



Carnegie Foundation
for the Advancement of Teaching



A New Vision for Skills-Based Assessment

This report is authored by

Ou Lydia Liu, Harrison J. Kell, Lei Liu, Guangming Ling, Yuan Wang, Caroline Wylie, Amit Sevak at ETS and

David Sherer, Paul LeMahieu, Tim Knowles
at Carnegie Foundation

Suggested Citation:

Liu, O. L., Kell, H. J., Liu, L., Ling, G., Wang, Y., Wylie, C., Sevak, A., Sherer, D., LeMahieu, P., & Knowles, T. (2023). *A new vision for skills-based assessment*. Princeton, NJ: Educational Testing Service.

Acknowledgements

The authors acknowledge the contributions of the following colleagues in the conceptualization, development, and refinement of this paper, in alphabetical order: Burcu Arslan, Christine Betaneli, Kito Cetrulo, Kadriye Ercikan, Lisa Ferrara, Paul Gollash, Sara Havaland, Patrick Kyllonen, Ida Lawrence, Daniel McCaffrey, Kara McWilliams, Jamie Mikeska, Kristen Mitchell, Teresa Ober, James Pellegrino, Sarah Rhame, and Jonathan Rochkind.

Abstract

Modern education has been plagued by assessment systems focusing on a limited set of cognitive skills that are easy to measure, misaligned with nonlinear educational pathways, and that miss opportunities to offer insights that are valuable for learners, educators, and policymakers. As students' educational pathways become increasingly nonlinear and learners acquire skills from a wide range of channels both in and outside of school, assessment systems must be transformed to expand the measures of skills that matter, innovate how a wide range of skills are measured, and generate powerful insights for multiple stakeholders. Due to demographic changes, technological advancements, and globalization, the future of the workforce also demands education systems that equip students with not only strong cognitive skills, but behavioral and affective skills as well. This report reviews existing frameworks and initiatives in competence-based education in both K-12 and postsecondary education, identifies and defines the critical skills deemed important for life, work, and education, proposes assessment principles and innovative task design in measuring skills that matter, and discusses the creation of professional learning communities for high fidelity implementation of the new assessment system.

Introduction

The current paradigm for defining and certifying educational attainment in the U.S. is outdated. This system is rooted in early 20th century perspectives on what skills and knowledge were most important for students to acquire and how best to instill them (Silva et al., 2015). Largely unchanged for over a century, this system still implicitly treats the K-12 classroom as the sole locus of learning and the object of that learning as discrete, fairly narrow academic disciplines. Diplomas are typically awarded based upon satisfactory demonstration of having acquired this content as evidenced by satisfactory performance on in-classroom assessments. This system is misaligned with the many nonlinear educational pathways through which students now acquire expertise (e.g., military service, internships, apprenticeships, volunteerism, community service) and the wide variety of knowledge and skills those diverse pathways impart, many of which do not concern academic topics. By granting degrees based solely on student achievement in academic disciplines, the U.S. K-12 and postsecondary systems fail to recognize the rich variety of skills students possess that do not fit neatly within those disciplinary boundaries. As a consequence, the system also does not provide direct instruction in non-academic skills that will allow students to obtain meaningful employment, attain upward mobility, and fulfill civic responsibilities. Reorienting the U.S. education system to cultivate the “whole student” (e.g., Darling-Hammond & Cook-Harvey, 2018) is critical to securing the long-term civic and economic flourishing of the country.

Where We Are and Where We Need to Go

The U.S. secondary and postsecondary systems certify knowledge, in the forms of diplomas, degrees, and certificates. In turn, many employers require applicants to hold a bachelor's degree as a minimal qualification for even being initially considered as viable candidates for many jobs. The fixation on a narrow slice of what people know by educators and employers is out-of-step with the modern world. Focusing solely on the cognitive knowledge of specific subject matter (e.g., language arts, mathematics) imparted by in-class instruction misses the fact that students acquire valuable expertise outside of the classroom. The narrow focus on academic content knowledge has led to serious skills gaps among learners. For example, while majority of employers believe that critical thinking, problem solving, and teamwork are essential skills for workforce performance, they do not think college graduates are equipped with these skills (National Association of

Colleges and Employers, 2019). The capabilities that matter also go beyond traditional, disciplinary learning. Going by many names (e.g., behavioral skills, interpersonal & intrapersonal skills, durable skills, power skills, social & emotional skills), these capabilities have long been recognized as being important components of work success and civic participation (e.g., Bowles & Gintis, 1976; Jencks, 1979; Putnam, 2000). An educational and occupational system that hinges primarily on a narrow domain of knowledge tied closely to school settings results in jobs going unfilled (Carnevale et al., 2013; Chamorrow & Frankiewicz, 2019), limited economic mobility (McGue et al., 2020), inequality (Boudon, 1974; Metcalf, 2003), and impaired civic participation (Brody, 1978; Campbell, 2006).

There is a way out. Rather than focusing only on what students know based on what they were explicitly taught in school, the system can be reoriented to focus on *what students know and can do, regardless of where the knowledge and skills were acquired*. *Skills- or competency-based education*¹ shifts the emphasis from certifying classroom-instilled academic knowledge to certifying students' knowledge and skills gained from a variety of educational, occupational, and societal experiences. Such a system is agnostic to where students acquired their skills – they could be through traditional or nontraditional pathways, via school or non-school activities, and in group or individual settings. The focus is on the outcome – demonstrated ability – not the process through which it is developed. For example, the shift to knowledge-based credentials to behavioral skills recognizes the huge diversity of experiences through which students can develop their talents. Recognizing learning gained through nontraditional pathways allows individuals a wider range of opportunities to demonstrate their qualifications, achieve upward economic mobility, and ultimately contribute to society.

Competency-based education has been successfully implemented in both K-12 (e.g., [XQ Institute](#), [Aurora Institute](#)) and higher education sectors (e.g., [Western Governors University](#), [Southern New Hampshire University](#)). These systems facilitate and recognize learning through a wide variety of means other than conventional instructional techniques, including hands-on projects, quizzes, internships, and standardized assessments, while also producing outcomes that are readily evaluable and quantifiable. Moreover, these skill-based systems seek to offer not only foundational academic knowledge but also a wide variety of proficiencies (e.g., interpersonal skills, self-management skills), demonstrating the promise of competency-based education for recognizing and supporting the development of a wider variety of skills than traditional educational models.

A parallel shift from certification of academic knowledge to skills-based evaluation is taking place in some occupational sectors. Significant labor shortages compel employers to look beyond traditional degrees and attempt to hire more directly based on demonstrated competence. Workforce initiatives such as the [T3 Innovation Network](#) by the U.S. Chamber of Commerce Foundation and the [Tear the Paper Ceiling](#) campaign by Opportunity@Work seek to help employers to standardize skills requirements across jobs in order to facilitate skill-centered hiring. These initiatives provide a platform for job seekers to showcase what they can *do*, regardless of the degree they hold, allowing them to move into higher paying occupations.

Despite the potential of competency-based education and hiring, they have not been adopted *at scale* (Gallagher et al., 2022). Most students progress through traditional secondary pathways based on, year-after-year, passing course-based tests whose content is based solely on in-school instruction. Students seeking to gain entry to postsecondary institutions are evaluated based on their grade point averages and standardized test scores; those lacking a high school diploma (or equivalent) will not even be considered for admission. While some technology companies have dropped degree requirements for certain roles, most job postings include degree requirements. For many jobs, applicants without postsecondary degrees will be automatically rejected. A wholesale transformation of the U.S. educational and

¹Skills and competencies are often used interchangeably in educational and occupational settings and we do so as well throughout this document.

occupational system is needed for skill-based education and hiring to reach their full promise. The entire ecosystem must be rethought, necessitating scientific breakthroughs in:

- defining, identifying, and measuring all the skills that matter to educational, occupational, and societal success;
- creating professional learning communities that help educators understand and implement new assessment and instructional practices focused on skills;
- developing a technological infrastructure that supplies dynamic, diagnostic, and continuous data insights that provide immediate and ongoing support for learners and educators;
- state policies promoting the adoption of competence-based education at scale; and
- mechanisms connecting K-12 stakeholders with higher education and workforce partners.

Objectives of This Report

This report lays the groundwork for reimagining educational assessment. It is addressed to many audiences, including policy makers, educators, educational leaders, employers, and researchers. The objectives of this report are to:

- Review and synthesize major frameworks for competency-based education in K-12 and higher education systems
- Identify gaps in existing frameworks and articulate a comprehensive taxonomy of skills that are essential for educational, occupational, and civic success
- Link our novel framework to K-12 disciplinary frameworks
- Synthesize the technological and AI tools that can be used to capture learning taking place in non-traditional forms
- Discuss assessment innovations that enable the measurement of complex skills with validity, reliability, and authenticity
- Propose a model of professional development that supports the implementation of skills assessment in classrooms

Review of Existing Work on Skills-Based Educational Efforts

Competency-based educational systems focus on mastery-based active learning that empowers students (Sturgis et al., 2011). They emphasize not only the acquisition of academic knowledge but knowledge of domains beyond it (e.g., intrapersonal, interpersonal) – along with the ability and willingness to apply that knowledge behaviorally in real-life. To meet their full potential, these systems require meaningful assessments that yield timely, personalized, and actionable insights that inform learning and facilitate improvement. Ultimately, these assessments must be effective proxies of performance, as the only way to truly assess behavior – what people can and are willing to do – is to evaluate performance of relevant behaviors themselves.

To understand the scope of current skill-based educational systems, we conducted a review of existing efforts in defining and assessing competencies across K-12, postsecondary, and workforce sectors. We selected frameworks that include one or more competencies which supplement disciplinary knowledge, and which are set to have an impact at a state, regional, or national level rather than on a smaller scale (e.g., at a school or district level). Table 1 summarizes the results of our review of the major components of the frameworks we surveyed. Although our primary focus is on K-12, as it currently serves as the bedrock on which further U.S. educational and occupational careers are built, we also included some

frameworks referring to sectors outside K-12, including some international frameworks, in order to develop a broad perspective on contemporary skill-based efforts.

Table 1. Skills Featured in Major Competency-Based Frameworks

Name	Major Skills
<u>The Collaborative for Academic, Social, and Emotional Learning (CASEL) Five</u>	Self-Awareness Self-Management Social Awareness Relationship Skills Responsible Decision-making
<u>XQ Student Performance Framework</u>	Holders of Foundational Knowledge Masters of All Fundamental Literacies Original Thinkers For An Uncertain World Generous Collaborators for Tough Problems Learners for Life
<u>Essential Skills and Dispositions: Developmental Frameworks for Communication, Collaboration, Creativity, and Self-Direction</u>	Collaboration Communication Creativity Self-Direction
<u>NGLC MyWays Student Success Framework</u>	Habits of Success Creative Know How Content Knowledge Wayfinding Abilities
<u>LifeComp: The European Framework for Personal, Social and Learning to Learn Key Competence</u>	Personal Social Learning to Learn
<u>Building Blocks for Learning: A Framework for Comprehensive Student Development</u>	Healthy Development School Readiness Mindsets for Self and School Perseverance Independence and Sustainability
<u>Habits of Mind: 16 Essential Characteristics for Success</u>	Persisting: Stick to it! Managing Impulsivity: Take your time! Listening with Understanding and Empathy: Understand Others! Thinking Flexibly Thinking About Your Thinking (Metacognition) Striving for Accuracy Questioning and Posing Problems Applying Past Knowledge to New Situations Thinking & Communicating with Clarity and Precision Gathering Data Through All Senses Creating, Imagining, and Innovating Responding with Wonderment and Awe Taking Responsible Risks Finding Humor Thinking Interdependently Remaining Open to Continuous Learning
<u>Asia Society /CCSSO Global Competence</u>	Investigate the World Recognize Perspectives Communicate ideas Take Action

Name	Major Skills
OECD Learning Framework 2030	Knowledge Skills Attributes and Values Transformative Competencies
Saudi Arabia Vision 2030: Human Capability Development Program	Values and Attitudes Basic Skills Skills for the Future Knowledge
UAE Future Skills 2030 Report	Personal Skills Cognitive Skills People Skills Knowledge
India National Education Policy 2020	Scientific Temper and Evidence-based Thinking Creativity and Innovativeness Sense of Aesthetics and Art Oral and Written Communication Collaboration and Teamwork Problem Solving and Logical Reasoning Vocational Exposure and Skills Digital Literacy, Coding, and Computational Thinking Ethical and Moral Reasoning Knowledge and Practice of Human and Constitutional Values Gender Sensitivity Citizenship Skills and Values Knowledge of India Environmental Awareness Current Affairs and Knowledge of Critical Issues

Our

analysis of these frameworks revealed notable consistencies in the skills featured. Some of the skills that appeared most frequently included communication, creativity, and varieties of awareness (e.g., self, social). In reviewing the frameworks the need for articulating fairly specific skills with concrete definitions became clear. Many frameworks offered two types of categories, one fairly broad and one more specific. We found that the broad skill categories often did not offer explicit definitions and, moreover, depending on the framework the same specific skills (which often did include definitions) might be grouped within different broad categories. For example, in the Collaborative for Academic, Social, and Emotional Learning's (2020) framework, self-awareness is a general competency with nine subskills; whereas in the XQ Institute's (2022) framework it is a specific competency nested within Learners for Life; in the Building Blocks for Learning (Turnaround for Children, 2016) framework it is included under School Readiness; and it appears within all four of the broad skill categories featured within the National Center for Innovation in Education and Educational Policy Improvement Center's (2015) framework.

A Comprehensive Taxonomy: Skills for the Future

Scientific advancement requires clear and consistent definitions (Gorskij, 1970; Hyland, 1985) and defining competencies requires a clear vision of educational goals. Existing competency-based efforts argue the goal of education should be to enable students for future careers, postsecondary education, civic participation, and success in learning, work, and life. To build a forward-looking, comprehensive skills taxonomy, it is critical to leverage influential prior efforts.

Derivation of the Taxonomy

The authors reviewed the broad and specific dimensions featured in all of the skills taxonomies and examined consistencies and discrepancies across the frameworks in terms of the names and definitions of dimensions. Via consensus they then derived 30 “meta-dimensions” that cut across many of the frameworks. These dimensions constitute our integrative and comprehensive framework. For each meta-dimension we wrote our own synthetic definition, drawing on those found in the frameworks we reviewed to serve as a foundation for our own.² These skill dimensions, and their accompanying definitions, are found in Table 2.

Table 2. Skills for the Future Taxonomy

Name	Major Skills
Adaptability	Working effectively in uncertain situations with shifting priorities by modifying one’s actions or learning new skills in light of changing tasks and goals
Building Relationships	Understanding the importance of trust, respect for human dignity, and equality, and using these principles to establish and maintain healthy and supportive relationships, negotiate conflict constructively, and navigate interactions with diverse individuals and groups
Civic Engagement	Playing an active role in the global and local community and the application of civic values
Collaboration	Working with others cooperatively and coordinating effectively to achieve collective goals
Communication	Use of context-relevant strategies, domain-specific codes and tools when interacting with others, including active listening, asking questions, synthesizing messages, storytelling and public speaking
Compassion	Feeling of sympathy with another person’s feelings of sorrow or distress, often involving a desire to help or comfort that person
Creativity	Production or development of novel and useful outputs (e.g., understanding, perspectives, ideas, theories, products)
Critical Thinking	Understanding, managing, and analyzing information and arguments by making sound inferences, recognizing and evaluating assumptions, seeing rational connections, identifying patterns, constructing knowledge, and drawing evidence-based conclusions
Curiosity	The drive to investigate novel stimuli, including situations, people, and bodies of knowledge
Decision-Making	The cognitive processes and actions that result in choosing between two or more alternatives.
Digital Literacy	Creating, consuming, analyzing, and adapting in productive and responsible ways to utilize technology and communication tools in social, academic, and professional settings
Disciplinary Literacies	Academic or subject specific literacy enabling learners to read, write, and speak like experts in a particular subject, including disciplinary knowledge, practices, and application skills
Educational & Occupational Awareness	Perception or knowledge of environments, people, facts, principles, and rules concerning school- or work-related topics and settings

²As with any term traceable to everyday speech (Cartwright & Bradburn, 2011), various sources – including frameworks we reviewed – define competencies and skills in different ways (e.g., Levine, 2021; Martinaitis, 2014; OECD, 2018; Soto et al., 2021). For our purposes we define a skill or competency as “a learned ability to perform an activity well”.

Educational & Occupational Attitudes	Relatively enduring and general evaluations of objects relevant to school or work that exist on an emotional dimension ranging from negative to positive that influence one's approach to ideas, persons, and situations associated with educational or occupational settings
Educational & Occupational Values	Internal representations and perceptions of who one is as a person and how one wishes to define and lead a meaningful and satisfying life through their educational and occupational careers
Empathy	Vicarious experience of another person's feelings, emotions and perspectives.
Growth Mindset	The belief that talents can be developed through persistent work, learning from risk taking and mistakes, and input from others
Leadership	Processes involved in directing others' efforts toward achieving individual, group, and/or organizational goals
Lifelong Learning	Understanding that learning takes place across the lifespan, having a positive attitude toward acquiring new skills across the lifespan, and engaging in acquiring new skills across the lifespan
Metacognition	Thinking about one's own cognition
People Skills	Behavioral interactions and behaviors to understand and manage the feelings of other individuals in team and other group settings to achieve individual or collective goals and develop productive working relationship to minimize conflict and maximize rapport
Perseverance	Overcoming obstacles and challenges by maintaining focus in the face of negative emotions, pursuing alternative routes to goal achievement, and persisting until the task is completed
Problem Solving	The mental processes individuals use when they formulate plans and translate them into prospective actions for identifying a problem, gathering and evaluating information, developing solution paths, executing action plans, attempting to overcome difficulties, drawing conclusions, and adjusting to situational changes
Reasoning	Logic-based thinking processes of an inductive or deductive nature that are used to draw evidence-based conclusions from data, facts or premises
Systems Thinking	Mental analyses of any system in order to understand system elements, the interconnections among the elements that drive the system to work as a whole, and how its constituent elements function both individually and in relation to each other
Self-Regulation	Regulating one's cognition and affect across different situations to maintain high motivation and energy through pursuing one's goals and restorative activities
Sensemaking	Gathering and interpreting data to rationalize and understand personal experiences and the world they live in and develop a personal sense of meaning
Stress Management	Regulating and decreasing stress via behavioral activities (e.g., breathing techniques, meditation) to stay positive, practice gratitude, and find ways to let go of worry
Taking Initiative	Proactively taking the first step in a task, enterprise, or process
Transformative Competencies	Competencies to transform the society and shape one's future to address the growing need to be innovative, responsible, and aware, including abilities to create new value, resolving and reconciling tensions and dilemmas, and taking responsibility

What Our Taxonomy Reveals

Our review of prominent skills-oriented taxonomies, and the framework we developed based on them, demonstrates that important constituencies across K-12, postsecondary education, and employment sectors value an extraordinarily broad array of skills, both in the U.S. and internationally. Most of these competencies are not an explicit focus of instruction in the U.S. K-12 system and proficiency in only one – Disciplinary Literacies – is tied to obtaining a secondary school credential.

A major motivation behind our creation of this framework, and the endeavor we are proposing more broadly, is that we believe that in order to be successful in their lives students need to master skills and acquire knowledge beyond the cognitively-oriented content offered in the discipline-specific courses that form the linchpin of the U.S. educational system. We demonstrate this point by classifying the skills comprising our taxonomy and, by extension, those featured in many prominent competency-based frameworks, according to the three major domains that human psychology has been divided into for millennia (Danziger, 1994; Wilt & Revelle, 2015): affect (what & how people feel), behavior (what people do & how they do it), and cognition (what & how people think). The K-12 system explicitly rewards students' achievement in the cognitive domain by awarding high grades for the demonstration of knowledge in specific courses. While academic achievement may be facilitated by demonstrating some affective and behavioral skills (e.g., collaborating with other students to study effectively, remaining calm when taking challenging exams), those skills are simply a means to an end and not in and of themselves recognized as valuable by current K-12 structures. By showing that the skills distilled from many prominent frameworks fall not only into cognitive but also affective and behavioral categories we concretely illustrate our point that students need to acquire competencies beyond those represented by academic achievement in order to be successful in their future educational and occupational careers.

Accordingly, four of the authors independently classified the skills in our taxonomy according to whether they best belonged to the affective, behavioral, or cognitive domains, based on the content of the competencies' definitions. Initial agreement among the team members was 86% for skills assigned to the affective category, 84% for behavioral skills, and 81% for cognitive skills. The four authors then met to resolve discrepancies in their classifications via discussion and come to a final decision as to which categories the 30 skills best belonged to. The final results of the classifications are shown in Figure 1.

It is noteworthy that a subset of the competencies in the Skills for the Future (SFF) Framework belong to more than one psychological domain. When initially coding the skills the four authors assigned them to the single domain they believed it was most closely aligned with – but when those authors met to resolve their coding discrepancies their discussion revealed that oftentimes those discrepancies were due to the fact that some competencies could reasonably be cross-classified across two (and occasionally all three) psychological dimensions. For example, *Building Relationships* is clearly behavioral in nature as its definition heavily relies on actions directed to toward other human beings (e.g., navigating interactions, negotiating conflict). Yet, the definition also specifies that these actions are underwritten by cognitive understanding of various principles (e.g., equality, respect for human dignity), leading the authors to ultimately decide it would be more appropriate to classify *Building Relationships* as both a behavioral and cognitive skill. By the same token, *Lifelong Learning's* definition contains affective (e.g., positive attitude toward learning), behavioral (e.g., acting to acquire new skills), and cognitive (e.g., understanding that learning can occur throughout life) elements, suggesting that sorting it into a single domain would fail to capture its full breadth and complexity. With the richness of some of the competencies in the taxonomy in mind, the four authors consensually determined which constructs were aligned with more than one psychological dimension and ultimately made a final decision as to which ones, resulting in the cross-classifications depicted in Figure 1.

Figure 1. SFF Components Classified According to Affective, Behavioral, and Cognitive Domains

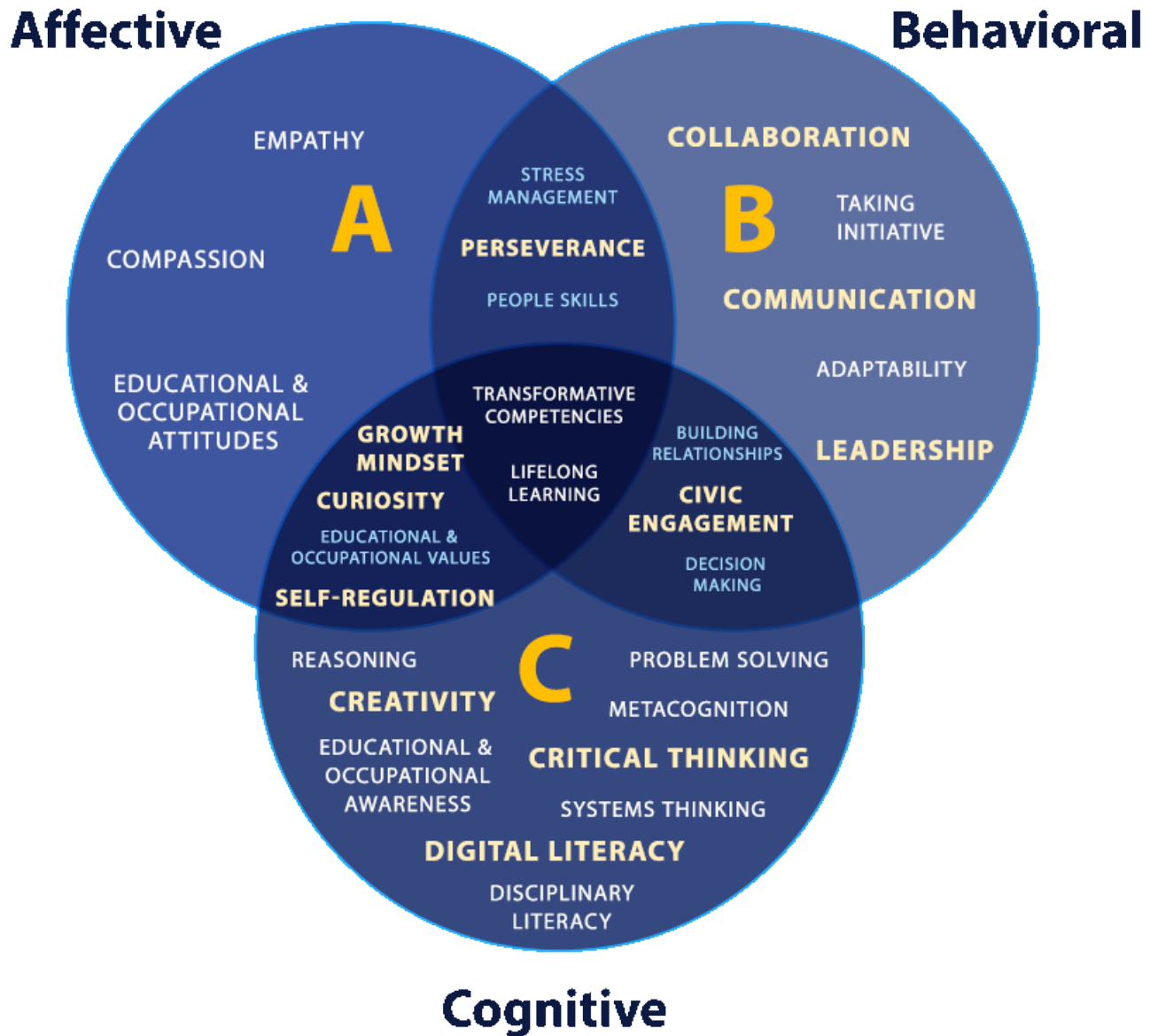


Figure 1. Assignments of the 30 skills comprising our taxonomy to the three major domains of human psychology: affective, behavioral, and cognitive. Four members of the author team independently sorted the 30 skills into the domains, with initial classification agreement being relatively high (81% to 86%). The authors then met to resolve the discrepancies in their classifications and decide on the final assignments of the 30 skills, including whether some would be best classified across multiple psychological domains, rather than assigned to a single one. The skills that are bolded in yellow represent those that were most prominent in our review of existing skills frameworks, they reflect our current thinking about the skills that may be most important to measure.

A Comprehensive Taxonomy: Skills for the Future

Importance of SFF

The U.S. K-12 system has long been focused primarily on cognitive skills due to its centering of disciplinary literacies, the indirect connection between affective and behavioral skills and those literacies, lack of adequate support for developing such competencies, and the challenges to assessing such “noncognitive” skills due to their complex and multidimensional nature. Nonetheless, conceptually, it has long been recognized that affective and behavioral skills are important and worthy of attention in K-12 settings (e.g., Dewey 1916; Montessori, 1948). Indeed, as early as 1920 E. L. Thorndike – one of the progenitors of the mass standardized testing familiar today – proposed the concept of “social intelligence”. It failed to gain traction in any school settings because the assessment approaches of the time period could not measure it well.

The relative neglect of affective and behavioral skills in U.S. K-12 education system is not reflective of the real-world value of these skills. Indeed, as shown in Table 3, affective and behavioral skills tend to predict the same outcomes as cognitive skills – and often with a similar degree of accuracy (Roberts et al., 2007). Although evidence for the practical importance of affective and behavioral skills has been accumulating since at least the 1970s (Bowles & Gintis, 1976; Jencks, 1979), they remain underemphasized in K-12 settings. This is particularly unfortunate given the many valuable life outcomes these types of skills have been consistently found to predict. Perseverance, for example, is related to educational attainment (Zamarro et al., 2018), salary (Ng et al., 2005), and longevity (Kern & Friedman, 2008), while empathy is associated with job performance (Sackett et al., 2022), civic participation (Ackermann, 2019), and health (Strickhouser et al., 2017). Many of these affective and behavioral skills are powerful predictors on their own, with their ability to forecast important outcomes only growing when they are considered in tandem (e.g., Ahadi & Diener, 1989).

Table 3. Real-World Outcomes Predicted by Affective, Behavioral, and Cognitive Skills

Outcome	Predicted by Affective Skills	Predicted by Behavioral Skills	Predicted by Cognitive Skills
Educational	Educational attainment (Hampson et al., 2007)	Educational attainment (Zamarro et al., 2018)	Educational attainment (Brown et al., 2021)
	K-12 grades (Poropat, 2009)	K-12 grades (Poropat, 2009)	K-12 grades (Galla et al., 2019)
	Postsecondary grades (Richardson et al., 2012)	Postsecondary grades (Richardson et al., 2012)	Postsecondary grades (Richardson et al., 2012)
Occupational	Career choice (Ackerman & Beier, 2003)	Career choice (Ackerman & Beier, 2003)	Career choice (Wai et al., 2009)
	Career satisfaction (Ng et al., 2005)	Career satisfaction (Ng et al., 2005)	Grant funding (Bernstein et al., 2019)
	Job performance (Sackett et al., 2022)	Job performance (Connelly & Ones, 2010)	h-index (Bernstein et al., 2019)
	Job satisfaction (Judge et al., 2002)	Job satisfaction (Judge et al., 2002)	Income/salary (Ng et al., 2005)
	Salary (Ng et al., 2005)	Salary (Ng et al., 2005)	Job performance (Nye et al., 2022)
			Job prestige (Lang & Kell, 2020) Scholarly productivity (Kuncel & Hezlett, 2007)

Outcome	Predicted by Affective Skills	Predicted by Behavioral Skills	Predicted by Cognitive Skills
Civic	Volunteerism (McCann, 2017) Voting (Obschonka et al., 2018)	Volunteerism (Ackermann, 2019) Voting (Bakker et al., 2016)	Volunteerism (Proulx et al., 2018) Voting (Deary et al., 2008)
Health	Longevity (Friedman et al., 2010) Mental health (Strickhouser et al., 2017) Physical health (Rocheffort et al., 2019)	Longevity (Kern et al., 2014) Mental health (Strickhouser et al., 2017) Physical health (Hampson et al., 2013)	Longevity (Calvin et al., 2011) Mental health (Davis & Humphrey, 2012) Physical health (Judge et al., 2010)

Improving Skills for the Future

Not only are the skills identified in our review predictive of a wide variety of important outcomes, they are also malleable and can be improved with intentional effort. Despite notorious historical skepticism that cognitive abilities cannot be improved (e.g., Jensen, 1969), contemporary research shows that cognitive skills can be improved via participation in educational systems (Carlsson et al., 2015; Lehman et al., 1988; Ritchie et al., 2015; Ritchie & Tucker-Drob, 2018; Tock & Ericsson, 2019) and targeted interventions (Humphreys et al., 2022; Protzko, 2017; Protzko et al., 2013). Similarly, comprehensive meta-analyses of affective and behavioral skill interventions implemented among K-12 students (Cipriano et al., in press; Durlak et al., 2011; Taylor et al., 2017) consistently show those interventions to be effective. Affective and behavioral skills have also been shown to be malleable via purposeful intervention in workforce, clinical, and community settings (Bleidorn et al., 2019; Martin-Raugh et al., 2022). Effective avenues for intervention include clinical treatment (Roberts et al., 2017), cognitive-behavioral therapy (Vittengl et al., 2003), social skills training (Piedmont, 2001), cognitive intervention (Jackson et al., 2012), mindfulness training (Krasner et al., 2009), situational judgment tests (Barron et al., 2022), developing and following developmental plans (Hudson et al., 2019), team-based training (Salas et al., 2008), coaching (Jones et al., 2016), and digital interventions (Allemand et al., 2023; Stieger et al., 2021).

Connecting Skills to K-12 Disciplinary Frameworks

K-12 education is intended to do more than just educate students academically. The broader purpose of K-12 education is to prepare learners for successful careers, civic engagement, and healthy and meaningful lives. Accordingly, the next generation of K-12 frameworks has shifted from content to competencies. They recognize that engaging in disciplinary learning requires more than content knowledge, and that skills are key in moving students from recall to mastery. Both the Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS) focus on evidence-based practices that demonstrate students can go beyond memorizing facts and are able to translate what they learn in school into concrete actions in applied settings.

Table 4. Practices in the Common Core Standards and the Next Generation Science Standards

ELA, Social Studies, and Tech Subjects	Mathematics	Science
<ol style="list-style-type: none"> 1. Demonstrating independence 2. Building strong content knowledge 3. Responding to the varying demands of audience, task, purpose, and discipline 4. Comprehending as well as critique 5. Valuing evidence 6. Using technology and digital media strategically and capably 7. Understanding other perspectives and cultures 	<ol style="list-style-type: none"> 1. Making sense of problems and persevere in solving them 2. Reasoning abstractly and quantitatively 3. Constructing viable arguments and critique the reasoning of others 4. Modeling with mathematics 5. Using appropriate tools strategically 6. Attending to precision 7. Looking for and make use of structure 8. Looking for and expressing regularity in repeated reasoning 	<ol style="list-style-type: none"> 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information

As can be seen in Table 4, the essential practices featured in the CCSS and NGSS standards not only overlap substantially across disciplines, but many are also readily interpretable through the lens of SFF. For example, “Understand other perspectives and cultures” is clearly aligned with SFF competencies such as Sensemaking, Awareness, and Empathy, while “Obtaining, evaluating, and communicating information” is aligned with Critical Thinking, Reasoning, and Communication. Indeed, even the notion of within-subject Disciplinary Literacies themselves are being rethought, taking a turn away from siloed disciplinary learning and integrating a wide range of competencies that extend beyond mere subject matter knowledge (Draper, 2015; Lent, 2015). For example, being disciplinarily literate in science alone requires students to interpret data, determine the validity of sources and quality of evidence, tap into curiosity to ask questions, and apply precise scientific vocabularies to communicate systematically (Hinchman & O'Brien, 2019). Thus, to be truly literate in scientific domains alone, learners must demonstrate skills such as Systems Thinking, Reasoning, Problem Solving, Critical Thinking, Awareness, Communication, Taking Initiative, and Sensemaking. More broadly, SFF Transformative Competencies that include affective, behavioral, and cognitive elements are well-represented in recommendations for enhancing K-12 curricula and classroom experiences (Lubicz-Nawrocka & Bovill, 2021), which acknowledge the importance of educating “whole students” and preparing them for success in their adult lives.

Reimagining Education Assessment Through Assessment of Skills for the Future

To successfully reimagine U.S. education, metrics rooted solely in academic knowledge need to be replaced by skills-based metrics. To accurately capture the full picture of what students can do, and inform what they should learn, a comprehensive assessment system must be developed and rooted in skills. To do full justice to students' skills this system must be innovative, featuring new construct definitions, innovative task designs, breakthrough measurement sciences,

complex psychometric analyses, precise human and automated scoring, and user-friendly score reporting. We sketch a vision for a new assessment system centered around SFF that will undergird the reimagining of K-12 education.

Five Assessment Principles

Current classroom instruction focuses primarily on a limited selection of cognitive skills that can be conceptualized and measured straightforwardly (Darling-Hammond et al., 2017; NRC, 2012). Grounded in the SFF taxonomy, the new assessment system will assess not only cognitive skills that extend beyond disciplinary literacies (e.g., creativity, critical thinking), but also a wide variety of affective (e.g., compassion, empathy) and behavioral (e.g., collaboration, communication) skills, along with skills that span multiple psychological dimensions (e.g., perseverance, self-management). The assessment system will encompass innovative assessments, an insights system that benefits multiple stakeholders including learners, educators, districts and states, and a professional learning community for educators. The skills featured in the system will be clearly and operationally defined, with assessment development guided by five authentic assessment principles (McArthur, 2022; Palm, 2008; Sokhanvar et al., 2021):

Principle One: Reflect the social and cultural backgrounds of students.

Students bring rich social, cultural, and linguistic backgrounds to the assessment experience. Cutting-edge assessments must fully embrace the diversity of the people who will be taking them. The SFF assessment system will connect with real-life and real-work experience and offer opportunities for learners to demonstrate their skills most effectively by offering an engaging, meaningful experience. In doing so the system will produce results that fully reflect the skills of learners from all backgrounds.

Principle Two: Center around equity and fairness.

Persistent ethnic and racial performance differences have long been a source of concern in the United States. In 2019, only 21% of all 12th grade students were proficient in math, including only 11% of Latina/o/x and 7% of African American students (U.S. Department of Education, 2019). [The next generation of assessments must](#) have equity and fairness at their core, acting as a catalyst for social and economic upward mobility. The design and implementation of the SFF system will serve all learners, rather than just the few who are already advantaged.

Principle Three: Benefit instruction and learning.

The system will collect signals generated by all types of students' skills and turn that information into actionable insights that will inform future learning and instruction. Insights from the assessment will be provided at individual and cohort levels, allowing for them to be used optimally by educators, administrators, and policy makers.

Principle Four: Use technology responsibly to generate insights.

Technological advances, in and of themselves, will not support the learners we serve. Effective design and development of future assessment techniques will rely on using technology responsibly, to produce scalable solutions that produce readily interpretable insights that benefit learners, educators, and policymakers alike. Automation and AI offer great efficiencies (e.g., automated scoring of student work) and flexibility (e.g., assessment can be integrated into learning) but they can only supplement teachers' activities, not replace them. Assessment advances should free teachers from repetitive, mundane tasks and allow them to focus on what matters: directly engaging learners.

Principle Five: Enable personalization.

The next generation of assessments will be fully personalized through tracing learner choices, inputs, and interactions. Assessments yield more meaningful insights when learners can tailor the assessment experience to fit their own

individualities. Traditional “score reports” will become “insight reports” that provide actionable information about not only what a learner knows and can do but also guidance about how those insights should be interpreted to support appropriate decision-making (e.g., admissions, future educational & occupational pathways, hiring). Insight reports will be dynamic, diagnostic, and continuous, provided to learners throughout their assessment experience to inform and enable learning.

Measuring Complex Skills Through Multimodal Assessment

A key emerging technological advance that will be integrated into the SFF system is multimodal assessment, which will allow learners to demonstrate their skills in novel ways and through multiple sensory modalities. Multimodal approaches expand the dimensions of constructs that assessments can accurately capture, enabling learners to showcase what they can do in ways unattainable through traditional, single mode assessment (e.g., reading, writing).

For example, traditionally oral communication is assessed in terms of aspects of verbal utterances, such as word choice, grammar, sentence structure, and tone. Multimodal assessment goes beyond this, uniting sensing technologies and machine learning to integrate information about nonverbal aspects of communication, such as hand gestures, body posture, and facial expressions, leading to a more complete portrait of learners’ skill in both the linguistic and social aspects of oral communication (Suendermann-Oeft et al., 2017). In the current digital age, holistic evaluations of students’ learning are necessary to inform students of their achievements and needs as comprehensively as possible (Ross et al., 2020). By integrating information across multiple sensory modes (e.g., auditory, visual, written), multimodal assessment is perfectly poised to provide these holistic insights.

Advancements in multimodal technology allow greater insights into learners’ skills. Multimodal assessment has been applied to a variety of domains including learners’ English language proficiency (Forsyth et al., 2019), literacy (Tan et al., 2020), and collaborative learning and behavior (Khan, 2017). Relevant to multimodal assessment, multimodal analytics refers to the inclusion of “advanced sensor technologies and machine learning systems to track and understand human behaviors” (Khan, 2017, p.175). Inferences from multiple sensory data can be made to draw conclusions about learners’ proficiencies, abilities, attitudes, and dispositions.

Stealth Assessment That Is Ongoing and Non-Intrusive

Measurement practices seamlessly woven into the instructional environment to support learning of content and skills will play a key role in the SFF assessment system. These practices – often called “stealth assessment” (Shute, 2011) – are embedded organically in the learning environment and can be used to enable personalized, formative feedback to inform teaching and learning (Shute, 2011; Shute et al., 2009). Stealth practices are unique in that, while learners are made aware of the fact they are being assessed, they are typically not aware of how or what is being assessed, leading to a less intrusive, less stressful experience. Stealth assessment is currently most commonly deployed in technology-enriched learning settings (e.g., game- or simulation-based), which allow students to engage in complex and varied behaviors, such as manipulating variables, making predictions, interacting with others, and reflecting on their thinking and conclusions. Drawing on the data produced by this rich array of actions, stealth assessment allows inferences to be drawn about a host of SFF simultaneously, from Disciplinary Literacies to Critical Thinking to Collaboration to Communication – all without having students feel that they are being obviously and intrusively tested. As technology continues to advance, insights from stealth assessment embedded in learning contexts can be integrated with insights gleaned from behavioral interactions with learning systems (e.g., frequency of checking messages from an instructor, speed in signing up for a class), allowing for the ongoing provision of personalized nudges, recommendations, and guidance to help students improve their educational decision-making and course performance (Machajewski et al., 2023).

Innovative Task Design

Accurately capturing SFF requires innovative task design. New assessment activities will go beyond traditional multiple-choice and constructed-response questions to enable the assessment of deep knowledge and thinking, reveal rich information about learners' interactions with the tasks (and, depending on the activity, other learners) through the generation of continuous process data, enable timely scoring at scale, and provide insights to help learners improve. Advancements in educational technology hold promise in enabling innovative task design. Immersive task environments can be designed to situate learners in authentic assessment situations. Game-based assessment offers simulation and interactivity, which expands the number and complexity of the constructs that can be measured precisely. The SFF system will use technology-rich environments to provide all learners with authenticity and interactivity during assessment experiences. In our application of advanced technological tools, we understand that digital tasks alone do not guarantee the quality of the assessment. Research to date documents the value of a cognition-centered design approach to ensure the fidelity of the innovative tasks (Keehner, Arslan, & Lindner, 2023).

An illustrative example of what can be accomplished with cutting edge educational technology is the measurement of collaborative problem solving (CPS). CPS is a very complex construct that involves engaging with others in finding a solution to a commonly shared problem. Tasks that assess CPS well need to cover *both* collaboration and problem-solving dimensions. Once requiring grouping learners and closely observing their interactions, CPS appraisal can now be accomplished through interactive digital platforms that enable machine scoring at scale. ETS researchers have designed CPS tasks that leverage the latest AI technology and data analytics (Hao, 2021; Hao et al., 2019). Collaboration and problem-solving skills are evaluated through authentic and virtual performance-based tasks. These tasks engage multiple learners simultaneously to solve a problem through an interactive assessment platform. The platform documents how individual learners share information, defend their stances, reconcile their opinions, and eventually identify a common solution. A chat function allows participants to display their problem-solving (cognitive) and collaborative (behavioral) skills dynamically as they interact with each other and the tasks themselves to come to solutions (Andrews-Todd & Forsyth, 2020).

Capturing Skills Gained from Multiple Educational Pathways

An important goal of the future skills agenda is to recognize and document skills gained through alternative pathways, manifested in the K-12 to postsecondary transition, education to career transition, and occupation switch in the workforce. Great strides are being made on the technological fronts to capture skills from a range of experiences and activities, but as frameworks are being created and algorithm developed, it is critically important to center around equity so equal opportunities are provided to learners as we document a wide range of skills.

On the technological fronts, when inferences are made about individuals' skills through sources other than degrees and transcripts, evaluators often rely on self-report (e.g., cover letter, personal statement), third-party evaluation (e.g., reference letter, teacher rating), or standardized assessment (e.g., cognitive test, personality inventory). New technology and widespread use of AI has enabled skills inference by parsing unstructured data (e.g., transcripts, resumes, employment history) into machine-readable data without the traditional evaluation (e.g., Sajjadiani et al., 2019). For example, teams at [Experience You](#), an initiative launched by the T3 Innovation Network and Education Design Lab, are working to turn unstructured data about individuals' educational, occupational, and experiential histories into quantitative, machine actionable data for documenting individuals' skills. The technologies and insights gained from these workforce initiatives hold great promise for high schools to offer credit for student learning that takes place outside of

school, to overcome the barrier that information about such activities (e.g., volunteering, internships, community service) is often available only in unstructured formats.

Broad considerations to equity issues should be embedded throughout the design, development, validation, and refinement of skills recognition and verification. When designing an analytical framework to capture skills from out of school experiences, it is important not to focus on extracurricular activities only available to students from resourceful families. For example, playing piano, practicing swimming, participating in a toastmaster program helps build resilience, perseverance, communication, and leadership skills. However, the framework we apply to look for such skills should not just focus on these activities, as these activities may not be available to students from underprivileged backgrounds. Equal consideration should be given to activities such as taking care of younger siblings, working at a local community shop, or even walking a far distance to school and being on time, as these activities represent resilience, perseverance, communication, and leadership as well. When conceptual framework and technological tools are used to capture skills, they need to be responsive to the experiences of students from all backgrounds.

Supporting Use of the Skills System

K-12 teachers will be critical to reimagining of the U.S. educational system through SFF. Incorporating SFF into teaching and learning and using the associated assessments effectively will require career-long development of ambitious pedagogy, including new instructional approaches that integrate SFF into disciplinary learning. SFF innovations are intended to prepare students for not only future educational opportunities but work and life more broadly. Accordingly, teachers must be equipped with the instructional competencies, curricular materials, and assessment literacies to foster these skills within their students. For the SFF system to meet its full promise, teachers' professional learning needs to be accompanied by strong communication and consistent engagement to develop buy-in with a wide range of stakeholders (e.g., parents, principals, superintendents).

Professional learning models to support SFF will have to be comprehensive, necessitating implementation early in teachers' careers, including the pre-service and induction stages. To foster SFF affective and behavioral skills, in addition to cognitive competencies beyond Disciplinary Literacies, it will be essential for teachers to have strong content *and* pedagogical knowledge. Teachers proficient in both of these areas are more likely to organize high-quality curricula that engage students in complex problem solving (Hill et al., 2005) and teach in ways that help students construct, make meaning, evaluate, and test new knowledge (Cunningham, 1998; Windschitl et al., 2009). For professional learning ventures to be effective they will have to imbue teachers with sophisticated reform-based practices (e.g., engaging in specialized discourses, relying on frequent assessment of student thinking, deep assessment literacy; Windschitl, 2009) needed to effectively nurture the integrated skillsets in students that are the defining feature of SFF. Key features of successful professional learning programs include sharing a vision for ambitious teaching and learning, relating teachers' learning to classroom practice, grounding the work in disciplinary teaching and learning, incorporating opportunities for active learning, and providing coherence with other learning activities (Darling-Hammond, 1999; Darling-Hammond et al., 2017; Garet et al., 2001). All of these elements, and more, will have to be marshaled to fully prepare teachers for educating students in SFF.

Improvement Science and Networks

The SFF system promises to offer new insights to educators as they seek to support students. However, providing the comprehensive supports that teacher need to improve their practice based on these insights is far from simple (Farrell & Marsh, 2016; Bertrand & Marsh, 2015). As has been documented in extensive research on educational program implementation, promoting improvements in practice at scale is beset with challenges (Honig, 2006). It's far easier to

encourage the widespread adoption of shallow tweaks vs. deep change (McLaughlin & Mitra, 2001). The complexity of teaching means that “one size fits all” approaches to teacher learning are unlikely to lead to sustained improvements (Lampert, 2001). The political instability of educational organizations, such as districts, means that system leaders must be vigilant about creating and maintaining coherent instructional policies in order to encourage and sustain pedagogical improvement (Cobb et al., 2020). Furthermore, even when efforts at instructional improvement are able to overcome these challenges and demonstrate effectiveness in one location, they often struggle when brought to a new context (Coburn, 2003).

In response to these long-standing challenges of promoting wide-scale change, a new approach has gained popularity in education over the past decade: improvement science (Cohen-Vogel et al., 2015, Tichnor-Wagner et al., 2017). Improvement science is a systematic process of problem-solving that relies on the rapid refinement of innovations in response to data, a spirit of continuous inquiry, and sensitivity to local context (Langley et al. 2009). Rather than insisting on “fidelity” of implementation, it calls for the “adaptive integration” of new ideas into educational settings in such a way that honors the core design features of an innovation while simultaneously encouraging customization for local contexts (Lemahieu, 2011; Bryk et al., 2015). Practitioners of improvement science insist on the active incorporation of educators into the design, refinement, and execution of new practices.

Our approach to supporting educational organizations to use the SFF system will anchor itself in improvement science. Teachers and administrators will be incorporated as active partners in the design of the assessment system and the pedagogical practices and model lessons (Windschitl et al., 2012) that will serve as essential supporting artifacts. Rather than treating teachers as passive recipients of “best practices,” we will recruit them into inquiry-based professional communities that collectively examine assessment results, plan and implement changes to their practice, and use evidence to continuously refine their work. These communities will provide collaborative and generative opportunities for teachers to understand the SFF framework and use it to decide how to connect the skills to curricula and instruction. Administrators too, will be invited to take part in inquiry groups that consider how to craft an inspiring instructional vision (Kay & Boss, 2021) and create policies that support the integration of these new assessments into their organization. The SFF system will offer new visibility into student progress and needs, but it will depend on the ingenuity and agency of local educators to develop the practices that support students to develop new skills.

Alongside the use of improvement science principles, our approach to supporting educators will rely on the construction of learning networks that encourage the development of shared knowledge, the cross-pollination of ideas across educator groups, and the collective pursuit of improvement throughout a system (Russell et al., 2019). Rather than providing support to isolated schools or teacher teams, the SFF initiative will bring together educators from various locations (schools within a district, or districts within a region), to work together to develop new ways to develop student skills. Recently, prominent philanthropies have invested heavily in the development of such improvement networks in the educational field (Bill and Melinda Gates Foundation, 2019). These networks can accelerate improvement by bringing together diverse sources of knowledge, energizing participants through productive collaboration, and providing a centralized source of learning (Kinlaw et al., 2020).

Conclusion

The current school assessment system is outdated. It limits learning to a constrained set of knowledge and skills, typically easy to measure (Darling-Hammond et al., 2017; NRC, 2012). It disregards the learning that takes place both in and outside of school. It fails to meet students where they are and does not offer timely or meaningful insights to guide

improvement. To prepare our next generation of learners for the challenges and opportunities of the future workforce, a transformational assessment system is needed, one that is guided by sound assessment principles, captures learning acquired through multiple educational pathways, and offers ongoing and continuous insights for learners, teachers, post-secondary institutions, and employers. The assessment system rooted in SFF integrates advanced measurement sciences, employs cutting-edge task designs, offers diagnostic insights to inform learning and improvement, and engages learners in a personalized way. The new assessment system represents a paradigm shift from focusing on traditional cognitive skills to assessing and improving broader affective, behavioral, and cognitive skills that matter for life, work, and education. The SFF system will build on the already remarkable progress that has been made in competence-based and skills-based education in both K-12 and postsecondary education. An ecosystem of partnerships is critical to offer the new system the right research foundation, innovative solutions, policy support, and learning communities for teacher professional development.

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