, it is the character of LIDT professionals that should enable them to respond to opportunities they discern for transforming learners and learning. No set of methods or processes themselves can accomplish this on their own. What a teacher does to show students they care is less important than that their actions arise out of their authentically caring disposition. This is not to argue that practices do not matter; certainly, students will view some actions as more caring than others. But practices must be situated in their proper place, as an outgrowth of a person’s existing, or at least developing, dispositions and character.

Expanding our view of LIDT should therefore begin by considering what dispositions and character are associated with practical judgment in the specific context of transforming learners and learning. Issues like this have received little attention in our field’s literature, although we can find a few examples (Belland, 1991; Parrish, 2012). As one example, if it is true that practical judgment “is mediated through feelings” (Dunne, 1997, p. 358), what emotional sensitivities are important for LIDT professionals to cultivate? One emotional sensitivity is certainly empathy (Matthews et al., 2017)—a disposition shared, of course, with other fields; this includes design. But how would our empathy change if we understood it in the same way the caring professions did—as the foundation of real relationships—instead of as a technique for making better products, as sometimes seems to be the case in design fields (Heylighen & Dong, 2019)?

Beyond this, are there other emotional dimensions of practical judgment, especially ones more distinct to the transformation of learners and learning? And how do we help LIDT professionals cultivate them? As we come to answer questions such as these, we can use what we learn as the basis for remixing useful practices into forms that reflect what we are trying to accomplish, while jettisoning those that are found to be counterproductive. Some of those practices could be derived from design. But others might also originate in science, nursing, teaching, law, or any other field where we find people exhibiting practical judgment in attempts to improve the human condition.

If this vision of LIDT's future appeals to you, the most important thing you can do is become the kind of professional that embodies the character and dispositions of practical judgment. We need a groundswell of professionals who are not satisfied to only create products, processes, or other services, but are also willing to explore other ways of transforming learners and learning. We also need people who are explorers—who are curious about what other forms of practice are missing from our repertoire that will help us pursue our mission. What else should be part of an LIDT identity that we haven't yet imagined? What do those dimensions contribute towards the transformation of learners and learning? And how can you become the kind of person who exemplifies these attributes?

Reflect upon these questions. Consider formalizing your reflection in a journal entry or personal statement of values:

- Based on *your* own background, talents, beliefs, and values, what do you find missing in our field's approach to learners and learning?
- Based either on precedent (examples you learn from elsewhere), or brainstorming (your own creativity), what new ideas could we incorporate into LIDT that address your concerns?
- What kind of character (practical judgment) could you exemplify to become the type of person who authentically pursues the transformation of learners and learning?
- How can you begin to develop your practical judgment through your education or practical experiences?

Conclusion

In this chapter, I have argued that design is not the pinnacle of LIDT as a field of practice. This does not mean that LIDT professionals should never design. Rather, it means that design alone is too narrow to help us accomplish our mission of transforming learners and learning. Instead, we should be a field organized around the dispositions and character associated with practical judgment. It is understandable why LIDT professionals would want to define themselves as designers. Design is fashionable. It provides the esteem that our field so often seems to desire. But the label *design* does not need to be attached to every method of attempting to improve the human condition. Design is also not the only way to enact the dispositions and character of practical judgment, which is the real core on which our field should focus. We should be in conversation with every field that exhibits such virtues, and not only design. It is true that an expanded vision for LIDT's purpose and practice will include some design activities. But if we only design, we will be limited in the types of influence we have. So, our practices should also include influences from other fields as well, remixed into a unique identity that reflects our primary focus on practical judgment and in service of our distinctive purpose. Thus, in conclusion, instead of asking how we design the future of LIDT, we should be asking instead: what future is possible for us that design does not provide?

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