A Skills-Based Vision for Assessment, Insight, and Educational Improvement

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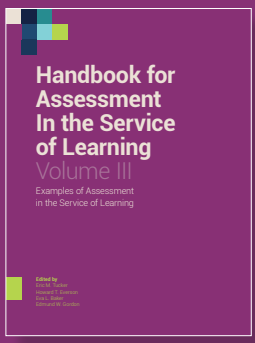

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Abstract

Our current educational system prioritizes traditional academic disciplines and views the K–12 classroom as the major learning environment. By focusing solely on academic learning, the system overlooks the broader variety of skills learners acquire both inside and outside the classroom, leaving critical skills such as communication, collaboration, and critical thinking underdeveloped. Furthermore, the current approach fails to reflect the diverse pathways through which learners develop expertise, such as military service, internships, or community engagement. Skills-or competency-based education 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. This chapter articulates design principles for educational assessments that address a skills focus and meet both academic and workforce needs. Beginning with a review of existing skills frameworks that outline key skills, competencies, and learning outcomes across various contexts in K–12, postsecondary, and workforce sectors, we identify skills deemed critical for the future by looking for commonalities across skills frameworks and state Portraits of a Graduate (PoG) frameworks. After establishing a taxonomy, the chapter discusses how to leverage technology and AI tools to capture skills acquisition, particularly skills that are developed and demonstrated in non-academic context. Then, the chapter discusses assessment design principles that enable the measurement of complex skills with validity, reliability, and authenticity. Finally, the chapter proposes a professional development model and continuous improvement approach that supports the implementation of skills assessment in classrooms.

Keywords: Skills-based assessment, Carnegie unit, multi-modal assessment, continuous improvement, durable skills

Author Note
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A Skills-Based Vision for Assessment and Educational Improvement

The way in which the U.S. educational system credits and validates learning is outdated. Our current system prioritizes traditional academic disciplines and views the K–12 classroom as the major learning environment (Silva et al., 2015). However, this approach fails to reflect the diverse, nonlinear pathways through which learners develop expertise, such as military service, internships, apprenticeships, volunteerism, and community engagement (Werquin, 2023). Furthermore, by focusing solely on academic learning, the system overlooks the broader variety of skills learners acquire both inside and outside the classroom, leaving critical skills such as communication, collaboration, and critical thinking underdeveloped (National School Boards Association, 2025). Most degrees are awarded based on acquisition of academic knowledge, but this narrow focus has led to serious skills gaps among learners (García-Chitiva, 2024; Ulloa-Cazarez, 2021). For example, while close to 100% of employers believe that critical thinking, problem solving, and teamwork are essential skills for workforce performance, less than 60% think college graduates are equipped with these skills (National Association of Colleges and Employers, 2019). To meet the needs of the modern workforce and society, shifting the focus of the U.S. education system to nurture the "whole student" (e.g., Darling-Hammond & Cook-Harvey, 2018; Durlak et al., 2011) is critical to securing the long-term civic and economic flourishing of the country.

In addition to broadening the skills that should be considered in talent preparation, it is also important to expand the pathways through which these skills are acquired. *Skills- or competency-based education*[1] shifts the emphasis from certifying classroom-instilled academic knowledge to certifying students' knowledge and

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

skills gained from a variety of educational, occupational, and societal experiences. Such a system is agnostic to where students acquired their skills. The focus is on the outcome—demonstrated ability—not the process through which it is developed. Recognizing learning gained through nontraditional pathways allows individuals a wider range of opportunities to demonstrate their qualifications, achieve upward economic mobility, and contribute to society (Bell, 2016).

Existing efforts in competency-based education (CBE) reflect a significant shift toward mastery of skills, competencies, and knowledge through applications in real-world situations. Such a shift is becoming increasingly prominent across K–12 (e.g., XQ Institute, Aurora Institute; Levine & Patrick, 2019), postsecondary (e.g., Western Governors University, 2019; Southern New Hampshire University, n.d.), and workforce sections (e.g., Opportunity@Work). In the K–12 space, organizations such as the XQ Institute and the Aurora Institute have been at the forefront of promoting CBE models, emphasizing personalized learning pathways, allowing students to progress at their own pace once they demonstrate mastery of a given skill of competency. Schools that adopt CBE models are exploring the replacement of traditional grading systems with skill-based assessments. In postsecondary education, institutions like Western Governors University and Southern New Hampshire University have embraced CBE to support adult learners by offering programs where students earn degrees by demonstrating mastery of competencies, rather than accumulating credit hours. These innovative programs allow students to leverage prior experiences from both academic and nonacademic settings to accelerate their skills development. Finally, in the workforce sector, initiatives like Opportunity@Work are reshaping how talent is recognized by advocating a "skills-first" hiring approach, where employers value demonstrated competencies over traditional credentials (Debroy & Auguste, 2025). As industries continue to evolve along with the advancement of technologies and globalization, there is a growing demand for skills such as digital literacy, interpersonal skills, and self-management skills (World Economic Forum, 2025). The future demands talents who can think critically, collaborate effectively, and continuously adapt to new environments and changes quickly with an open-mind. Programs like those developed by Opportunity@Work are necessary to respond to industrial demands.

All these examples show that CBE supports diverse learning pathways and acknowledges that learners acquire skills and knowledge through various experiences from both in-school and out-of-school settings. The shift of focusing

from time-based learning to mastery of skills requires a corresponding shift in how student progress and learning outcomes should be measured (OECD, 2018). Traditional assessments that focus on content knowledge and rote learning are insufficient for capturing the broader range of skills necessary for the future. Assessments must be transformed to evaluate not only what students know but also what they can do with that knowledge in real-world contexts (National Research Council, 2001). Similarly, the need for changes in admission and hiring systems is also becoming increasingly evident (Debroy & Auguste, 2025; Liu, 2021). Traditional systems that rely heavily on seat-time requirements of completing prerequisite courses may not fully capture a student's future readiness. Instead, demands of skills-based admissions and alternative credentialing models may be on the rise.

This chapter focuses on articulating design principles for educational assessments that address a skills focus to meet both academic and workforce needs. The discussion is situated in the context of the Skills for the Future (SFF) initiative (Liu et al., 2024; Ober et al., 2025b), a partnership between the ETS and Carnegie Foundation for the Advancement of Teaching. SFF serves three primary goals to measure what matters, develop innovative measures, and generate insights for key stakeholders. It aims to expand beyond traditional disciplinary learning by focusing on durable skills that matter in young learners' academic and workforce success. It also experiments on how student experience from a wide range of sources (e.g., school, family, community, workplace) can be considered to build a learner skills profile, through both innovative assessment and non-assessment evidential tools. Last, to address the information gaps in many previous assessments in which teachers and other stakeholders struggle to make sense out of the assessment results, SFF aims to adopt a co-design approach with educators and other stakeholders to best understand how assessment results can turn into insights for teaching and learning improvement.

The following chapter begins with a brief historical review of previous efforts at measuring a broader set of student skills. Then it reviews existing skills frameworks that outline key skills, competencies, and learning outcomes across various K–12, postsecondary, and workforce contexts. The review helps to identify gaps in existing frameworks and create a comprehensive taxonomy of skills for educational, occupational, and civic success, which will serve as a blueprint for future skills-based assessments being explored in SFF. The

chapter also discusses how technology and AI tools are used to capture skills acquisition, particularly the skills that are developed and demonstrated in non-traditional contexts. Then, the chapter discusses the assessment design principles that enable the measurement of complex skills with validity, reliability, and authenticity. Finally, the chapter proposes a professional development model and continuous improvement approach that supports the implementation of skills assessment in classrooms for SFF.

Previous Efforts to Measure a Broader Set of Student Skills

The past twenty years have seen an increasing and enduring interest in measuring a broader set of student skills beyond traditional academics. Many terms have been used to describe non-disciplinary skills such as 21st century skills, durable skills, transferable skills, employability skills, and the like (Trilling & Fadel, 2009). There is also considerable variation with regard to how frameworks define specific skills, provide guidance for possible assessments, and offer contexts of administration and use.

The Partnership for 21st Century Learning (P21) is one of the earliest collaborative initiatives seeking to infuse 21st century skills into education (Battelle for Kids, 2019). It defines key skills such as critical thinking, communication, collaboration, and creativity, and offers frameworks for educators to integrate these skills into curricula. P21 provides tools, resources, and professional development to a broad partnership of educators. While primarily focused on foundational issues such as identification and definition of the relevant skills, P21 also identified the need for and offered prototypes of associated assessments.

The Cognitive Readiness (CR) initiative of the US Department of Defense has made substantial investment in assessments of skills and traits closely related to the 21st century skills (Morrison & Fletcher, 2001). CR focuses primarily on human decision making in complex and stressful situations, endeavoring to develop the preconditions and skills necessary for effective decision making in military contexts. They employ innovative technologies such as simulations through virtual reality to design assessments for the targeted skills.

Assessing and Teaching 21st Century Skills (ATC21S) is a research initiative that aims to develop assessments for 21st century skills (Griffin et al., 2012). It focuses on defining, assessing, and integrating skills like collaboration, critical thinking,

and communication into educational frameworks. ATC21S has produced a set of innovative assessment tools for educators to evaluate students' 21st century skills. It has involved collaboration across a number of countries, leading to a rich exchange of ideas and practices. The project has generated substantial research on how to effectively assess these skills, contributing both specific tools and broader understanding of how to develop them.

The above-mentioned work, along with others (e.g., Pellegrino & Hilton, 2012; Cavanagh, 2010), provide early evidence for: (1) Demonstrations of framework development, dissemination, and adoption, and (2) Prototyping, testing, and refining approaches to assessing these nontraditional skills. These initiatives also helped promote awareness, understanding, and appreciation of the importance of the 21st century skills for learning and life.

At the same time, prior skills efforts also revealed challenges in measuring new, nontraditional skills in the complex contexts of the real world, data privacy concerns, integrating new forms of assessment into existing instructional and learning activity sets, professional development for educators' successful implementation, and assessment scalability in diverse educational settings.

SFF aims to draw upon previous efforts in executing its three goals in expanding what to measure, innovating how to measure, and generating insights. The following section discusses in detail prior assessment frameworks for complex skills, and describes a skills taxonomy that guides the assessment development for SFF.

Skills that Matter: A Review of Existing Skills-Based Educational Efforts

To more deeply understand the landscape of skill-based education systems, we conducted a review of current initiatives focusing on defining and assessing competencies across K–12, postsecondary, and workforce sectors. Our review included various skills frameworks and states' Portrait of a Graduate initiatives to identify priority skills of shared interests. Across major skills frameworks (The Collaborative for Academic, Social, and Emotional Learning [CASEL, 2020]; XQ student performance framework [XQ Institute, 2023]; OECD Learning Compass 2030 [OECD, n.d.]; NGLC MyWays Student Success Framework [Lash & Belfiore, 2017]; the European Framework for Personal, Social and Learning to Learn Key Competence [Sala et al., 2020]; Habits of Mind: 16 Essential Characteristics for Success [Institute for Habits of Mind, n.d.]; and Asia Society /CCSSO Global

Competence [Asia Society, 2013]), there is a significant overlap in social-emotional skills such as self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. Overlaps in these skills highlight the crucial roles these skills play in navigating complex, interconnected, and globalized worlds (Kim, Allen, & Jimerson, 2024). In addition, there is a strong emphasis on 21st century skills such as collaboration, communication, critical thinking, problem-solving, and creativity, which highlights the shift in educational goals toward preparing learners for the demands of the future workforce (Burning Glass Institute, 2023; National Research Council, 2012; Liu et al., 2023). These 21st century skills are becoming increasingly important as routine, repetitive tasks are being rapidly automated and unique human expertise plays a defining role in individuals' career success. Digital literacy and adaptability are especially emphasized in workforce-aligned frameworks (World Economic Forum, 2025; Burning Glass Institute, 2023), which also reflects the changing nature of future work and life driven by rapid technological advancements and industrial evolutions.

In analyzing these frameworks, it became evident that there was a need for clearer, more concrete definitions for many of the frequently cited skills. A notable pattern across the frameworks was the varying grainsize when skills are defined. Skills defined at broad levels often lack explicit definitions, making it difficult to understand the dimensions and sub-dimensions that underly the skills. For example, self-awareness is categorized as a broad competency with nine subskills in the CASEL framework (2020). In contrast, in the XQ framework (2023), self-awareness is positioned as a specific competency within the broader category of Learners for Life. This variation across frameworks illustrates how the same skill can be interpreted very differently, leading to potential confusion for educators attempting to implement these models.

Portrait of a Graduate (PoG) frameworks have also gained popularity in the United States. These frameworks are developed by individual states, outlining key competencies expected of their high school graduates. As of 2025, over 40 U.S. states have developed or are in the process of developing a PoG framework (Howard Terrell et al., 2025). We reviewed the PoG frameworks from 22 states which have provided adequate competency definitions. Several key skills emerged as common priorities across the majority of states (See Table 1). Communication was the most frequently mentioned skill, appearing in 21 out of 22 frameworks. Critical thinking and problem solving followed closely, mentioned by 19 and 17

states respectively. Collaboration was cited by 17 states. Other notable skills include civic engagement (13), perseverance (9), creativity (7), and growth mindset (7). The overlaps in essential skills across states suggest a shared vision for preparing K–12 students with a blend of cognitive, interpersonal, and personal competencies. The focus on these shared priority skills aligns with the demands of the 21st century workforce.

Table 1.
Overlaps in Skills Mentioned in States' PoG Frameworks.

Skill	# of States mentioned
Communication	21
Critical Thinking	19
Problem Solving	17
Collaboration	17
Civic Engagement	13
Perseverance	9
Growth Mindset	7
Creativity	8
Digital Literacy	7

A Comprehensive Taxonomy for the Skills for the Future

Creation of the Skills for the Future Taxonomy

The authors, along with a broader ETS research team, 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. Through an iterative, consensus-seeking discussion, they then derived 30 "meta-dimensions" that cut across many of the frameworks. These dimensions form the basis of the integrative and comprehensive framework for SFF. A synthetic definition is provided for each meta-dimension, drawing on those revealed in the frameworks that were reviewed[2] (Table 2).

2 As 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".

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

Table 2. (continued)

Name	Major Skills
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
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

Table 2. (continued)

Name	Major Skills
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

The SFF skills taxonomy consists of three primary domains (Danziger, 1994; Wilt & Revelle, 2019): 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. Aligned with many prominent frameworks, the SFF skills taxonomy emphasizes competencies beyond those represented by academic achievement for learners' future educational and occupational success.

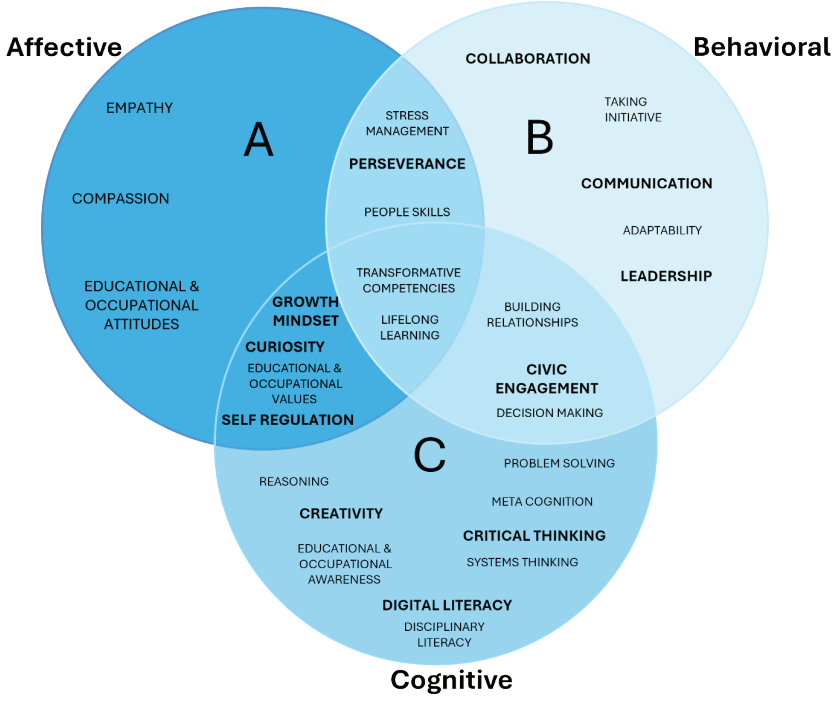
The research team independently classified the skills in the SFF taxonomy according to whether they best belonged to the affective, behavioral, or cognitive domains, based on the content of the competencies' definitions. Initial agreement among the team members was 86% for skills assigned to the affective category, 84% for behavioral skills, and 81% for cognitive skills. The researchers then met to resolve discrepancies in their classifications and collectively identified a category for the skills classification. The final results of the classifications are shown in Figure 1.

It is noteworthy that a subset of the competencies in the SFF Framework belong to more than one psychological domain. Each skill was initially assigned to a single domain that it was mostly aligned with. Through addressing the coding discrepancies in skill assignment, it became clear that some of the discrepancies stemmed from the fact that some skills fall into multiple categories. For example, *Building Relationships* is clearly behavioral in nature as its definition heavily relies on actions directed 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 to the conclusion that it is more appropriate to classify Building Relationships as both a behavioral and cognitive skill. By the same token, the definition of *Lifelong Learning* contains elements that are 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), suggesting that sorting it into a single domain would fail to capture its full breadth and complexity. Assigning the skills to multiple domains reflects the richness and complexity of these skills.

Figure 1. SFF Skills Taxonomy.

SFF Components Classified According to Affective, Behavioral, and Cognitive Domains

Note. The skills that are bolded represent those that were most prominent in our review of existing skills frameworks.



Why do Skills for the Future Matter?

Skills captured in the SFF taxonomy predict important education, career, and life outcomes. Affective and behavioral skills tend to predict the same outcomes as cognitive skills—and often with a similar degree of accuracy (Roberts et al., 2017). Although evidence for the practical importance of affective and behavioral skills has been accumulating since at least the 1970s (Bowles & Gintis, 1977; 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) **K–12 grades** (Poropat, 2009) **Postsecondary grades** (Richardson et al., 2012)	**Educational attainment** (Zamarro et al., 2018) **K–12 grades** (Poropat, 2009) **Postsecondary grades** (Richardson et al., 2012)	**Educational attainment** (Brown et al., 2021) **K–12 grades** (Galla et al., 2019) **Postsecondary grades** (Richardson et al., 2012)

Table 3. (continued)

Outcome	Predicted by Affective Skills	Predicted by Behavioral Skills	Predicted by Cognitive Skills
Occupational	**Career choice** (Ackerman & Beier, 2003) **Career satisfaction** (Ng et al., 2005) **Job performance** (Sackett et al., 2022) **Job satisfaction** (Judge et al., 2002) **Salary** (Ng et al., 2005)	**Career choice** (Ackerman & Beier, 2003) **Career satisfaction** (Ng et al., 2005) **Job performance** (Connelly & Ones, 2010) **Job satisfaction** (Judge et al., 2002) **Salary** (Ng et al., 2005)	**Career choice** (Wai et al., 2009) **Grant funding** (Bernstein et al., 2019) h-index (Bernstein et al., 2019) **Income/salary** (Ng et al., 2005) **Job performance** (Nye et al., 2022) **Job prestige** (Lang & Kell, 2020) **Scholarly productivity** (Kuncel & Hezlett, 2007)
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** (Rochefort 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)

Are Skills for the Future Malleable?

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., 2023; 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; Martín-Raugh et al., 2022). Effective avenues for intervention include clinical treatment (Roberts et al., 2017), cognitive-behavioral therapy (Vittengl et al., 2004), 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).

Design Principles for Educational Assessment: Measuring Skills for the Future

There have been many efforts to incorporate non-academic skills in K–12 education. For example, 49 U.S. states and the District of Columbia have at least one policy that supports social-emotional learning (SEL) in schools, and 83% of U.S. school principals reported adopting a SEL curriculum (Skoog-Hoffman et al., 2024). Despite that many schools implement SEL, very few report scores on these skills, due to concerns about privacy, validity of assessment tools, and misuse of data (Skoog-Hoffman et al., 2024). Given the need for students to demonstrate a broader set of skills, approaches to help quantify learners' mastery of these skills are urgently needed.

A comprehensive assessment system is essential to provide a fuller understanding of what students can do and to guide their future learning pathways (Woo & Diliberti, 2022). This system must be rooted in rigorous research and innovation, featuring refined and new constructs, innovative task designs, breakthrough measurement sciences, advancements in measurement science (Wilson et al., 2005), sophisticated psychometric modeling (Embretson & Reise, 2013), precise

and reliable scoring methods (both human and automated; Bennett & Zhang, 2015), and accessible and actionable score reporting (Brookhart, 2013). SFF reimagines a skills-based assessment system with the following principles.

Five Assessment Principles

The SFF 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 SFF assessment development guided by five authentic assessment principles (McArthur, 2023; Palm, 2008; Sokhanvar et al., 2021).

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

Students bring rich social, cultural, and linguistic backgrounds to the assessment experience (Elwood & Murphy, 2015). Assessments must fully embrace the diverse social and cultural backgrounds of the people who will be taking them (Lane, 2020). This requires the integration of culturally responsive assessment design, which considers linguistic diversity, varied ways of knowing, and equitable access to content and format (Gay, 2018). The SFF assessment system aims to bridge the gap between traditional assessments and the real-world applications of skills by incorporating authentic, context-rich tasks that mirror real-life and workplace experiences (Pellegrino & Hilton, 2012). By embedding tasks in meaningful and engaging scenarios, the system allows learners to demonstrate their competencies in ways that align with their lived experiences, ensuring a more holistic and equitable measurement of their abilities (Darling-Hammond et al., 2013). This approach not only enhances motivation and relevance for diverse learners but also improves the validity of assessment outcomes, as it captures a more comprehensive picture of their skills while minimizing cultural and contextual biases (Mislevy, 2018).

Principle Two: Centering around equity and fairness.

Persistent ethnic and racial performance differences in academic achievement have long been a critical concern in the United States, reflecting systemic inequities in educational opportunities, resources, and access to high-quality instruction (Ladson-Billings, 2006). In 2019, only 21% of all 12th-grade students demonstrated proficiency in mathematics, with significantly lower rates among historically

marginalized groups—just 11% of Latina/o/x students and 7% of African American students—highlighting enduring disparities in STEM education (United States Census Bureau, 2021; National Center for Education Statistics [NCES], 2020). The SFF assessment focuses on capturing a broad range of skills and knowledge in ways that reflect the varied experiences and strengths of learners, rather than favoring those who have had access to more traditional forms of academic preparation. The next generation of assessments must be designed to provide meaningful opportunities for all learners to demonstrate their abilities, serving as a tool for expanding access to educational and career pathways (Darling-Hammond et al., 2014). By incorporating real-world tasks, leveraging flexible assessment formats, and ensuring that measures are adaptable to different learning backgrounds, the SFF assessment aims to create a more effective and accurate representation of individuals' capabilities, ultimately helping to remove unnecessary barriers to success (Ober et al., 2025a; Liu et al., in press).

Principle Three: Benefiting instruction and learning.
The SFF assessment captures a broad spectrum of learners' abilities, going beyond traditional right-or-wrong scoring models to measure complex cognitive, affective, and behavioral skills. For example, when gathering evidence of students' critical thinking skills, the SFF assessment includes both direct assessment of students' critical thinking but also educators' submission of authentic evidence of students' critical thinking. By analyzing rich performance data, including students' problem-solving processes, decision-making strategies, and collaborative interactions, the system will generate actionable insights that can guide both individualized learning pathways and system-wide instructional improvements. These insights, provided at both the individual and cohort levels, aim to help students increase awareness of the skills that matter and understand their own skills level, and to help educators to incorporate skills in disciplinary instruction.

Principle Four: Using technology responsibly to generate insights.
The SFF system will leverage technological advancements in automated scoring and AI-supported assessments that are purposefully designed to enhance learning rather than simply introduce new tools without meaningful impact (Williamson et al., 2020). Beyond scoring, AI can support assessment design by analyzing large-scale learning data to identify key skill gaps, ensuring that assessments are aligned with real-world competencies and personalized learning needs (Mislevy, 2018).

When used responsibly, AI does not replace human judgment but rather augments educators' expertise by automating repetitive tasks, generating real-time feedback, and informing curriculum improvements, ultimately allowing teachers to focus on engaging students in deeper learning experiences (Dede, 2019).

Principle Five: Enabling personalization.
The SFF assessments will incorporate personalized choices for students to select the skills they want to be assessed about, the context of the skills, and ways of evidence demonstration. Personalized assessments allow learners to engage with tasks in ways that align with their unique strengths and learning pathways, leading to richer and more accurate insights about their abilities (Shute & Rahimi, 2021; Mislevy, 2018). Its insights reports aim to provide actionable, real-time feedback, offering a holistic view of what learners know and can do, as well as guidance on how to interpret and apply these insights for educational and career decision-making. These reports will be dynamic, diagnostic, and continuous, evolving with the learner to track progress over time rather than offering a single snapshot of performance (Bennett, 2018). By integrating real-time analytics, AI-driven feedback, and predictive modeling, assessment systems can support informed decision-making in areas such as admissions, educational progression, and workforce hiring (Williamson et al., 2020). Ultimately, this transformation in assessment design aims to empower learners, educators, and employers with deeper, more actionable insights that enable ongoing learning and skill development (Zieky & Perie, 2021).

Measuring Complex Skills Through Multimodal Assessment
SFF assessment will incorporate multimodal formats to enable learners to demonstrate their skills through diverse modalities, such as speech, gestures, writing, and digital interactions (Jaques et al., 2021). Multimodal assessment moves beyond traditional text-based responses, allowing for more authentic, interactive, and adaptive demonstrations of skills (Shute & Rahimi, 2021). Multimodal approaches expand the dimensions of skills that assessments can accurately capture, enabling learners to showcase what they can do in ways unattainable through traditional, single-modality 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, as an example, 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.

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 (Redecker & Johannessen, 2013). 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 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 Pathways

An important goal of the SFF assessment is to recognize skills gained through alternative pathways, manifested in the K–12 to postsecondary transition, education to career transition, and occupation switch in the workforce. 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)—data sources which have been found to highly favor wealthy students (Chetty et al., 2023)—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 (T3 Innovation Network, n.d.), 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 (Wilson & Martin, 2020). For example, when designing an analytical framework to capture skills from out of school experiences, it is important not to focus on extracurricular activities that are often only available to students from resourceful families. Playing piano, practicing swimming, and participating in a toastmaster program helps build resilience, perseverance, communication, and leadership skills. However, the SFF skills 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 (Putnam, 2015). Equal consideration should be given to unstructured 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 (Larson, 2000). When conceptual framework and technological tools are used to capture skills, they need to be responsive to the experiences of students from all backgrounds.

What Types of Educational Experiences Promote the Development of Skills for the Future?

While the skills system we describe in the paper will provide valuable infrastructure and insights, for students to develop these skills, they will need access to new educational experiences. Traditional, didactic learning experiences in which students are asked to take in and regurgitate static information will not promote the development of skills for the future. Instead, through SFF assessment we hope to provide opportunities for students to demonstrate skills they gain from multiple authentic experiences, whether these experiences take place inside or outside of the schoolhouse and school day. By authentic, we mean learning experiences that are tied to actual performance and work associated with professions or academic disciplines (Collins & Duguid, 1989). In recent research, such experiences have been documented within extracurricular and elective experiences, where "Students were no longer vessels to be filled with knowledge, but rather people trying to produce something of real value," (Mehta & Fine, 2019). By Project-based, we mean learning experiences that are connected to real-world problems and contexts, driven by collaborative and social interactions among students, and students themselves

actively involved in the learning process (Kokotsaki, Menzies, & Wiggins, 2016). Teaching in authentic and project-based ways has been linked to the development of skills for the future such as collaboration, leadership, and communication (e.g., Vogler et al., 2018).

Supporting the Use of the SFF Assessment 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. Accordingly, teachers must be equipped with the instructional competencies, curricular materials, and assessment literacies to foster these skills within their students. For the SFF assessment system to be effectively executed in the classrooms, 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 necessitate 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 skill sets 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, 2000; Darling-Hammond et al., 2017; Garet et al., 2001). All of these elements, and more, will have to be developed to prepare teachers for educating students in SFF.

Improvement Science and Networks

The SFF system aims to provide insights report for educators to understand students' skill levels and provide guidance on skills improvement. However, providing the comprehensive support that teachers need to improve their practice based on these insights is not 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., 2018). 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 are being involved in the co-design process for assessment development, as prior research (Windschitl et al., 2012) shows that educator involvement improves the alignment between assessment and instruction. Rather than being treated as passive recipients of "best practices," teachers are being involved in 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 are likely to 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, are currently taking 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.

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 brings 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 & 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 limits its focus to a constrained set of knowledge and skills, typically easy to measure (Darling-Hammond et al., 2017; NRC, 2012; Schleicher, 2018; OECD, 2023). States have made attempts to support competence-based education out-of-schools (D'Brot, 2017), but assessment efforts to quantify learning gained from out of schools are limited. To prepare our next generation of learners for the challenges and opportunities of the future, 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 SFF aims to design is guided by assessment principles, integrates measurement sciences, and offers personalized assessment to engage learners. New skills-based assessment

requires 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. As a response to the paradigm shift, the SFF assessment system is a worthy experiment that builds on the already remarkable progress that has been made in competency-based and skills-based education in both K–12 and postsecondary education.

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