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# Human Learning and Development: Theoretical Perspectives to Inform Assessment Systems

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## INTRODUCTION

Advances in understanding the complexity and fundamentally cultural nature of human learning and development are foundational for efforts to achieve equity in educational systems at all levels: classroom instruction, curriculum, and assessment; district, state, and federal accountability assessment; and teacher preparation and learning in practice. In this chapter, we draw heavily on analyses and syntheses of human learning and development research from multiple perspectives (e.g., sociocultural, cognitive, epigenetic) and across multiple disciplines (e.g., neurosciences; cognitive, developmental, and social psychology; anthropology; learning sciences and education sciences). The conception we outline herein acknowledges how multiple dimensions of human development and learning (e.g., cognitive, social, emotional) are interdependent and culturally situated. Accordingly, all facets of educational systems need to focus on the whole child, as well as the multiple communities in which a child is situated.

The conception we outline asserts that learning unfolds through participation in the cultural practices of families and communities—including school classrooms, disciplinary communities (e.g., mathematics, science, social studies, literature, the arts), and out-of-school interest and affinity groups. It emphasizes the processes, not just the outcomes, of human learning. These processes encompass psychosocial dimensions of development (e.g., identity, resilience, mindset), including the emotional dimensions of such development, as well as the cognitive. Furthermore, this conception makes clear that diversity is a fundamental characteristic of the human species. It is thus essential to understand the diversity learners bring to formal and informal learning contexts, the pathways their learning takes, the support they need to make those journeys, and the outcomes of their learning and development.

We are not the first to argue for an expanded view of the goals of schooling if educational systems are to be able to prepare citizens for life in the 21st century. As we entered the 21st century, various sectors of society noted the transformation of the U.S. and global economy from one rooted in assembly line mass production to one that valued innovation, creativity, and relational rather than individual ways of working (21st Century Workforce Commission, 2000; Ananiadou & Claro, 2009; Binkley et al. 2012; Griffin et al., 2012; Voogt & Pareja Roblin, 2012). Dubbed by some the "knowledge society," competencies deemed important for success entail problem solving, collaborative work, and flexible knowledge to support its use in new and novel situations. "Deep learning" emerged as the term to capture the contrast between learning to reproduce content and procedures in contrast to instruction that aimed for principled knowledge that allowed knowledge learned in one context to transfer and be useful in new situations (National Research Council, 2012; William and Flora Hewlett Foundation, 2013). There was also a push to expand the range of targeted competencies beyond cognition, including what the National Research Council (2012) referred to as intrapersonal and interpersonal competencies. The intrapersonal include intellectual regulatory, monitoring, and evaluative competencies and the interpersonal include collaborative, leadership, and communicative competencies. Fullan (2015) proposed a similar set of "deep learning" goals that he referred to as the 6 Cs: character education, citizenship, communication, critical thinking and problem solving, collaboration, and creativity and imagination.

Character education and citizenship, he argued, were essential to individuals' well-being and positive relationships with others (Fullan, 2015).

In a similar vein, the recent National Academy of Education report *Educating for Civic Reasoning and Discourse* argues that public education, in particular, plays an important role in preparing young people to engage in civic reasoning and discourse (Lee et al., 2021). The complex structure of democracy in the United States is designed with pathways to assist in navigating differences. This type of democratic republic requires both knowledge of the structures of governance and that citizens—broadly defined to include all who live in the country—embody dispositions to empathize with others, weigh multiple points of view and evidence, and value complexity over simplistic responses to complex problems. Thus, an expansive, equity-focused system of education and its assessments should address these dispositional goals as well.

In contrast to this expansive view of educational goals, traditional educational goals and assessments have been focused on achievement narrowly defined as cognitive skills, procedures, and an established canon of information (see Chapter 1 of this volume, "Reimagining Balanced Assessment Systems: An Introduction"). Progress through school has been measured by normative definitions of adequate progress—typically one year's worth—along these cognitive dimensions. Whether through the National Assessment of Educational Progress (NAEP) or state assessments, there is a persistent history documenting disparate learning outcomes associated with race/ethnicity and class (de Brey et al., 2019). These assessment outcomes have been used to sort students, leading to widespread tracking and an absence of robust learning opportunities for racially and ethnically minoritized students, students from rural areas, and students whose families live in poverty (Legette, 2018; Lucas, 1999; Oakes, 2005; Tyson, 2011). In addition, outcomes from state and district assessments have been used for accountability, often resulting in even more restrictive teaching under the assumption that students with presumed lower-level skills cannot be taught complex conceptual knowledge. Balanced assessment systems—as defined in Chapter 1 of this volume, "Reimagining Balanced Assessment Systems: An Introduction"—require reframing the purposes of assessment from sorting and accountability to providing actionable information about student thinking and learning, information that supports teachers in meeting students where they are, and providing culturally responsive and sustaining learning opportunities (Armour-Thomas et al., 2019; Evans, 2021).

Enacting balanced assessment systems that are aligned with 21st-century conceptions of the goals of schooling requires reckoning with the complexity of human learning and development and acknowledging its fundamentally sociocultural and situative dimensions (Greeno & Middle School Mathematics through Applications Project Group, 1998; Nasir et al., 2021; Rogoff, 2003). Contemporary research on human learning and development calls for reconceptualizing assessment to reflect cultural, social, emotional, and cognitive dimensions (National Academies of Sciences, Engineering, and Medicine, 2018). Broadening and expanding what is to be learned and how it is learned requires changes in both what is assessed and the systems that do the assessing (Darling-Hammond & Conley, 2015). At the student level, assessments need to consider students' cultural repertoires, the ecological systems that support their learning inside and outside of school, and how these interact with assessments of the multidimensional components of learning (e.g., the 6 Cs [Fullan, 2015], the three sets of

competencies delineated by National Research Council, 2012; and the civic reasoning and discourse goals identified in Lee et al., 2021). At the classroom level, the what and how of instruction and the what and how of assessment should be both aligned and coherent. At the systems level, interpretations of assessment outcomes should account for key indicators that mediate outcomes—such as Opportunity to Learn (OTL; Marion, 2020)—and the availability of resources for teachers to create classrooms rich in OTL (e.g., time and material resources as well as structures for ongoing teacher learning).

In brief, we argue that robust balanced assessment systems will yield the most productive information if informed by a comprehensive understanding of the complexities of human learning and development. In this chapter, we first outline a basic contemporary understanding of these complexities, and then consider the implications for equitable classroom learning, instruction, and assessment.

## THE COMPLEXITIES OF HUMAN LEARNING AND DEVELOPMENT

The fundamental propositions regarding human learning and development reflected in this chapter are informed by a variety of disciplinary research, including developmental sciences, cognitive sciences, learning sciences, educational science, neurosciences, social psychology, and anthropology (Lee, 2017; Lee et al., 2020; Nasir et al., 2020; National Academies of Sciences, Engineering, and Medicine, 2018). The dispositions entailed in human learning are rooted in our evolution as a human species, including making sense of experiences, developing supportive relationships, "reading" others' internal states, and feeling efficacious and safe (Cole, 2007; Quartz & Sejnowski, 2002; Tomasello, 2021). Thinking and learning are not solely cognitive activities—knowledge construction and organization involve motivational, affective, perceptual, and conceptual dimensions. The process of making sense of experiences involves recruiting prior knowledge as a resource for engaging new learning; understanding perceptions of the self along multiple dimensions; and analyzing perceptions of tasks, including the relevance of settings and relationships with others in those settings. These dimensions are in dynamic relationship with one another during learning.

Learning is anything but a passive process. Psychological, developmental, and neurosciences research have established that learners actively interact with people, other animals, objects, and physical environments (National Academies of Sciences, Engineering, and Medicine, 2018; National Research Council, 2000). Learners select what they attend to, as well as how they interact and with whom. These decisions are influenced by the learners' perception of themselves along multiple dimensions, what they perceive as relevant knowledge, the emotional salience they attribute to their experiences, the resources they recruit from the historical moments of their life experiences, and the repertoires they employ from their participation in multiple cultural communities of practice (Spencer, 2006). Perceptions of the self include a sense of self-efficacy, motivation, and relevance. Indeed, there are well-established correlational relationships among academic resilience (e.g., dealing effectively with challenges, setbacks, adversity, and pressures in the academic setting), motivation, self-efficacy (confidence as a learner), and persistence (e.g., Martin & Marsh, 2006).

The correlational findings are supported by experimental behavioral and neurosciences studies that have established that the cognitive/knowledge and psychoso-

cial dimensions of learning intersect in significant ways (Osher et al., 2018). On the behavioral side, Dweck (2006) and Good and Dweck (2006) report that people's beliefs about the nature of intelligence impact their motivation to learn and their willingness to exert effort during learning tasks. Those who believe that intelligence is fixed and unalterable are less likely to persist and invest effort in academic tasks—especially if they are challenging—compared to those who believe that intelligence is malleable. Cognitive neuroscience provides evidence that thinking, feeling, and perceiving operate in dynamic relations with one another at the neural level. As learning occurs, regions of the brain associated with social and affective processes are activated, along with regions associated with cognitive processes and executive functioning (e.g., Damasio, 1995; Immordino-Yang & Damasio, 2007).

Neural pathways in the brain evolve as humans observe, imitate, interact with, and take their cues from those in their cultural, experiential, and interactional contexts. Although the brain is most malleable from infancy through adolescence, it retains its plasticity across the life course (Cantor et al., 2018). Contrary to conceptions that the brain is wired at birth and will never change, neural pathways and connections are responsive and transform throughout the lifespan. Understanding this reality contributes to growth mindsets that promote persistence—especially in the face of challenging tasks.

### Learning Is Participation in Cultural Practices

Learning is fundamentally social: humans interact with other humans and the cultural artifacts that human communities create across time (Rogoff, 2003). Cultural artifacts are manifestations of the routine cultural practices of a community, including their belief systems, systems of knowledge, routinized forms of social interaction, the tools for problem solving that they create (Cole, 1998), and the ways of using language that characterize participation in that community's practices (Gutiérrez & Rogoff, 2003; Rogoff, 2003). People participate in multiple communities of practice across multiple settings (Bronfenbrenner & Morris, 1998), beginning with the family and broadening to extended family groups and age- and interest-based communities (e.g., infant and toddler groups, sports clubs, school communities). Individuals begin as peripheral participants in these communities and gradually—through observation, imitation, and incrementally increasing their involvement in the community's routine practices—develop into fully participating members (e.g., Lave & Wenger, 1991). In moving from peripheral to full participation in these groups, learners adopt and adapt the group's discourse, norms, and values. Social relationships and attachments and perceptions of safety, self-efficacy, and relevance matter for development and goal setting (Bandura, 1993; Barron, 2006). In particular, perceptions of the self develop and unfold over the life course—including of the self as an individual, as a member of social groups, and as a member of cultural communities characterized by routine cultural practices and belief systems that evolve and have longevity over time and space.

Thus, participation in cultural practices and social interactions is essential to human development from the moment of birth in all areas of development: Learning language, learning to infer the internal states of others—human and animate, learning to walk and learning to manipulate objects (Gopnik et al., 1999; Kuhl & Meltzoff, 1996; Lee et

al., 2020; Meltzoff, 1988, 2013). In the case of language, at birth, infants can hear all the sounds and phonemes of all human languages (Meltzoff et al., 2009). However, through imitating, hearing, testing, and reproducing the sounds of the language or languages around them, infants' neural networks undergo a pruning process to hone in on the functionalities of the language or languages of their social environment (Kuhl, 2011; Kuhl et al., 2014; Meltzoff & Kuhl, 2016). Language development also illustrates that human learning is an outgrowth of biological processes, taken up as people engage in the routine cultural practices of a range of social groups, beginning with the family and extending outward to peers, affinity groups, community-based groups, etc.

The diversity of cultural practices in which an individual participates necessarily gives rise to variation in pathways, processes, and timing of what is taken up by whom and under what conditions. That is, while there are fundamental tasks to be accomplished at different stages of the life course—particularly from infancy through adolescence—how these tasks are learned and what social and individual functions they play are diverse, influenced by the communities of routine cultural practices in which the individual develops (Rogoff & Chavajay, 1995). Diversity is also crucial to adaptability and survival. For example, diversity in the gene pool increases the resilience of a species and the likelihood of survival in the face of extreme threats (Booy et al., 2000). Thus, diversity in pathways of development is both normal and essential for the evolution of the species.

### Constancies in Learning and Developmental Processes

At the same time that we can expect diversity in how individuals accomplish fundamental tasks at different life stages, developmental theorists identify several constancies of development and learning. One such constant is the homeostatic principle: systems seek to maintain balance. Jean Piaget referred to this as equilibration: organisms strive to achieve a balance between the new (accommodation) and the old (assimilation) (Ginsburg & Opper, 1988). Humans strive to balance the degree to which they change in response to new experiences and social interactions against the degree to which they fit new ideas or experiences into their existing conceptions of the physical, cognitive, and social worlds. In the social realm, Heider (1958) argued that humans seek balance in relations by choosing new groups as we change or changing our beliefs and thinking to fit the groups we are in.

Continuity and change as constant oppositional forces in learning and development also play a central role in Lev Vygotsky's sociocultural theory (van der Veer, 2014). For Vygotsky, development and learning could only be understood by considering both what is known and what is yet to be learned, with the latter reflecting the process of learning. He proposed that accounting for development and learning required the consideration of what children could do on their own (what is known) and what they could do in collaboration with adults, labeling this the *zone of proximal development* (ZPD) (Zaretskii, 2009). What the learner can do on their own reflects what has developed; what they can do with the assistance and guidance of a more knowledgeable other—typically an adult but also possibly more knowledgeable peers—is the process of learning. Providing effective guidance depends on assessing what the learner can do on their own in conjunction with an understanding of what constitutes "next steps" in

that individual's learning process. In other words, providing effective guidance must consider where the learner is as well as where they are going—what processes have completed their cycle of development as well as what processes are still in development. Zaretskii (2009) also pointed out that while Vygotsky died before setting out the pedagogical implications of the ZPD, concepts such as diagnostic assessment and dynamic assessment (Feuerstein, 1979; Feuerstein et al., 2002) are outgrowths of Vygotsky's broadening the conception of development to include not just what has developed but the learning process that creates future developmental outcomes.

Finally, as humans participate in cultural practices and what they know about the world and themselves grows, information becomes more differentiated, creating a need for organizing systems (Werner, 1957). An apt example of differentiation comes from Nelson's (1973) account of word learning. She proposed that during early word learning, labels are applied in accordance with the functions of objects. That is, anything that is round, rollable, and/or throwable may initially be labeled *ball*. This concept becomes differentiated as toddlers interact with perceptually round objects that vary in size, texture, squeezability, bounceability, and so on. At some point, toddlers distinguish between round things and create functionally relevant distinctions (e.g., balls that bounce, balls that we eat such as apples or oranges). With respect to content taught in school, similar reorganizations should be expected as students acquire content through their experiences in communities of classroom practice. Organizational systems must be adaptive and allow individuals to use what they know to function flexibly in response to changing environmental and contextual conditions.

### Principles of Human Learning and Development

Box 3-1 summarizes the foundational principles of human learning and development we have discussed. These principles are at the core of efforts to develop balanced assessment systems and practices as defined in this volume (see Chapter 1 of this volume, "Reimagining Balanced Assessment Systems: An Introduction"): systems that are centered and designed to function at the classroom level to provide teachers and students with feedback that guides instruction and supports students with appropriate learning opportunities. Developing such systems requires expanding and differentiating among the existing purposes and functions of assessment (e.g., Bennett, 2011; Penuel & Shepard, 2016; Shepard, 2019). That is, balanced assessment systems must expand beyond summative assessments *of* learning, often used to sort students, to focus on assessment *for* and *as* learning (Black & Wiliam, 2009; Wiliam, 2011). Assessment *for* learning provides information about where students are relative to where they are headed, thus informing ongoing instructional planning to support further learning (e.g., Bennett, 2011; Penuel & Shepard, 2016; Shepard, 2019). Assessment *as* learning reflects the inherently social and cultural nature of learning, a principle fundamental to our argument in this section. Assessment *as* learning focuses on the process of learning as it is happening and is visible to participants in the learning situation (Bennett, 2011; Penuel & Shepard, 2016, Shepard, 2019). All three types of assessments should attend to the range of prior knowledge, dispositions, and belief systems that learners bring to new opportunities to learn. Admittedly, this is a complex mandate to achieve but it is critical to creating anti-racist and equitable educational systems.

**BOX 3-1**
**Foundational Principles of Human Learning and Development**

- Learning entails dialogic relations among thinking, emotional salience attributed to experience, and perceptions of the self along multiple dimensions
  - Thinking and the role of prior knowledge in new learning
    - Conceptual knowledge
    - Procedural knowledge
    - Epistemology
  - Emotional salience
    - Perceptions of safety and self-efficacy (e.g., growth mindset)
    - Perceptions of relevance
  - Perceptions of the self
    - As an individual
    - As a member of cultural communities of practice (family; social networks; interest networks; and institutional settings such as schools, community organizations, age cohorts, etc.)
- Relationships matter
- Participation in routine cultural practices within and across settings, within and across time
  - Affordances of artifacts, belief systems, and practices in cultural communities
  - Relationships across different cultural communities of practice
  - Where learners are in the life course
- Learning is malleable across the life course
- Diversity in developmental pathways is essential for the human species

## IMPLICATIONS FOR TEACHING, LEARNING, AND ASSESSMENT

The foundational principles of learning and development we have identified imply several goals for designing robust and equitable learning environments, several of which are included in Box 3-2. New learning needs to build on what learners already know, based on their experiences as well as the language and discourse practices with which they are familiar. At the same time, more knowledgeable others (e.g., adults, peers) with whom learners interact introduce new ways of thinking, reasoning, and using language in ways that extend but connect to what learners already know and do. Making thinking and knowledge construction processes visible and objects of reflection makes the processes learners are engaged in concrete, helping to bridge the new and old, creating a means of balancing assimilation and accommodation processes. Periodically, learners will shift how they organize what they know to reflect differences and similarities that become noticeable as they accumulate more information through interaction with others and objects in their environments. Such reorganization can be expected to have functional value for the learner, making routine tasks and cultural practices more efficient and effective. Assessment that targets processes of reorganization has the potential to contribute new insights to the diversity of developmental trajectories that characterize human learning.

The design goals specified in Box 3-2 should guide the goals, purposes, and motivations for making decisions about curriculum (what content, principles, and perspec-

**BOX 3-2**
**Goals for Designing Robust and Equitable Learning Environments**

- Connect students' prior knowledge and experiences across multiple domains to new learning targets
- Build nurturing relationships
- Make reasoning processes public
- Focus on rich conceptual knowledge and the practices by which it is generated
- Support students as they engage in inquiry, knowledge-building, and reorganization
- Support students in seeing and understanding the relevance of learning targets to students' perceptions of their needs
- Support and position students as self-efficacious

tives will be taught), instruction, and assessment practices. Goal setting and purposeful learning arise out of perceptions of the epistemic goals and relevance of the task(s) (i.e., why am I doing this?), self-efficacy about the task(s), and relationships with others in the setting (Eccles & Wigfield, 2002). These perceptions undergird motivation to engage, persist, and achieve the end goal. When learners have little understanding of the purposes of the work they are doing and do not perceive the relevance of the tasks they are asked to complete, they are likely to have little to no motivation and exert minimal. Epistemic purposes that contribute to robust and equitable learning include valuing complexity and inquiry. These purposes contrast with memorizing facts and procedures "for the test." Teaching and assessments need to pay greater attention to differences in learners' perceptions of epistemic purpose and relevance and work toward those that foster engagement in inquiry and grappling with complexity.

In addition, realizing the design goals shown in Box 3-2 requires embracing a vision of instruction and assessment as participation in communities of cultural practices. The norms, discourse, values, and goals inherent in cultural practices are negotiated and re-negotiated by the members of the community, making a shared sense of agency, authority, and ownership possible (Gee, 1992; Lave & Wenger, 1991). Increased attention to where and with whom the agency and authority for making these decisions lies is fundamental to achieving anti-racist equitable educational systems. Deliberations around such decisions need to involve multiple stakeholders, including teachers, parents, students, community stakeholders, and governmental authorities. Ideally, such deliberations are informed by commitments to democratic principles and equitable goals.

### Designing Learning Environments as Communities of Cultural Practices

Learning environments designed to create communities of cultural practices are not only consistent with the complexity of human learning and development but can also be a powerful means of supporting active, agentive learning in educational settings (Lee, 2010). Classroom communities of practice engage students in the active construction of knowledge, asking them to wrestle with conundrums that arise in their inquiries and to

work independently and collaboratively to make sense of often conflicting information, perspectives, and values. The goals of school-based communities of cultural practices can include both knowledge construction in the moment and individual and collective development in the future.

The sensemaking processes in which students engage in classrooms designed as communities of practice are developmentally appropriate forms of the knowledge generation processes and practices engaged in by members of professional disciplinary communities. Rather than simply learning facts and procedures, classroom communities of practice engage students in doing intellectual work that approximates professional disciplinary practice. Knowledge is generated or constructed through interactions with others, material resources, and goals (e.g., Vygotsky & Cole, 1978). As such, these classrooms instantiate a form of apprenticeship in which more knowledgeable others (e.g., teachers, mentors, tutors, and peers) make knowledge generation processes (cognitive, intrapersonal, interpersonal) and the results of those processes (solutions to problems, theories and revisions of theories, tools) visible (Collins et al., 1989). These interactions and observations become the basis of internalized knowledge representations and include cognitive (memory, perceptual, reasoning process), social, and affective dimensions. In turn, what has been internalized shapes how learners experience and observe subsequent interactions—how and what learners think and feel arises from complex interactions that reflect learners' cultural and contextual circumstances. The individual and their community are changing and evolving together through their joint participation (Rogoff, 1997). Learning is then defined, in part, as the transformation of an individual's participation in valued social and cultural activities. Such learning can also involve transformations of what social and cultural practices are valued. Which processes an individual engages in can involve emotional, motivational, and relational aspects of self—not just knowing (Holland & Lave, 2009).

Content domains or disciplines can be conceptualized as communities of practice wherein the members negotiate and re-negotiate the norms, conventions, and criteria for proposing, arguing for, establishing, and evaluating knowledge claims and the arguments put forth to support them (Lave, 2012; Lave & Wenger, 1991). Criteria are established for what constitutes valid and reliable inquiry practices, including patterns of logic and reasoning for connecting evidence to the claims it is intended to support (Toulmin et al., 1984). Evidence that does not meet these criteria compromises whatever claims are being made on the basis of that evidence. Members of a disciplinary community also share common epistemic commitments to the aims, goals, and purposes of argument and knowledge generation within their discipline (e.g., explanation, evaluating alternatives, proposing policies) and the representational forms used to communicate their ideas with one another (e.g., Bazerman, 1985; Goldman et al., 2016; Shanahan et al., 2011). It is important to note that disciplinary communities often invite contestation and diversity of aims and goals (e.g., Knorr Cetina, 1999). Such dispositions are often reflected in contested power relationships manifesting from the history of who has contributed to specific norms, modes of reasoning, and forms of representation. One example includes recent attention to Indigenous knowledge systems as scientific conceptions of the relationships between humans and the rest of the natural world (Bang & Marin, 2015). At the same time, it is important to recognize that disciplines evolve. As Kuhn (2012) notes, the evolutionary histories of a variety of disciplines are

replete with consequential shifts in assumptions about what counts as evidence and epistemic goals. For example, Osborne et al. (2003) have argued that students need to study the history of science to understand how epistemic shifts unfold and why, leading to a deeper understanding and appreciation of science itself. As teachers navigate the integration of students' cultural repertoires into content area instruction, knowledge of these epistemic negotiations is important. These epistemic negotiations are also important for those engaged in assessments (e.g., diagnostic, formative, summative) so that they might bring such breadth of knowledge to assessment design. We illustrate the relationships between everyday cultural repertoires and disciplinary knowledge in the final section of this chapter.

As such, instruction and assessment based on the goal of engaging learners in developmentally appropriate forms of the cultural practices of the discipline apprentice learners into becoming full participants in *classroom* disciplinary communities replete with the cultural practices of knowledge generation, including multiple ways of participating in disciplinary inquiry. In such classrooms and learning situations more broadly, learners build an understanding of disciplinary concepts, principles, processes, representational forms, discourse genres, and conventions of language use through inquiry processes and problem solving.

One issue for consideration in the context of anti-racist and equitable instruction and assessment design is how decisions are made regarding what is developmentally appropriate and what constitutes acceptable diversity in conceptions of the disciplines. Do those decisions reside at local, national, or federal levels? If manifest in standards, what latitude is there for adaptation at the local level to address learners' diversity in experiences, language, goals, and values?

### *Challenges of Design and Implementation*

There are several challenges inherent in designing and implementing communities of disciplinary practice in classrooms. First, it is important to recognize the complexities of what is presumed a disciplinary community of practice, and by whom. Some disciplines—as in the study of literature or history—value debate on the logic of argumentation and place high value on relations between claims and evidence. Considerations of what it means to recruit repertoires of knowledge, practice, and discourse from students rooted in diverse cultural communities requires revisiting what constitutes disciplinary practice. Indeed, this is not a challenge isolated to students from diverse cultural communities because, typically, few students enter classrooms having experienced the discourse and formal practices of disciplines. Such considerations may include theorizing what are the conceptual and discursive relationships between everyday cultural practices and an academic discipline; rethinking the historical evolution of knowledge within a given discipline; and/or examining the diverse forms of reasoning and representations of concepts that may be captured across different cultural communities. Indeed, how federal and/or state standards are specified as "developmentally appropriate" is bound up in issues of who decides what is valued and the latitude afforded for adaptations at various levels of the educational system (e.g., specific districts, schools, teachers, students), adaptations that value and respect the specific implementation context. The point here is that connecting the repertoires that students bring into the

classroom with what may be identified as formal disciplinary knowledge is a complex undertaking. Due to this complexity, thinking about how to design instruction and assessments that make these connections visible requires systemic support.

Effective learning spaces are safe, efficacious, and driven by attachments to other people. Such spaces value and build on cognitive, social, and cultural resources that individuals bring to learning situations—whether those situations are formal schooling, virtual, or community spaces. Dispositions toward learning, identity as learners, and resilience in the face of adversity are important orientations to formal and informal instructional situations. For example, instructional literacy programs that build on Indigenous Hawai'ian narrative participation structures, African American narrative structures, and rapping all welcomed and valued linguistic repertoires not typically sanctioned in formal school settings (Au, 2013; Champion, 1997, 2003; Emdin, 2013; Pinkard, 1999). In these situations, students were invited into the conversation in ways that made safe spaces for participating in the linguistic practices of the school curriculum. Later in this chapter, we offer case studies of teaching, learning, and assessment designs that push the boundaries of traditional conceptions of particular disciplinary communities of practice.

The multidimensional nature of human learning implies that classrooms organized as disciplinary communities of practice need to attend to the interconnected social, emotional, cultural, and cognitive facets of learning and development. This attention includes critical examination of what is assumed to constitute disciplinary communities of practice. Conceptualizing disciplinary communities of practice in the context of schooling involves understanding distinctions between expectations in professional disciplinary communities and the developmental demands of disciplinary learning in schools, as well as examining the historical and political influences on how a given discipline is represented institutionally. Creating and valuing multiple pathways and trajectories is fundamental to achieving equitable instruction that is safe, supportive, and efficacious across a broad spectrum of learners.

## Implications for Assessment Systems

Balanced assessment system design is a critical aspect of achieving equitable learning environments. As cogently argued by Shepard (2021) and Shepard et al. (2018), assessments that inform learning must be closely aligned to where and how learning is happening, as well as how that learning and its assessment are supported. In the context of schooling, that means assessment must be closely aligned with instructional practices, processes, and outcomes. Thus, assessment must be reconceptualized, designed hand in hand with instruction, and both assessment and instruction need to attend to knowledge as well as the social and affective dimensions of learning. In the following, we briefly discuss the limitations of currently available instructional and assessment materials to show why a fundamental and thorough reconceptualization of both is necessary to address the cultural foundations of learning.

*Limitations of Existing Commercial Products*

Most commercial curricula include instructional practices embedded in materials and tasks, as well as resources for assessing student learning. However, there are few examples of commercial instructional materials, including curricula and assessments, that embody the principles of learning and development discussed in this chapter. Even diagnostic assessments fall short, even though they are typically closest to instruction on the ground and are intended as assessments *for* learning. Specifically, diagnostic assessments often provide a picture of only what a student has already mastered and can do independently (assessment *of* learning), ignoring the exploration of what the student can do with support or in collaboration with peers, tutors, or teachers (assessment *as* learning). The concept of learning progressions, however, can contribute to teaching and the design of assessments that consider what students can do with support (Duncan & Hmelo-Silver, 2009; Duschl et al., 2011). Research on learning progressions, most focusing on mathematics and science, identifies conceptual relationships between lower-level skills and higher-order reasoning. Typical diagnostic assessments do not capture many important aspects of the learning process because they are often constrained to a subset of facets of the knowledge dimension. There are, for example, no easily available commercial diagnostic assessments of epistemological orientations, perceptions of self or tasks, recruitment of cultural repertoires into sense-making and problem solving, or engagement with disciplinary practices. Understanding what students can do with support requires understanding the relationships between what students already know and the demands of the "next level" of tasks. Furthermore, pathways of support must go beyond the cognitive, to attend to epistemology, understandings of the self and the task, and of relationships among those engaged in the learning process.

Existing assessments are also severely limited with respect to the aspects of disciplinary learning that are assessed, especially for social studies, science, and the arts. In reading comprehension—whether diagnostic, formative, or summative in function—few if any assessments provide insight into how students reason with texts. Furthermore, although knowledge of academic language is essential to reading, writing, and discussion within and across academic disciplines, it is not widely assessed. This is so despite the existence of a useful assessment of academic language, namely *Core Academic Language Skills* (Uccelli et al., 2015). Assessments of writing tend to focus on mastery of rhetorical structures with a lesser emphasis on content, logic, and reasoning. Writing assessments also rarely if ever consider the functions of language variation as rhetorical tools. Finally, although we have emphasized the importance of perceptions of safety and belonging in learning, attention to social-emotional learning is typically siloed and not integrated into content area instruction and assessment.

*Designing to Address the Cultural Foundations of Learning*

In brief, we argue that what is needed is a fundamental reconceptualization of how learning-centered assessment addresses the cultural foundations of learning. Thinking, feeling, and perceptions are intertwined, and it is these relationships that fuel learning. Accordingly, instruction and assessment must address these relationships. Both instruction and assessment need to encompass the breadth of knowledge, problem

solving, and epistemological orientations within content domains, as well as the history of knowledge construction that accurately captures students' contributions across time and space. In addition, instruction and assessment need to encompass conceptions of possible and expansive futures and the kind of supports needed to propel students to realize these futures. Undertaking such a reconceptualization is a prerequisite for ensuring that assessment plays a pivotal role in providing actionable information regarding the full range of competencies that inform and explain learning. Critically, such a reconceptualization needs to address issues of equity for communities that face persistent structural challenges related to race, ethnicity, gender, socioeconomic status, perceptions of ability, or language variation.

Learning-centered assessments need to provide insights and feedback about the following issues:

- Opportunity to learn as reflected in, for example, teacher quality, curriculum quality, and access to expansive learning
- What knowledge and reasoning is valued and worth assessing as well what counts as legitimate displays of that knowledge and reasoning
- The consequences of assessments for students' identity with respect to the disciplines and their future orientations to disciplinary pathways

Interrogating these issues requires rethinking ongoing assumptions about what constitutes knowledge in the disciplines. For example, research on Indigenous knowledge systems about the natural world indicate an epistemological orientation that centers culture–nature relations as lived (Bang & Marin, 2015). This Indigenous orientation is typically not considered in assessments of scientific reasoning even for students from Indigenous communities who have been socialized with this orientation. Similarly, research in the field of ethnomathematics documents diverse practices that entail mathematical reasoning but that do not look like the standard practices that are valued, instructed, and assessed in the majority of U.S. schools (Ascher, 1991). This is also the case for language instruction and assessment in that both ignore research showing the affordances and functionalities of language diversity and variation from so-called Standard English (Smitherman, 1995). Thinking broadly about assessment regarding issues of equity also requires a reconsideration of the concepts of group membership, particularly regarding the constructs of race, ethnicity, and gender. It is important to avoid what Gutiérrez and Rogoff (2003) call the "box problem," or assuming homogeneity within cultural communities.

Although assessments are typically thought of as tests given at different time scales during instruction, it is also important to consider the informal assessments that teachers make in the moment—"on the fly"—as instruction unfolds. These serve important formative purposes—assessment *for* and *as* learning, depending on the way the assessment unfolds and how the information is used. For example, looking at student work while it is being produced may provide the teacher with valuable information about what a student does and does not understand, and thus what instructional "next steps" would be useful. Often, such embodied assessments unfold in class discussions. This kind of informal assessment during instruction is important for moment–to–moment responding as well as day-to-day planning. Such assessment requires that

teachers have deep pedagogical content knowledge and expansive understanding of child and adolescent development (in the K–12) classroom to understand what student responses, assertions, and representations convey, and the implications for where students are with respect to instructional goals (Goldman & Snow, 2015). For example, Magdalene Lampert (1990, 2003)—a math education researcher, grade 5 math teacher, and university faculty member—illustrated in detail how she made assessments of student learning during instruction, the knowledge base she drew from to respond in the moment, and how to adapt her plans for subsequent days. Similar work has been carried out by Ball (Ball & Cohen, 1999), who recruited what she learned from her own teaching to inform professional development for university students studying to become teachers. There is also an expanding literature on the use of these types of informal assessments to inform responsive instruction in other disciplines (e.g., Elby et al., 2014; Jaber et al., 2022; Michalchik & Gallagher, 2010; Ruiz-Primo & Furtak, 2007).

Box 3-3 summarizes the foregoing discussion of the characteristics and design considerations of balanced assessment systems that are aligned with equitable learning environments that reflect the complexity of human learning and development.

## REALIZING INSTRUCTION AND ASSESSMENT IN THE CONTEXT OF THE COMPLEXITY OF HUMAN LEARNING AND DEVELOPMENT

The breadth of what influences learning and its implications for assessment can be overwhelmingly complex. In the following sections, we offer cases of instruction and assessment that embody the principles discussed in this chapter. The cases connect teaching, learning, and assessment to students' knowledge and repertoires developed through their participation in everyday, routine cultural practices. They articulate the breadth of what disciplinary knowledge entails and connect teaching and assessments in ways that reveal the breadth of relevant student knowledge and dispositions. They

**BOX 3-3**
**Characteristics and Design Considerations for Equitable and Learning-Centered Assessment Systems**

- Vertical coherence among classroom practices, class/school level assessments, and district/state assessments
- Provision of actionable data on opportunity to learn rather than accountability
- Addresses cognitive processes and practices of reasoning
- Addresses perceptions of:
  - self-efficacy
  - mindset
  - motivation
  - relevance
- Examines relations between multiple sources of prior knowledge and targets of new learning
- Makes students' reasoning and inquiry processes visible
- Addresses classroom climate, school culture, and district policies
- Includes learners and teachers in the design process

take place in real classrooms and involve real collaborations among teachers and researchers.

Cases 1 through 4 illustrate instruction and assessment that recruit students' everyday repertoires and connect them to learning goals in the disciplines of mathematics, science, literacy, and history. Each case identifies unique opportunities to learn the nuances of what students can do that are not typically considered in traditional curricula or assessments. Each case took place in a real classroom, was developed through collaborations between practitioners and researchers, pushing the boundaries of what it means to show competence in disciplinary problem solving. Each case illustrates the kinds of reflection required to consider relationships between students' everyday experiences—situated in cultural communities of practice—and the academic disciplines taught in schools. Case 5 demonstrates how building on these illustrations of scaffolding everyday knowledge to teach and assess disciplinary knowledge can provide possibilities for supporting and assessing outcomes beyond siloed cognitive knowledge. The final three cases speak to issues at the systems level. Case 6 illustrates how teachers' pedagogical reasoning can be supported through professional learning communities and how this reasoning can, in turn, support ambitious and equitable instructional practices. Cases 7 and 8 illustrate how the many dimensions of human learning and development can be taken up at the district level—Case 7—and the level of broader systemic assessments—Case 8.

### Case 1: Mathematics: Examining Everyday Repertoires of Practice as Linked to Disciplinary Learning

Case 1 demonstrates how careful observations of children in a particular community engaging in purchasing practices outside of school can shed light on the complexities of their understanding of base ten computation. A collaboration between researcher Edd Taylor and a practitioner, this work led to the design of a classroom-based assessment that situated problems in the context of the children's everyday purchasing practices (Taylor, 2009). The work provided a window into more nuanced understandings of children's computational skills than the traditional measures that had been used.

Taylor examined and documented how a population of African American children, aged 4–10, from a low-income community, engaged in computational reasoning when they purchased goods (e.g., candy, toys) from a local store. Taylor (2009) made the following observations:

> Observation l: A girl about the age of 8 collects and replaces different combinations of lollipops and small candies while looking at change in her hand. After a few moments of collecting higher and lower values of candy she walks up to the clerk and asks, "Can I owe you 20 cent?" Having correctly determined the amount she needed, and with the owner's consent, she places her change on the counter and exits the store with her purchase.
>
> Observation 2: In a separate corner of the store a third-grade boy fingers through about $8 in cash halfway pulled out of his front pocket. He negotiates with two of his classmates about how much he can loan them and still be able to buy all the items he has collected for himself.

> Observation 3: A child places a quarter on the counter and grabs four pieces of "nickel-candy." The clerk tells the child, "Grab another one," referring to the nickel-candy. The child grabs a fifth piece of candy and departs. (p. 374)

These observations documented complex computational reasoning in an ecology of learning beyond the classroom. Children's reasoning provided evidence of their understanding of different denominations of U.S. currency as artifacts (e.g., half-dollars, quarters, dimes, nickels, pennies), their purchasing motivations, and the supports provided by the store clerk and their peers. Having documented this system of purchasing, Taylor analyzed the types of mathematical problems present in each phase of this system and their relevance for teaching computational reasoning in the primary grades. Table 3-1 indicates the different phases of making a purchase and the mathematics involved. Taylor also analyzed supports available in the learning ecology of the store, as represented in Figure 3-1.

Based on these analyses of the computational reasoning and supports embedded in one of this community's everyday cultural practices, Taylor worked with a teacher to create a mock store in the classroom—complete with a variety of items to be sold, the currencies that could be used to purchase the various items, and the computational reasoning involved in purchasing each of the items—as summarized in Table 3-2. As a designed artifact, the mock store afforded opportunities for the students to recruit their everyday practices in the classroom. This provided opportunities for the teacher and Taylor to examine and assess the children's computational reasoning. The mock store provided an opportunity for informal assessment, situated in a classroom and designed to provide a window into both the computational strategies children use and their conceptual understandings of the currency artifacts.

The design of this informal assessment provided opportunities for the teacher and Taylor to examine the students' reasoning strategies, as illustrated in Table 3-3.

The rubric identified in Table 3-3 provided the teacher with detailed information about students' reasoning processes—not simply outcomes of problem solving. Access to students' reasoning enables teachers to plan subsequent instructional moves intended to move students' thinking toward more successful strategies and reasoning processes.

**TABLE 3-1** Types of Mathematical Problems Children Engage During Phases of the Purchasing Practice

| Phase | Mathematics Encountered |
|---|---|
| Selection | • Reading of notational representations of prices (price tags)<br>• Comprehension of number words spoken by the clerk |
| Payment | • Coin recognition and knowledge of coin value and equivalence<br>• Addition of coin and bill values<br>• Addition of item prices<br>• Subtraction of total cost of items and amount money on hand<br>• Equivalence relations of bills and coins |
| Change | • Estimation of change expected<br>• Calculation of expected change |

SOURCE: Taylor (2009). Reprinted with permission.

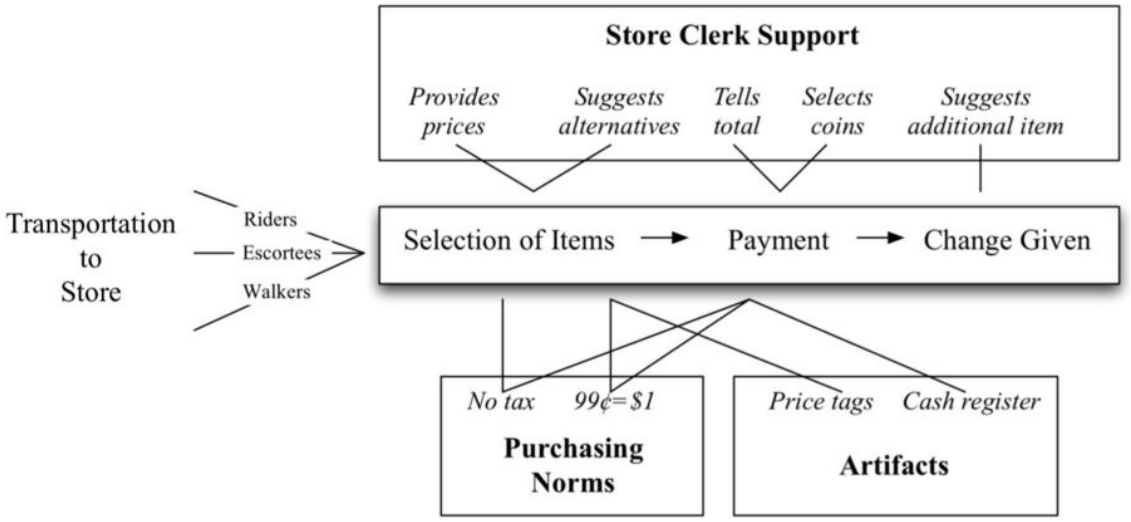


**FIGURE 3-1** Influence of types of support at particular phases of purchasing.
SOURCE: Taylor (2009). Reprinted with permission.

**TABLE 3-2** Mock Store Shopping Lists, Purchase Totals, Mathematics Considerations, and Currency Available

| List | List Items | Total of Items | Currency | Mathematics |
|---|---|---|---|---|
| A | 1 bag of chips<br>1 lollipop | $1.24 | Quarters only | More than one dollar, coordinates dollars and cents, few items |
| B | 1 box of cookies<br>2 pieces of taffy | $1.20 | All currency | More than one dollar, coordinates dollars and cents, few items |
| C | 1 box of cookies<br>2 lollipops | $1.50 | All currency | More than one dollar, coordinates dollars and cents, more items |
| D | 3 lollipops | $0.75 | All currency | Less than one dollar, more items |
| E | 1 lollipop<br>2 pieces of taffy<br>1 piece of gum | $0.50 | All currency | Less than one dollar, more items |

SOURCE: Taylor (2009). Reprinted with permission.

**TABLE 3-3** Definitions and Examples of Students' Mock Store Strategies

| Strategy | Definition | Example |
|---|---|---|
| More Successful | | |
| Total | Student determines the total amount needed through mental calculation and presents coins/bills together for payment. | Student grabs two pieces of taffy (10 cents each) and one piece of gum (5 cents). Pauses, thinks, then places one quarter on the table for payment. |
| One-to-one | Student matches each bill or coin to an item worth that amount. | Student places one dime next to the taffy, one nickel next to the gum, and one quarter next to the lollipop. |
| Less Successful | | |
| Dollar-as-one | Student considers the value of cents and dollars as the same. When counting cents, child counts dollars as if they were one cent. | Student presents one quarter and one dollar as 26 cents. |
| Coin-as-ones | Regardless of the value of the coin, student counts the coin as being worth one or one cent. | Student counts collection of three nickels and three quarters as "one, two, three, four, five, six cents." |
| One-for-all | Students presents one coin for a multiple number of same-priced items. | Student presents one quarter to pay for three lollipops that cost 25 cents each. |
| Idiosyncratic | Student appears to use a strategy but one that does not follow any known logical pattern. | Student grabs a box of cookies and places a one-dollar bill on the table. The child then grabs two lollipops and places a random handful of change and calls it "three cents." |
| No strategy | Student appears to have no strategy because he or she is unable to provide payment or reports guessing. | "I guessed." |
| Unknown | The category could not be determined due to inadequacy of notes or audiotaping. | Not applicable |

SOURCE: Taylor (2009). Reprinted with permission.

### Case 2: Science: Relationships Among Discourse Registers

Learners' understanding of science concepts may be underestimated if the language and context of the assessment are not aligned with experiences in which students understand the concepts, even if they express their understanding in non-technical terms. Relationships between everyday language and technical knowledge of disciplines—especially in science—are significant tasks to master. Case 2 spotlights Bryan A. Brown's research to illustrate the complexities of wrestling with these discourse relationships and how attention to language dimensions can be a useful focus for both teaching and assessment.

In one study, Brown and Kloser (2009) examined implicit understandings of physics concepts among high school baseball players and how these understandings mapped to formal physics principles. An ethnically diverse group of high school baseball players (11 African American, 7 Hispanic American, 7 Caucasian American, and 2 Asian American) were interviewed about their understanding of why a curveball moves as it does. The situation in question is illustrated in Figure 3-2 and shows the forces that influence the direction and speed of a curveball in the baseball context.

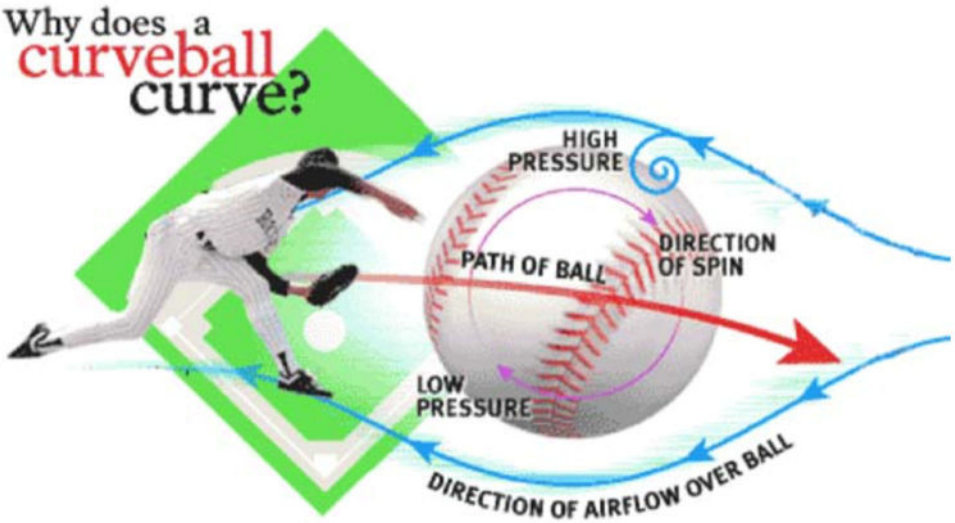


**FIGURE 3-2** Causal factors for a curveball.
SOURCE: Brown & Kloser (2009). Reprinted with permission.

The researchers were interested in what the adolescents understood, how their understandings mapped to the formal physics principles impacting the movement of the curveball, and the relationships between the language of baseball and the formal language of physics. Brown and Kloser (2009) framed these relationships as issues of conceptual continuity, consisting of cognitive and linguistic dimensions. Cognitive continuities focus on conceptual relations between everyday and disciplinary concepts (i.e., similarities and differences between students' conceptual understanding of velocity and speed in the informal baseball context compared to the formal high school physics curriculum). Language continuities refer to relations between everyday discourse and disciplinary discourse. Brown and Kloser (2009) argued that both sources of continuity and discontinuity between everyday and disciplinary practices needed to be addressed.

To address these relationships, an interview protocol was designed to ask questions in both baseball and physics genres, providing access to students' conceptual understanding across these two discursive contexts. For example, one form of a question used colloquial baseball language: "Please describe how the seams play a part in how the ball moves through the air when the pitcher attempts a curveball." This question was followed with a more canonical question using technical terms of physics: "Please describe how the seams affect the drag, velocity, and air pressure that affect the ball when a pitcher attempts a curveball" (Brown & Kloser, 2009, p. 879).

The researchers classified the students' responses into four categories: everyday discourse, baseball discourse, science discourse, and hybrid discourse. Table 3-4 defines each category and provides examples from student interviews.

An interesting finding from this study was that a formal, traditional multiple-choice science assessment administered before and after the baseball season showed no evidence that student performance had improved. However, in their responses to the interview protocol students' explanations of what forces impacted the curve and speed of the ball did show shifts in the discourse genres present, toward the inclusion

**TABLE 3-4** Modes of Discourse

| Code Name | Code Description | Example |
|---|---|---|
| Everyday discourse | Instances where the player's descriptions of why curveballs curve involves the use of everyday (non-scientific/non-baseball) talk that is associated with baseball | Yeah, 'cause the—'cause when you throw the ball, the air is gonna hit the seams, so I guess that's the main point of making the curve ball |
| Baseball discourse | Instances where the player's description of why curveballs curve involves the use of genre-specific talk that is associated with baseball | If you throw a curve ball, the seams cutting through the air, it's gonna cut down |
| Science discourse | Instances where the player's description of why curveballs curve involves the use of science terms to explain why a curve baseball curves | So I guess probably the top one's high pressure and the bottom one's low and it's pushing it down so that it looks like it's curving |
| Hybrid discourse | Instances of talk where students explain science concepts using both blended versions of either science and baseball words or science and everyday terms associated with baseball to explain phenomenon | It doesn't break at all. I mean, it hangs—it actually didn't break because it had enough spin like a front spin on it so it would drop |

SOURCE: Adapted from Brown & Kloser (2009). Reprinted with permission.

of more hybrid and science discourse postseason. Students were able to communicate their conceptual understanding using baseball registers, scientific registers, and hybrids of both. Based on their analyses, Brown and Kloser argued for the importance of understanding students' everyday practices that embody links to disciplinary concepts, and the importance of examining relationships between how such understandings are communicated in both everyday and disciplinary contexts:

> We argue that viewing students' science understanding through two modes of conceptual continuity: (a) conceptual continuity as cognitive and (b) conceptual continuity as linguistic provides descriptive evidence of how students' understanding exists at varying levels of continuity with science ideas. These continuities are critical in enabling students to use their native ways of understanding the world in meaningful ways. (Brown & Kloser, 2009, p. 895)

Complementing the work in physics, in an earlier classroom-based study, Brown and Ryoo (2008) experimentally tested the differential impacts of teaching fifth grade students to understand a scientific construct using everyday language as compared to using only formal scientific language. In the treatment group, concepts and principles of photosynthesis were introduced using everyday language before the introduction of formal scientific language. In the comparison condition, photosynthesis concepts were taught using only formal terminology. Performance on pre-post assessments showed that students in the treatment group developed a deeper understanding of the concepts and principles of photosynthesis (Brown & Ryoo, 2008).

The work of Brown and colleagues (Brown & Kloser, 2009; Brown & Ryoo, 2008) illustrates the complexities and possibilities of recruiting prior knowledge from every-

day experiences and language repertoires from non-academic settings as resources for disciplinary learning. Brown (2019) further developed this argument in his book *Science in the City: Culturally Relevant STEM Education*, wherein he examined how issues of identity, relevance, and perceptions of self-efficacy are taken up in science, technology, engineering, and mathematics (STEM) education that seeks cultural relevance. His arguments are well aligned with the foundational concepts informing the science of human learning and development discussed in this chapter.

Brown's work has important theoretical and empirical implications for instruction and assessment because it demonstrates that attention to conceptual continuities between formal disciplinary discourse and diverse, everyday language has the potential to open up broader learning opportunities than is typically the case. From a theoretical perspective, the results call attention to the need to consider conceptual continuity as a framework for understanding students' science learning. A conceptual continuity framework has the potential to restructure contemporary theories of science learning by challenging the paradigm of teaching from an assessment of "right" and "wrong" answers towards demonstrations of levels of conceptual continuity. This approach reflects a dialogic between concepts as manifest in familiar activities and everyday settings and as manifest in more formal disciplinary contexts.

Attention to relationships among everyday practices and disciplinary knowledge provides opportunities to address the transfer of knowledge directly. Everyday practices, when routine, include a range of kinds of knowledge, including conceptual, procedural, epistemological, and discursive. All four of these dimensions of knowledge are also central to learning in academic disciplines. Making connections between the everyday and the disciplinary and among the multiple dimensions entailed in deep understanding can be embedded into routine practices in classrooms.

### Case 3: Literacy: Problems of Figuration

Case 3 illustrates how everyday language and experiences provide students with access to conventions and norms of literary reasoning and interpretation. Specifically, this case examines how to build conceptual and procedural reasoning around problems of figuration in literature. Problems of figuration are uses of language that are not intended to be interpreted literally. Unreliable narration and irony are figurative tropes that may be localized or exist as genres when they characterize the attention of an entire literary work. Both are taken up in everyday discourses and genres (e.g., cartoons, film, music lyrics, visual arts). The reasoning processes entailed in detecting figurative tropes as non-literal and inferred meanings are documented in the world of literary criticism. For example, Wayne C. Booth has written extensively on both approaches in *A Rhetoric of Irony* and *The Rhetoric of Fiction* (Booth, 1975, 1983). Building on literary criticism and the work of George Hillocks (2016), Michael W. Smith developed strategies for teaching students to detect and interpret irony and unreliable narration (Smith, 1989, 1991).

For detecting unreliable narration, Smith extrapolated the following questions as heuristics:

1. Does the narrator's self-interest make you suspicious of his or her reliability?
2. Is the narrator sufficiently experienced to be reliable?

3. Is the narrator sufficiently knowledgeable to be reliable?
4. Is the narrator sufficiently moral to be reliable?
5. Is the narrator too emotional to be reliable?
6. Are the narrator's actions sufficiently inconsistent with his or her words to make you suspicious of his or her reliability?

Through multiple everyday practices, students typically have experience in detecting unreliable narration and extrapolating meaning from such narratives. Smith has conducted several studies in high school classrooms where students are given everyday texts that embody unreliable narration (Smith, 1992). Students then apply Smith's heuristics to these everyday texts as a scaffold to formal literary texts. The *Calvin and Hobbes* cartoon shown in Figure 3-3 is an example of an everyday text used to detect unreliable narration.

Most students will recognize that Calvin, the little boy in the cartoon, really likes the new girl, despite his emotional disputations. This text is accessible, likely of interest to students, and while their reasoning for detecting that Calvin does not mean what he says is likely tacit, it is possible, through dialogue focused on supporting students in making their thinking visible, to help them make explicit the metacognitive reasoning that underlies their recognition of what Calvin really thinks. Such metacognitive reasoning is susceptible to transfer.


**FIGURE 3-3** Calvin and Hobbes.
SOURCE: © 1985 Bill Watterson. Reprinted with permission of Andrews McMeel Syndication. All rights reserved.

This teaching approach requires that teachers or curriculum designers are first able to articulate the breadth of knowledge required to tackle the problem of interest—in this case, unreliable narration. They can then identify tasks that recruit students' everyday knowledge, bringing meaningful relations to the disciplinary tasks like understanding sources of congruence and dissonance as well as interactional patterns of discourse, activities, and assessments that provide windows into the developmental pathways from the everyday to the formal discipline.

This case of figuration in literary works draws on students' prior knowledge and cultural repertoires and makes problem solving explicit, thereby supporting students' self-efficacy and sense of relevance. Conceptualizing reasoning processes in everyday practices and their relationships to disciplinary problem solving can inform diagnostic assessments that center relevant knowledge that decontextualized assessments do not.

### Case 4: History: Designing for Historical Reading and Reasoning

Case 4 illustrates a set of instructional design principles that capitalizes on the continuities and discontinuities between everyday language and experiences and disciplinary language and practices. Ms. H, a middle school history teacher, participated in a design-based research project aimed at implementing history instruction that engaged students in developmentally appropriate forms of historical inquiry (Goldman & Popp, 2022; Goldman et al., 2016). The instructional design dealt with several challenges posed by historical reading and reasoning for sixth grade students, including the linguistic complexity of historical documents, students' limited background knowledge of many of the topics and events in the curriculum, and preconceptions about history typically held by students of this age range (Goldman et al., 2016; Lee & Sprately, 2009; National Research Council, 2005). The design principles reflect the developmental principle of balancing what is known with what is new, as well as the importance of making visible what it means to read, think, and reason like a historian. Four instructional strategies were consistently employed throughout the instructional units. Taken together, they built on students' everyday knowledge and forms of linguistic expression to make visible what it means to read, think, and reason like a historian. The four instructional strategies were to:

- *Build on learners' everyday experiences and language* (Lee, 2007; Moll et al., 2006). Historical reasoning practices were first introduced *informally*, using language and experiences that were familiar to students (e.g., Who wrote the article?). More formal labels for historical reasoning practices (e.g., sourcing, corroboration) were introduced only after students were already doing the practice (e.g., taking note of the author, comparing and contrasting content).
- *Make historical reading and reasoning processes visible*. This involved the teacher modeling historical reading and reasoning (i.e., conducting a think-aloud while reading) followed by metacognitive conversations about the modeling. Going "meta" made the teacher's thinking an explicit object of student reflection, thereby increasing their awareness of what the teacher was doing as well as how and why she was doing it. Making these processes visible provided students with

concrete examples of strategies for reading historical texts and ways of thinking that define historical inquiry.

- *Keep complexity manageable by minimizing reading demands when introducing new practices*. For example, when Ms. H first introduced students to the kinds of questions historians ask about artifacts, she did so in the context of objects and photographs. Only after the students had practiced asking these kinds of questions about the objects and photographs were print-based artifacts (e.g., newspaper excerpts, catalog ads) introduced. The same practice was then applied to increasingly more complex and varied text genres.
- *Employ social support for reading linguistically challenging documents and other historical artifacts*. Reading assignments were organized in a sequence of three phases: students independently read and annotated chunks of texts, then discussed with a partner, and then discussed with the whole class (Schoenbach et al., 2012).

These instructional principles were incorporated into a year-long sequence of instructional units that prepared students to conduct their own historical investigations. Ms. H relied on classroom whole and small group discussions, exit slips, and short essays to assess students' thinking throughout the units. These informal assessments showed Ms. H how students were engaging with the historical sources as they debated the merits of claims within those sources. Ms. H attended to what students were noticing in the properties of the sources—in particular, whether they were noting source properties that had implications for interpreting the information contained within (e.g., author, when the source was written, and type of source). Ms. H used this information formatively to make decisions about subsequent lessons. She also regularly modified what she had planned to do the next day to focus on areas where her informal assessments indicated students needed additional opportunities to engage in historical reading and/or reasoning practices. Importantly, Ms. H was attuned to the students' reasoning processes, whether they were expressed through everyday language (e.g., the authors of these two sources are saying different things) or more formal language (e.g., these sources do not corroborate each other's accounts). Over the course of the year, summative assessments encompassed more of the historical inquiry process. That is, early in the year, inquiry tasks for summative purposes might only require that students summarize the position expressed in two different sources, whether the student agreed with that position, and why. Mid-year, summative inquiry tasks required students to evaluate more sources and additional perspectives. By the end of the year, students were provided with more open-ended inquiry tasks and resources from which they could choose what information they would use to provide their descriptive accounts of the focal historical event. Throughout the year, Ms. H downplayed the importance of specific formal terminology (e.g., sourcing, contextualizing, corroborating, chronology, and periodicity) and emphasized the processes to which the terminology refers.

### Case 5: Recruiting Everyday Repertoires to Support Disciplinary Conceptual, Procedural, and Epistemological Knowledge in Tandem with Identity Development and Engagement: Cultural Modeling

Cultural Modeling is a design framework aimed at recruiting everyday repertoires to support learning in disciplinary content areas (Lee, 1995, 2007, 2014). Since discourse is essential for learning, engagement, and relating with others, the problem of discourse norms for communication within the classroom is important. In Cultural Modeling, classroom discourse seeks to recruit how students use language and interact with one another to maximize engagement, while simultaneously apprenticing students to understanding and using the language of the discipline orally and in writing. The Cultural Modeling framework draws from syntheses of research on human learning and development that articulate the complex ways that thinking, perception, emotional salience attributed to experience, and relationships work together in learning and development. The framework requires deep analyses of the demands of disciplinary learning; the cultural—including linguistic—repertoires of the discipline and of the learners; and the opportunities that disciplinary learning can offer for identity development. Since neither commercial curriculum nor available assessments capture these multiple dimensions of learning and development, implementing Cultural Modeling in classrooms has historically involved engaging teachers and researchers to collaboratively examine the demands of texts and the prior knowledge and cultural repertoires of their students. These studies were conducted in classrooms and schools that serve predominantly African American student populations that live in low-income communities (e.g., Lee, 1995, 2007). The framework, as developed by Lee (2007) and discussed here, focuses on teaching literary reasoning.

Early work in Cultural Modeling focused on points of convergence between problems of figuration in a genre of African American English called signifying—a form of ritual insult—and in literature (Lee, 1995). Figuration, whether in everyday discourse or works of literature, involves language whose meaning is not literal (e.g., metaphors, symbolism, irony, satire). Everyday knowledge of signifying, as established in sociolinguistics research, entails both reasoning strategies and epistemological dispositions to value figuration. Instructional planning begins by drawing from work in literary criticism to identify established expert heuristics for detecting and interpreting the use of figuration, including symbolism, irony, satire, and unreliable narration. Smith's work (1989, 1991) presented in Case 3 illustrated heuristics for unreliable narration. Once heuristics are identified, planning seeks to identify everyday genres and tasks with which students are familiar and thus are likely to have the skills to interpret. These genres and tasks are referred to as cultural data sets. The first phase of instruction involves students interpreting cultural data sets and engaging in "metacognitive conversations" with their peers during which they make explicit the thinking and reasoning processes they are using. Teachers observe these conversations and support and assist students in explicating their reasoning processes—how they know what they know. Instruction then moves to carefully sequenced literary texts that pose the same problem of figuration with the expectation that students will transfer the processes made visible with the cultural data sets to the literary texts. The Cultural Modeling framework is concerned with both developing technical competence and using disciplinary knowledge as a

medium for "identity wrestling"—an important dimension of human learning and development. Literature offers important opportunities for readers to wrestle with the conundrums of the human experience. Literature focusing on particular cultural communities (race/ethnicity, gender, age cohort, religion, communities at different points in cultural/historical history) entails authors wrestling with life course complexities. In classes that employ Cultural Modeling, the goal is to identify literary texts that offer possibilities for students to grapple with life challenges that are particularly relevant to them as adolescents and members of particular communities.

Cultural Modeling work has been largely carried out with middle- and high-school students—age groups that include important transitional points in adolescent development. This work has also been carried out predominantly with African American students, who must wrestle with both the normative challenges of early and late adolescence and the challenges of navigating and resisting negative stereotypes and structures of discrimination. Thus, the initial formal literary texts in units of instruction invite students to wrestle with issues related to their racial and ethnic identities. Later texts examine similar themes but in different cultural and historical contexts. The classroom design requires that students wrestle with the same technical aspects of figuration first in everyday cultural data sets, then culturally close literary texts, and then culturally distant literary texts.

In Cultural Modeling classrooms, discourse norms recruit how students use language and interact with one another to maximize engagement. Simultaneously, these norms apprentice students into understanding and using the language of the discipline—both orally and in writing. In Cultural Modeling classrooms, when African American students are present, African American English is recruited as a medium of oral communication.

Assessment aligned with the aims of Cultural Modeling addresses the following:

- Everyday knowledge relevant to problem solving in the domain
- Conceptual knowledge in the discipline
- Epistemological knowledge related to the discipline
- Students' perceptions of learning

Early phases of the Cultural Modeling work included assessments of students' abilities to interpret signifying dialogues. Students were given assessments of signifying dialogue drawn from exemplars in the sociolinguistic literature (Lee, 1993) as well as assessments of formal literary reasoning based on Hillocks' taxonomy for assessing literary reasoning (Hillocks & Ludlow, 1984). Hillocks's taxonomy is an example of how to disentangle processes of comprehension specific to literature. This taxonomy stands in contrast to typical assessments of literature, which pose questions that are outcomes of comprehension but do not provide any windows into the kinds of challenges students face in comprehending and interpreting literature. Hillocks's taxonomy includes the following:

1. Basic stated information—explicit and central to the narrative.
2. Key details—occur at important points in the narrative and bear causal relationships with what happens in the narrative.

3. Stated relationship—relationship between at least two pieces of information in the narrative.
4. Simple implied relationship—similar to stated relationships except they must be inferred and the details are typically localized within a section of the narrative.
5. Complex implied relationship—relationships that must be inferred; details informing the inference are distributed across the text.
6. Author generalization—questions about themes.
7. Structural generalization—questions about the language and structural choices made by the author and what they imply.

Essentially, Hillocks's taxonomy provides criteria for different levels of literal and inferential comprehension, as well as broader extrapolation and attention to features of the entire text. As such, it offers a framework for both designing literature comprehension questions and for differentiating among different levels of literary text comprehension. For example, the final two question types in the list above—author generalization and structural generalization—are crucial for literary interpretation. When assessments are designed by teachers, Hillocks's taxonomy can serve as an instructional planning tool because teachers must analyze for themselves the sources of complexity in literary texts. This kind of qualitative analysis goes beyond traditional measures of text complexity (Goldman & Lee, 2014).

In a three-year longitudinal study in a high school serving African American students living in a low-income community, Lee (2016) included measures of reading based on Hillocks's taxonomy; epistemological knowledge assessed through a measure of epistemological dispositions toward reading literature (Yukhymenko-Lescroart et al., 2016); self-efficacy; established measures of racial identity (Sellers et al., 1998); and students perceptions of learning using the TRIPOD survey (Kuhfeld, 2017), an established and widely used instrument that captures students' perceptions of learning along seven dimensions:

- Care—show concern for students' emotional and academic well-being
- Confer—encourage and value students' ideas and views
- Captivate—spark and maintain student interest in learning
- Clarify—help students understand content and resolve confusion
- Consolidate—integrate and synthesis of key ideas
- Challenge—insist that students persevere and do their best work
- Classroom management—foster orderly, respectful, and on-task classroom behavior

TRIPOD served as a formative assessment, in that it was given as a pre- and post-test each year, providing teachers and the school community with data regarding students' perceptions of their experiences in English Language Arts classrooms. TRIPOD focused teachers' attention on the salience of students' perceptions, and in terms of school climate, revealed opportunities for the department and school administration to consider how to address these important dimensions of learning and engagement.

Examining relations across these multiple measures, researchers found positive relationships between students' everyday knowledge, conceptual knowledge in liter-

ary reasoning, a positive racial identity, epistemological beliefs in the social functions of reading literature and importance of multiple readings, and positive perceptions of the learning environment and instructional practices (Lee, 2016). The use of multiple measures that index a range of constructs interacting to support learning illustrates a holistic systematic opportunity to understand robust learning.

### Case 6: Building Teacher Professional Learning Communities as Central to Building Capacity for Learning, Teaching, and Assessments: Chèche Konnen

Cases 1 through 5 reveal some of the complexities of connecting students' everyday repertoires to disciplinary learning. For teachers to learn to navigate such complexities, they need systemic supports. The knowledge required for such instructional planning and assessment development is complex and not typically embedded in teacher professional development in the United States. There is, of course, the example of the Lesson Study in Japan—where teachers in school-based communities research their own practices—but due to systemic difference, the Lesson Study model has not been tractable in the United States given the organization of teachers' workload and school day (Fernandez & Yoshida, 2004; Lewis et al., 2006).

Case 6 illustrates a model of support for teacher learning through participation in professional learning communities, where teachers and other collaborators examine a problem of practice together. Such collaborative wrestling often yields new insights that arise through dialogic interactions within these communities of practice—insights that are rare when teachers work through these problems of practice individually. Case 6 focuses on a collaboration between the Chèche Konnen professional learning community of teachers, who work with diverse student populations in the Boston area, and researchers who collaboratively investigate the teaching of science and mathematics in diverse classrooms (Warren et al., 2001). In Haitian Creole, Chèche Konnen means, roughly, "to find out." In this work, they have documented many instructional exemplars that recruit everyday repertoires to support STEM learning. The teams collaborate in planning instruction, but equally important teachers bring to the group problems of practice, and situations where students do and say things that are challenging to fully understand in the moment. Unpacking these situations as a group, with time to reflect, can provide new insights into student thinking and understanding—a key component of assessment situated close to instruction. The work of the Chèche Konnen professional learning community supports teachers as they learn to make in situ evaluations of student activity and discussions.

In Case 6, we focus on one example of a discussion among the Chèche Konnen community about one teacher's unit on plant growth. The teacher's class is ethnically and racially diverse and many students are multilingual, with different degrees of competence in speaking English. The discussion under focus here regards two Latinx students in Mrs. Pertuz's third grade classroom (Ballanger, 2004). One is middle class with parents who are university professionals. The second is a recent immigrant who is dominant in Spanish and emergent in English. The unit being taught focused on understanding the conditions of plant growth. The middle-class and English-dominant Latinx student conveyed the logic of plant growth by referencing a formal chart students created. The teacher understood this student's argument because it mapped onto

the formal representations she had taught in the class. By contrast, the teacher struggled in the moment to understand the explanation provided by Elena, the recent immigrant who was less fluent in English.

> Elena: "I think I got the answer to Juana's question. That I don't-I don't think we could see them grow but I think they could feel theirselves grow. Sometimes we can feel ourselves grow because my feet grow so fast cuz this little crinkly thing is always bothering my feet. That means it's starting to grow. It's starting to stretch out." (Ballanger, 2004, p. 308)

Teachers cannot fully predict what students will say or do during instruction, and when students' language and/or actions do not map directly to teachers' expectations, they are faced with a conundrum of practice. In this case, Mrs. Pertuz brought this discussion to her Chèche Konnen learning community and together they struggled to understand the logic and epistemological assumptions informing Elena's response (Warrant & Rosebery, 2008; Warren et al., 2001). They looked to the history of science for possible explanations. This type of effort—to continuously think critically about the discipline being taught—is a core requirement for linking everyday prior knowledge and dispositions with those of the academic disciplines in ways that inform instruction and assessment. The group concluded that what has come to be called embodied cognition is and has been a heuristic used by scientists when investigating a phenomenon about which they have limited formal understanding. They focused in on a particular exemplar of embodied cognition as manifest in Albert Einstein's imagining and reasoning about time that were inspired by the clock tower in downtown Bern, Switzerland.

> Einstein heard the toll one evening in May 1905. He had been confounded by a scientific paradox for a decade, and when he gazed up at the tower he suddenly imagined an unimaginable scene. What, he wondered, would happen if a streetcar raced away from the tower at the speed of light?
>
> If he was sitting in the streetcar, he realized, his watch would still be ticking. But looking back at the tower, the clock – and time – would seem to have stopped. It was a break-through moment. Six weeks later, he finished a paper outlining a "special theory of relativity." Later he would show how space-time, as he called it, affected mass, energy, and gravity, foreshadowing the nuclear age, space travel, and our understanding of how stars and celestial bodies interact. (Bleiberg, 2016)

Einstein imagined himself inside the phenomenon of interest as a resource for making sense of a phenomenon he did not fully understand. Such positioning has been documented in the history of science as a mode of reasoning when confronting unknown phenomena. The Chèche Konnen professional learning community drew on this embodied reasoning to make sense of Elena's response. Elena was drawing on her own lived experience of knowing that she was growing but not actually being able to see that growth. She imagined that it might be the same for plants. Thus, the group connected Elena's reasoning to Einstein's experience and connected that to findings in the study of embodied cognition.

Mrs. Pertuz, through her dialogic collaborative problem solving in a professional learning community, recognized that Elena was introducing a new epistemological

resource for reasoning about scientific phenomena, particularly where one's formal knowledge may be less clear or developed: the role of imagination—placing oneself inside the phenomenon of interest, just as Einstein had. Mrs. Pertuz was now able to think about how to both scaffold Elena's learning and how to make a wider range of reasoning resources available to her students. In collaboration with her professional learning community, Mrs. Pertuz was able to engage with her class in this broader context instead of simply interpreting Elena's response as incorrect.

Chèche Konnen is one example of professional learning communities that exist in the United States—within schools, within practitioner organizations, and across multiple sites (e.g., The National Writing Project). Chapter 5 of this volume, "Assessment Literacy and Professional Learning," discusses the importance of professional learning communities for teacher learning, as well as the important features and supports needed for such communities, while Chapter 6 of this volume, "District and School Practices and Assessments to Support a Learning-Centered Vision," expands on necessary school and district supports.

Case 6 represents an example of the kind of embedded assessments that teachers routinely conduct during daily instruction. As a field, educators need to understand the range of pedagogical content knowledge, child and adolescent development as relevant in K–12 classrooms, the funds of knowledge that students bring to the classroom from their lived experiences (Moll & Gonzales, 2004), and the importance of such knowledge as a critical element of a balanced assessment system.

### Case 7: District Level: Research Practice Partnership

To have the greatest impact at scale, assessment systems need to address relations among teaching and assessments within classrooms and within and across schools. Penuel and Watkins (2019) report on a research-practice partnership (Coburn & Penuel, 2016) involving Denver Public Schools, University of Colorado Boulder, Northwestern University, the Tidemark Institute, Clark University, the Biological Sciences Curriculum Study (BSCS), and Project VOYCE. Key features of this partnership include collaboration at all levels of the educational system and across the project in identifying goals, practices, and evaluation, with equity as an overarching theme. The partnership defined

> an equitable educational *system* as one in which all students encounter opportunities where they can connect what they are learning to their lives outside of school and that help them to imagine and pursue futures where they can apply knowledge and practices at work, in civic and family life, and at play. (Penuel & Watkins, 2019, p. 205; Penuel et al., 2016)

In addition, the partnership focused on what they call "epistemic justice," which involves attention to, appreciation of, and uptake of modes of reasoning and foundational belief systems from across diverse communities as central to processes of learning and knowing (Fricker, 2007). This project focused specifically on teaching, how students learn, and assessment in science education.

Important takeaways from this district-level research–practice partnership include:

- Core instructional practices were designed through collaborations between district-level leadership, school-level leadership, teachers, and community partners.
- The assessments developed and used focused not only on cognitive outcomes but also importantly on indicators of students' engagement, perceptions of relevance, and efficacy.
- The underlying design of instruction and assessment required collaborative teams to identify investigations in instructional materials that were rooted in students' interests and expectations, as well as to have students identify and lead investigative projects addressing the application of scientific reasoning to a real-world problem.

Two important features of the instructional and assessment design were protocols for developing investigation questions and how teachers would evaluate students' perceptions of their experiences during the course of the investigations. To develop questions for investigations, the partnership created protocols for "anchoring phenomenon routines" to be enacted by teachers. To exemplify the protocols, Figure 3-4 provides the protocol for *Developing and Using a Driving Questions Board* (Penuel & Watkins, 2019).

These routines were collaboratively developed and regularly reviewed as teaching unfolded, and were thus subject to in-process revisions from members of the partnership. The attention in this protocol to identifying failures in implementation and design along with guidelines for how to address them reflects how this practice can serve as an assessment tool.

Evaluating the unfolding investigations included not only teachers and district personnel but also and importantly, students themselves. The project design included the use of Student Electronic Exit Tickets (SEETs) at pivotal points in the unfolding of a unit. The student entries are digital, allowing access and analyses by the collaborative planning groups. Importantly for achieving the goals of equity and epistemic justice, these exit tickets expand on typical exit tickets that ask students to demonstrate purely cognitive understanding of a lesson. SEETs address constructs that reflect many of the characteristics we listed in Box 3-3, such as relevance to students' lives and their communities, students perceptions of lesson coherence, and students' sense of belonging in science class. (See for discussion Penuel et al., 2023.) Penuel and Watkins (2019) describe the use of these SEETs as follows:

> We examine variation in equity of experience and epistemic justice both within classrooms and across classrooms, looking for patterns that show evidence of epistemic injustice (e.g., fewer African American students are contributing to large group discussions or feeling that their voices are consequential in such discussions) as well as to inequity of opportunity (e.g., some teachers are not using the driving question board at all, while others are using it to partner with students in setting the direction for the units). Then, in a meeting that includes district leaders and partners who help us to design and provide professional learning opportunities for teachers, we discuss results and their implications for supporting teachers in ways that can better meet our partnership's goals for equity and epistemic justice. (p. 210)

**Name:**
Developing and Using a Driving Questions Board

**Actors and Goals:**
The practice will support *teachers* and *students* in jointly constructing a learning pathway for the class that addresses the anchoring phenomenon for the unit and related phenomena from student experiences.

The practice will also support teachers and students in holding each other accountable for answering students' questions.

**Stakeholders:**
Students, teachers, district leaders, curriculum writers.

**Trigger:**
Teacher is introducing a new unit related to a disciplinary core idea in science.

**Main Success Scenario:**

1. Teacher introduces the phenomenon to students.
2. Teacher elicits students' initial "noticings and wonderings" and records them.
3. Students make and share initial models of the phenomenon and identify additional questions.
4. Students develop questions to explain the anchoring phenomenon.
5. Students and teacher build a public record of student questions, a Driving Questions Board, and generate initial ideas for how to investigate them.
6. Teacher and student return on a regular basis (at least every 3–4 classes) to the Driving Question Board at the beginning or end to see which ones have been answered and what new questions should be pursued.

**Failure Conditions:**
Most of the student questions are unrelated to what is in the storyline already.

Some of the student questions could take students on a long detour from the planned route through the curriculum. Students construct a Driving Question Board, but it isn't used.

**Failure Handling:**
Select anchors that connect to student interests and are perceived as relevant to them.

Before developing storylines, implement the anchoring phenomenon routine with multiple groups of teachers.

Use detours as opportunities for differentiation and make time for individual or small group inquiry.

**Develop a routine where responsibility for returning to the Driving Questions Board periodically is shared among students** and the teacher.

**FIGURE 3-4** Use Case 1: Building and making use of a driving question board.
SOURCE: Adapted from Penuel & Watkins (2019). Reprinted with permission.

Case 7 is an exemplar of how the processes of recruiting students' funds of knowledge, supporting students' identities as learners, and the challenges of such work can be supported at scale with deliberative collaborations among key stakeholders—including students themselves—seeking to attend directly to dialogic relations among instruction and assessments. Chapter 6 of this volume, "District and School Practices and Assessments to Support a Learning-Centered Vision," offers further guidance on such collaborations.

### Case 8: Systemic Work in Assessment: PISA

The final case illustrates what is involved in creating national systems of teaching and assessment that provide the breadth and depth of data necessary to help understand and explain variation in learning outcomes. Case 8 examines the Programme for International Student Assessment (PISA), an international assessment of 15-year-olds in reading, science, and mathematics. We offer PISA as a contrast to the only national K–12 assessment in the U.S. education sector—NAEP. NAEP assesses reading, mathematics, science, history, and civics in grades 4, 8, and 12 and reports levels of proficiency for knowledge outcomes in these content areas. NAEP also gives surveys to teachers, administrators, and students—in part to capture data on opportunity to learn (e.g., resource allocations, instructional practices) and asks students about their perceptions of each content area. However, the breadth and depth of issues addressed in NAEP surveys are not as expansive as those used in PISA. For example, PISA asks students about their sense of well-being and connections to school. This kind of attention to social and affective well-being reflects dimensions of learning and development discussed in this chapter— dimensions that go beyond attention only to cognitive outcomes.

We note that recent efforts by panels established by the National Assessment Governing Board (NAGB) to spearhead revisions to the next iterations of NAEP assessments in mathematics and reading have called for changes that can have greater explanatory power, including changes to post-test surveys that capture both opportunity to learn and psychosocial variables (e.g., self-efficacy, motivation, and engagement) that correlate with national and sub-group performances. While these recommendations have been accepted by NAGB, how they will be implemented is yet to be seen. We think, therefore, that it is informative to consider how PISA has addressed the assessment of dimensions beyond the cognitive.

Neither NAEP nor PISA focus on individual scores, but rather group trends over time nationally and, in the case of PISA cross-nationally, as a function of periodic administration to targeted population groups. Thus, they not only document performance at varying grade and age levels but also how those performances change over time and their relationships to postsecondary outcomes like participation in higher education and the workforce. They draw from multiple assessments and surveys to extract inferences about longitudinal patterns. However, these inferences are not about the same populations, but due to their size comparisons across data at different time points in the same participating nations, the assessments offer the possibility of inferring broad longitudinal trends.

In addition to assessment results, the PISA 2018 report includes a longitudinal examination of data from the Trends in International Mathematics and Science Study for data on fourth grade students as well as the Survey of Adult Skills, a product of the Organisation for Economic Co-operation and Development (OECD) Programme for the International Assessment of Adult Competencies (Organisation for Economic Co-operation and Development, 2018). The main PISA assessment program for 15-year-olds also includes indicators of students' sense of self-efficacy, sense of belonging in schools, effort and perseverance, career expectations, and measures of both concentrations of economic disadvantage and disciplinary climate in schools (Organisation for Economic Co-operation and Development, 2018). Analyses explore how equity in students' well-

being has evolved as well as the extent to which disadvantaged students are socially and emotionally resilient.

The OECD PISA international assessment of reading, science, and mathematics is given to 15-year-olds in participating nations every four years. Along with reports of proficiency outcomes, OECD also produces a social disparity report. As expressed in the 2018 report, the PISA Social Disparities report examines the complexities of how socioeconomic status impacts learning outcomes across participating nations (Organisation for Economic Co-operation and Development, 2018):

> [T]he fact that the impact of social background on educational success varies greatly across countries shows there is nothing inevitable about disadvantaged students performing worse than more advantaged students. Results from education systems as different as Estonia, Hong Kong, Shanghai and Viet Nam show that the poorest students in one region might score higher than the wealthiest students in another country. Within countries too, there are many students who succeed despite predicted failure. On average across OECD countries, more than one in ten disadvantaged students are among the top quarter of achievers in science. (p. 3)

The report concludes:

> Countries can also set ambitious goals for and monitor the progress of disadvantaged students, target additional resources towards disadvantaged students and schools, and reduce the concentration of disadvantaged students in particular schools. They can also develop teachers' capacity to identify students' needs and manage diverse classrooms, promote better communication between parents and teachers, and encourage parents to be more involved in their child's education. Teachers and schools can foster students' well-being and create a positive learning environment for all students by emphasizing the importance of persistence, investing effort and using appropriate learning strategies, and by encouraging students to support each other, such as through peer-mentoring programmes. (Organisation for Economic Co-operation and Development, 2018, p. 15)

Broadly speaking, OECD takes a broad ecological framing for documenting and understanding trends in social disparities around educational equity, as illustrated in Figure 3-5.

In addition to the indicators outlined in Figure 3-5, OECD draws from extant research to help inform interpretations of findings.

The 2012 PISA report on social disparities includes data and recommendations for policies and practices that build capacity in the educational system to support all students, especially students from low socioeconomic backgrounds (Organisation for Economic Co-operation and Development, 2014). These include supports for teachers, equitable allocation of resources across all schools, and robust pedagogy and curriculum. More details on such systemic supports are discussed in Linda Darling-Hammond's *The Flat World and Education: How America's Commitment to Equity Will Determine Our Future* (2010).

In referencing PISA, we must also acknowledge critiques of the program (Sjøberg, 2016; Teltemann & Klieme, 2017). PISA has been criticized as privileging develop-

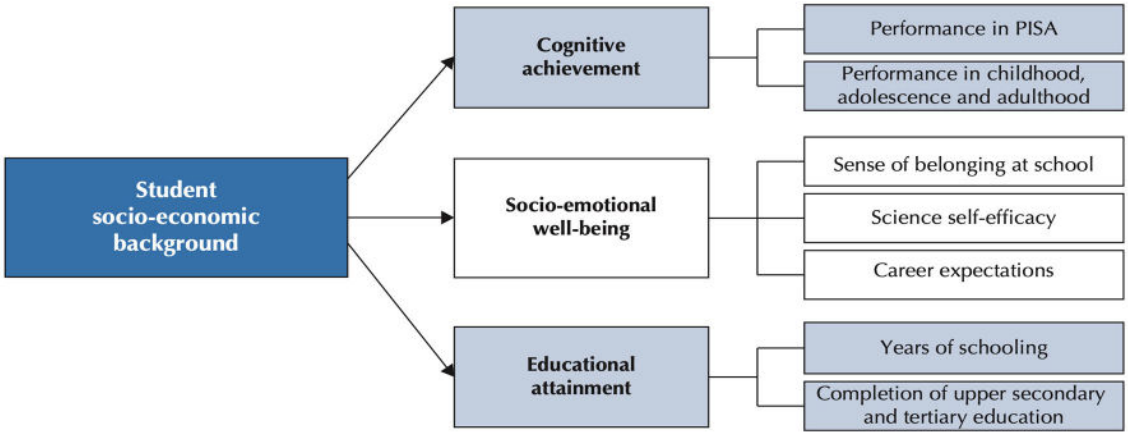


**FIGURE 3-5** Equity in education outcomes.
SOURCE: Organisation for Economic Co-operation and Development (2018).

ing countries and not adequately addressing issues of cultural relevance of content. However, even with these limitations, OECD's efforts to address systemic features of educational systems that contribute to PISA outcomes are worth investigating.

We offer this final case as an existence proof that it is possible to design a program of assessment that can both inform needed changes and identify what works in a system—as opposed to assessment programs that only consider cognitive outcomes. This is particularly important because whether from NAEP data or international comparisons from PISA and Progress in International Reading Literacy Study (PIRLS), socioeconomic status and race/ethnicity continue to be associated with disparities in performance outcomes.

## Cross-Case Analysis

We offer these eight cases to illustrate possibilities of how teaching and assessment practices can address the features of robust equitable teaching, learning, and assessments as articulated in Box 3-3. In Table 3-5, we summarize the features of such practices that are captured in each case. These cases provide but a glimpse into the kinds of considerations that need to be taken into account in the design of balanced assessment systems. We would be the first to admit that while each of these cases depicts some important features of assessment *for* or *as* learning, none of them constitute an exemplar of a balanced assessment system.

The cases presented in this chapter are useful in that they are not merely theoretical but have been enacted in real classrooms and schools. At the same time, there are few exemplars of assessment systems that address the goals of equity in opportunity to learn and that seamlessly connect all levels of the system—broader policies, school culture, and classroom climate—and that include instruction and assessment across all levels. We hope these cases stimulate insights and innovative ideas for conceptualizing balance assessment systems that are equitable and just.

**TABLE 3-5** Features of Equitable Teaching, Learning, and Assessment for Each Case

| | Case | Features of Equitable Teaching and Assessment |
|---|---|---|
| 1 | Mathematics: Examining Everyday Repertoires of Practice as Linked to Disciplinary Learning | 1. Addresses cognitive processes and practices of reasoning.<br>2. Examines relations between multiple sources of prior knowledge and targets of new learning.<br>3. Makes visible how students reason through mathematical inquiry. |
| 2 | Science: Relationships Among Discourse Registers | 1. Addresses cognitive processes and practices of reasoning.<br>2. Examines relations between multiple sources of prior knowledge and targets of new learning.<br>3. Makes visible how students reason through science inquiry. |
| 3 | Literacy: Problems of Figuration | 1. Addresses cognitive processes and practices of reasoning.<br>2. Makes visible how students reason through literary inquiry. |
| 4 | History: Designing for Historical Reading and Reasoning | 1. Addresses cognitive processes and practices of reasoning.<br>2. Examines relations between multiple sources of prior knowledge and targets of new learning.<br>3. Makes visible how students reason through historical inquiry. |
| 5 | Recruiting Everyday Repertoires to Support Disciplinary Conceptual, Procedural, and Epistemological Knowledge in Tandem with Identity Development and Engagement: Cultural Modeling | 1. Addresses cognitive processes of reasoning.<br>2. Addresses perceptions of:<br>a. self-efficacy<br>b. mindset<br>c. motivation<br>d. relevance<br>3. Examines relations between multiple sources of prior knowledge and targets of new learning.<br>4. Makes visible how students reason through literary inquiry.<br>5. Includes learners, teachers, classroom climate, and school culture. |
| 6 | Building Teacher Professional Learning Communities as Central to Building Capacity for Learning, Teaching, and Assessments: Chèche Konnen | 1. Addresses cognitive processes of reasoning.<br>2. Examines relations between multiple sources of prior knowledge and targets of new learning.<br>3. Makes visible how students reason through problem solving.<br>4. Includes learners, teachers, classroom climate, and school culture. |
| 7 | District Level: Research Practice Partnership | 1. Addresses cognitive processes and practices of reasoning.<br>2. Examines relations between multiple sources of prior knowledge and targets of new learning.<br>3. Provides actionable data on opportunity to learn versus accountability that negatively impacts students, teachers, and schools.<br>4. Addresses perceptions of:<br>a. self-efficacy<br>b. mindset<br>c. motivation<br>d. relevance<br>5. Includes learners, teachers, classroom climate, and school culture. |
| 8 | Systemic Work in Assessment: PISA | 1. Provides actionable data on opportunity to learn versus accountability that negatively impacts students, teachers, and schools.<br>2. Addresses perceptions of:<br>a. self-efficacy<br>b. mindset<br>c. motivation<br>d. relevance<br>3. Includes learners, teachers, classroom climate, school culture, and district policies. |

## CONCLUSION

There are multiple complex challenges to enabling the vision of balanced assessment systems that are "intentionally designed to provide feedback to students and information for teachers to support ambitious and equitable instructional and learning opportunities" (Chapter 1 of this volume, "Reimagining Balanced Assessment Systems: An Introduction," p. 2). The challenges are not merely technical. They require a fundamental reconceptualization of human learning and development. They require understanding the multiple pathways through which humans as individuals and communities engage in sense-making, problem solving, and learning. In addition, these challenges call for attention to the multi-dimensional, interactive dialogic processes that contribute to human learning and development. Lastly, these challenges necessitate fundamental reconceptualization of knowledge in the academic domains—not only in terms of cultural practices across diverse communities, but also in the history of how, when, and under what circumstances knowledge in these disciplines evolved and continues to evolve. These reconceptualizations have strong implications for foundational concepts in assessment theory—in particular, validity and how assessment validity is determined. We must ask "Valid for whom, under what circumstances, and in what contexts?" Addressing these challenges will require building infrastructures for professional learning communities among educators—teachers; school administrators; and district, state, and federal leaders—because the commercial resources typically available to schools are restrictive. Robust teaching leading to equitable outcomes cannot be based on curricula that impose scripted teaching and uniform pacing of instructional content. Rather equitable teaching and assessment requires that teachers be adaptive experts (Hatano & Inagaki, 1986) so that they may implement rigorous and challenging instruction that respects and values their students and communities at the same time that it opens up multiple pathways to disciplinary learning.

The processes through which research informs policy also present challenges, including political processes that the research community often does not thoroughly understand. The uptake of the recommendations made in this report is complicated by the fact that public education in the United States is constitutionally the purview of individual states. The current heated battles over what is taught in schools at district and state levels are complex—how to teach history and what is included as part of that discipline, and the banning of books and topics—virtually all of which are influenced by perceptions and belief systems around race/ethnicity and gender/sexual orientation (Pollock et al., 2022). In short, the uptake of the recommendations from this report is not simply a technical exercise.

The field of assessment can offer substantive levers to support robust learning to the extent that assessments can:

- shed light on the multiple dimensions of knowledge, including how these dimensions differ across academic disciplines;
- tap into the psychosocial dimensions of learning (e.g., perceptions of the self, self-efficacy, relevance);
- be sufficiently dynamic to capture multiple pathways and modes of reasoning; and
- address opportunity to learn.

Furthermore, assessment systems should not be limited to formal schooling. Learning takes place in multiple settings, particularly in communities outside of school. Assessment systems should be broad enough to include supports for learning in the variety of non-school settings in which people interact and learn.

In conclusion, for assessment systems to achieve equity, they must be sufficiently flexible to be responsive to the diversity of pathways and funds of knowledge that students from across diverse communities bring to the learning process. This flexibility means that support will be required for all levels of the assessment system, including the work of teachers in classrooms; administrators in schools and districts; and policy makers at district-, state-, and federal levels. Achieving equity also means expanding expectations for learning outcomes beyond limited technocratic goals and that these expectations must address the holistic needs of youth and communities. We have argued that a broad conception of human learning and development—including the cognitive, social, cultural, and identity dimensions that contribute to learning—are captured in current syntheses of the science of human learning and development, a science that takes up propositions from sociocultural theories of learning, but substantially expands understanding of the intertwined nature of these dimensions.

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