Transcend
BUILDING BEYOND THE LIMITS OF SCHOOL DESIGN

Designing for Learning

A Primer on Key Insights from the Science of Learning and Development

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About Transcend

Transcend 🔗 is a national nonprofit that accelerates innovation in the core design of school. We do this by constantly developing and improving three core R&D assets: a rigorous knowledge base, a world-class talent force with deep expertise in and capacity for innovation, and a national network that stitches together all of the supports (funding, advocacy, talent, and more) innovation requires. We partner with school communities everywhere to build and spread learning environments that better enable ALL young people to thrive in—and transform—the 21st century. To learn more about working with Transcend, reach out to us at **explore@transcendeducation.org** 🔗.

Transcend taps into both academic research and our on-the-ground partnerships with dozens of P-12 learning communities to create a dynamic, practical knowledge base related to school design. We apply three lenses to our creation of knowledge products: Empirical Evidence, Equity, and Exception as the Norm.

Empirical Evidence - What insights do findings from scholarly research and on-the-ground practice provide?[1]

Equity - How can we ensure that our inquiry process includes all of the relevant voices, particularly voices often marginalized by traditional power structures? How can our process and products disrupt systems of oppression?

Exception as the Norm - How can our insights and inquiry process avoid designing for the monolithic "average" person and instead also consider every individual as unique and different?

You can find more of our knowledge products **here** 🔗.

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[1] At Transcend we are challenging the notion that scholarly academic research is the only valid source of empirical evidence. Instead we believe the day-to-day practices occurring in our schools can also add to our knowledge base. As a result, we work closely with our school partners to set up rigorous processes to test and learn from their own work.

Help Us Continue to Improve This Resource

One of our **core values** ∞ at Transcend is Perpetual Beta—we are always looking to learn, grow, and improve. As a result, this resource, like all of our knowledge products, will be updated regularly in response to feedback, lessons learned, and external research developments. If you have comments or suggestions for our next iteration, please contact **cynthia@transcendeducation.org** ∞ .

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Introduction

Purpose and Organization of This Primer

Two of the most important questions in designing, or redesigning, learning environments are: **How does learning happen?** and **How can we best create environments that support learning?** While empirical research has unearthed important insights and established agreed-upon models to help answer these questions, this research base is extensive, complex, and often not honored by the design of traditional schools. To that end, our *Designing for Learning Primer* aims to summarize the essence of what's known about how learning happens in a way that is digestible and actionable.

Factors
Key influencers in how learning happens including, cognition, motivation, identity, and individual differences.

Principles
Critical findings related to each factor regarding how people best learn.

Implications
Conditions learning environments should strive to create and design choices with the potential to support these conditions.

This primer is not meant to be a fully comprehensive review of the literature. Instead, it is an introduction to four key factors that impact learning—cognition, motivation, identity, and individual variability. We selected these areas because a wealth of research indicates that each plays a critical role in how learning happens. Then, using this research, we developed a set of core principles that help explain these roles. Finally, we identified various implications for learning environments based on these principles and related research. Within the discussion of these implications, we've also included examples of specific design decisions that could be made to honor each principle. These decisions relate to topics like curriculum, assessment, scheduling, adult roles, and more. However, we also recognize that the specific context within which a learning environment is situated will greatly influence these specific decisions. As a result, these examples are only meant to be illustrative.

How This Resource Complements Others

This is not the first attempt to pull together research on how learning happens. In fact, many rich, science-informed resources exist across the field. Below are just a few that significantly inform this primer; additional resources we reviewed are listed throughout the primer, as well as in the work cited list.

- ***Building Blocks for Learning*** 🔗 | Brooke Stafford-Brizard with Turnaround for Children
- ***Breakthrough Leadership in the Digital Age***: ***Using Learning Science to Reboot Schooling*** 🔗 | Frederick M. Hess and Bror V. H. Saxberg
- ***Drivers of Human Development: How Relationships and Context Shape Learning and Development*** 🔗 | David Osher, Pamela Cantor, Juliette Berg, Lily Steyer, and Todd Rose
- [***Foundations for Young Adult Success***](#) 🔗 | Jenny Nagaoka, Camille A. Farrington, Stacy B. Ehrlich, and Ryan D. Heath
- ***The Evidence Base for How We Learn*** 🔗 | Stephanie M. Jones and Jennifer Kahn with the Aspen Institute's National Commission on Social, Emotional, and Academic Learning
- ***Learn Better: Mastering the Skills for Success in Life, Business, and School, or, How to Become an Expert in Just About Anything*** 🔗 | Ulrich Boser
- ***Malleability, Plasticity, and Individuality: How Children Learn and Develop in Context*** 🔗 | Pamela Cantor, David Osher, Juliette Berg, Lily Steyer, and Todd Rose
- ***The Science of Learning*** 🔗 | Deans for Impact
- ***The Science of Summit*** 🔗 | Summit Public Schools

The goal of our resource is to complement this exciting and growing body of knowledge in a way that supports *whole-school design*. To that end, we've tried to bring together research on multiple factors that impact learning. In doing this, we look beyond the cognitive aspects of learning to consider motivation, the role of identity, and how individual variability comes into play. We've also tried to apply a school design lens that considers not just classroom-based instruction, but also other elements of a learning environment's design, such as the role of adults, schedules, partnerships with the community, and more.

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As mentioned above, we stop short of prescribing specific design choices (e.g., how to design schedules, curricula, technology platforms, etc.) since these are so context-specific and since the empirical evidence on the efficacy of specific design choices is thinner to date. In place of specific recommendations, we've developed a supplementary tool—our ***Designing for Learning Cards*** 🔗 . These cards and the activities that accompany them, are intended to help designers deepen their understanding of the ideas and make design choices that adhere to the research, but make sense for their context..

Overview of Our Framework for Learning

This primer focuses on four factors that impact learning—cognition, motivation, identity, and individual variability. The following paragraphs briefly describe each.

The set of processes by which individuals take in both new and familiar stimuli from the world around them, process these stimuli into memories, and retrieve these memories to inform their day-to-day decisions and actions.

How individuals make meaning of their unique combinations of personalities, physical characteristics, group memberships, values, beliefs, attitudes, and life experiences.

The willingness to start, put in mental effort, and persist even in the face of challenges.

The various cognitive, social, emotional, and physical ways by which individuals differ that affect-- and are affected by--the environments, experiences, and relationships they encounter throughout life.

Cognition

Cognition refers to the set of processes by which learners take in new stimuli, process these stimuli into memories, and retrieve these memories to deploy in future actions. These processes occur through a relationship between working memory (sometimes called short-term memory) and long-term memory. When learners become conscious of new sensory stimuli, their own passing thoughts, or even past memories, they are held in working memory where learners can grapple with them, connect them to what they already know, and apply them. In making meaning of them, learners encode new memories into long-term memory—where a virtually infinite amount of memories can be stored. These memories are the basis of learning. They can relate to knowledge (e.g., retrieving information about the Civil War or the Pythagorean Theorem), skills (e.g., writing a compelling essay or navigating conflict with peers), and even mindsets (e.g., thinking optimistically or holding a growth mindset). While this process may sound straightforward, it can break down if key principles of learning are not honored. For example, if working memory is trying to make sense of too much at once, it can become overloaded and ineffective.

We'll explore these concepts more in the Cognition section on pages 12-29. Specifically, we'll dive into the science behind the six principles listed below as well as into how we can honor these principles in our learning environments.

Principle 1: Focused Attention	People learn best when they direct their focus toward the content and experiences most relevant to learning.
Principle 2: Manageable Cognitive Load	People learn best when they are challenged but are processing a manageable amount in their working memory.
Principle 3: Meaningful Encoding	People learn best when new learning is experienced in memorable ways and is related to prior knowledge.
Principle 4: Effective Practice	People learn best when they practice challenging-but-doable skills at frequent, focused intervals and across diverse contexts.
Principle 5: High-Quality Feedback	People learn best when they receive timely and targeted feedback to guide their improvement.
Principle 6: Metacognitive Thinking	People learn best when they are able to plan, observe, evaluate, and adjust their own learning processes.

Motivation

While we believe that young people are naturally motivated to learn, it is still hard work. Just ask anyone who has practiced scales on a musical instrument for hours each day! Tasks like paying attention, engaging in focused practice, and taking in critical feedback require real effort. As a result, motivation—or the willingness to start, put in mental effort, and persist—is vital if learners are to engage in challenging cognitive tasks.

Research has found that various factors influence how motivated a learner is, and when present, can positively support learning and development. Here, we've highlighted four factors that influence motivation: (1) whether or not the learner finds value in the learning, relationships, or the process; (2) the extent to which the learner feels self-efficacy—or a belief in his or her ability to complete the learning tasks; (3) the learner's sense of control over the process and outcomes of learning; and (4) the extent to which the learner is in a constructive emotional state while learning. Of course, what learners value, their confidence in their own abilities, the barriers they perceive, and their emotional state are all deeply affected by their unique background, knowledge, identities, physical and cognitive differences, lived experiences, and more. As a result, motivation is deeply intertwined with cognition, identity, and individual variability.

We'll explore these concepts more in the Motivation section on pages 30-38, where we'll also dive into the science behind the four principles of motivation listed below and their general implications for the design of learning environments.

Principle 7: Value	People learn best when they find the content, outcomes, processes, and relationships associated with learning important and relevant.
Principle 8: Self-Efficacy	People learn best when they believe in their ability to grow and achieve mastery of what they are learning.
Principle 9: Sense of Control	People learn best when they perceive that they have meaningful and appropriate agency over their learning.
Principle 10: Constructive Emotions	People learn best when they are in constructive emotional states versus feeling excessive stress or anxiety.

Identity

Identity stems from how learners—and those around them—make meaning of their unique combinations of personality traits, physical characteristics, group memberships, values, beliefs, attitudes, and life experiences. An individual can simultaneously hold a racial identity, a cultural identity, a gender identity, a religious identity, and a family role identity, among others. Identity is also not static; it evolves over time. Learners' identities are one of the main determinants of what motivates them to engage in tough cognitive work. So developing self-understanding—including knowledge of one's personal history, strengths, areas for growth, and interests—helps learners understand what they value and what they need to feel motivated. Learners' identities can impact learning in ways other than their influence on motivation. For example, if an identity that a learner perceives as positive is triggered, that identity marker can make it easier to understand a concept and/or free up space in working memory to engage in a task. Conversely, if an identity that a learner perceives as negative is triggered, this may surface feelings of inadequacy and insecurity, dramatically hindering cognitive processes.

We'll explore these concepts more in the Identity section on pages 39-47. There, we'll dive into the science behind the three principles related to identity listed below.

Principle 11: Self-Understanding	People learn best when they have a deep understanding of who they are and can use this knowledge to maximize their learning.

Principle 12: Sense of Belonging	People learn best when they feel connected to, and accepted by, the people and environment around them.
Principle 13: Navigating Identity Threats	People learn best when negative beliefs associated with their identity are minimized or buffered against.

Individual Variability

As anyone who has ever worked with more than one young person knows, each is unique. They vary along many dimensions—including their physical attributes, prior knowledge, cognitive processing, affect, developmental state, exposure to adversity, and so many other factors. In fact, the science of individuality[2] suggests that there is no such thing as the "average" learner. Thus, the more learning environments can account for how young people vary, the more successful they will be in supporting their learning.

These differences are especially critical given how they intersect with identity, motivation, and cognition. For example, different experiences or capacities may influence how learners come to understand themselves in relation to the world around them, leading to a more positive or negative sense of identity. This identity subsequently influences one's levels of motivation. Some elements of individual variability require specific learning modes in order to optimize cognitive processes. For example, to support learners who are blind, Braille literacy instruction can be provided. Matching instructional modes to individuals' needs makes it much easier for them to effectively engage in cognitive processes.

We'll explore these concepts more in the Individual Variability section on pages 48-58. We'll also dive into the science behind the three principles listed below and what they mean for design.

Principle 14: Life Experiences	People learn best when their unique life advantages and adversities are understood and responded to.
Principle 15: Developmental State	People learn best when their experiences align with where they are developmentally.
Principle 16: Learning Differences	People learn best when their unique learning needs are identified and resources and supports are aligned with these needs.

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[2] Rose, 2016.

In the following sections we go into the principles related to each factor of learning in more detail. We briefly explain the role each principle plays in learning, followed by some implications for the design of learning environments. We organized this resource so that readers can break it apart and focus on specific factors, or even principles, in isolation. We did this to make the complex ideas within it more manageable and to allow readers to focus on specific principles of interest. However, it's absolutely critical to keep in mind that *all* the principles in this framework are important and that they *interact in complex ways* to support or hinder learning. As a result, focusing exclusively on one factor or principle in isolation from the others will result in an incomplete picture and will not enable you to fully optimize learning. Ultimately, you should develop an understanding of all the ideas in this primer and work to design learning environments that strike a balance between factors.

Common Themes Across the Framework

In reviewing research, talking with experts, and exploring other resources related to the science of learning and development, we identified a few common themes:

- **Learning is a deeply individual and variable process**. The principles explored in this primer apply to how everyone learns: young people and adults, typically and atypically developing learners. However, the specific ways these principles interact to influence learning vary for each individual learner. The Individual Variability section touches on this in the most detail; however, individual variability impacts nearly all of the other principles. Everything from whether one's working memory becomes overloaded in a specific context, to what one finds value in, to what might trigger an identity threat, will vary from learner to learner.
- **Emotions play an important role at many points of the learning process**. Emotions work hand in hand with cognition to enable or impede learning. Emotions can distract, motivate, and be powerful cues to help remember information later. As a result, you'll notice references to the influence of emotions on learning across many principles.
- **Social connections support deep learning in various ways.** As you'll see in the pages that follow, research suggests that secure relationships, a sense of community, and collaboration can all positively impact learning. How this occurs is complicated. For example, sometimes relationships provide a buffer against traumatic life experiences, identity threats, or low self-efficacy. Other times they provide a greater sense of value and motivation. Similarly, working collaboratively might lead to constructive emotions for learners but can also support meaningful encoding and lasting learning.

As you read, you'll notice these themes are woven into the explanations of many of the principles of learning and the implications for learning environments. However, given their cross-cutting importance, we felt it was also important to highlight them here.

Overview

Learning is hard work. It requires that individuals actively notice, grapple with, remember, apply and expand on new content and experiences. This involves complex cognitive processes like attention, encoding, and retrieval that occur through a relationship between working memory and long-term memory.
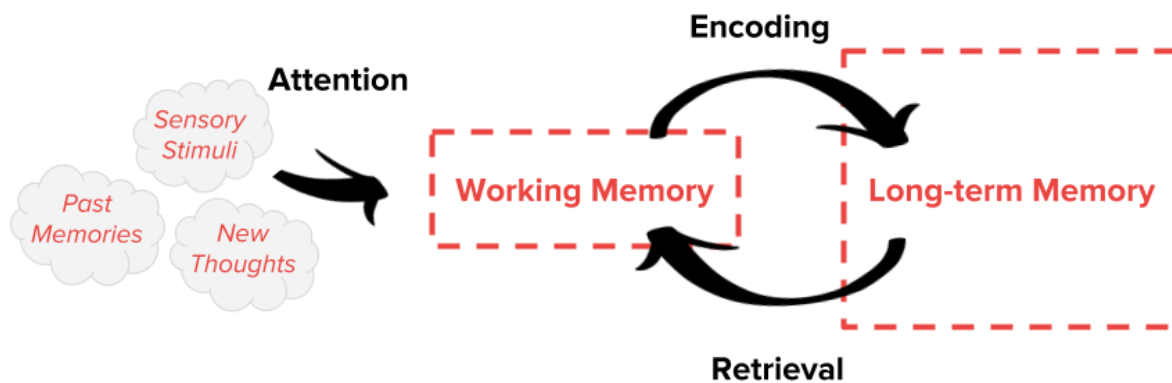
As the visual above shows, when learners consciously attend to something—whether it's new sensory stimuli, passing thoughts, or past memories—it is held in working memory. This is where learners grapple with ideas, make connections, generate understanding, and solve problems. These processes help learners encode information into long-term memory in ways that are meaningful and memorable. Then, by regularly engaging in practice, receiving high-quality feedback, and thinking about their own thinking, learning becomes even deeper and longer-lasting.

As designers, we can support this process by creating environments that honor the principles listed below.

Principle 1: Focused Attention	People learn best when they direct their focus toward the content and experiences most relevant to learning.

Principle 2: Manageable Cognitive Load	People learn best when they are challenged but are processing a manageable amount in their working memory.
Principle 3: Meaningful Encoding	People learn best when new learning is experienced in memorable ways and is related to prior knowledge.
Principle 4: Effective Practice	People learn best when they practice challenging-but-doable skills at frequent, focused intervals and across diverse contexts.
Principle 5: High-Quality Feedback	People learn best when they receive timely and targeted feedback to guide their improvement.
Principle 6: Metacognitive Thinking	People learn best when they are able to plan, observe, evaluate, and adjust their own learning processes.

Focused Attention
People learn best when they direct their focus toward the content and experiences most relevant to learning.

How It Works

Individuals are *always* learning. This may seem surprising at first, but it makes sense when we consider that the mind continually confronts **stimuli** from all kinds of different sources. These stimuli include sights, sounds, smells, tastes, or feelings stemming from new experiences. They also include spontaneous thoughts that are remembered ("Shoot, I needed to bring money for lunch today!") or that develop in the moment ("I think she's talking about me behind my back"). What learners attend to—or direct their focused **attention** toward—is held within **working memory** where it can be grappled with, made meaning of, or applied to accomplish a goal,[3] whereas *most* of what learners do not pay attention to is simply forgotten.[4]

Ideally, learners would attend to the stimuli most critical to learning. However, they may also attend to stimuli that are counterproductive to, or distract from learning. What learners attend to depends on many factors, including how salient information is to their goals and interests as well as to their physical and emotional needs.[5] [6] In addition, research suggests there is a hierarchy when it comes to how individuals process stimuli. Higher priority stimuli override lower priority stimuli.[7] This research indicates that the brain processes stimuli that pose a threat first ("I hear a siren getting closer"), followed by stimuli that generate strong emotions ("The character in this book reminds me of a terrible argument I had with my sister"), followed by goal-related stimuli ("I need to understand this concept to create a great experiment"). [8]

Implications for Learning Environments

We can't force learners to focus. However, we can remove or minimize distractions caused by physical or psychological threats, confusion, and competing sensory stimuli.

Learning environments should be designed to tend to any feelings of physical or psychological threat, inside or outside of school, because *a*

To support <u>Focused Attention,</u> learning environments should:

❏ Help learners feel physically and psychologically safe and healthy

❏ Ensure learning objectives and activities are clear

❏ Minimize sensory distractions

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[3] Sousa, 2016
[4] Ibid.
[5] Ibid.
[6] Katsuki & Constantindis, 2013
[7] Sousa, 2016
[8] Ibid.

learner's cognition will attend to these first. These threats produce negative emotions that hijack a learner's attention. However, emotional distractors are sometimes given less priority within learning environments than distractors like noise. This should not be the case. We can intentionally design against emotional distractors by developing policies and routines that ensure our facilities are warm and secure. Example routines could include having adults check for a learner's emotional state at the door each morning or having a calming breakfast among peers to diffuse negative emotions versus a large group breakfast in a busy cafeteria. In addition, our curriculum could integrate contemplative practices to help learners manage stress. We could also develop additional adult roles or create partnerships with community organizations to ensure learners have access to health and wellness resources inside or outside the learning environment. We can also ensure educators and administrators are well-equipped to identify a learner's emotional state and help manage it.

Next, we must design against distractions resulting from confusing and overly complex learning objectives or learning activities. When this happens, learners are unsure where to direct their focus and may attend to the wrong content or engage in a task in the wrong way. To prevent this, we can ensure that curricula and other instructional materials are clear and organized. We can also ensure that adults have the knowledge and skills to communicate ideas to learners clearly and to design logical learning experiences.

Finally, we can address sensory distractions like excess noise, poor lighting, or even uncomfortable temperatures by designing physical spaces and facilities with good acoustics, considering the quality and brightness of lights, and ensuring rooms have temperature control whenever possible. We can also create community-wide routines and policies that foster a sufficiently calm environment without being overly restrictive, and grant flexibility with these routines and policies when needed.

Additional Resources

- **Focus: The Hidden Driver of Excellence** ⌒ | Daniel Goleman
- **Strategies for Getting and Keeping the Brain's Attention** ⌒ | Edutopia

Manageable Cognitive Load
People learn best when they are challenged but are processing a manageable amount in their working memory.

How It Works

Working memory is used to temporarily hold content and experiences important to learning. It's also where conscious thinking happens. Unfortunately, working memory is fragile and easily overwhelmed. In adults, working memory can only hold approximately three to five pieces of information at once and can only retain the information for seconds or minutes. In children and adolescents, this number is more like three or four chunks of information. In toddlers, working memory's capacity is even more limited; it can only hold approximately one or two chunks of information at once.[9] When **cognitive load**—the amount being held and grappled with in working memory at any one time—is too large, learners lose the ability to process new information. In fact, it's actually surprisingly easy for learners (especially those who are novices) to experience cognitive *overload*. This can occur when learners have to hold or process too many *new* things at once. It can also happen when working memory is forced to do extraneous processing that does not support the instructional objectives—factors such as hunger, stress, threats to identity, strong emotions, or lingering thoughts from past situations.

What is manageable for working memory varies across individuals and across contexts.[10] In other words, what is manageable for one learner may overwhelm another, even if they are similar ages and in the same learning environment. This is not *typically* because working memory itself is weaker or stronger across individuals—although neurodevelopmental differences like ADHD can diminish working memory—but because of learners' different emotional and physical states, as well as the relevant knowledge and expertise they already hold. In some cases, emotional and physical states may lead learners to have competing thoughts ("I feel like I don't fit in here" or "I'm incredibly hungry"). In other cases, a learner's lack of prior knowledge may increase cognitive load by forcing the learner to grapple with additional ideas that are beyond the scope of the learning objectives but are not yet held in long-term memory.

The latter example highlights the importance of **prior knowledge** to future learning—a finding backed by extensive research.[11] [12] Having prior knowledge or relevant existing expertise allows a learner to manage the concepts and tasks at hand more quickly and effortlessly and to grapple with new learning. This is because some automated processing can be done by

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[9]Ibid.
[10] Willingham, 2008
[11] Tobias, 1984
[12] Lui ,Grady & Moscovitch, 2016

long-term memory.[13] For example, a reader who is automatically able to decode words and read with fluency has more capacity in working memory to focus on comprehension.

Implications for Learning Environments

If learners are grappling with more than their working memory can manage, they are unlikely to learn effectively. To prevent this, learning environments must continue managing distractions, organize learning objectives and activities thoughtfully, and support each learner to achieve competency in tailored ways.

While focus helps individuals *attend* to the content and experiences essential to learning, ensuring a manageable cognitive load helps them *process* the content and experiences. In both cases, minimizing distractions is critical. This is because distractors can compete for

To support Manageable Cognitive Load, learning environments should:

- ❏ Minimize cognitive and emotional distractors
- ❏ Break learning into manageable, logically sequenced increments
- ❏ Represent content and experiences clearly
- ❏ Respond to individual learner readiness with tailored supports and pacing
- ❏ Ensure individual learners achieve competency with prerequisite objectives before they move on

limited working memory capacity even if a learner is attempting to focus. This again reinforces how important it is to help learners feel physically and emotionally safe by designing secure facilities, ensuring learners are supported by caring adults, and creating ways for learners to practice self-management as well as to access additional resources and supports when needed.

Preventing cognitive overload also has implications for how content and experiences are organized.[14] First, learning should be broken into manageable chunks and logically sequenced to support future learning. In addition, experiences should minimize confusion and extraneous processing. For example, when multiple modalities—such as visuals, text, and sound—are all used at once, these modalities should complement each other instead of competing with each other since processing competing information can unnecessarily occupy a learner's limited working-memory capacity.[15] [16] [17] To accomplish this, we can hire and train educators who have the knowledge and skills needed to design clear and organized curricula, learning activities, and materials. Alternatively, pre-designed curricula can free educators up to spend more time working with learners. Either way, as these resources are developed, we'll need to ask tough questions like: How many standards can we really expect a learner to "master"? And how much time do learners realistically need to reach mastery? Minimizing distractions should also push us

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[13] Sweller, 2011
[14] Ibid
[15] Clark & Mayer, 2011
[16] Tabbers, Martens & van Merrienboer, 2004
[17] Tindall-Ford, Chandler & Sweller, 1997

to reflect on other parts of our designs too. For example, we should consider how much thinking our physical spaces require learners to do, and whether that thinking supports learning or is a distraction. In many cases it may be helpful to develop some routine learning activities—such as using the same Socratic seminar format every Friday—to prevent learners from having to build understanding of new processes over and over.

Our designs should also empower educators and learners to adjust fluidly in response to individual readiness and should ensure each learner achieves competency with critical prerequisites before moving on. A competency-based and customized approach like this is very different from what schools traditionally do and thus requires new design choices. For example, this approach calls for a more robust and flexible curriculum than is typically the case today. This curriculum should allow learners to move through content in different ways and should have scaffolds embedded within it to support different learners, such as different representations of information, graphic organizers, worked examples, or adult or peer support.[18] [19] Assessment practices will also need to shift from being primarily whole group activities that occur at single, fixed intervals, to being available on-demand to individual learners as they work through learning objectives *and* until they achieve competency with those objectives. Lastly, because learning requires ongoing retrieval, curriculum and assessments must consider how best to spiral and revisit content over time.

Additional Resources

- **Combating Cognitive Load** 🔗 | Sanford Inspire
- **Cognitive Load Theory** 🔗 | MindTools
- **Information and Cognitive Overload, How Much is Too Much?** 🔗 | Richard L. Byyny

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[18] Deans for Impact, 2015
[19] Vygotsky, 1978

Meaningful Encoding
People learn best when new learning is experienced in memorable ways and is related to prior knowledge.

How It Works

The limited processing capacity of working memory means **long-term memory** is critical for *lasting* learning. Long-term memory is the mind's deep storage space. The knowledge, skills, and mindsets in long-term memory are retrieved and get applied to material in working memory to guide decisions and actions. When complex tasks such as driving or reading are practiced sufficiently, they become automated by long-term memory. The knowledge and skills stored in long-term memory free up capacity within working memory to grapple with *new* topics and ideas. Luckily, long-term memory is both broad and deep, holding a vast quantity of memories and retaining them for months, years, or even a lifetime. However, storing new learning in long-term memory requires that individuals successfully **encode** it first. Encoding is the process of *taking in* information and then *relating* it to what's already known. Research suggests the basic goals when encoding new learning should be to make the initial intake of content and experiences distinctive—or unique and memorable—and to create **organizing schemas** that connect and relate different content and experiences.[20]

A memory can be made more distinctive through elements of the context that are present when the memory is first made—like sights and smells—as well as a learner's emotional state at the time. This is why moments associated with strong emotions like anger or awe are more likely to be remembered later. It is also why certain images or scents can trigger vivid memories. These memories are often referred to as flashbulb memories.[21] However, emotions like anxiety and fear can also embed negative experiences, and the beliefs and mindsets associated with them, into learners' long-term memory. This is one reason adverse childhood experiences (ACEs) can be so detrimental to development and learning—these experiences are embedded in long-term memory and may be triggered by sights, sounds, smells, feelings, or other contextual cues associated with the traumatic event.

Successful encoding also involves learners relating and building on ideas in ways that are logical and personally meaningful. This process is sometimes referred to as **cognitive elaboration** and involves connecting and grouping ideas into organizing schemas.[22] The relationships learners establish through these organizing schemas may be factual ("This event happened before that one") or conceptual ("The core themes here are the same"). Organizing

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[20] Sweller, 1988
[21] Hunt, 2003
[22] Klein & Loftus, 1988

ideas into thematic categories, connecting visuals with written ideas, developing mnemonic devices, and outlining information are all examples of ways learners commonly develop organizing schemas. Research suggests that the importance of cognitive elaboration is likely part of the reason why generating one's own understanding of a topic can be so impactful.[23] It is also why having related prior knowledge helps to accelerate future learning—prior knowledge provides something for new learning to be related to.[24] [25] This increases the likelihood that the new learning will be remembered.[26] Continually expanding prior knowledge enables long-term memory to grow exponentially—the more that is stored in it, the easier it is to keep adding and the more complex ideas can be.

Implications for Learning Environments

Encoding content and experiences into long-term memory effectively must be a priority, otherwise what young people learn will not last. We can support this by making the actual experience of learning memorable, as well as by helping young people connect what they are learning to what is already in their long-term memory.

We can make the experience of learning more memorable by designing activities and contexts that inspire emotions like wonder, surprise, and even purposeful anger, as well as by building sensorily-rich (though not overwhelming) environments. Our designs can achieve this by, for example, connecting learning to topics that young people feel wildly angry or curious about, integrating hands-on learning experiences that appeal to learners' senses into the curriculum, or varying the physical space within which learning happens in purposeful ways. Collaborative learning can also foster positive emotions, plus it provides learners with a context to explain, compare, evaluate, and revise their understandings, leading to improved organizing schemas. However, all of these actions must be done in a way that supports learning goals versus just introducing new stimuli that might distract learners from the task at hand.

Once we design memorable processes and contexts for learning, we can work to help young people build rich organizing schemas for what they learn. These organizing schemas are created when learners make factual and conceptual connections between different things they

To support Meaningful Encoding, learning environments should:

- ❏ Promote distinctive or emotionally compelling learning experiences
- ❏ Ensure learners connect new learning to their prior knowledge and experiences
- ❏ Help learners make underlying factual and conceptual connections
- ❏ Integrate multiple representations of content through different modalities, problem types, and contexts

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[23] Schmidt, 1983
[24] Tobias, 1994
[25] Lui ,Grady & Moscovitch, 2016
[26] Klein & Loftus, 1988

are learning. For example, a learner might see a cause and effect relationship between two historical events or a similar theme across two novels. They are also created when learners connect new learning to their own individual prior knowledge and experiences. Generating one's own understanding of a topic is a powerful way to support the development of organizing schemas because it requires learners to unpack relationships and use prior knowledge to make meaning of something new. Hands-on, discovery-based learning is one pedagogical approach that supports this. However, it also requires us to make hard decisions about pacing to ensure all learners have sufficient time to really grapple with tough concepts. Without sufficient time, learners may struggle to achieve competency with the knowledge and skills they will need to support subsequent learning. Unfortunately, many adults are not trained to facilitate the type of learning that supports meaningful encoding. They may feel uncomfortable letting young people grapple with ideas themselves versus providing them with the answers. Or they may not be well-versed in asking questions to deepen understanding or in providing appropriate scaffolds. Luckily, we can account for many of these barriers if we are proactive with our designs.

Additional Resources

- **Creating Multi-sensory Experiences to Improve Memory Retention** ∞ | Sanford Inspire
- **Engaging Emotions to Improve Memory Retention** ∞ | Sanford Inspire
- **Dual Coding** ∞ | The Learning Scientists
- **Organizing Information to Improve Memory Retention** ∞ | Sanford Inspire
- **Elaboration** ∞ | The Learning Scientists
- **Concrete Examples** ∞ | The Learning Scientists
- **What Works, What Doesn't** ∞ | John Dunlosky, Katherine A. Rawson, Elizabeth J. Marsh, Mitchell J. Nathan, and Daniel T. Willingham

Effective Practice

People learn best when they practice challenging-but-doable skills at frequent, focused intervals and across diverse contexts.

How It Works

Even if new memories are initially encoded into long-term memory, they may be forgotten without effective practice. Practice ensures a learner is engaging in **retrieval**—the process of drawing stored memories back into one's working memory to apply them. Retrieval itself helps to more deeply "wire patterns and processes into long-term memory"[27] and makes learning long-lasting.[28] Individuals engage in retrieval all the time: a simple example might be thinking repeatedly about a favorite scene from a movie. In learning environments, research suggests there are various characteristics that make practice more effective and enhance retrieval. Specifically, practice should be:

- **Purposeful** - Goal-oriented practice consciously devoted to achieving a specific, well-defined goal or skill that is important for a learner to achieve.[29]
- **Rigorous** - Practicing at the edge of one's "comfort zone" just beyond what is automatic for the learner so it is doable, yet challenging.[30]
- **Spaced** - Practicing in multiple sessions distributed over time versus all at once.[31]
- **Interleaved** - Mixing up, or weaving together, practice with related topics through different types of problems that require different strategies.
- **Across Contexts** - Practicing across diverse, authentic contexts to support transfer.[32]
- **Frequent and Focused** - Practicing at routine intervals that are brief enough to ensure 100% focus.[33] [34]

As these characteristics demonstrate, effective practice does not entail "cramming" or rote practice of the same types of problems over and over. These forms of practice may help a learner remember something for a short time, but the learning will not be as long-lasting as it would be with more effective forms of practice.[35]

Implications for Learning Environments

Learning environments must know what individual learners need to practice, as well as provide a sufficient number of well-designed opportunities to do so.

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[27] Hess & Saxberg, 2014, p. 41

[28] Melton, 1963

[29] Ericsson & Pool, 2016

[30] Ibid

[31] Hess & Saxberg, 2014

[32] Kirschner & van Merrienboer, 2008

[33] Willingham, 2004

[34] Ericsson & Pool, 2016

[35] Ibid

Understanding the current proficiency level of each learner is essential to designing impactful practice. If practice is focused on skills learners have already mastered, or the level is not matched to their current skill level, then it will not help learners improve. However, few schools have systems that allow them to understand each learner's proficiency in a comprehensive way, such as on-demand, formative assessment systems or competency-based approaches to grading.

To support <u>Effective Practice</u>, learning environments should:

❏ Use each learner's current proficiency to plan opportunities for practice

❏ Provide learners with ongoing opportunities to engage in focused, frequent practice, across diverse contexts

❏ Build learners' own understanding of effective practice

Our environments need to provide sufficient opportunities for effective forms of practice. As discussed earlier, this means practice is frequent, but spaced out; short enough to ensure learners can devote their complete focus to practicing; woven together—or interleaved—so learners are applying different but related skills and working through various types of problems; and occurring across different contexts and disciplines. Achieving this can be tough. Traditional school designs sometimes foster a sense of urgency and an inclination to push forward in the curriculum instead of building in more opportunities for practice. In addition, content areas are often very siloed from each other, making transdisciplinary practice rare. In addition, many adults are not deeply trained in the science of effective practice, making it hard for them to design for it. To combat this, our designs should purposefully consider the knowledge, skills, and mindsets adults need to support effective practice and work to build them. They should also consider ways to integrate more interdisciplinary work as well as ways to ensure the schedule and pace of learning provides sufficient time for practice.

Finally, for learners to become more self-directed, it's critical for them to understand the importance of practice and to know what effective practice does and does not look like. We can support this by building a culture of practice and explicitly teaching learners about the science of practice, just like we teach the adults who support them.

Additional Resources

- **Retrieval Practice Library & Downloads** 🔗 | RetrievalPractice.Org
- **Spaced Practice** 🔗 | The Learning Scientist
- **Interleaving** 🔗 | The Learning Scientist
- **Retrieval Practice** 🔗 | The Learning Scientist
- **Strengthening the Student Toolbox** 🔗 | American Educator
- **Expert Practice** 🔗 | Character Lab

High-Quality Feedback

People learn best when they receive timely and targeted feedback to guide their improvement.

How It Works

Practice alone is not enough; in order to optimize learning, it must be coupled with targeted feedback. Targeted feedback helps address misconceptions and guides further practice. However, not all feedback is equally effective for supporting learning. Feedback should be:

- **Specific and Accurate** - Feedback should accurately communicate *specific* aspects of performance relative to *specific* goals.[36]
- **Process- *and* Outcome-Focused** - Feedback about both the process *and* the outcome of learning is helpful. Learners need to know whether the strategies they're using to complete a task are appropriate *and* whether they're meeting performance standards.[37]
- **Elaborative** - Feedback should explain a learner's performance and how improvements can be made versus just providing a summary of what was correct and incorrect or a single grade.[38]
- **Timely** - Ideally, feedback should be provided soon after practice and with sufficient time for learners to correct misunderstandings and practice more. However, even feedback delivered much later can be helpful if it is followed by additional opportunities to practice.[39]

Implications for Learning Environments

High-quality feedback helps learners correct misunderstandings and chart a path forward. Our learning environments can support this by building learners' understanding of the goals they are working toward, integrating sufficient and well-placed opportunities for feedback into the schedule, and ensuring the content of feedback will help a learner improve.

Feedback will be less meaningful if learners do not know the goals they are working toward and what success looks like. As a result, our curricula and instructional approaches should clearly communicate the learning objectives. In

To support High-Quality Feedback, learning environments should:

- ❏ Build learners' understanding of what success looks like
- ❏ Offer sufficient, timely opportunities for giving and receiving feedback so learners can improve
- ❏ Ensure feedback provides a sufficient and accurate analysis of a learner's progress and guidance for improving

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[36] Ambrose et al., 2010
[37] Hattie & Timperley, 2007
[38] Ambrose et al., 2010
[39] Ibid.

addition, learners should have access to exemplars against which they can compare their own work as a form of self-reflective feedback.

As described above, for feedback to drive learning it must be provided at a point in time that ensures learners still have an opportunity to improve after receiving it. This requires thoughtful scheduling so that educators can review work, formulate feedback, and provide that feedback to learners before it is irrelevant. It may also require new ways of allocating adults' time and using space so that adults can provide feedback in small groups or one-to-one versus trying to do so in large groups. The importance of timely feedback also suggests a need to shift away from using only large summative projects and exams to assess learner progress toward more bite-sized checks for understanding that can provide more timely and formative feedback.

The content of feedback is also incredibly important. For feedback to drive learning, it needs to focus on the process of learning and how a learner can improve versus only focusing on one's current level of achievement. It is hard, if not impossible, to give this type of feedback without deep understanding of what is being learned, how people typically learn it, and common misconceptions that occur along the way. Some learning environments are tackling the very real challenge of giving high-quality feedback to many students by using adaptive technologies to help young people understand what they got wrong and why; other schools have tutoring systems where specialists are assigned to a small group of learners to give them more time and feedback on a specific subject. Schools that use a lot of manipulatives may have feedback built into the materials themselves. For example, consider a learner who is putting a square block into a triangular slot: this material—given the way it is designed—provides the learner immediate feedback that squares and triangles are not the same shape.

Additional Resources

- **Delivering Effective Feedback** 🔗 | Sanford Inspire
- **5 Research-Based Tips for Providing Students with Meaningful Feedback** 🔗 | Edutopia

Metacognitive Thinking
People learn best when they are able to plan, observe, evaluate, and adjust their own learning processes.

How It Works

While feedback from adults and peers can effectively support learning, as young people progress through their education and lives they will need to take greater responsibility for their learning. To do this, learners need to develop **metacognitive thinking skills**—or the ability to think about their own thinking.[40] [41] When applying metacognitive skills, learners engage in a variety of processes to *monitor* and *control* their own learning.[42] These processes include assessing the demands of a task, evaluating their knowledge and skills, planning their approach, monitoring their progress, and adjusting their strategies as needed.[43] Metacognitive thinking is a powerful driver of learning. Research suggests that it increases one's ability to transfer learning to different contexts because it supports a higher level of understanding that extends beyond the specific task or subject area.[44]

However, metacognitive thinking is challenging, particularly for learners with cognitive load issues stemming from grappling with a lot of new content or managing negative emotional states. Luckily, research suggests that just like other skills, metacognition can be developed through instruction, practice, and feedback focused on skills like goal setting, planning, and assessing progress.[45] [46] In fact, simply asking learners to explain why they got something correct or incorrect or how well they believe they understand a certain concept or skill can push them toward thinking more metacognitively. Research also suggests that metacognitive skills are more likely to develop in learners who believe that intelligence is malleable and that learning requires effort. Finally, research on brain development suggests that metacognitive thinking skills also tend to deepen as learners get older and executive functions develop further, especially throughout adolescence and young adulthood.[47] This does not mean young learners can't engage in metacognitive thinking by—for example—identifying learning strategies they used or exploring why they got an answer wrong; it simply suggests increasingly complex metacognitive work should be asked of older learners.

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[40] Ibid.
[41] Bransford, Brown, & Cocking, 2000
[42] Zimmerman, 2001
[43] Ambrose et al., 2010
[44] Bransford, Brown, & Cocking, 2000
[45] Ambrose et al., 2010
[46] Tanner, 2012
[47] Ambrose et al., 2010

Implications for Learning Environments

Being able to think metacognitively is an important part of being a self-directed learner. However, metacognitive thinking takes real work; like anything we want young people to learn, it needs to receive dedicated time and focus within our learning environments.

Learners should receive explicit instruction on goal setting, planning, reflecting on progress, and making adjustments, and they should have opportunities to apply these skills across different contexts. To support this, we can make creative choices about how time is used. For example, our schedules could include 30 minutes each week for young people to reflect on the learning strategies they're using, their progress, and what to do next. This time could be further maximized by using it as an opportunity for feedback or relationship building as well. Alternatively, we could train educators to include more metacognitive practice alongside the learning young people are already doing. This can be as simple as adding a self-reflection component to existing assignments, projects, and exams that asks learners to recount the learning strategies they used, challenges they faced, and how much they believe they learned.

One especially critical understanding we want to build in our learners is that their thinking does not happen in a vacuum. Instead, it is impacted by a lot of different factors. These factors include their own personal values and beliefs, but also larger societal messages that may be shaping learners' thinking. These messages may be empowering or threatening. Either way, they are often very subtle, yet can have a great impact on learners' belief in themselves.

The development of a "culture grounded in metacognition" is also helpful.[48] In such an environment, everyone is open about their own learning, including the processes they are using and the progress they are making. To support this, we can ensure our instructional approach and schedule provides learners with opportunities to voice confusion and ask clarifying questions. Additionally, we can ensure adults are transparent about their own confusion and model their use of metacognitive skills.

> **To support Metacognitive Thinking, learning environments should:**
> - ❏ Make the skills and mindsets that support metacognition explicit learning objectives
> - ❏ Help learners understand how different beliefs and messages may be impacting their thinking
> - ❏ Ensure opportunities for learners to apply metacognitive thinking strategies across all learning contexts
> - ❏ Develop a culture where thinking about one's thinking is the norm

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[48] Tanner, 2012

Additional Resources

- **Boosting Metacognition and Executive Functions in the Classroom** 🔗 | The Learning Scientists
- **How to Improve Your Metacognition and Why It Matters** 🔗 | The Learning Scientists
- **Metacognition** 🔗 | Vanderbilt University
- **Metacognition and Self-Regulation** 🔗 | Education Endowment Foundation
- **Metacognition: How Thinking About Thinking Can Help Kids** 🔗 | Child Mind Institute
- **Self Regulation Graduate Aims Entry** 🔗 | Transcend
- **That's So Meta(cognitive)** 🔗 | Smithsonian Science Education Center

Part 2 | Motivation

Overview

Despite learners' natural curiosity, the hard work of learning requires motivation—the willingness to start, put in mental effort, and persist. This is especially true in the face of challenges.[49] [50] For example, learners don't usually do loads of focused practice for enjoyment—it's challenging and may not be much fun. Motivation helps get learners through. Motivation is personal; what motivates someone and how motivated they are by a particular task varies from person to person, context to context, and even from time to time.[51] However, research that looked across many studies of motivation has found four main factors that can drive or block motivation: value, self-efficacy, a sense of control, and constructive emotions.[52]

Since nothing happens without motivation, one of our central goals as designers should be to support motivation with each learner, whether this means sustaining learners' natural curiosity and motivation, helping to expand on it, or removing barriers to it. We can do this by honoring the principles listed below.

Principle 7: Value	People learn best when they find the content, outcomes, process, and/or relationships associated with learning important and relevant.
Principle 8: Self-Efficacy	People learn best when they believe in their ability to grow and achieve mastery of what they are learning.
Principle 9: Sense of Control	People learn best when they perceive that they have meaningful and appropriate agency over their learning.
Principle 10: Constructive Emotions	People learn best when they are in constructive emotional states versus feeling excessive stress or anxiety.

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[49] Headden & McKay, 2015
[50] Ormrod, 2014
[51] Ryan & Deci, 2000
[52] Clark & Saxberg, 2018

People learn best when they find the content, outcomes, processes, and relationships associated with learning important and relevant.

How It Works

Motivation flows when learners perceive that what they are learning has value to them. This value may spring from the relationship a learner has with what is being learned, how they are learning it, who they are learning it with, or why it is being learned.[53] In other words, a learner might feel that a task has value because it's fun ("I value the excitement of this science experiment"), because of its relevance to family or community ("I value learning about diabetes because I can better support my dad's battle with high blood sugar"), because of who is around when it's being completed ("I value doing this with friends who are counting on me"), or because it is a required step on the way to achieving a future goal ("I value this geometry lesson since I want to be an architect"). What is perceived as valuable, and in turn motivating, also changes as learners develop. For example, research suggests young children are highly motivated by relationships with parents and other caregivers, like educators. On the other hand, adolescents are increasingly motivated by their relationships with peers and by social perceptions.[54] [55]

Value may also stem from a desire to achieve certain outcomes or rewards. These rewards are sometimes extrinsic, which isn't necessarily a bad thing. However, research cautions that working toward a major goal for an **extrinsic reward** over time tends to reduce any **intrinsic motivation** learners initially felt for a task. So using rewards or incentives—be it grades, treats, or points—should be done carefully.[56] One way to do this is by using extrinsic rewards to incentivize smaller steps when learners are working toward something big that they find intrinsically interesting. Note that common extrinsic rewards can be challenging because the rewards that are meaningful to one person may be meaningless to another.

Implications for Learning Environments

When learners see value in their learning, they are more intrinsically motivated. Our environments can support this by making the process and goals of learning feel relevant and compelling, as well as by using extrinsic motivators with care.

Research suggests a few ways to make learning more relevant and interesting to young people. For example, learners' identities can be taken into account when planning in order to align

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[53] Ryan & Deci, 2000
[54] Wigfield & Wagner, 2005
[55] Yeager, Lee & Dahl, 2017
[56] Ryan & Deci, 2000.

content and experiences to their interests, goals, and prior knowledge from the start. We can also help learners make these connections themselves with any learning activity, even ones not explicitly designed with their identities in mind. This can be done by providing learners with an opportunity to explain how what they are learning is relevant to their lives.[57] Another powerful strategy is to provide learners with opportunities to shape their own learning process so they can increase the relevance themselves.[58] Finally, we can leverage the social aspect of learning and provide opportunities for young people

To support Value, learning environments should:

❏ Ensure that *what* is being learned feels relevant to learners' interests and goals

❏ Ensure *how* learning occurs feels compelling to learners

❏ Enable learners to work with peers and adults with whom they have meaningful relationships

❏ Only use extrinsic rewards sparingly and to support progress toward intrinsically motivating goals

to interact with those they have meaningful relationships with. We can make learning more relevant to young people via specific design choices like focusing on project-based learning, using authentic assessment, integrating real-world internships, offering a diversity of electives, or fostering collaboration. We can also ensure the adults in our environments deeply understand the learners they work with and demonstrate cultural competence.

Fostering value through the intrinsically motivating practices described above should be a priority; however, there may also be times when extrinsic motivators can increase the value of learning too. Examples of using extrinsic motivators carefully include giving learners badges or small prizes to mark their progress toward a bigger, personally-meaningful goal.

Additional Resources

- **Be the Spark: Nurturing Student Inspiration** ∞ | Sanford Inspire
- **Building Connections** ∞ | Character Lab
- **Differentiation Strategy: Student Choice** ∞ | Sanford Inspire
- **Helping Students "Want" to Achieve** ∞ | Sanford Inspire
- **Student Motivational Theory: "I Can" and "I Want"** ∞ | Sanford Inspire

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[57]Hulleman, Godes, & Harackiewicz, 2007
[58] Clark & Saxberg, 2018

Self-Efficacy

People learn best when they believe in their ability to grow and achieve mastery of what they are learning.

How It Works

Another way that motivation is built and sustained is through self-efficacy, or the belief in one's innate ability to achieve a goal.[59] Like all factors that influence motivation, self-efficacy is context and task specific, so learners might feel they can handle algebra but not writing or history. This is because it is a function of self-held beliefs regarding one's ability ("I'm just not a computer person") as well as beliefs about any broad social identities that may be cued in the moment ("Asians are good at math and science"). Developmental factors also influence a learner's self-efficacy. For example, beliefs regarding one's ability to succeed are often higher in young children and can be shaken during adolescence.

To feel efficacious, learners need to believe they have the knowledge and skills to be successful at learning something. These beliefs are built up by experiencing prior success following hard work. Like anything, with repeated practice, these beliefs become cemented in long-term memory. Once there, the beliefs can be cued and retrieved into working memory to enhance self-efficacy, provide motivation, inform behavior, and drive learning. It is important to note that learners may also have memories of failure that lead to a diminished sense of self-efficacy and decreased motivation to learn.

Implications for Learning Environments

It is hard for a learner to be motivated if they don't believe they can succeed. As a result, our learning environment should enable all learners to experience wins, help them develop skills and mindsets that support a belief in themselves, and ensure they have a supportive adult to reach out to when their beliefs are shaken.

Self-efficacy increases when learners experience the connection between hard work and success. For this to happen, the goals learners are working toward need to be

To support Self Efficacy, learning environments should:

❏ Engage learners in tasks that are challenging-but-doable

❏ Help learners regularly set goals, plan toward them, and reflect on progress

❏ Reframe failure as a temporary state that can be changed by changing one's behavior

❏ Ensure learners have trusted adults they can seek help from when they feel insecure about their abilities

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[59] Bandura, 1982

challenging—so that learners are doing real work—but also achievable with effort and supports. Learners also need to understand their progress and have multiple opportunities to improve. Using a competency-based or mastery-based approach to instruction, grading, and learner progression is one way to design in support of self-efficacy. Having adaptive curricula, likely supported by high-quality technology, can also help give young people content that is appropriate for where they are academically so they can be both challenged and set up for success. School grading policies that allow learners to redo assignments and improve grades can also support self-efficacy. Such policies signal to learners that their effort really counts and that there is no such thing as getting things completely right the first time around.

Learners are also better prepared to achieve goals if they are planning, setting goals, breaking the task into smaller pieces, and assessing progress at regular intervals—in other words, if they are engaging in rigorous metacognitive thinking. Of course, there will also be times when learners really struggle, so our learning environments need to be places where this is seen as a normal part of learning that can be overcome with the right resources, support, effort, and strategies. The language educators use is incredibly important here. For example, research suggests that praising learners more for effort and process instead of outcomes better supports self-efficacy.[60] However, research also warns that this praise should be sincere and earned. If learners receive praise for work they judge to be mediocre, they may interpret this as a signal that they can't do any better or that mediocrity is an acceptable outcome.[61] In addition, eliminating negative talk about learners' abilities from adults' language and correcting learners when they engage in negative self-talk can also support self-efficacy. A specific example is changing "I can't do this" to "I can't do this *yet*." In addition, it's helpful to ensure each learner has someone they trust, or someone who is similar to them and has successfully achieved the goal they are struggling with.[62] [63] This all has big implications for how we define adults' roles as well as how we hire and train adults.

Additional Resources

- **Growth Mindset Lesson Plan** ∞ | Khan Academy
- **Mindset Kit** ∞ | Mindset Kit
- **Helping Students Believe They "Can" Achieve** ∞ | Sanford Inspire
- **Student Motivational Theory: "I Can" and "I Want"** ∞ | Sanford Inspire
- **Examples of Constructive Praise and Encouraging Comments** ∞ | Daniel T. Willingham

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[60] Willingham, 2005
[61] Ibid.
[62] Clark & Saxberg, 2018
[63] Hulleman, Godes & Harackiewicz, 2007

Sense of Control

People learn best when they perceive that they have meaningful and appropriate agency over their learning.

How It Works

When learners have a sense of control over their learning, they believe they can impact both how they learn and the success they achieve. They see ways to shape the goals they are working toward and how they achieve them to make them more meaningful, enjoyable, or impactful. They also see their performance as a matter of their own effort that is not hindered by things outside their control like a lack of time, insufficient resources, or unsupportive adults. On the other hand, when learners lack a sense of control over their learning they see no ways to shape the learning process to better suit them or may believe that barriers beyond their control are preventing their success. When this happens, a learner may exert less effort and quit more easily.[64]

Implications for Learning Environments

Since owning your learning is motivating, our environments should create conditions that support it and remove barriers that prevent it.

First, our environments should provide learners with an appropriate level of decision-making power so they can shape their own goals and the processes used to achieve them. This could, for example, take the form of learners choosing the specific topics they will research or how they will demonstrate what they learned. Guardrails are important here, especially for novices. This is because novices may experience cognitive overload when presented with too much choice or if they are still developing the self-awareness, metacognitive skills, or understanding of the learning objectives needed to make a choice. We can put guardrails in place by providing learners with a menu of high-quality choices versus giving them free reign.

To support Sense of Control, learning environments should:

- ❏ Provide appropriate autonomy over when, where, or how learning is pursued
- ❏ Help learners attain the supports and resources needed to achieve their goals
- ❏ Minimize external barriers to learning

Learners need to feel like the choices they make and the hard work they put in will pay off in the near and long term, and that factors beyond their control will not compromise their learning.

[64] Dweck, 2006

This has critical implications for everything from our budget and operations to the physical spaces we create to the capacity of the adults we hire, and more. For example, our budgeting and operational decisions have the potential to either inhibit or ensure learners' access to the materials and technology needed for learning. Similarly, our physical spaces can either be too crowded, noisy, and hot or they can be spacious and comfortable and educators can either be capable and motivated or lack critical expertise and disengage. Learning environments can also enable and support learners in becoming self-advocates who speak up and hunt for solutions when they feel they don't have the support needed to succeed.

Additional Resources

- **GripTape Agency Framework** 🔗 | GripTape
- **Agency Graduate Aims Entry** 🔗 | Transcend
- **The Key Benefits of Choice from Learning to Choose, Choosing to Learn** 🔗 | Mike Anderson

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Constructive Emotions

People learn best when they are in constructive emotional states versus feeling excessive stress or anxiety.

How It Works

A learner's emotional state directly impacts motivation. Some emotional states are constructive when one is trying to learn; for example, joy is a powerful emotion that supports lasting learning in positive ways.[65] However, if learners are in an emotional state marked by negative feelings such as anxiety, fear, or depression, it can damage motivation. A negative emotional state may result from the breakdown of other drivers of motivation like sense of control ("It wasn't my fault I failed; the teacher didn't teach me enough, and now I'm angry"), self-efficacy, ("I just don't feel like I can do this work"), or value ("I'll never use what I'm learning so who cares"). It can also be caused by something occurring outside the learning environment such as family struggles or conflicts with friends. It is important to keep in mind that emotions are also deeply individual, so some learners may experience a negative, unconstructive emotional state while others remain positive in the same situation. This may be a result of differences in prior experiences involving such situations. Similarly, emotions may fluctuate throughout development, and even over the course of a day. They are very context dependent.

Implications for Learning Environments

Motivating learning environments help learners achieve constructive emotional states—this could mean working to alleviate things like stress and anxiety, channeling anger into productive action, or experiencing joy while learning.

In order to create constructive emotional states, our environments should be warm and joyous spaces where learners have positive relationships with their peers and adults. We can do this through community-building routines such as advisory groups, restorative practices, circles, or mentorships. We can also create physically welcoming spaces that showcase learners' lives and accomplishments and feel inviting.

To support Constructive Emotions, learning environments should:

❏ Be warm and and joyful spaces

❏ Foster positive relationships between peers as well as between adults and learners

❏ Support physical and psychological health and wellbeing

❏ Help learners diffuse negative emotional states

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[65] Willis, 2007

Our environments should also support constructive emotions by supporting learners' physical and mental health. This includes making operational and scheduling decisions that ensure learners have access to healthy food while at school, can attain a good night's sleep, and get sufficient opportunities to be active. We can also help learners manage negative emotional states by integrating contemplative practices like mindfulness and other emotional regulation strategies into our curriculum. In some instances, taking action may also be an effective way to channel emotions that may otherwise be unconstructive, such as anger or sadness. In these cases, enabling learners to engage in projects or take other productive action can be restorative and support learning. However, we should not expect learners to always manage negative, unconstructive emotions on their own. Instead, we should create environments that ensure learners who need physical and psychological services to tackle tough problems have access to them. We can ensure learners and their families have access to mental health services by expanding the types of services our environment provides through community partnerships or by hiring for different roles.

Additional Resources

- **Joy in School** 🔗 | Steven Wolk
- **Using Circle Practices in the Classroom** 🔗 | Edutopia
- **Teaching Restorative Practices with Classroom Circles** 🔗 | Center for Restorative Process

Overview

Learners' identities stem from how they make meaning of their unique combinations of personalities, physical characteristics, group memberships, values, beliefs, attitudes, life experiences, and more. Individuals who understand and act in alignment with their values, interests, and goals tend to live happier, healthier, and more successful lives.[66] Having a secure sense of identity and understanding of oneself can also support learning because it informs what a learner determines is valuable to learn, fosters energy and constructive emotions, and supports metacognitive thinking.[67] [68] When identities that are incongruent with academic success are cued within learners' minds, it can be demotivating and prevent learning. As designers, it's our role to create environments where learners are able to explore questions of identity, express who they are, feel affirmed, and reconceive themselves as individuals capable of learning and success.

As a result, grappling with questions of identity is a critical developmental task. However, it also takes real cognitive effort, and learning environments must be built to account for this. This can be supported by honoring the following principles:

Principle 11: Self-Understanding	People learn best when they have a deep understanding of who they are and can use this knowledge to maximize their learning.
Principle 12: Sense of Belonging	People learn best when they feel connected to, and accepted by, the people and environment around them.
Principle 13: Navigating Identity Threats	People learn best when negative beliefs associated with their identity are minimized or buffered against.

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[66] Damon, 2008.
[67] Demetriou, 2000.
[68] Damon, 2008.

Self-Understanding

People learn best when they have a deep understanding of who they are and can use this knowledge to maximize their learning.

How It Works

Learners can hold various identities simultaneously. These include current identities ("I'm a good learner") and possible future identities ("I want to be a doctor"), as well as personal identities ("I make really funny jokes") and broad group identities ("I am Native American"). These identities evolve over time through a process of **exploration** ("How do I like to dress?", "What privileges do I carry?"), **commitment** ("I want to wear baggy clothing", "My whiteness gives me privileges"), and **re-exploration** ("Should I keep dressing this way now that I have this job?", "What biases am I noticing in myself?").[69] This process takes real cognitive effort as working memory grapples with past memories, current experiences, emotions, others' reactions, and more. If learners do not have the dedicated time and mental space to take on identity development and change, it will happen regardless, but in ways that may compete with other learning goals.

Identity development becomes particularly relevant in adolescence, when identity formation is *the* key developmental task.[70] [71]Young people question their former assumptions about identity, engage in in-depth exploration of various aspects of themselves, and take action to commit to important identity markers.[72] During this time, adolescents tend to demonstrate many different identities that vary based on the social context. An individual may dress, speak, and behave one way with family, another with friends, and yet another when alone. Learners' broad social identities—including their racial, ethnic, and gender identities—also become more salient during adolescence, and many learners become especially vigilant to ensure role conformity for themselves and others, especially when around peers.[73] Ideally, as learners develop a deeper understanding of their talents, interests, and desires, they move away from this state of multiple, evolving, and possibly divergent identities to a more secure, integrated identity that is positive and supportive of success.[74]

While a learner's individual developmental state impacts identity formation, so do other elements of individual variability like the social groups a learner is a part of. For example, research suggests that identity development differs for white versus black versus biracial learners, for men and women, and for individuals in different countries.[75] [76] The existence of

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[69] Marcia, 1966
[70] Erickson, 1972
[71] Meeus, Iedema, Helsen & Vollebergh, 1999
[72] Klimstra et al., 2010
[73] Steinberg & Morris, 2001
[74] Nagaoka et al., 2005
[75] Kroger, 2017

inequity, how learners come to recognize (or not recognize) this, and its impact on them are key drivers of differences in how identity develops.[77] In American society, members of more dominant, privileged groups (e.g., whites, males, heterosexuals, members of dominant religions, able-bodied, middle or upper class, etc.) are often "the standard against which everyone else is measured."[78] As a result, individuals from traditionally oppressed groups may feel less than, like they do not belong, or like their own identities are not represented.

Implications for Learning Environments

Our learning environments should help learners explore and commit to both current and future identities, while also ensuring learners have space to re-explore and recommit as they develop and change.

We can start by providing learners with opportunities to deeply explore where they come from and opportunities to engage with new people, contexts, and activities that they may not otherwise encounter. This will help learners make important discoveries about themselves and the world around them. We can design for this by bringing learners' cultures into both *what* they are learning and *how* they are learning it. Learners should also have opportunities to think, talk, and write about their life stories, heritage, family, and community so they can explore the impact each has had on them.[79] All of this has implications for the curriculum we design and pedagogical approaches we use with young people. In designing each, we should think about how to partner with members of the local community, learners, and families to ensure learning is authentically relevant. Our environments should also provide learners with opportunities to engage with new people, contexts, and activities that they may not otherwise encounter. We can do this by building intentionally diverse communities, creating an extensive network of partnerships that extend learning well beyond school walls into other contexts around the world, or designing the curriculum with a deliberately global perspective.

To support Self Understanding, learning environments should:

❏ Deepen learners' understanding of their life story, heritage, and community

❏ Immerse learners in new contexts and activities

❏ Offer opportunities for learners to express their various changing identities

❏ Help learners reflect on their current identities, desired future identities, and how best to bridge the two

Learners also need opportunities to commit to elements of their current and future identities, bridge gaps between who they are now and who they want to be in the future, and re-evaluate parts of who they are as they learn and develop. As a result, our environments should support

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[76]Tatum, 1992
[77] Ibid.
[78] Kimmel, 2016
[79] McAdams, 2001

learners in expressing and living into their identities. To accomplish this we can—for example—integrate personal narratives and storytelling activities into the curriculum. We can also provide opportunities for learners to shape the learning process to help them achieve their desired future identities. Research suggests contemplative practices like mindful breathing, visualization, and journaling foster this type of self-reflection and self-awareness, as does honest feedback from individuals who know learners well.[80]

Additional Resources

- **Self-Awareness Graduate Aims Entry** 🔗 | Transcend
- **Sense of Purpose Graduate Aims Entry** 🔗 | Transcend
- **Summary of Stages of Racial Identity Formation** 🔗 | Racial Equity Tools

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[80] Davidson & Kaszniak, 2015

Sense of Belonging

People learn best when they feel connected to, and accepted by, the people and environment around them.

How It Works

The need for social belonging is "a basic human motivation."[81] When learners feel like they belong in their school community, it helps to affirm and strengthen their identity, can be a source of motivation, and supports learning. More specifically, research indicates that learners with a positive sense of belonging engage in fewer problem behaviors, are more open to feedback, take advantage of educational opportunities at a higher rate, have more positive attitudes, experience less depression, and stay in school. [82] [83] Conversely, learners who question their belonging are less likely to demonstrate these positive outcomes and are more vigilant to cues from the environment related to their identity and whether they fit in. This makes them more apt to experience identity threats, which can occupy working memory and impede learning. Research also demonstrates that learners from underrepresented and traditionally oppressed groups are generally those most likely to question their belonging within learning environments. Taken together, the importance and challenges of fostering belonging has powerful implications for learning and equity.

Implications for Learning Environments

As designers, it's our job to create and maintain environments where all learners feel like they belong to a larger community by making them feel welcomed, heard, and like they fit in.

We can help learners feel welcome by creating environments that are relevant to and celebratory of their identities. For example, we can ensure learners' identities are represented in the broader staff and peer population. We can construct a physical environment with art or other objects from their community. We can infuse the curriculum with books written by individuals who share important identity markers with learners.

To support <u>Sense of Belonging,</u> learning environments should:

- ❏ Feel relevant to and celebrate learners' identities
- ❏ Provide all learners with opportunities to be heard and encourage participation
- ❏ Hold high expectations for all learners
- ❏ Help learners understand self-doubt happens to everyone
- ❏ Minimize zero-tolerance and utilize restorative practice to re-establish trust and connectedness

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[81] Walton & Cohen, 2007, p. 82
[82] OECD, 2017
[83] Romero, 2017

We can develop routines that reflect culturally-relevant practices. We can also help learners feel like they are welcome by normalizing feelings of self-doubt. Adults can help by openly and honestly modeling their own moments of insecurity. Other role models, like older peers, could do the same.

In addition to feeling welcomed, learners should also feel heard and respected. We can do this by providing all learners with opportunities to contribute to important community-wide decisions. For example, learners can be involved in defining community norms, decorating the physical space, or planning events. In addition, policies and practices should ensure learners are treated fairly and guard against feelings of shame that may arise when a learner must receive different supports because of an individual difference.

In addition to these proactive ways of building a sense of belonging across a community, we must also actively work to rebuild this atmosphere during difficult moments. Restorative practices and circles can be helpful in these moments. These routines and policies are not at odds with having consequences for breaches; rather, they enable learners to work through mistakes in a way that is grounded in reflection, trust, and support. These practices can prevent feelings of shame and disengagement, as well as the disruptive behaviors which are associated with more exclusionary discipline practices like suspensions and expulsions.[84]

Additional Resources

- **Linking Identity & Achievement through Cultural Competence** 🔗 | Sanford Inspire
- **Teachers as Agents of Change** 🔗 | Sanford Inspire
- **Weekly Circles for Students and Faculty** 🔗 | Edutopia and Valor Collegiate

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[84] Mallet, 2015.

Navigating Identity Threats

People learn best when negative beliefs associated with their identity are minimized or buffered against.

How It Works

We use our identities as a lens for how we see the world. When learners interpret a task as congruent with their identity—because it should be doable or important to "people like them"—then they are more likely to do it. This is especially true when the tasks are difficult. The tricky thing is that people have many identities, not all of which are active at a given moment. To influence motivation, an identity must be present in working memory at that time. Broad social identities like race, gender, and ethnicity are often "psychologically salient,"[85] therefore, they are likely to be cued by a wide range of situations, and are *more* likely to be cued than narrow individual identity markers, such as one's identity as an artist or scientist. For some learners, these broad social identities can disrupt their ability to learn and experience success because of identity threats.

Take, for example, what research tells us about **stereotype threat**. Stereotype threat refers to the "tension that arises in members of a stereotyped group when they fear being judged according to these stereotypes."[86] Studies have found that simply calling attention to an individual's membership in a stereotyped group is enough to bring that identity to mind and activate negative stereotypes.[87] Research also shows that stereotype threat negatively impacts performance, regardless of a person's ability, their level of preparation or self-confidence, or even their belief in the stereotype itself.[88] Stereotype threat has this impact because it adds to learners' cognitive load: once certain stereotypes have been activated, learners will expend mental energy reacting to the perceived threat through anger, rumination, disengagement, or added vigilance to the setting.[89] This diverts attention and working memory away from the task at hand. Unfortunately, these stereotypes can be activated by seemingly innocuous comments and can affect children as young as five years old.[90] The risk of stereotype threat can present an added hurdle for learners who are already struggling to overcome other disadvantages associated with poverty, sexism, or racism.[91] Stereotype threat isn't the only type of identity threat that has an impact on learning. **Imposter syndrome** is another example, and can make learners feel exposed; in *Whistling Vivaldi*, Claude Steele vividly describes his experience as the

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[85] Oyserman & Destin, 2010. p. 1010
[86] Ambrose et al., 2010
[87] Ibid.
[88] Ibid.
[89] Steele, 2011
[90] Ibid.
[91] Ibid.

only black student in a PhD program where "excellence seemed to have an identity [linked to whiteness] which I didn't entirely have and worried that I couldn't get."[92]

Implications for Learning Environments

As designers, we can counteract identity threats by cueing identities that motivate learning, challenging the narrative about broad social identities that have been stigmatized, and helping learners fight against inequality.

Learners' visions of their future selves can provide motivation and learning environments should tap into this. We can do this ensuring that learners—particularly learners from traditionally oppressed groups—regularly reflect on their vision for their future selves, articulate strategies for attaining these visions, and discuss what might get in their way.[93] Once learners have these identities clear in their minds, we should ensure that content and learning experiences are relevant and that this relevance is apparent to learners. This requires thoughtful curriculum design and skillful facilitation of learning by adults.

To support <u>Navigating Identity Threats</u>, learning environments should:

❏ Cue learners' motivating identities over identities that may trigger stereotypes or self doubt

❏ Minimize actions, words, or images that may trigger stereotypes or feelings of self-doubt

❏ Expose learners to individuals who have countered identity threats

❏ Support learners in understanding and acting against systemic inequity and personal experiences of bias

Since learners also have broad social identities that are easily cued and sometimes carry stereotypes, our environment should be designed to minimize actions, words, or images that might lead a learner to think about and internalize these biases. This will require us to build adults' understanding of diversity, equity, and inclusion topics and practices. It will also require us to consider everything from the pictures in—or not in—books that young people read to cultural practices we honor through our community building routines.

Finally, even with our best efforts, many learners will still experience bias. Building *all* learners' understanding of systems of oppression and privilege can prevent learners from wrongly blaming themselves for these negative events as well as prevent learners from perpetuating them.[94] In addition, providing learners with opportunities to act against these systems can build a sense of empowerment. Developing affinity groups can create a safe space to dig into these topics. And again—since representation matters—it's also helpful for learners to encounter examples of people who are like them and who are happy and successful. At times, learners may also benefit from the same types of contemplative practices that support deeper

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[92] Ibid., p. 153
[93] Oyserman & Destin, 2010
[94] Steele, Spencer & Aronson, 2002

self-awareness and counteract trauma. All of this will require curriculum and scheduling decisions that prioritize social justice, the development of critical consciousness, and mindfulness practices.

Additional Resources

- **Empirically Validated Strategies to Reduce Stereotype Threat** ∞ | Stanford University
- **Critical Consciousness Graduate Aims Entry** ∞ | Transcend

Overview

Learners differ in all kinds of deeply intertwined ways. These include differences in cognitive processing, emotion, background knowledge, interests, personality, physical abilities, exposure to trauma, and cultural values, among others. These differences impact identity development, motivation, cognitive processing, and, in turn, learning. Often, schools have not recognized these differences, viewed them as deficits, or not been designed to respond well to them. Instead, many schools have been designed around the mythical concept of "the average learner."[95] When a school is designed for the average learner, it takes a "one size fits all" approach that may not be best for learning. For example, learners may be engaging in practices that are too easy or too hard based on prior mastery, or they may not see the personal relevance and value in the tasks they are engaged in.

A core challenge for our design process is to find creative ways to ensure that learners' individual profiles are *deeply understood* and *responded to* by the surrounding learning environment. We can do this by honoring the following principles.

Principle 14: Life Experiences	People learn best when their unique life advantages and adversities are understood and responded to.
Principle 15: Developmental State	People learn best when their experiences align with where they are developmentally.
Principle 16: Learning Differences	People learn best when their unique learning needs are identified and resources and supports are aligned in response to these needs.

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[95] Rose, 2016

Life Experiences
People learn best when their unique life advantages and adversities are understood and responded to.

How It Works

An individual's life experiences are critically important to development. In fact, much of the biological diversity in individuals stems from their earliest life experiences, some of which occur before birth. These experiences "are built into our bodies, creating biological 'memories' that shape development, for better or for worse."[96] These early experiences include the relationships infants and young children form with caregivers, the environments that surround them, the nutrition they receive, and more. These early experiences can be advantageous—secure and positive attachments with caregivers, environments free of toxins, eating healthy foods and activities like sleep and exercise—or they can be adverse—neglectful or abusive relationships, exposure to traumatic events or pollution, and highly processed or inadequate food.[97] The relative advantage or disadvantage a learner faces, especially in developmentally-sensitive periods, lays the foundation for mental and physical health later in life.

While all learners experience both advantageous and adverse life experiences, powerful systems of privilege and oppression also create patterns of greater adversity for some and greater advantage for others. For example, racism and economic inequality lead learners of color and those in poverty to be impacted by chronic adversity at a statistically higher rate than white, middle, and upper class learners.[98] Adverse childhood experiences (ACEs) can have an especially harmful impact on learning. Examples of ACEs include exposure to poverty, emotional or physical abuse, the death of a close family member, or a parent being incarcerated. Additionally, learners who identify or are identified as part of a traditionally oppressed group based on their gender, race, ethnicity, religion, age, ability, sexual orientation, or other marker may deal with microaggressions, stereotyping, and bias on a regular basis.

The pervasive nature of these experiences can be toxic to cognitive, socioemotional, and physical development. More specifically, prolonged stress from sustained exposure to trauma can actually disrupt the development of the brain and other organs leading to greater risks of certain diseases.[99] It has also been shown to impact one's sense of identity in harmful ways, leading to negative emotional states, leaving individuals feeling less efficacious and in control,

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[96] Center on the Developing Child, 2010.
[97] Ibid
[98] Wade, Shea, Rubin & Wood, 2014.
[99] Center on the Developing Child, n.d.

and prompting excessive rumination that distracts from learning.[100] Over time, this can result in tangibly different life outcomes for a child. For example, research indicates that young people who experience six or more ACEs struggle more with learning and even have shorter lifespans. [101] However, facing a manageable level of adversity *while surrounded by supportive relationships* may actually result in more positive outcomes—like greater resilience when confronting challenges—than not facing any adversity at all![102] [103] [104] In these scenarios, the adversity provides a learning opportunity while the supportive relationships provide a buffer against stress, thereby helping learners build critical skills such as planning, monitoring, and regulating behavior, and adapting to changing circumstances.[105]

The buffering effect of positive relationships demonstrates one way in which relationships can be "a positive developmental force between children and their physical and social context."[106] Research also suggests that healthy relationships build a foundation for lifelong learning; promote adaptability; help integrate social, emotional, and cognitive processes; and over time actually change our genetic makeup.[107] Additionally, some research suggests that supportive relationships may have an even more positive impact on low-income learners.[108] While there is no consensus within research on what constitutes a healthy developmental relationship, important characteristics include attunement with, and ability to respond to, a learner's emotions and needs, working together to complete tasks, compassionate communication, high expectations, consistency, trust, and cognitive stimulation.[109]

Implications for Learning Environments

Learning environments must be responsive to the fact that each learner carries "a backpack filled with very different experiences."[110] This requires that all learners are deeply known within their learning environments, that they receive support to heal from past adversity as well as buffer against ongoing adversity, and that their families and communities are engaged as assets in the learning process.

Knowing what all learners carry in their unique "backpacks" requires a deeper understanding of each learner than many learning environments currently hold. In other words, it requires us to go beyond knowing learners' current levels of academic proficiency and diagnosed learning needs to understanding the backgrounds they come from, environments they've developed in, and how they make meaning of their various life experiences. We can make design decisions

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[100] Osher, Cantor, Berg, Steyer & Rose, 2018
[101] Ibid.
[102] Rutter, 2001.
[103] DiAngelo, 2011.
[104] Center on the Developing Child, 2007
[105] Center on the Developing Child, 2010
[106] Osher, Cantor, Berg, Steyer & Rose, 2018
[107] Ibid.
[108] Murray & Malmgren, 2005
[109] Osher, Cantor, Berg, Steyer & Rose, 2018.
[110] Pape, n.d.

that help educators develop this deep understanding. For example, we can build routines and policies that enable caregivers to communicate with adults in the learning environment about their young people's lives, such as open-door policies and consistent opportunities for conferences. We can also develop similar opportunities for learners themselves to communicate about their lives. We may also want to develop ways to document learners' varying life experiences to ensure *all* adults who support them fully understand a learner's unique background. Technology-enabled learner profiles (when appropriate and with robust data security measures) are one way to accomplish this.

To support <u>Life Experiences,</u> learning environments should:

- Understand the unique privileges and adversities that each learner carries
- Ensure each learner is supported by a caring adult
- Use trauma-informed practices to respond to adverse childhood experiences
- Provide or connect learners and their families with non-academic resources and supports
- Leverage assets in learners' home and community contexts to support learning

Next, it's important that learners who face persistent or passing adversities receive responsive supports. Research suggests relationships with trusted adults, trauma-informed practices, and access to supplemental resources are all beneficial.[111] To build these supports, we could develop unique mentoring roles for adults and then develop hiring practices or trainings to ensure adults have the knowledge, skills, and mindsets required to fill these roles. We may also choose to integrate relationship-building routines (e.g., check-ins with mentors) into the day, include stress-management strategies like mindfulness in the curriculum, or develop community partnerships with organizations that provide additional supports when our environments can't. These supports may include physical and mental health services, job training and placement, or even a food pantry.

As we consider how to respond to individual learners' unique life experiences, we should also recognize assets that exist in learners' home and community contexts and leverage these to support learning. These assets could include community centers, local artists, family members with special expertise on a topic young people are learning about, athletic coaches, and much more. In order to leverage these powerful assets, we might design a formal partnership with a local business to provide real-world learning opportunities and engage a community activist to work with learners. Some schools also formally invite family members and other important people from learners' lives to be parts of teams that support learners in defining goals, making plans to reach them, and evaluating their progress along the way. Identifying and incorporating these community assets should be a priority that receives operational and budgetary support.

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[111] Osher, Cantor, Berg, Steyer & Rose, 2018

Additional Resources

- **Understanding the Impact of Trauma on Students** 🔗 | Sanford Inspire
- **Understanding Anxiety in Children and Teens** 🔗 | Child Mind Institute
- **Supporting Trauma-Exposed Students** 🔗 | Sanford Inspire
- **Toxic Stress** 🔗 | Center for the Developing Child
- **Dream Teams in the Greenfield Model** 🔗 | Achievement First

Developmental State
People learn best when their experiences align with where they are developmentally.

How It Works

Extensive research tells us that developmental changes matter a lot for identity development, motivation, and cognitive processing. While the literature on child development is robust and far too much to cover here, we can better design for learning by understanding some of the key physical, cognitive, emotional, and social shifts that occur. Below, these changes are grouped into three overlapping and fluidly-defined life stages: early childhood, childhood, and adolescence. While research suggests "the shape of each child's growth is unique and includes plateaus, reversals in direction, and stage-like jumps in development over time,"[112] these stages provide a general starting point to help understand a child's developmental state.

Infancy and the earliest years of childhood are a highly sensitive developmental phase that significantly influences later outcomes.[113] Cognitive changes include the brain creating more than a million new connections every second. In fact, from birth to age two, the brain actually overproduces new connections. As a result, the brain is the most flexible (or "plastic") during this time.[114] The brain later "prunes"—or eliminates—connections that are not used. Forming attachments with caregivers is also a key developmental task during this time. These relationships are critical to socioemotional development. Children rely on relationships to cope with stress and regulate emotions. Since young children learn through observation and imitation, these relationships also provide early models for learning. Together, all of this means that very young children's brains are highly malleable and can be influenced in *profound* ways (positively and negatively) by their environments and relationships. This makes healthy life experiences particularly critical during early childhood.

When learners traditionally enter school, vast developmental differences are already apparent. They come into school at different points in their physical development. This includes differences in height and weight, but also in the extent to which they've developed gross and fine motor skills, balance, and endurance.[115] Cognitively, learners' brains are continuing to develop. One important finding is that their executive function skills—which support the ability to hold onto and work with information, focus thinking, and direct attention—have a window of opportunity for dramatic growth around ages three to five.[116] Most young children also exhibit

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[112] Osher, Cantor, Berg, Steyer & Rose, 2018
[113] Davies, 2010
[114] Center on the Developing Child, 2007
[115] Davies, 2010
[116] Center on the Developing Child, 2012

high levels of curiosity as they come able to grapple with more complex ideas and have new experiences they want to understand.[117] Socially, children are beginning to form relationships outside their family and primary caregivers. These relationships provide learners with an opportunity to transfer critical interpersonal skills to new social interactions. Learners are also becoming increasingly aware of themselves and how they compare to others.[118]

Adolescence is a critical developmental time for learners. Adolescent brains typically begin extensive "remodeling" that lasts into early adulthood. This process involves accelerated "pruning" as well as the strengthening of connections that are heavily used. This makes pathways in the brain more effective and efficient. The prefrontal cortex also further develops. This is the area responsible for the executive function skills mentioned earlier, as well as for complex processes like higher-order and metacognitive thinking. However, it is important to note that this area is not typically fully developed until one's mid-twenties. As a result, teens often rely on other parts of their brains for decision making—particularly the amygdala, which is responsible for more immediate, emotion-driven reactions. The socioemotional changes learners experience are closely intertwined with identity development which, as mentioned earlier, is "the key developmental task" of adolescence.[119] Learners work to explore the world and individualize themselves. Often, they begin to look to their peer group to set expectations for behavior and values instead of their family, as was the case in childhood. In exploring their identity, they also grapple with their sexual orientation and future career and life goals. Just like any other type of learning, this self-exploration takes real cognitive effort.

The above describes very broad trends across early childhood, childhood, and adolescence. However, it is critical to reiterate that the specific physical, cognitive, social, and emotional states of each learner, at any given point in development, will be unique. This means that all learners will be unique in the speed at which they move through each aspect of each phase.

Implications for Learning Environments

Our learning environments should be aligned to general developmental trends while also being customized to each learner's developmental trajectories in ways that are well informed and empowering.

Designing in response to general developmental trends pushes us to consider what it might look like to create environments and experiences that support the key

To support Developmental State, learning environments should:

❏ Support key developmental tasks that occur across different phases of life

❏ Respond flexibly to reach all learners at their *unique* developmental zones physically, cognitively, socially, and emotionally

❏ Support learners in understanding and responding to their own development

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[117] Davies, 2010
[118] Ibid.
[119] Erickson, 1972

developmental tasks of different phases of life. For example, many young children are extremely curious since so much is new to them . As such, we should consider how we can honor this in our designs. We could do this by applying inquiry-based and project-based pedagogical approaches, for example. As another example, peer relationships are deeply important to most adolescent learners and can foster motivation but can also lead to unhealthy social comparisons and identity threats. We should consider how to ensure sufficient time for adolescents to socialize, but also embed routines that foster healthy peer relationships.

Of course, not all learners develop to the same degree or at the same rate. As such, designing only for general developmental phases is insufficient—we also need to design environments that understand and respond to each individual's specific developmental state, or zone of proximal development.[120] Mixed-age classrooms are an example of a design choice that seeks to address both general developmental phases and learners' specific developmental states. Other design choices include flexible curriculum and on-demand assessment systems that allow learners to move fluidly through learning as they master different objectives, as well as flexible scheduling that allows learners to move to different spaces based on their progress and needs. Responding to differences in development—like responding to differences in life experiences—will require tremendous shifts in the way we manage and share information. Using technology to manage this information and create meaningful profiles of all learners is one way to support this.

Finally, our learning environments should help learners understand and respond to their *own* development. This supports other key principles of learning such as self-understanding, sense of control, and metacognitive thinking, which in turn foster self-direction. We can do this by building learners' understanding of development and by designing ways for educators to communicate transparently with learners about their individual development.

Additional Resources

- **Stages of Development and How Children Learn** ∞ | Age of Montessori
- **The Zone of Proximal Development: An Affirmative Perspective in Teaching ELLs/MLLs** ∞ | NYSED Office of Bilingual Education and World Languages 1
- **Let Learners Get in Their Zone (of Proximal Development)** ∞ | EdSurge

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[120] Vygotsky, 1978

Learning Differences

People learn best when their unique learning needs are identified and resources and supports are aligned with these needs.

How It Works

There is extensive variability in how individuals learn. Some of this variability stems from life experiences or the developmental state a learner is in. However, other differences stem from variations in cognitive, social, and emotional traits and abilities. These are differences that may manifest in various ways as young people grow older, but likely will always be present in some way. While there is no single agreed-upon set of learning differences, many specialists break them into categories related a learner's ability to read, write, work with numbers, focus attention, and engage executive functions. For example, dyslexia is a widely researched learning difference impacting reading abilities, while dyscalculia is a difference that impacts math abilities. The purpose of this section is not to give an overview of these various learning differences—that could be a book in and of itself. Instead, we want to highlight some general implications for learning environments and point readers toward additional resources.

Unfortunately, traditional school designs often do not fully account for the array of learning differences that exist. Instead, they tend to focus only on legally and medically defined differences. Other times, differences are viewed from a deficit perspective versus being seen as a normal part of human variability—or a source of strength. Autism is an often cited example. Traditionally, autism has been viewed as a disability that leads to repetitive behaviors and impairs social skills, speech, and nonverbal communication. However, scientists have come to understand (as many families have long known) that autistic individuals often also have advanced visual and spatial skills.[121] Both these unique challenges and strengths have significant implications for how a child with autism best learns.

Implications for Learning Environments

As designers, we should strive to build environments that help educators understand and respond to differences in how *each* individual child learns while maintaining high expectations for *all* learners.

To accomplish this, our environments must, again, start by developing deep knowledge of each learner. In this case, that knowledge will focus on how each young person learns. Ensuring this knowledge exists for *every* learner embraces the ideas that everyone can benefit from an individualized learning plan and transitions away from having structures, like individualized education programs (IEPs), for only *some* formally-identified learners. As suggested above,

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[121] Silber, 2015.

these more robust "learner profiles" can give adults and learners a deeper understanding of the differences already discussed. In order to manage such a wide array of information at scale, high-quality learner information systems are needed and can be enabled by using technology thoughtfully and securely.

Next, it's critical that learners' needs and strengths are not just known, but understood and responded to. Principles from the Universal Design for Learning offer instructional guidance in this area. This guidance focuses on integrating multiple ways to: 1) perceive new information; 2) navigate and express learning; and 3) maintain engagement.[122] Flexible sequencing of learning goals and flexible pacing for their completion can also facilitate learner engagement, motivation, and agency, as long as sufficient support and guidance are provided. Finally, when learners *are* engaged in the same activities, scaffolds can be employed to reach young people at different readiness levels. As designers, it's important that we develop systems and structures that support these instructional strategies and the flexibility they require. This will likely include a robust curriculum that learners can move through in different ways, a variety of assessment formats, and even assistive technologies—such as text to speech applications, assistive listening systems, and others—that can scaffold learning for young people with differing abilities.

Finally, it's critical that we not lower expectations in response to these learning differences. This means, for example, that all learners should be working toward, and assessed on, the same standards but with different supports and accommodations provided to some learners based on needs. In short, our operational decisions should ensure that resources are allocated in a way that provides more to learners who need more. This includes providing learners who are struggling the most with the strongest educators, among other strategies. We can also make thoughtful decisions about scheduling that prevent learners from being excluded or having fewer opportunities because of their learning needs. And finally, our hiring and professional learning structures can ensure that the adults in our learning environments believe all learners can achieve at high levels.

> **To support Learning Differences, learning environments should:**
> - ❏ Ensure individual learners' unique needs and strengths are understood by adults and learners themselves
> - ❏ Respond to differences by enabling learners to take in, engage with, and demonstrate learning in different ways
> - ❏ Provide tailored scaffolds and supports in response to specific needs
> - ❏ Maintain high standards for all learners no matter their unique needs

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[122] UDL

Additional Resources

- **Universal Design for Learning** ∞ | CAST
- **Agents of Their Own Success: Self-Advocacy Skills and Self-Determination for Students With Disabilities in the Era of Personalized Learning** ∞ | National Center for Learning Disabilities
- **An Advocate's Guide to Transforming Special Education** ∞ | Innovate Public Schools
- **Experience Personalized Tools** ∞ | Understood.org

Conclusion

In this resource, we've explored how learning happens through a discussion of cognition, motivation, identity, and individual variability. While we hope the resource deepened your understanding of these topics, we also know that this is just the tip of the iceberg. Now it's time to take action by digging deeper into these ideas and applying them within your own community.
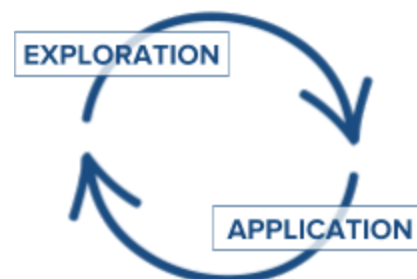
Engaging in Further Exploration

While any one of the principles we named could warrant a long paper in its own right, we hope the knowledge shared here will be a jumping-off point for further exploration. In other words, we hope you'll treat this resource not as the complete answer, but as an initial framework to guide deeper exploration. This is why we've included additional resources specific to each principle throughout the previous sections. Below you'll also find a list of books, research summaries, and frameworks that will help deepen your *general knowledge* about learning and development. Finally, at the end of this conclusion, you'll find the full list of research we reviewed in order to create this primer.
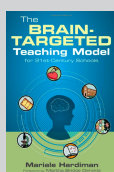
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The Brain-Targeted Teaching Model for 21st Century Schools 🔗 Mariale M. Hardiman	***Breakthrough Leadership in the Digital Age*** 🔗 Frederick M. Hess and Bror V. H. Saxberg
Building Blocks for Learning 🔗 Brooke Stafford-Brizard	***Drivers of human development: How relationships and context shape learning and development*** 🔗 David Osher, Pamela Cantor, Juliette Berg, Lily Steyer and Todd Rose
The Evidence Base for How We Learn 🔗 Stephanie M. Jones and Jennifer Kahn	***Foundations for Young Adult Success*** 🔗 Jenny Nagaoka, Camille A. Farrington, Stacy B. Ehrlich, and Ryan D. Heath
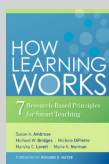
How Learning Works: 7 Research-Based Principles for Smart Teaching 🔗
Susan A. Ambrose, Michael W. Bridges, Michele DiPietro, Marsha C. Lovett, Marie K. Norman
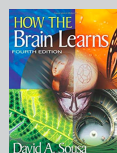
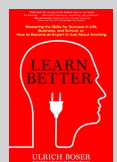**How the Brain Learns** 🔗
David A. Sousa
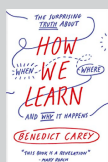
How We Learn: The Surprising Truth about When, Where, and Why it Happens 🔗
Benedict Carey

Learn Better: Mastering the Skills for Success in Life, Business, and School, or, How to Become and Expert in Just About Anything 🔗
Ulrich Boser

Make it Stick: The Science of Successful Learning 🔗
Peter C. Brown
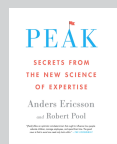
Malleability, Plasticity, and Individuality: How Children Learn and Develop in Context 🔗
Pamela Cantor, David Osher, Juliette Berg, Lily Steyer and Todd Rose

Optimising Learning: Implications of Learning Science Research 🔗
R. Keith Sawyer

Peak: Secrets from the New Science of Expertise 🔗
Anders Ericsson and Robert Pool

The Science of Learning 🔗
Deans for Impact

The Science of Summit 🔗
Summit Public Schools
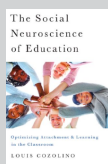
The Social Neuroscience of Education 🔗
Louis Cozolino
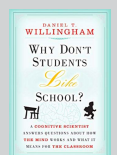
Why Don't Students Like School 🔗
Daniel T. Willingham

As you continue your exploration, consider a few things about your process:

- **Who is involved** - Are the stakeholders most impacted by the decisions you're making—such as learners and families—included in the process? Are you ensuring your full community is well versed in all parts of the content, given that they are inextricably connected? Don't assume, for example, that cognitive principles are not relevant to physical education or that only the adults working with young people who have documented "disabilities" need to understand the role of learning differences.
- **How you break up the work** - Are you spreading out your exploration of learning science in ways that make it manageable and support learning? Will the pacing allow participants

to experience a manageable cognitive load? Will it ensure they have space to make meaning and practice? One example of how you might consider breaking it up is to use this content as a "book study" for professional development.

- **What is the framing** - How are you presenting this work to your community? Is this framed as just an opportunity to learn? Or do those involved feel empowered to make real changes based on their new knowledge?

These considerations will help ensure the process is equitable and supports how learning happens, even for adults!

Apply What You've Learned

In addition to spurring additional exploration and learning, we also aspire for this primer to prompt all of us to apply what we've learned to our own work. Of course, designing for all these principles requires us to think about many interrelated pieces that come together to create the whole. For example, if we aspire to integrate high-quality practice into a learning environment, it means everything from the curriculum to the schedule to the knowledge, skills, and mindsets held by adults will need to align in support of this aspiration.

At Transcend, we use the framework below to help us think about the various "system elements" that must be designed and built in alignment with a community's vision for learning. As you consider how each principle can be applied to your school design, it may be helpful to do so through the lens of these system elements.

Curriculum, Pedagogy, and Assessment	The content young people learn, how they learn it, how they demonstrate that learning, and how they advance to new learning objectives.
Schedules and Routines	How learners move through time, for example, when they arrive and leave, how long they spend engaged in different experiences, and how this varies by learner.
Adult Roles and Adult Learning	How adults (whether staff, volunteers, families, community members, etc.) conceive of their roles, what knowledge, skill and experience profiles those roles demand, and the resources that support how adults communicate, interact, and develop.
Community and School Culture	The makeup, rituals, and climate of the entire learning community.
Community Partnerships	How learners, families, and staff interact with the broader world outside the immediate learning community.

Space and Facilities	How the physical surroundings influence learning, interactions, culture, and connection to the broader community.
Budget, Operations, and Logistics	How budgets are allocated, as well as operational dimensions such as transportation, nutrition, and meal systems.
Ongoing Learning Improvement and Innovations	How everyone in the learning community understands success and progress, learns and reflects together, and influences the evolving model.
Technology and Tech Infrastructure	How learners, families, and school staff engage in online learning and collaboration; build digital fluency; and connect to educational opportunities in the broader world via technology.

As mentioned in the introduction, our **_Designing for Learning Cards_** ∞ can help design teams apply the information in this primer. Each card states one of the 16 principles discussed above on the front and includes "How might we" questions aligned to the implications on the back. These cards are a tool for engaging in various design activities. We included two example activities with the cards linked above. The first activity explains a process for generating design ideas related to the various system elements above based on some or all of the 16 principles. The second walks you through an activity to analyze an existing or aspirational learning environment for some or all of the principles.

What's Next for Transcend

At Transcend, we will continue to explore the research on how learning happens with the goal of making this knowledge increasingly accessible and usable for design teams everywhere. This will inevitably involve continuing to update this primer based on new research and what we learn from using it with our school partners. Over time, we will take on a few concrete projects in order to further expand the knowledge base, which are briefly described below.

- **Elaborating on Implications for Design** - We'll work to further understand the many design decisions that could support the research on how learning happens.
- **Illustrating the Principles in Action** - We'll engage in a focused search for school designs that embody the ideas in this primer.

We recognize that many other individuals and organizations are also tackling similar challenges. If you are interested in collaborating with us as we embark on this journey, please email **cynthia@transcendeducation.org** ∞ .

Principles of Learning & Implications for Learning Environments

Cognition

Principle 1: Focused Attention
People learn best when they direct their focus toward the content and experiences most relevant to learning.

To support <u>Focused Attention</u>, learning environments should:
- ❏ Help learners feel physically and psychologically safe and healthy
- ❏ Ensure learning objectives and activities are clear
- ❏ Minimize sensory distractions

Principle 2: Manageable Cognitive Load
People learn best when they are challenged but are processing a manageable amount in their working memory.

To support <u>Manageable Cognitive Load</u>, learning environments should:
- ❏ Minimize cognitive and emotional distractors
- ❏ Break learning into manageable, logically sequenced increments
- ❏ Represent content and experiences clearly
- ❏ Respond to individual learner readiness with tailored supports and pacing
- ❏ Ensure individual learners achieve competency with prerequisite objectives before they move on

Principle 3: Meaningful Encoding
People learn best when new learning is experienced in memorable ways and is related to prior knowledge.

To support <u>Meaningful Encoding</u> learning environments should:
- ❏ Promote distinctive or emotionally compelling learning experiences
- ❏ Ensure learners connect new learning to their prior knowledge and experiences
- ❏ Help learners see underlying factual and conceptual connections
- ❏ Integrate multiple representations of content through different modalities, problem types, and contexts

Principle 4: Effective Practice
People learn best when they practice challenging-but-doable skills at frequent, focused intervals and across diverse contexts.

To support <u>Effective Practice</u>, learning environments should:
- ❏ Use each learner's current proficiency to plan opportunities for practice
- ❏ Provide learners sufficient opportunities to engage in focused, frequent practice across diverse context at various points in learning?
- ❏ Build learners' own understanding of effective practice

Principle 5: High-Quality Feedback	**To support <u>High-Quality Feedback</u>, learning environments should:**
People learn best when they receive timely and targeted feedback to guide their improvement.	❏ Build learners' understanding of what success looks like ❏ Offer sufficient, timely opportunities for giving and receiving feedback so learners can improve ❏ Ensure feedback provides a sufficient and accurate analysis of a learner's progress and guidance for improving
Principle 6: Metacognitive Thinking	**To support <u>Metacognitive Thinking</u>, learning environments should:**
People learn best when they are able to plan, observe, evaluate, and adjust their own learning processes.	❏ Make the skills and mindsets that support metacognition explicit learning objectives ❏ Help learners understand how different beliefs and messages may be impacting their thinking ❏ Ensure opportunities for learners to apply metacognitive thinking strategies across all learning contexts ❏ Develop a culture where thinking about one's thinking is the norm

Motivation

Principle 7: Value	**To support <u>Value</u>, learning environments should:**
People learn best when they find the content, outcomes, process, and/or relationships associated with learning to be important and relevant.	❏ Ensure that *what* is being learned feels relevant to all learners' interests and goals ❏ Ensure *how* learning occurs feels compelling to learners ❏ Enable learners to work with peers and adults with whom they have meaningful relationships ❏ Only use extrinsic rewards sparingly and to support progress toward intrinsically motivating goals
Principle 8: Self-Efficacy	**To support <u>Self-Efficacy</u>, learning environments should:**
People learn best when they believe in their ability to grow and achieve mastery of what they are learning.	❏ Engage learners in tasks that are challenging but doable ❏ Help learners regularly set goals, plan toward them, and reflect on their progress ❏ Reframe failure as a temporary state that can be changed by changing one's behavior ❏ Ensure learners have trusted adults from whom they can seek help when they feel insecure about their abilities

Principle 9: **Sense of Control** People learn best when they perceive that they have meaningful and appropriate agency over their learning.	**To support <u>Sense of Control</u>, learning environments should:** ❏ Provide appropriate autonomy over when, where, or how learning is pursued ❏ Help learners attain the supports and resources needed to achieve their goals ❏ Minimize external barriers to learning
Principle 10: **Constructive Emotions** People learn best when they are in constructive emotional states versus feeling excessive stress or anxiety.	**To support <u>Constructive Emotions</u>, learning environments should:** ❏ Be warm and and joyful spaces ❏ Foster positive relationships between peers as well as between adults and learners ❏ Support physical and psychological health and wellbeing ❏ Help learners diffuse negative emotional states

Identity

Principle 11: **Self-Understanding** People learn best when they have a deep understanding of who they are and can use this knowledge to maximize their learning.	**To support <u>Self-Understanding</u>, learning environments should:** ❏ Deepen learners' understanding of their life story, heritage, and community ❏ Immerse learners in new contexts and activities ❏ Offer opportunities for learners to express their various changing identities ❏ Help learners reflect on their current identities, desired future identities, and how best to bridge the two
Principle 12: **Sense of Belonging** People learn best when they feel connected to, and accepted by, the people and environment around them.	**To support <u>Sense of Belonging</u>, learning environments should:** ❏ Feel relevant to and celebrate learner's identities ❏ Provide all learners with opportunities to be heard and encourage participation ❏ Hold high expectations for all learners ❏ Help learners understand self-doubt happens to everyone ❏ Minimize zero-tolerance and utilize restorative practice to re-establish trust and connectedness

Principle 13: Navigating Identity Threats People learn best when negative beliefs associated with their identity are minimized or buffered against.	**To support <u>Navigating Identity Threats</u>, learning environments should:** ❏ Cue learners' motivating identities over identities that may trigger stereotypes or self-doubt ❏ Minimize actions, words, or images that may trigger stereotypes or feelings of self-doubt ❏ Expose learners to individuals who have countered identity threats ❏ Support learners in understanding and acting against systemic inequity and personal experiences of bias

Individual Variability

Principle 14: Life Experiences People learn best when their unique life advantages and adversities are understood and responded to.	**To support <u>Life Experiences</u>, learning environments should:** ❏ Understand the unique privileges and adversities that each learner carries ❏ Ensure each learner is supported by a caring adult ❏ Use trauma-informed practices to respond to adverse childhood experiences ❏ Provide or connect learners and their families with non-academic resources and supports ❏ Leverage assets in learners' home and community contexts to support learning
Principle 15: Developmental State People learn best when their experiences align with where they are developmentally.	**To support <u>Developmental State</u>, learning environments should:** ❏ Support key developmental tasks that occur across different phases of life ❏ Respond flexibly to reach all learners at their *unique* developmental zones physically, cognitively, socially, and emotionally ❏ Support learners in understanding and responding to their own development
Principle 16: Learning Differences People learn best when their unique learning needs are identified and resources and supports are aligned with these needs.	**To support <u>Learning Differences</u>, learning environments should:** ❏ Ensure individual learners' unique needs and strengths are understood by adults and learners themselves ❏ Respond to differences by enabling learners to take in, engage with, and demonstrate learning in different ways ❏ Provide tailored scaffolds and supports in response to specific needs ❏ Maintain high standards for all learners no matter their unique needs

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