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Promoting Grit, Tenacity, and Perseverance:

Critical Factors for Success in the 21st Century

November 2018

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This report is being released now as it was in 2014-15 because, although some of the technologies have changed in the intervening 3 years, the framework described and issues addressed are still of value to researchers and education stakeholders.

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Executive Summary

What can practitioners, researchers, and policymakers in education do to support children and adolescents to strive for and achieve success in school and life in the face of 21st-century challenges?

This brief takes a close look at grit, tenacity, and perseverance, factors that underlie the tendency to strive for success at long-term and higher-order goals and to persist in the face of challenges, obstacles, and setbacks. By success, we mean the attainment of important educational outcomes, such as strong academic performance and graduation from high school and college, as well as significant life outcomes, such as productive employment, physical and psychological well-being, and making contributions to society. We explore this broadly and also specifically with respect to the new opportunities and challenges associated with the expanding capabilities of digital technologies in education.

Along with a handful of other essential *noncognitive factors,*[1] grit, tenacity, and perseverance have become an important and popular topic of discussion among educators and political leaders alike. They have been identified in research and practice as among the potentially high-leverage factors contributing to success in school and life. Researchers have found that these and closely related factors can have just as strong an influence on achievement as intellectual ability. Furthermore, with the implementation of a wide range of programs to support these competencies in various ways, practitioners and researchers are moving beyond the limited notion that these are traits residing only within the student and are starting to generate evidence that learning environments can be designed to foster their development.

Digital technology is playing an important role in these shifting priorities. While technology by itself does not provide quick fixes for the challenges of promoting perseverance, it can offer tools and resources to enhance and expand the capabilities of human-centered learning environments. For example, established and emerging technologies provide greater adaptation to individual learning needs, a growing wealth of online resources, and online interpersonal networks that can enable learners to persist toward goals that, for many, were previously unattainable. In concert with other high-leverage factors such as quality instruction, social supports, and personal interactions with supportive adults, technology has the potential to significantly impact students' grit, tenacity, and perseverance toward their most important long-term and higher-order goals.

1 "Noncognitive factors" are the attributes, dispositions, social skills, attitudes, beliefs, and intrapersonal resources independent of intellectual ability that high-achieving individuals draw on for success.

Now is an important and exciting time to take stock and prepare to move forward. Research and practice in education, psychology, economics, educational technology, and other fields provide a wealth of knowledge about these factors. There is a need to navigate this complex landscape of knowledge and distill what is important and actionable. The purposes of this brief thus are

1. **to review the research and practical work to date on grit, tenacity, and perseverance;**
2. **to develop organizing frameworks to understand theory, measurement, and existing programs, approaches, and technologies; and**
3. **to use these frameworks to develop recommendations for practitioners, researchers, and policymakers.**

We emphasize technology as an important theme, highlighting the roles it is playing and can play in this work. The brief explores the possibility that grit, tenacity, and perseverance are not just fixed traits but can be malleable and teachable, creating potential for new paths to increase success for all students.

Overview of the Brief

This brief is organized around four main clusters of research questions. To answer these questions, we used two complementary research approaches: a systematic narrative review of existing research and interviews with 27 experts and thought leaders. The brief has five chapters:

- **Chapter 1** introduces the context for the research and the research methods used to develop the brief.
- **Chapter 2** addresses questions about theory: *What are grit, tenacity, and perseverance? What are the key components of these competencies? What psychological and contextual factors support and promote them?*
- **Chapter 3** addresses questions about measurement: *How are these factors measured currently? How can they be measured in the future? How can technology provide new tools and strategies?*
- **Chapter 4** addresses questions about practice: *What types of programs, approaches, and technologies have been developed to promote these factors for a wide variety of learners?*
- **Chapter 5** addresses future directions: *What are key conclusions and recommendations for practice, research, and policy?*

What Are Grit, Tenacity, and Perseverance? A Hypothesized Model

Chapter 2 reviews the research literature and develops a hypothesized model of grit, tenacity, and perseverance. The purpose is to organize the complex literature and provide practitioners, researchers, and policymakers with foundational knowledge about the multifaceted nature of the interrelated concepts of grit, tenacity, and perseverance. The following highlights are key principles of the model.

- **Integrating diverse perspectives on grit, tenacity, and perseverance, we establish a working definition of *grit* for the purpose of this brief.** Researchers describe a phenomenon called the "Jingle/Jangle" Problem: "Jingle" occurs when the same term is used to refer to different concepts, and "jangle" occurs when different terms are used for the same concept. In this case, different communities have varying ideas about what exactly grit, tenacity, and perseverance actually are. For the purpose of this brief, we integrate the big ideas from several prominent theories in the literature into the following broad, multifaceted definition of *grit*: Perseverance to accomplish long-term or higher-order goals in the face of challenges and setbacks, engaging students' psychological resources, such as their academic mindsets, effortful control, and strategies and tactics.

- **Sociocultural context can play an important role in an individual's grit, tenacity, and perseverance.** Students' socioeconomic or cultural context can have a significant influence on the types of goals they want to accomplish, the types of challenges they face, and the resources they can access. For example, it is well documented that students from high-poverty backgrounds are particularly likely to face great stress and limited social support for academic achievement—factors that can undermine perseverance on a wide range of goals. For more affluent students, there are widespread concerns that they are being pushed so hard to get into top-tier universities that their high school years are filled with intense stress, and they are not being adequately prepared to deal with real-life challenges. Regardless of socioeconomic conditions, ethnicity, and gender, all students encounter difficult challenges throughout their schooling.

- **Learning environments can be designed to promote grit, tenacity, and perseverance.** Our research synthesis points to two potentially important factors. *First, students need opportunities to take on worthwhile long-term or higher-order goals that are optimally challenging and are aligned with what students value.* Optimally challenging goals are those that are within the student's range of proximal development—not too difficult and not too easy. *Second, students need a rigorous and supportive environment to accomplish these goals and develop critical psychological resources.* As students engage in pursuing their goals, they may encounter a wide range of challenges. Students will be more likely to persevere when the learning environment has a fair and respectful climate, conveys high expectations, emphasizes effort over ability, and provides necessary tangible resources (materials, human support, and time).

- **Students can develop psychological resources that promote grit, tenacity, and perseverance.** The research synthesis points to three facets—all of which have been shown to be malleable and teachable under certain conditions:

- *Academic mindsets.* These constitute how students frame themselves as learners, their learning environment, and their relationships to the learning environment. They include beliefs, attitudes, dispositions, values, and ways of perceiving oneself. Compelling evidence suggests that mindsets can have a powerful impact on academic performance in general and in particular on how students behave and perform in the face of challenge. A core mindset that supports perseverance is called the "growth mindset"—knowing that "My ability and competence grow with my effort, strategies, and help from others."

- *Effortful control.* Students are constantly faced with tasks that are important for long-term goals but that in the short term do not feel desirable or intrinsically motivating. Successful students marshal willpower and regulate their attention during such tasks and in the face of distractions. Although this can seem austere or no fun, research shows that students stronger in these skills are happier and better able to handle stress.

- *Strategies and tactics.* Students are also more likely to persevere when they can draw on specific strategies and tactics to deal with challenges and setbacks. They need actionable skills for taking responsibility and initiative and for being productive under conditions of uncertainty—for example, defining tasks, planning, monitoring, changing course of action, and dealing with specific obstacles.

- **Potential misconceptions can lead to damaging misapplications.** While grit itself is unlikely to be harmful, some misconceptions about it can potentially be damaging when applied by even the most well-intentioned educators. For example, persevering to accomplish goals that are extrinsically motivated, unimportant to the student, or in some way inappropriate for the student might have detrimental impacts on students' long-term retention in school, conceptual learning, and psychological well-being.

Measuring Grit, Tenacity, and Perseverance

Assessment can be used to support students' perseverance, learning, development, and well-being in a wide variety of ways. It can provide practical tools for educators and learners, tools for program design and evaluation, diagnostic indicators for vulnerable students, and instrumentation needed for research to understand how to promote grit. Chapter 3, geared primarily toward those interested in the design and evaluation of programs and implementation of basic research,[2] provides an overview of measurement methods, directions for future work, and important legal and ethical considerations in data and measurement.

A key distinction has important implications for measurement—whether perseverance is conceptualized as a *disposition* or a *set of processes*. If perseverance is conceptualized as a disposition, measurement may target it as a general or enduring tendency to persevere. Disposition measures can help researchers understand how this tendency relates to academic variables, and they can provide helpful information to students, teachers, and parents about

2 Note that *accountability* is not a use of assessment considered in this brief. This review examines how information about grit, tenacity, and perseverance can be used to inform the support of learning and persistence, not as high-stakes or consequential metrics to judge student or teacher performance.

students' tendencies and preferences. If perseverance is conceptualized as a *set of processes*, measurement may focus on sequences of behaviors, emotions, physiological reactions, and/or thoughts that unfold over time during learning, extracting indicators of persistence and giving up. New technologies are beginning to focus on micro-level, moment-by-moment data within digital learning environments to provide feedback to adapt learning tasks to personalized needs. Measurement may also target the *psychological resources* that contribute to and interact with perseverance (i.e., academic mindsets, effortful control, and strategies and tactics).

The chapter reviews and provides illustrative examples of key methods and approaches to measuring grit, tenacity, and perseverance:

- *Self-report* methods typically ask participants to respond to questions about their perceptions, attitudes, goals, emotions, beliefs, and so on. Advantages are that they are easy to administer and can yield scores that are easy to interpret. Disadvantages are that people are not always valid assessors of their own skills, self-reports can be intrusive for evaluating participants' in-the-moment perceptions during tasks, and self-reports can lose validity over time as students come to realize what is being measured.

- *Informant reports* are made by teachers, parents, or other observers. Advantages are that they can sidestep inherent biases of self-report and provide valuable data about learning processes. The main disadvantages are that these measures can often be highly resource intensive—especially if they require training observers, time to complete extensive observations, and coding videos or field notes—and that informants do not have access to many of the psychological factors, such as students' attitudes, beliefs, and affect, that contribute to grit, tenacity, and perseverance.

- *School records* can provide important indicators of perseverance over time (e.g., attendance, grades, test scores, discipline problems). Advantages are the ability to identify and follow longitudinally students who are struggling to persevere. Disadvantages are that these records themselves do not provide rich information about individuals' experiences and nuances within learning environments that may have contributed to the outcomes reported in records.

- *Behavioral task performance* measures within digital learning environments can capture indicators of persistence or giving up. Advantages are that new methods can be seamlessly integrated into the learning environment and provide opportunities for adaptivity and personalized learning. Disadvantages are that these methods are still new and require intensive resources to develop.

Researchers and other professionals who collect data from people have ethical and, in many cases, legal obligations to take appropriate actions to ensure privacy, confidentiality, and informed consent for data collection activities. The *Family Educational Rights and Privacy Act* (FERPA) generally requires that parents and eligible students (i.e., students who have reached 18 years old or are attending a postsecondary institution at any age) provide written consent before an educational agency or institution discloses personally identifiable information from students' education records. Some legal exceptions are noted in Chapter 3. In addition, research projects must undergo internal review by an Institutional Review Board (IRB) that adheres to the Code of Federal Regulations as set forth in 45 CFR 46. Participants must be provided a consent form that states the specific purpose for the collection of data, how the data will be used, and who will have access to the data. Researchers are charged to keep data confidential, except in the case of harm to self or others. In addition, data collection is limited to the aims of the specific goal of the research.

Programs, Approaches, and Technologies for Learning Environments to Promote Grit, Tenacity, and Perseverance

Chapter 4 provides practitioners, researchers, and policymakers a review of approximately 50 programs, approaches, and technologies for promoting different facets of grit, tenacity, and perseverance. This is intended as a broad but not exhaustive characterization of work in the area. It is organized around five conceptual clusters based on targeted age level, learning environment, and which facets of the hypothesized model are addressed. While a need still exists for empirical evidence that these factors can be taught as *transferable competencies* across situations, there are a wide range of promising programs and approaches. The five conceptual clusters are as follows.

1. **School readiness programs that address executive functions.** These programs at the preschool and early elementary school levels help young children develop the *effortful control* that is necessary for the transition into formal schooling. Approaches include training with games, aerobic exercise and sports, martial arts and mindfulness practices, and classroom curricula and teacher professional development. Many programs have substantial empirical evidence of their success, and a major finding is that children best develop attention regulation and self-control when they can practice skills in a supportive environment that addresses cognitive, social, and physical development together.

2. **Interventions that address mindsets, learning strategies, and resilience.** There is growing research demonstrating that brief interventions (e.g., 2 to 10 hours) can significantly impact students' *mindsets* and *learning strategies* and, in turn, academic performance. Empirically based mindset interventions include activities that explicitly teach students to have a "growth mindset," help students frame difficulty not as personal failings but as bumps in the road to success, provide students with opportunities to affirm their personal values, help relate course materials to students' lives, or incorporate multiple approaches to address different needs. Empirically based learning strategy interventions help students clarify their goals and anticipate in advance how to deal with likely obstacles; they may also develop general study skills, build a resource-rich social network, and/or develop content-specific metacognitive skills to monitor progress. Some programs build these types of skills as protective positive assets that support resilience in the face of adversity.

3. **Alternative school models and school-level reform approaches.** This cluster comprises four approaches. *Character education* models include explicit articulation of learning goals for targeted competencies, clear and regular assessment of and feedback on student progress, intensive teacher professional development, and discourse about these competencies throughout the school culture. In *project-based learning and design thinking models,* students develop competencies through engagement in long-term, challenging, and/or real-world problems that require planning, monitoring, feedback, and iteration. Mindsets are addressed through feedback and iteration, and projects are often aligned with students' interests. *School-level reform programs* work with schools to help them set up learning environments that support students' perseverance. Such programs may provide teacher professional development, networks of school communities, and strategies to improve school organizational structure. Anecdotal evidence of these models' success is extensive, but further research is needed to determine impacts. *What Works Clearinghouse Practice Guides* provide broad recommendations to educators for promoting perseverance to complete high school and navigate the path to college.

4. **Informal learning programs.** We reviewed informal learning programs that support persistence in and outside school. Several provide structured social support networks for students who will be the first in their families to go to college. Such programs provide academic support, community involvement, and guidance for the processes of college exploration, application, and initial college adjustment. Other types of programs focus on activities to spark and support interest and persistence in STEM professions. Many programs are beginning to teach explicitly about grit, drawing on models similar to the character education models. In most cases, there is considerable anecdotal evidence of program success, but further research is needed to determine impacts.

5. **Digital technologies, online resources, and tools for teachers.** Digital learning environments can provide optimal challenge through adaptivity; help educators promote a rigorous and supportive classroom climate; motivate students through gamification of learning environments; promote productive mindsets, learning strategies, and effortful control; and provide a wealth of resources and interpersonal networking that can enable learners to persist toward goals that, for many, were previously unattainable. Data are available showing the impacts of some of these technologies on both noncognitive factors and academic achievement.

Together, these findings provide a source of optimism that grit, tenacity, and perseverance can be teachable and transferable. Future work will need to examine how educators can adopt or adapt these approaches in their own settings.

Conclusions and Recommendations

Promoting grit, tenacity, and perseverance across educational contexts for a wide variety of students will require significant and pervasive shifts in educational priorities. *There are no quick fixes;* making significant progress will require the efforts of all communities of educational stakeholders and fundamental paradigm shifts in the culture of education. The following recommendations are tailored to the specific needs and responsibilities of practitioners, researchers, and policymakers.

Recommendations for Practitioners

1. **Use research-based best practices to promote grit, tenacity, and perseverance.** Research points to actionable best practices. We present these recommendations as promising but not proven; evidence of impact at scale is limited, and the field still needs coherent methods for integrating these practices into school culture, teaching practices, curriculum, and technology—especially under conditions that present significant barriers. Chapter 5 outlines specific strategies.

    a. Educators should provide students with opportunities to take on worthwhile long-term or higher-order goals that are optimally challenging and are aligned with what students value.

    b. Educators should provide students with a rigorous and supportive context for pursuing these goals.

    c. To the extent possible, educators should provide the tangible resources—materials, human support, and time—necessary to overcome challenges and accomplish their goals.

    d. Educators should support the psychological resources that can promote grit, tenacity, and perseverance: academic mindsets, effortful control, and strategies and tactics.

2. **Consider adopting and adapting established programs, approaches, and/or technologies. Such a process should include multiple cycles of program design, implementation, evaluation, and refinement.** The programs reviewed in Chapter 4 are summarized above. Educators may choose to investigate the utility of one or more of these approaches for their own contexts. Note that this review was not intended to be exhaustive, and educators are encouraged to look more broadly before making final decisions on programs. Regardless of the chosen approach, educators should proceed carefully and expect to go through multiple cycles of program design, implementation, evaluation, and refinement. When considering technology specifically, educators should also evaluate digital learning environments with respect to the degree to which their designs are aligned with the research-based best practices.

3. **Be mindful to address potentially damaging misconceptions.** Practitioners should consider some important realities: (1) promoting perseverance for goals inappropriate for the student can induce stress and have detrimental long-term effects, (2) being nice to students and encouraging them is important but it can take more to promote perseverance, (3) perseverance promoted in performance-oriented cultures can potentially undermine grit, (4) adults could potentially overemphasize the importance of grit as a personality characteristic, (5) students may give up on important goals too early if they do not understand that the passion that can drive grit must often develop through hard work, and (6) technology by itself does not provide quick fixes for the challenges of promoting perseverance.

Recommendations for Researchers

1. **Seek to clarify and unify constructs.** Across communities of practice and research, inconsistency in conceptual terminology concerning grit, tenacity, and perseverance is a barrier to collaboration and progress. Researchers should seek to (1) tease apart conceptual distinctions that are critical to practice and (2) construct and work within consolidated frameworks that unify concepts and findings. Collaborative partnerships, working groups, professional conferences, and peer-reviewed publications should promote unifying themes and common definitions.

2. **Develop models of pathways for development over time and in different contexts.** Such work would inform the development of potential learning trajectories for grit, tenacity, and perseverance and construction of age-appropriate and context-appropriate interventions. Researchers may conduct (1) longitudinal studies to develop coherent models of developmental pathways in different contexts and (2) systematic research examining the same individuals striving to accomplish goals in different contexts.

3. **Investigate how to integrate practices within disciplines.** Researchers should investigate how to integrate best practices for promoting grit, tenacity, and perseverance into discipline-specific curriculum and pedagogy. For example, researchers may explore how instructional activities and teaching practices to foster learning of academic content could incorporate best practices to support perseverance and/or associated key psychological resources.

4. **Continue to advance technologies, especially in how they can provide new structural supports in underresourced settings.** Researchers should work closely with technology developers to continue to explore how to integrate best practices for promoting grit, tenacity, and perseverance into new and emerging digital learning environments for a range of purposes.

5. **Continue to advance measurement methods, especially in support of adaptive and personalized learning that promotes persistence.** Researchers should continue to investigate how to leverage and augment new technology-based digital learning environments to provide useful data that can be used both as practical tools for educators and learners and to inform program design, evaluation, and research instrumentation. Research efforts should include assessment experts, who can apply techniques such as evidence-centered design to design and validate measures aligned with advances in theory.

6. **Conduct field-based implementation research at small and large scale.** Although there are many programs demonstrating impacts in particular contexts, there is still a gap between the research and what practitioners need to know to use the various intervention approaches effectively across a wide variety of settings for a diversity of students. Researchers should translate research findings into actionable programs and practices through field-based implementation research that includes small-scale design research grounded in everyday practice, as well as larger scale efficacy studies to explore variations across settings and effectiveness studies to establish impacts at scale.

7. **Investigate potential misconceptions that can lead to damaging misapplications.** Practitioner Recommendation 3 urges practitioners to be mindful of potential misconceptions and misapplications of knowledge, yet research offers little guidance on this. Research in this area will help educators gauge and fine-tune interventions, models, practices, and approaches.

Recommendations for Policymakers

1. **Provide resources and structural supports to enable educators to implement best practices and effective programs.** In many settings, tremendous barriers remain to implementation of essential best practices and programs. Pervasive barriers include unsupportive school cultures, lack of time and resources for students and teachers, lack of access to teacher professional development, and toxic stress for young children. State, district, and school leaders should provide resources and structural supports to enable enactment. Examples may include devoting resources to relevant professional development and curriculum materials, creating opportunities for coordination among institutions to support early identification of children at risk, and outreach to families and community.

2. **Invest in programmatic portfolios of interdisciplinary research and development.** Foundations and federal agencies should invest in programmatic portfolios of research on perseverance that investigate mutually informing research questions spanning the range from basic theory to intervention and evaluation research to assessment research. Portfolios should leverage the capacities of multidisciplinary teams and program networks. For maximum impact, sectors of the education enterprise (e.g., government, academy, practice, philanthropy) must work together and coordinate efforts to move this work to a central focus.

A Final Recommendation for All Stakeholders: Get the Word Out

Those who understand the importance of these factors and are passionate about incorporating them into educational priorities, within their own institutions and beyond, need to become proactive advocates for change to gain buy-in, tangible support for students as they pursue big goals, financial resources for schools and programs, and broad political support. Researchers also need to actively translate important findings to be accessible and actionable.

1 Introduction

> *"…the cognitive hypothesis: the belief, rarely expressed aloud but commonly held nonetheless, that success today depends primarily on cognitive skills…in the past decade, and especially in the past few years, a disparate congregation of economists, educators, psychologists, and neuroscientists have begun to produce evidence that calls into question many of the assumptions behind the cognitive hypothesis…increasingly these scientists and educators are finding one another and making connections across the boundaries of academic disciplines. The argument they are piecing together has the potential to change how we raise our children, how we run our schools, and how we construct our social safety net."*
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> Paul Tough, *How Children Succeed: Grit, Curiosity, and the Hidden Power of Character* (Tough, 2012, pp. xiii–xvi)

What can practitioners, researchers, policymakers, and technology developers in education do to support children and adolescents to strive for and achieve success in school and life in the face of 21st-century challenges? By success, we mean the attainment of important educational outcomes, such as strong academic performance and graduation from high school and college, as well as significant life outcomes, such as productive employment, physical and psychological well-being, and making contributions to society. The pathways to these kinds of successes can be fulfilling yet also challenging. In the 21st century, for example, many students face problems associated with poverty, many students are preparing themselves for demanding careers that can require extensive education and specialized knowledge work, and all students will need to learn how to respond to rapidly changing workforce needs and economic volatility. At the same time, digital technologies are expanding in capabilities and becoming more and more deeply integrated into 21st-century school, work, and life, providing new opportunities and challenges.

This brief takes a close look at grit, tenacity, and perseverance, factors that underlie the tendency to strive for success at long-term and higher-order goals and to persist in the face of challenges, obstacles, and setbacks. These are an important subset of the noncognitive factors—attributes, dispositions, social skills, attitudes, beliefs, and intrapersonal resources independent of intellectual ability—that high-achieving

individuals draw on for success. Grit, tenacity, and perseverance have been identified in research and practice as potentially high-leverage factors that can be fundamental to educational achievement and life outcomes. For example, a meta-analysis of correlational research showed that academic performance is similarly correlated to both the characteristic of conscientiousness ("dependability and will to achieve") and intellectual ability at both the secondary and postsecondary levels of education (Poropat, 2009). Another study showed that for adults this characteristic of conscientiousness is associated with both objective success (e.g., income and wealth) and subjective success (e.g., life satisfaction and positive affect) (Duckworth, Weir, Tsukayama, & Kwok, 2012).

These factors have become an important and popular topic in education broadly and in educational technology specifically. Whereas conventional educational approaches have tended to focus on intellectual aspects of success, such as content knowledge, recognition is increasing that knowledge is *necessary* but not *sufficient* for students to achieve their full potential. Practitioners, researchers, and policymakers are looking beyond the limited notion that grit, tenacity, and perseverance are traits residing only within the student and are expanding the ways that formal, informal, and digital learning environments can be designed to foster their development. For example, several private foundations have initiated programs to push the frontiers of theory, measurement, practice, and technology concerning these and related factors, particularly for at-risk and vulnerable students. These factors are also emphasized in influential policy documents such as the Common Core State Standards for Mathematics, which now include *persistence* as a core mathematical practice, and the National Research Council's (2012) report on 21st-century competencies. At the same time, practitioners and policymakers are placing greater emphasis on social and emotional learning (SEL), which includes the development of *self-management*, the ability to set and work toward personal and academic goals (Weissberg & Cascarino, 2013).

Digital technology is playing an important role in these shifting priorities. Although technology by itself does not provide quick fixes for the challenges of promoting perseverance, it can offer tools and resources to enhance and expand the capabilities of human-centered learning environments. For example, new and emerging technologies permit greater adaptation to individual learning needs and sophistication of assessment. Also, technologies designed in alignment with educational best practices and research in psychology are offering new opportunities to promote the development of the productive mindsets and other skills that can underlie perseverance. Furthermore, the online world provides a growing trove of resources and interpersonal networks that can enable learners to persist toward goals that, for many, were previously unattainable. In concert with other high-leverage factors such as quality instruction, social supports, and personal interactions with supportive adults, technology has the potential to significantly impact long-term outcomes.

Now is an important and exciting time to take stock and prepare to move forward. Research and practice in education, psychology, economics, educational technology, and other fields provide a wealth of knowledge about these factors. Navigating this complex landscape of knowledge to distill what is important and actionable is essential.

The purposes of this brief thus are (1) to review the research and practical work to date on grit, tenacity, and perseverance; (2) to develop organizing frameworks to understand theory, measurement, and existing programs, approaches, and technologies; and (3) to use these frameworks to develop recommendations for practitioners, researchers, and policymakers. We emphasize technology as an important theme, highlighting the roles it is playing and can play in this work. Theoretical foundations are grounded in reviews written primarily for research audiences, most released within the last three years. This information is complemented by interviews with a broad spectrum of expert informants from practice, research, and policy domains. The brief is closely tied to themes in the Expanding Evidence report, which explores new and emerging opportunities in rapidly evolving and expanding technology (U.S. Department of Education Office of Educational Technology, 2013). It culminates in key conclusions and recommendations for practitioners, researchers, and policymakers.

A Critical Need in Education: Why Grit, Tenacity, and Perseverance?

American children in the 21st century need support as they encounter a variety of challenges unprecedented in history. As the world becomes increasingly complex, technical, multicultural, and competitive, children and adolescents also face a weakening of the family and informal community support that was once available. As discussed in more detail in the callout box, students in high-poverty areas face particular challenges of stress, limited social support, lack of critical resources, and psychological disempowerment and disenfranchisement. These issues contribute to dramatic gaps in achievement that are detrimental to individuals and corrosive to society as a whole. It is especially important to design learning environments for these students that provide contextual supports to persevere through the challenges of schooling—mastering conceptually difficult material, preparing for college, graduating from high school, getting into and completing college, and transitioning into a viable career.

Scholars and practitioners are also exposing challenges emerging for the middle and upper classes. Education researcher Denise Clark Pope in her 2001 book *Doing School: How We Are Creating a Generation of Stressed-Out, Materialistic, and Miseducated Students*, provided research and vivid examples of how middle class students are being pushed so hard to get into top-tier universities that their high school years are filled with intense stress and they are not being adequately prepared for a thriving adulthood. In our interview with him, Dominic Randolph, principal of the Riverdale Country School in New York City, expressed a similar sentiment about the more privileged students coming through his private school. He had deep concern that these students knew how to work hard to "do school" but were not developing the life skills to persevere in the face of the challenges they would encounter in the real world.

Challenges of Students in High Poverty in the United States

All students face challenges, but one of the greatest national issues for education is the achievement gap for high-poverty students. As Paul Tough discussed in his book *How Children Succeed: Grit, Curiosity, and the Hidden Power of Character* (Tough, 2012), students from high-poverty backgrounds are particularly likely to face great stress and limited social support in the home for academic achievement, which can create psychological distress and undermine perseverance toward both short-term and long-term goals in education and extend into adulthood. Early exposure to severe and frequent adversity "can damage the architecture of the developing brain and increase the likelihood of significant mental health problems," as well as impair early learning, school readiness, and academic achievement outcomes (National Scientific Council on the Developing Child, 2008/2012, p. 2). Stress and deprivation can impede children's development of the executive functions (i.e., self-regulation, problem-solving, and attentional control) necessary to learn to persevere on cognitively demanding tasks and comply with norms and rules. These are not necessarily permanent deficits, and many highly stressed children respond extremely well when their challenges are addressed. Yet there is a risk that issues early in life that go unaddressed can have a downward spiraling effect on behavior and achievement.

Farrell et al. (2007) investigated the problematic situations in adolescence particular to high-poverty urban African American middle school students. They found that in addition to experiencing many of the same problems as other young people, these youth are more likely to lack essential material support and experience victimization. This is because of the depletion of neighborhood infrastructure, local financial resources, and social capital and the prevalence of crime, drug use, and violence. They are also more likely to lack the developmental assets of supportive and functional parents, teachers, and other community adults. Further, they face the challenges of being surrounded by adults coping with complex stressors. A set of three longitudinal studies showed that stressful life events can impair self-control, an important factor for perseverance, in adolescents (Duckworth, Kim, & Tsukayama, 2013).

Students in high poverty thus face conditions that may do little to promote (or may undermine) perseverance and provide limited opportunities to develop the psychological resources that set them up for success. They may also lack the social resources to get academic help when needed and guidance on how to navigate high school successfully and graduate, get into college, and begin a career. Additional research has shown that ethnic minority students may be particularly prone to feelings of alienation and lack of belonging in the educational institution—both of which can undermine their desire to persevere academically (e.g., NRC & IM, 2003).

Prevailing stereotypes of poor performance in school can also undermine persistence. African American students, for example, are often aware of a stereotype that African Americans have poor verbal skills. When faced with an evaluative situation—such as a diagnostic test of their verbal ability—students may experience what psychologist Claude Steele and colleagues call *stereotype threat*, a threat that induces a felt pressure and anxiety that their poor performance may confirm the negative stereotype (e.g., Steele, 1997; Steele & Aronson, 1995). Similar findings have been documented for women in the context of mathematics test performance (Spencer, Steele, & Quinn, 1999). This threat diverts attentional resources from the task at hand, undermining effective perseverance in conditions of difficulty.

Regardless of socioeconomic conditions, ethnicity, and gender, all students encounter challenges throughout their schooling. The greatest difficulties that adolescents themselves report in their everyday lives are interpersonal conflicts, concerns about their changing identity, and concerns about their future as they anticipate educational, occupational, and career challenges in an increasingly competitive job market requiring higher levels of education (Seiffge-Krenke, Aunola, & Nurmi, 2009). This will necessitate developing complex skills for the 21st-century workplace and capacities to deal with changing economic conditions. Indeed, many students will be preparing for STEM (science, technology, engineering, and mathematics) and other professional careers that require complicated training pathways over many years and mastery of extensive and difficult disciplinary material. As they engage in these pathways, they must decide on an ongoing basis how to deal with distractions from their longer term goals, persist to complete academic assignments that are important but not necessarily intrinsically interesting to them, and manage competing demands on their time. Unfortunately, many students will also encounter adverse circumstances, such as bullying, illness, and family problems.

Because of the daunting challenges students face across the board, there is an emerging and convergent recognition in research, practice, policy, industry, and popular culture that the noncognitive factors—and particularly grit, tenacity, and perseverance—must play an essential role in evolving educational priorities.

An Exciting Time of Change and Progress

Many individuals and groups from across various communities are already making great progress in exploring how to promote grit, tenacity, and perseverance. Many are exploring what these factors are and how they operate and what it might take to incorporate them into schooling, to leverage new technologies, and to get the word out to the public. While the evidence is still sparse that grit, tenacity, and perseverance are teachable as transferable traits per se across contexts, there is reason to be optimistic that learning environments can be built with contextual supports to promote these qualities and/or prepare students with psychological resources that can continue to pay off. For example, some important developments are as follows:

- **Research in laboratories and school settings provides a rich empirical foundation for understanding grit, tenacity, and perseverance and best practices to promote them.** Building on decades of research in psychology, education, and economics, researchers are constructing theoretical models of how these factors function in education, drawing direct implications for practices for setting up learning environments, designing curriculum, and providing teacher professional development. Chapters 2 and 4 provide overviews of this theoretical and practical work.

- **A broad range of programs across settings have begun to implement and test models to teach and/or promote these factors for a wide variety of students at all age levels.** As reviewed in Chapter 4, in our interviews and literature review to prepare this brief, we encountered many programs, approaches, and technologies designed to promote a range of aspects of grit, tenacity, or perseverance. These target students across the age span from preschool to postsecondary education. Settings include school readiness programs, brief interventions in schools, alternative school models and school-level reform approaches, informal learning programs, and digital learning environments, online resources, and tools for teachers. Many of these programs have data suggesting impacts on both perseverance and achievement.

- **Educational technology is providing opportunities to promote grit, tenacity, and perseverance in new ways.** As discussed in the *Expanding Evidence* report (U.S. Department of Education, Office of Educational Technology, 2013), the landscape of educational technology is rapidly expanding and evolving. Across formal and informal learning settings, blended learning is integrating classroom-based activities with technologies such as web-based digital learning resources, intelligent tutoring systems, online courses and learning communities, feedback systems such as "clickers," games that engage players as they learn content, and simulations of complex real-world phenomena. These technologies are increasing in ubiquity as they become not only more usable, affordable, and adaptable, but also more accessible through open digital repositories and resource sharing platforms. They provide a variety of new affordances that can be leveraged to support students' grit, tenacity, and perseverance in several ways. Key examples are the following.

    - Digital learning environments with sophisticated assessment and adaptation can potentially promote perseverance through personalization that responds to individual learning needs.

    - Digital learning environments can potentially promote productive mindsets and learning strategies that research shows contribute to persistence in the face of academic challenge. The callout box below gives examples.

    - Technologies can promote the development of the effortful control and executive functions required to maintain the focus and attention necessary for challenging academic pursuits.

    - Technologies can help educators promote students' perseverance. Several digital tools are intended to help teachers promote positive classroom cultures and support perseverance.

    - The online world provides a growing wealth of resources and interpersonal networking that can enable learners to persist toward goals that, for many, were previously unattainable. Exhibit 1 shows an example of a social network designed to promote grit.

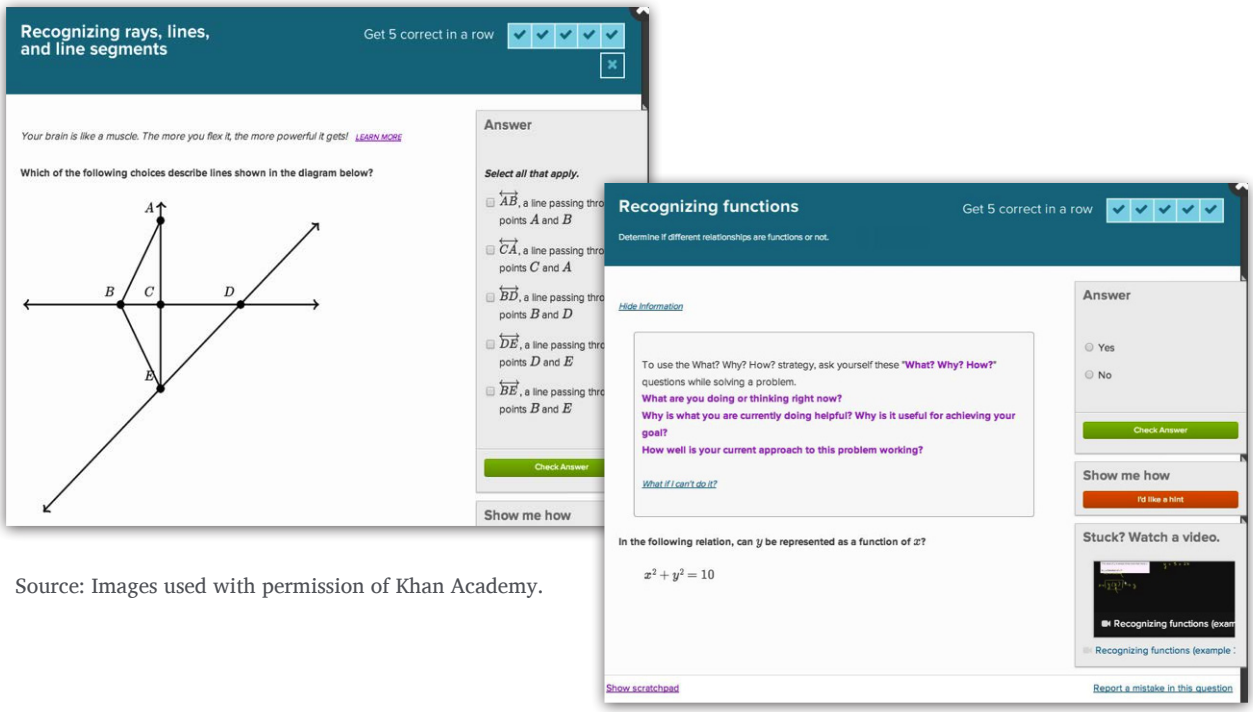
Digital Learning Environments That Promote Academic Mindsets and Learning Strategies Essential to Perseverance

Research in psychology shows that in many situations, students are more likely to persist and succeed at challenging academic tasks when they have

- *A growth mindset*—the belief that their ability and competence grow with their effort, strategies, and help from others, and
- A toolkit of learning strategies to help them reflect on their own understanding and try new approaches

This research is discussed in detail in Chapter 2 (e.g., Dweck, Walton, & Cohen, 2011; Yeager & Dweck, 2011; Yeager, Walton, & Cohen, 2013).

Designers of digital learning environments are exploring how to incorporate supports for such mindsets and strategies. For example, as students work on mathematics problems in Khan Academy (https://www.khanacademy.org/), the system sometimes provides reminders such as the one shown below, "Your brain is like a muscle. The more you flex it, the more powerful it gets!" The system also provides students with a "Why? Why? How?" strategy that encourages metacognitive reflection on their approach to doing problems. Consistent with research in psychology, preliminary findings from recent research in the Khan system suggests that simply giving students messages stating that their ability grows with their effort can have small but significant effects on persistence and achievement.



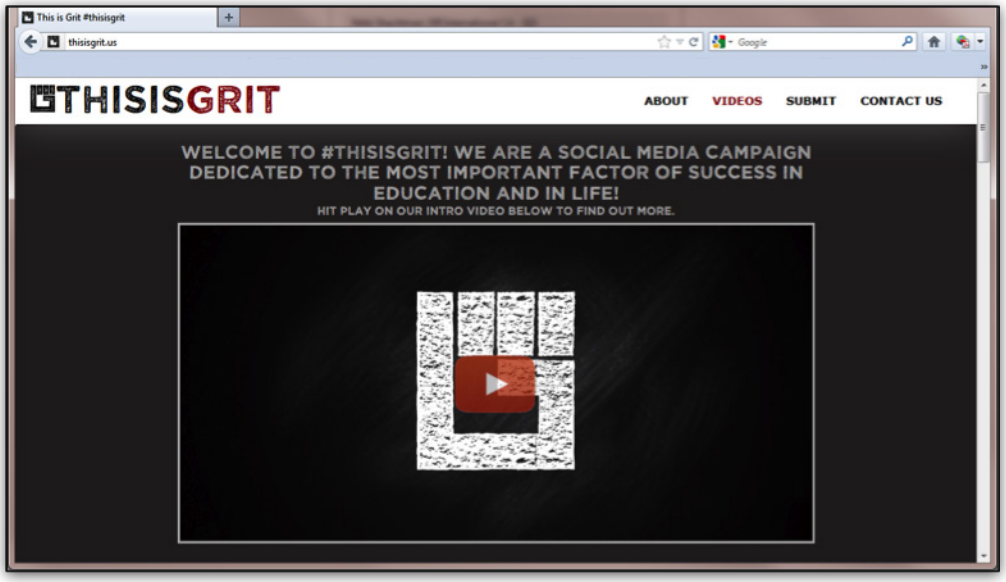
Source: Images used with permission of Khan Academy.

Math 180 (http://teacher.scholastic.com/products/math180) draws on research showing that students can develop a growth mindset through explicit instruction about the brain and how the growth mindset works. Math 180 is a blended learning approach that targets middle grades students who have a history of failure and are unlikely to have a growth mindset about mathematics. The first two weeks of the Math 180 curriculum focus on establishing a supportive classroom culture and teaching students about productive mindsets and learning strategies. This period includes teacher-led lessons about the brain. Within the digital curriculum, students are provided opportunities to demonstrate their growing abilities and mastery and are provided feedback about this that is intended to reinforce their confidence in their ability to learn.

Source: Images used with permission of Math 180.

Exhibit 1. This Is Grit social network

This Is Grit (http://thisisgrit.us) is a social network for individuals to share videos of their stories about grit, tenacity, and perseverance to inspire others to persist in the face of challenge.



Source: Retrieved from http://thisisgrit.us.

- **Private foundations have been supporting progress in developing theory, measurement, and practice relative to these factors.** For example, the Bill & Melinda Gates Foundation, the Raikes Foundation, the Lumina Foundation, the Stupski Foundation, the Spencer Foundation, the Gordon and Betty Moore Foundation, and the MacArthur Foundation have supported significant advances. Some examples follow.
    - Foundations funded comprehensive research literature reviews on academic tenacity (Dweck, Walton, & Cohen, 2011), the role of noncognitive factors in shaping school performance (Farrington et al., 2012), and the landscape of student academic mindset interventions (Snipes, Fancsali, & Stoker, 2012).
    - The Raikes Foundation cosponsored a White House convening in May 2013, "Excellence in Education: The Importance of Academic Mindsets." This meeting brought together diverse experts in practice, policy, and research to produce an action agenda for exploring what needs to be learned in order to effectively promote academic mindsets in U.S. educational settings.
    - The Moore Foundation sponsors the Science Activation Lab, which is conducting research to understand the most important contributing factors for persistence in participation in science and how to leverage them in the design of learning environments.
    - The MacArthur Foundation's Digital Media & Learning Program is investigating how to leverage new digital and social media to provide students with material resources and human capital that make it possible to achieve goals previously unattainable by many students.

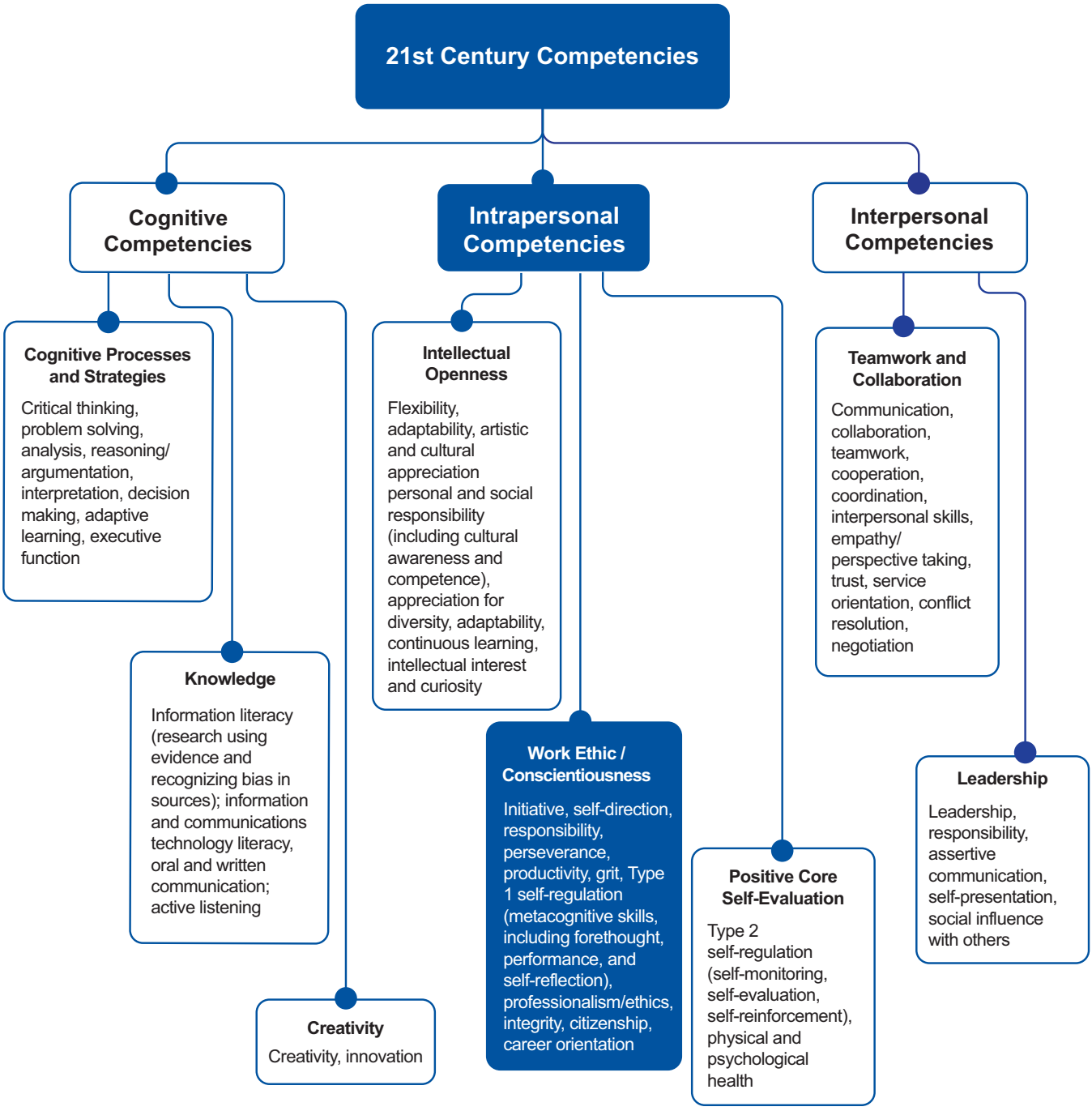
- **These factors have been central in important national educational policy documents and initiatives.** Some examples follow.

    - In 2012, the National Research Council released the report *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21-st Century* (NRC, 2012). In this report, the Committee on Defining Deeper Learning and 21st- Century Skills laid out a research-based framework of the critical competencies and recommendations for research, policy, and practice. As shown in Exhibit 2, it pointed to three broad domains of competence: cognitive, intrapersonal, and interpersonal. Grit, tenacity, and perseverance are in the center of the intrapersonal domain, which involves "the capacity to manage one's behavior and emotions to achieve one's goals" (p. Sum-3). The authors presented a series of recommendations for how to move this work forward in research, policy, and practice.

    - In support of conceptual learning, authors of the Common Core State Standards for Mathematics incorporated perseverance explicitly in the first practice standard: "Make sense of problems and persevere in solving them." Proficiency in this standard includes the skills for students to "monitor and evaluate their progress and change course if necessary." The standard is consistent with findings in the math education research literature that providing the opportunity to struggle with important mathematical ideas is a key teaching practice found to facilitate the development of students' conceptual understanding (Hiebert & Grouws, 2009, p. 387).

- **These factors have been receiving increasing attention in the popular media, indicating their appeal to the general public.** As an indication of the appeal of and demand for these factors in the general public, we turn to the popular media, where there has been increasing attention on their importance. In September 2012, Paul Tough's book *How Children Succeed: Grit, Curiosity, and the Hidden Power of Character* was released and received wide national attention. According to the overview, the book "introduces us to a new generation of researchers and educators who, for the first time, are using the tools of science to peel back the mysteries of character…. [H]e uncovers the surprising ways in which parents do—and do not—prepare their children for adulthood. And he provides us with new insights into how to improve the lives of children growing up in poverty" (Tough, book sleeve). There have also been a number of articles, newscasts, and blogs in media such as *Time* magazine, the *New York Times Magazine*, National Public Radio, *Mind/Shift*, and the *Marshall Memo*.

Exhibit 2. Clusters of 21st-century competencies



Source: National Research Council. (2012). *Education for life and work: developing transferable knowledge and skills in the 21st century.* Washington, DC: The National Academies Press.

An Important Time to Take Stock and Prepare to Move Forward

While the work to date is rich, exciting, and full of possibilities and opportunities, a common theme in the literature and across all our interviews with researchers, practitioners, and policymakers is that there is still much that needs be done for grit, tenacity, and perseverance to become a pervasive priority in education. *There are no quick fixes;* making significant progress requires the efforts of all communities of educational stakeholders and fundamental paradigm shifts in the culture of education.

We must also consider that this is a rich but nascent field. In fact, the term "grit" made it into the research literature as a viable topic of study in education only in 2007 (i.e., Duckworth, Peterson, Matthews, & Kelly, 2007). The NRC report on 21st-century skills pointed out that there have been extensive research on and advances in understanding cognitive competencies, but the research on the intrapersonal and interpersonal competencies is limited and primarily correlational in nature. This limitation is consistent with the historical emphasis on intellectual factors over noncognitive factors in research, practice, and policy. Core recommendations of the NRC report were that foundations and federal agencies should support research programs to develop theory, assessment, and interventions that fill critical gaps (NRC, 2012).

Now is an important time to take stock and prepare to move forward. There is a strong need to look across the variety of areas of work to distill the major themes; evaluate the state of available empirical understandings; find out what is actionable in terms of best practices, technology, measurement, and the design of learning environments; and uncover important gaps in practice, research, and policy. To construct this brief, the methods were designed to allow us to examine the rich theory and evidence that *do* exist and draw out specific conclusions that we *are* and *are not* in a position to make at this point, along with recommendations for moving forward.

Research Questions and Research Design

This brief was designed to integrate answers to driving research questions into a useful framework with accompanying conclusions and recommendations. The remaining chapters focus on the following questions:

1. **What are grit, tenacity, and perseverance? What are the key components of these competencies? What psychological and contextual factors support and promote them?**
2. **How are these factors measured currently? How can they be measured in the future? How can technology provide new tools and strategies?**
3. **What types of programs, approaches, and technologies have been developed to promote these factors for a wide variety of learners?**
4. **What are key conclusions and recommendations for practice, research, and policy?**

We used two complementary research approaches. The first was a systematic exploration of the corpus of existing research and narrative review. Following methods for narrative integrative research reviews (e.g., Cooper, 1989; Cook et al., 1994), we began with a systematic search for research reviews and individual studies. Using literature search databases and talking to experts (see interviews below), we sought out key literature reviews that examine educational outcomes and facilitating factors for grit and other noncognitive characteristics, such as engagement, academic tenacity, and intrapersonal 21st-century skills. We also conducted ancestry searches (i.e., mining bibliographies), a manual search of the tables of contents of major educational research journals over the past 10 years, and a manual search of websites of key experts and organizations. We then screened each for relevance and quality and examined overall findings, methodological assumptions, theoretical conclusions, and inferences that could be drawn. We extracted important and relevant themes for answering our research questions.

The second approach was to interview experts and thought leaders to gather their perspectives on the issues raised in the questions. We identified 27 high-profile and respected researchers, practitioners, policymakers, funders, and technology designers who are experts or thought leaders in noncognitive factors in education or educational technology. In part, this roster was drawn from the authorship of key pieces of literature. Other interviewees were nominated in consultation with Department of Education or other informants, using a "snowball" process, to identify the best possible informants. The semistructured interview protocol developed for each informant was designed to elicit in-depth responses about key emerging issues, adding to, refining, confirming, or disconfirming conceptual elements in our literature review and leading to the development of the overarching framework. We also used these interviews to identify use cases that would be helpful in highlighting key concepts. Interviews were conducted by phone, except in a few cases when in-person interviews were particularly useful or convenient. Extensive notes were taken on responses during interviews; in some cases, the interviews were recorded and transcribed. Analysts summarized the interview data for each informant and coded it thematically with respect to the research questions.

We synthesized the findings from these two approaches to create the integrated framework, explicating theoretical assumptions and putting forth what we consider to be the most useful conceptualizations and recommendations. The References section indicates the key literature reviews that we used, and informants are listed in the Acknowledgments.

2 What Are Grit, Tenacity, and Perseverance?

A Hypothesized Model

> *"What do academically tenacious students look like? First, they believe that they belong in school academically and socially…. Second, they are engaged in learning, view effort positively, and can forgo immediate pleasures for the sake of schoolwork…. Third, difficulty, be it intellectual or social, does not derail them. They see a setback as an opportunity for learning or a problem to be solved rather than as a humiliation, a condemnation of their ability or worth, a symbol of future failures, or a confirmation that they do not belong. This is true at the level of a given task and at the level of their studies in general. Tenacious students know how to remain engaged over the long haul and how to deploy new strategies for moving forward effectively."*
>
> Carol Dweck, Gregory Walton, and Geoffrey Cohen
> (Dweck et al., 2011, pp. 5–6)

To support progress in understanding how to promote grit, tenacity, and perseverance, there is a need for common language and shared understandings. Research on these concepts has roots in many different traditions and communities, and the concepts are complex and multifaceted. Further, different communities address them in different ways, emphasizing different pieces of the puzzle. This can make it challenging to navigate the terrain.

The purpose of this chapter is to organize the complex literature and provide practitioners, researchers, and policymakers with foundational knowledge about the multifaceted nature of grit, tenacity, and perseverance. We begin by discussing definitions of the family of concepts, pulling out the common themes. We then present a hypothesized model that organizes the concepts across the literature. We emphasize that this is

a *hypothesized* model; the research literature does not yet lend itself to a rigorously tested comprehensive theory. The chapter concludes with an investigation of some of the potential risks and costs of grit misapplied or misunderstood.

Definitions of Terms

School engagement researchers Reschly and Christenson (2012) described a phenomenon called the "Jingle/ Jangle" Problem—"jingle" occurs when the same term is used to refer to different concepts, and "jangle" occurs when different terms are used for the same concept. Indeed, a common finding across our interviews and in the literature was that people have different ideas about what exactly grit, tenacity, and perseverance are and that there is a need to clarify both the terminology and conceptualizations. In this section, we review a family of related terms and definitions, concluding with one we developed to use throughout this brief.

Exhibit 3 presents key terms and definitions from prominent scholars. A common theme among most of them is the exertion of effort or will necessary to achieve goals. The definitions of *grit, academic tenacity, agency, academic perseverance,* and *persistence* also include a tendency to keep going in the face of failure, adversity, obstacles, and setbacks. There are also important differences among them. Duckworth and colleagues described *grit* in terms of persistence over years to attain difficult long-term goals. They characterized this with respect to stamina, emphasizing the role of effort, interest, and passion in staying on course over the long haul (also see Von Culin, Tsukayama, & Duckworth, 2013).

But persistence in the face of challenge can also be important at shorter timescales and may have a variety of different contributing factors beyond interest and passion. Dweck and colleagues (2011) discussed *academic tenacity* in terms of the *mindsets and skills* that allow students to set short-term concerns aside to withstand challenges and setbacks en route to longer term or higher-order goals. By *mindsets*, these authors are referring to how students frame themselves as learners, their learning environment, and their relationships to the learning environment. These include beliefs, attitudes, dispositions, values, and ways of perceiving oneself. *Skills* refer to strategies, such as planning, monitoring, and modifying actions. The Raikes Foundation (2012) used a similar definition for *agency*. Farrington and colleagues (2012) included grit and persistence in their superordinate definition of *academic perseverance* and incorporated the additional notion of effortful control—delayed gratification, self-discipline, and self-control. Note that these authors did incorporate mindsets and skills into their overall model of noncognitive factors in academic success but separated them out from academic perseverance. The NRC (2012) used *conscientiousness* as a broader term that contains *grit* and also includes mindsets and skills of a sort, folding in the additional aspects of initiative and productivity.

The school engagement literature has close ties as well, as this research tradition emerged in part to explore how to prevent school dropout and support persistence to graduation. Fredricks and colleagues' (2004) definition of *behavioral engagement* included the participation necessary for achieving academic goals, and *cognitive engagement* encompassed the effort necessary to master complex skills.

Resilience is another closely related term, representing an extensive research tradition with important overlap with grit, tenacity, and perseverance. Research and intervention work on resilience focuses on how individuals bounce back from adverse and traumatic life experiences. It investigates which social and emotional assets within the person and their environmental context are most protective in the face of risk, supporting positive outcomes. A departure from grit, tenacity, and perseverance is that resilience does

not focus on the attainment of goals specifically; rather, it is indicated by positive adaptation in the face of risk. However, as Masten, Cutuli, Herbers, & Reed (2009) pointed out, positive adaptation for children and adolescents may include attainment of achievements that are consistent with expected developmental milestones. Within the resilience literature, researchers examine specifically *academic* or *educational resilience*, with a focus on factors in the environment and within the student that enable at-risk students to succeed despite a high risk of failure (e.g., Borman & Overman, 2004; Wang, Haertel, & Walberg, 1994). This work seeks to identify protective factors that can be established in schools, homes, communities, and state and district policies to promote perseverance for students who face a high level of adversity. While we have chosen not to include resilience specifically in the model, the review draws on the resilience literature to gain insight into the special case of persevering toward goals in the face of adverse life events.

Additionally, beyond the scope of this focus are other research traditions that have potentially important overlaps with these constructs. For example, Lopez, Gallagher, and Marques (2013) showed that *hope* was a significant predictor of college students' retention and achievement. Their conceptualization of hope —a person's ability to formulate goals, develop pathways to reach those goals, and initiate and sustain agency for using those strategies—also emphasizes sustaining effort through challenges. Future work should examine how research on grit, tenacity, perseverance, resilience, and other related constructs might be mutually informing.

Exhibit 3. Contrasting definitions of key terms

Term	Definition
Grit (Duckworth et al., 2007, pp. 1087-1088)	Grit entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress. The gritty individual approaches achievement as a marathon; his or her advantage is stamina. Whereas disappointment or boredom signals to others that it is time to change trajectory and cut losses, the gritty individual stays the course.
Academic Tenacity (Dweck et al., 2011, p. 5)	Academic tenacity is about the mindsets and skills that allow students • To look beyond short-term concerns to longer term or higher-order goals, and • To withstand challenges and setbacks to persevere toward these goals.
Agency (The Raikes Foundation, 2012)	By building agency, young people utilize effective learning strategies and demonstrate a positive mindset that not only helps them drive their own learning to do better in school, but also helps them to navigate the typical barriers to success, both inside and outside the classroom.
Academic Perseverance (Farrington et al., 2012, p. 9)	Academic perseverance refers to a student's tendency to complete school assignments in a timely and thorough manner, to the best of one's ability, despite distractions, obstacles, or level of challenge…. To persevere academically requires that students stay focused on a goal despite obstacles (grit or persistence) and forgo distractions or temptations to prioritize higher pursuits over lower pleasures (delayed gratification, self-discipline, self-control).
Persistence and Perseverance (Peterson & Seligman, 2004, pp. 229-230)	We define persistence as voluntary continuation of a goal-directed action in spite of obstacles, difficulties, or discouragement. Simply measuring how long someone works at a task does not adequately capture the essence of perseverance because continuing to perform something that is fun or rewarding does not require one to endure and overcome setbacks. We use the terms *perseverance* and *persistence* interchangeably.
Conscientiousness, 21st Century Competency (NRC, 2012, pp. 2-13)	Initiative, self-direction, responsibility, perseverance, productivity, grit, Type I self-regulation (metacognitive skills, including forethought, performance, and self-reflection).
Conscientiousness, Personality Factor (Poropat, 2009, p. 322)	Dependability and will to achieve.
Engagement (Fredricks et al., 2004, p. 60)	The research literature…defines engagement in three ways. *Behavioral engagement* draws on the idea of participation; it includes involvement in academic and social or extracurricular activities and is considered crucial for achieving positive academic outcomes and preventing dropping out. *Emotional engagement* encompasses positive and negative reactions to teachers, classmates, academics, and school and is presumed to create ties to an institution and influence willingness to do the work. Finally, *cognitive engagement* draws on the idea of investment; it incorporates thoughtfulness and willingness to exert the effort necessary to comprehend complex ideas and master difficult skills.
Resilience (Masten et al., 2009, p. 117)	Positive adaptation in the context of significant challenges, variously referring to the capacity for, process of, or outcomes of successful life-course development during or following exposure to potentially life-altering experiences.
Educational resilience (Wang et al., 1994)	Educational resilience…is defined as the heightened likelihood of educational success despite personal vulnerabilities and adversities brought about by environmental conditions and experiences.

For the purpose of this brief, we have decided to integrate key ideas from these definitions into a broad, multifaceted definition of grit. As illustrated in Exhibit 4, the big ideas we have drawn out are (1) perseverance to accomplish goals in the face of challenges and setbacks and (2) engaging the mutually influencing *psychological resources*:

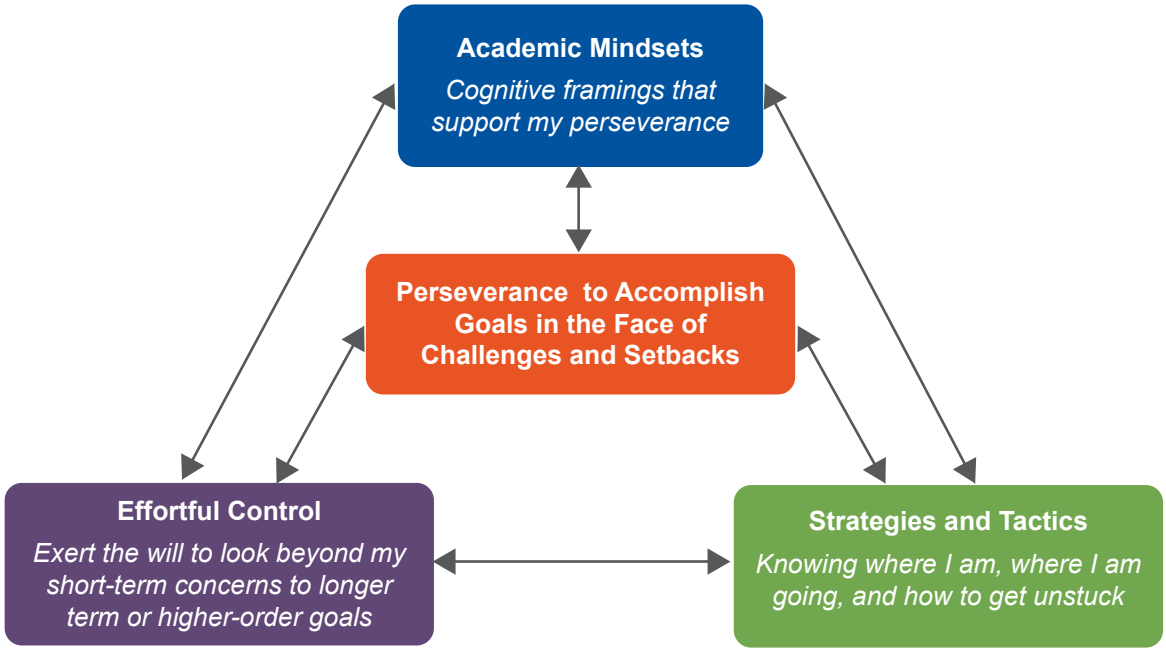
1. **Academic mindsets.** These are how students frame themselves as learners, their learning environment, and their relationships to the learning environment. Mindsets include beliefs, attitudes, dispositions, values, and ways of perceiving oneself.

2. **Effortful control.** Students are constantly faced with tasks that are important for long-term goals but that in the short term may not feel desirable or intrinsically motivating. Successful students marshal willpower and regulate their attention in the face of distractions.

3. **Strategies and tactics.** Students are also more likely to persevere when they can draw on specific strategies and tactics to deal with challenges and setbacks. They need actionable skills for taking responsibility and initiative and for being productive under conditions of uncertainty—for example, defining tasks, planning, monitoring, and dealing with specific obstacles.

Exhibit 4. A broad definition of grit for the purpose of this brief

Perseverance to accomplish long-term or higher-order goals in the face of challenges and setbacks, engaging the students' psychological resources, such as their academic mindsets, effortful control, and strategies and tactics.



A Hypothesized Model

This hypothesized model integrates findings from our interviews and five research reviews (or sets of reviews):

1. The 2012 report released by the University of Chicago Consortium on Chicago School Research presents a comprehensive review of the research literature on the role of noncognitive factors in shaping school performance (see Farrington et al., 2012). This report articulated a hypothesized model of noncognitive factors broadly and examined the research on how major categories of noncognitive factors—academic mindsets, academic perseverance, learning strategies, and social skills—influence academic behaviors and performance. We focus on the categories particularly relevant to the support and development of grit, tenacity, and perseverance.

2. The National Research Council's 2012 report *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century* (NRC, 2012) includes a detailed literature review of the noncognitive factors.

3. Research reviews by Dweck and colleagues (2011), Yeager and Walton (2011), and Snipes and colleagues (2012) provide comprehensive overviews of the research on mindsets and interventions that are being tested to impact them.

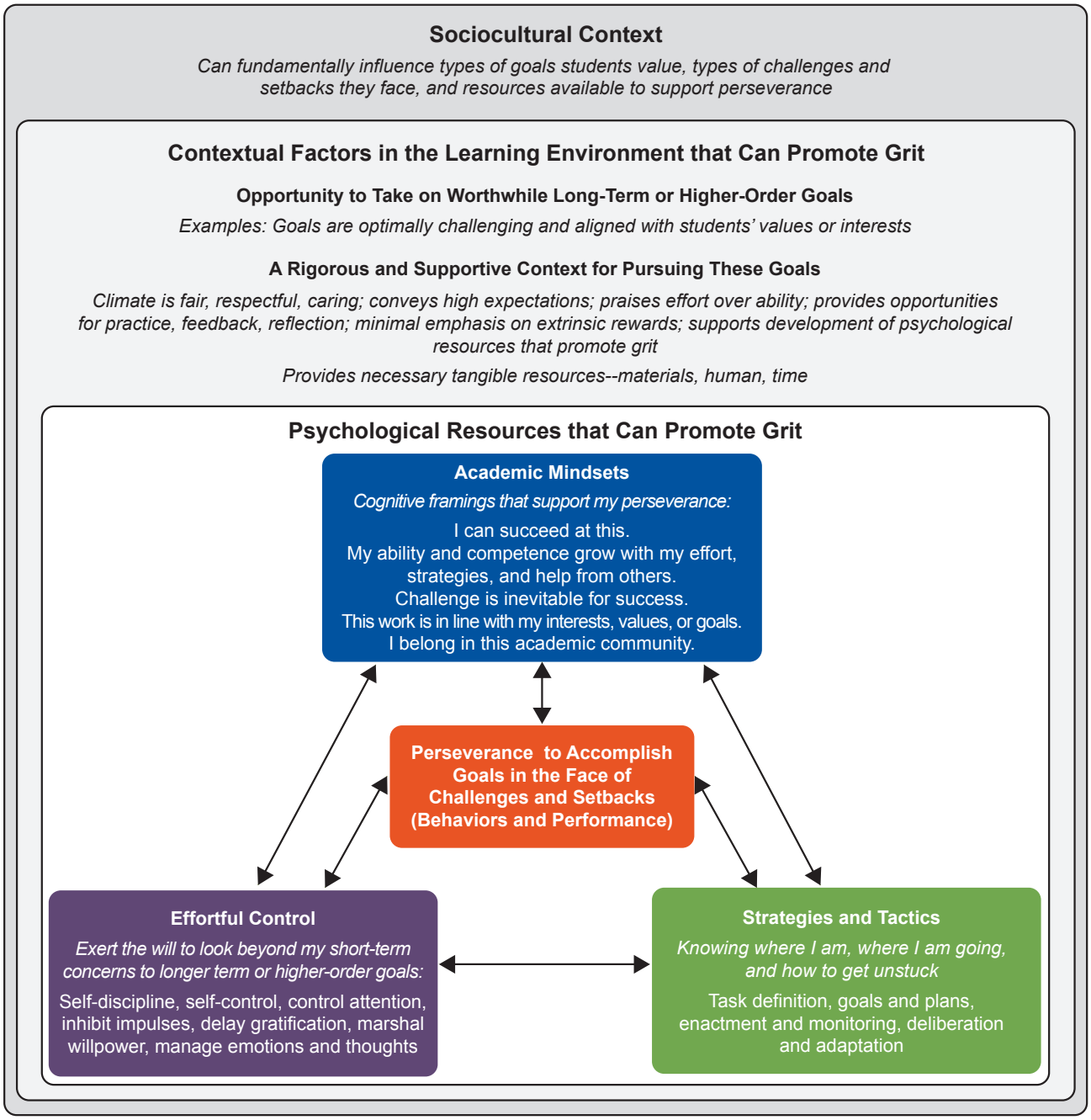
4. Research and reviews by Duckworth and colleagues explore the various facets of effortful control across multiple populations and developmental stages (Duckworth & Allred, 2012; Duckworth & Kern, 2011; Duckworth, Peterson, Matthews, & Kelly, 2007; Duckworth, 2009, 2011). An additional review by Diamond and Lee (2011) lays out approaches for improving executive functions in the early school years.

5. The 2003 report *Engaging Schools,* released by the National Research Council and Institute of Medicine, provides a comprehensive review of the literature on fostering students' motivation to learn (see National Research Council and Institute of Medicine, 2003). These factors are also directly applicable to promoting grit and persistence.

Exhibit 5 presents the full model. In the following sections, we examine the research on each facet. At the end of the chapter, we will return to the model as a whole, discussing hypotheses about the relationships among each of the facets and contextual factors.

Exhibit 5. Hypothesized model of grit, tenacity, and perseverance, and the contextual factors and psychological resources that promote them

Students pursue a wide range of goals and encounter many different types of challenges and setbacks. Sociocultural context can play an important role in determining what students value and want to accomplish, the types of challenges they face, and the resources they have access to. Their perseverance may be directly influenced by contextual factors in the learning environment and can require engagement of important psychological resources— academic mindsets, effortful control, and strategies and tactics.



Sociocultural Context

Sociocultural context can play a fundamental role in influencing the types of goals students will value, the types of challenges and setbacks they will face, and the resources they will have access to for supporting perseverance. As discussed in the callout box at the beginning of Chapter 1, high-poverty student populations face particular challenges of stress, limited social support, lack of critical resources, and psychological disempowerment and disenfranchisement. These issues contribute to dramatic gaps in achievement that are detrimental to individuals and corrosive to society as a whole. Scholars and practitioners are also expressing concerns that more affluent children are learning how to work hard to "do school" but are not developing the life skills to persevere in the face of the challenges they will face in the real world. A critical question in education is how to set up learning environments for a wide variety of students that are most likely to promote grit, tenacity, and perseverance. Chapter 4 explores a range of interventions that are being developed and showing success for different types of populations.

Contextual Factors in the Learning Environment That Can Promote Grit, Tenacity, and Perseverance

Our research pointed to two major aspects of a learning environment that, together, can promote grit, tenacity, and perseverance. First, students need to have the opportunity to take on long-term or higher-order goals (or purposes) that, to them, are worthwhile to pursue. Second, they need a rigorous and supportive learning environment to help them pursue these goals. These aspects are interdependent. Students given the opportunity to tackle worthwhile goals without appropriate support to enact them may not be well equipped to deal with challenges. Conversely, students in a supportive environment who are not pushed to take on truly worthwhile goals may not have the opportunity to stretch themselves and demonstrate perseverance. We now take a closer look at each of these.

Opportunity to Take on Worthwhile Long-Term or Higher-Order Goals

Students will take on a wide variety of different types of goals throughout schooling. Goals can be categorized on a variety of dimensions, for example:

- **Developmental stage.** Goals and life concerns vary considerably for preschoolers, elementary school students, middle school students, high school students, postsecondary students, and adults. Students' age is a key consideration in understanding goals and perseverance.
- **Timescale.** Goals can be relatively short term, such as solving a difficult math problem; medium term, such as studying for a test or completing a complicated inquiry-science project; or long term, such as graduating from high school and being ready for college.
- **Complexity.** Independent of timescale, goals can have lesser or greater complexity. Becoming the National Spelling Bee champion and completing all the educational milestones to become a STEM professional are both lofty long-term goals, but the latter will most likely require a more complex sequence of actions over time.

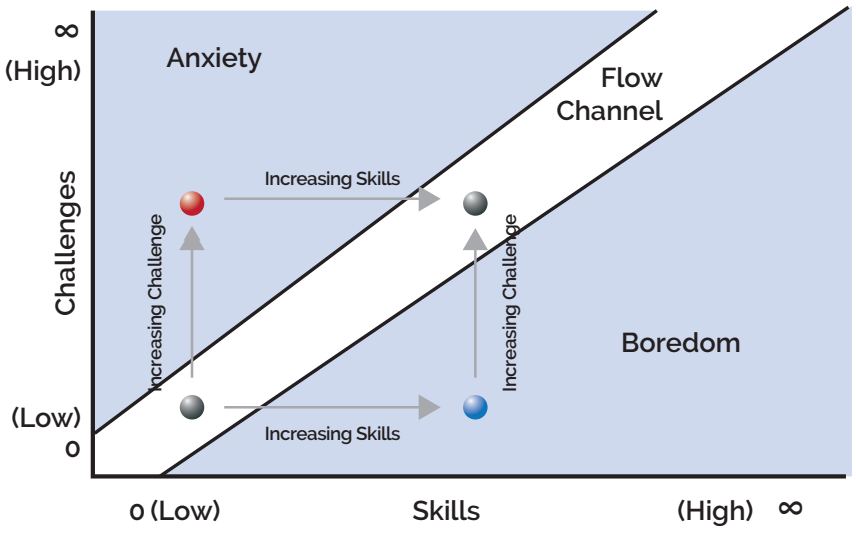
- **Academic content domain or setting.** If the goals are content focused, they can differ depending on whether they are within math, science, language arts, an extracurricular activity, or some other content domain. For example, achieving deep understanding of the concepts of calculus requires different actions and supports than learning to shape the rhetoric of essays.
- **Nature of the reward and students' valuing of attaining the goal.** Pursuit of goals can be motivated by intrinsic interests, extrinsic pressures for performance, and/or fear of failure. The same goal can be valued quite differently depending on the student. For example, for many students, getting into college is of extremely high value; it is less so for many other students.

One way of understanding what can make particular goals *worthwhile* is through the lens of *expectancy-value theory*, a research tradition in psychology that has identified two major factors that tend to contribute to a student's perseverance in the face of challenge: expectancy of success and valuing of a goal or task (e.g., see the review by Wigfield, Tonks, & Klauda, 2009). Each is examined in turn.

Expectancy of success. This is defined as the students' belief about how likely they are to succeed at their short-term or long-term goals. This belief is closely tied to students' self-efficacy, their evaluation of their own competence in that area. In other words, students are more likely to persist in the face of challenge when they believe that they can succeed.

Many of the education experts we interviewed, as well as psychologists, game designers, sports experts, and others who deal with pushing people to do their best, discussed how students are most likely to demonstrate persistence when tasks or goals are *optimally challenging*—they require some perseverance to succeed but not so much that they seem overwhelming or impossible. Exhibit 6 shows Csikszentmihalyi's (1990) model illustrating one way of conceptualizing the relationship between an individual's skill level and the challenge he or she perceives in a given task. On the x-axis is the level of skill, and on the y-axis is the degree of challenge or expectancy of success of an activity. When the individual has skills that exceed the challenge of the activity (i.e., shown in the lower right-hand quadrant), she or he could become at risk of giving up because of boredom. When the activity is challenging in a way that exceeds the individual's skills and expectancy for success (i.e., shown in the upper left-hand quadrant), he or she is more likely to experience anxiety that could undermine perseverance. Optimal challenge occurs in the area in which the individual's level of skill matches the expectancy of success. This area is called the "flow channel" because in many cases individuals are intrinsically motivated to seek out such optimal challenges and are most productive and motivated in the face of them.

Exhibit 6. Csikszentmihalyi's model of optimal challenge in striving toward a goal



Source: Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience.* New York, NY: Harper & Row.

This is only a model, and many real-life instances are inconsistent with it. For example, as anyone who has worked with children and adolescents knows, in many situations students welcome the chance to do work that is too easy for them, depending on their interests, goals, and enjoyment of challenge. Also, many individuals thrive on taking on challenges that they do not know they can actually accomplish. Furthermore, flow is not synonymous with perseverance; sometimes hard work just needs to be done in the service of a higher-order goal, and it might not be enjoyable at that time.

Students' valuing of a goal or task. Goals are also more likely to be worthwhile to students when they have what theorists call "task-value." Task-value has four components: (1) *attainment value*, or the personal importance of succeeding; (2) *intrinsic value*, or the enjoyment the student gets from engaging in the task or the interest he or she has in the subject; (3) *utility value*, or how well a task relates to current and future goals, even if the student is not interested in the task for its own sake; and (4) *cost*, or the perceived negative aspects of engaging in the task, such as performance anxiety, effort needed to succeed, or opportunity cost of choosing one task over another (e.g., Wigfield, Tonks, & Klauda, 2009). Many researchers have found that students are more likely to persist in the face of challenge when they are working toward goals that have high task-value for them—they are meaningfully connected to their personal values, are inherently interesting or enjoyable to them, and/or are clearly in service of future success that they care about and that they perceive will have value that exceeds any immediate costs.

Educators can play an important role in supporting students in striving to attain worthwhile goals with high expectancy of success and high task-value. For example, educators can intentionally design tasks to connect with students' values, interests, and aspirations and that push or encourage students to strive for highly valued goals that are optimally challenging. Educators can also play an important role in helping students

make connections among tasks that in the short term may not seem immediately interesting or important but that are critical for attaining long-term goals and successes. Similarly, educators can play an important role in providing the support and resources to help ensure that challenges are not overwhelming or impossible but rather fall into a zone of optimal challenge.

A Rigorous and Supportive Learning Environment for Pursuing These Goals

When students have big and important goals, educators can promote perseverance by providing support. Just as there is an array of types of goals, there is also a wide variety of challenges, setbacks, obstacles, and adversities that students may encounter in pursuit of their goals. We first examine this variety of challenges and then take a close look at two dimensions of learning environments that can be important for supporting perseverance in the face of these challenges.

Many of the challenges and setbacks have extremely different implications for supports necessary to persevere. Examples follow:

- **Conceptual complexity or lack of tactical knowledge.** When the goals concern learning content, many students are challenged by the conceptual complexity. Students may also be challenged by lack of tactical knowledge about how to handle new or large goals that require planning and monitoring, for example, a long-term inquiry-based science project or taking the steps necessary throughout high school to get into college.
- **More dominant distractions, lack of intrinsic motivation, boredom.** No matter how worthwhile a long-term goal may be, students will encounter particular subtasks or periods of time when other activities, such as surfing the Internet or hanging out with friends, may seem much more attractive in the short term. Inevitably, students face choices about how they will spend their time and focus their attention.
- **Lack of resources.** Time, materials, and human resources can be essential for accomplishing many goals. Lack of resources can be a critical obstacle to a wide range of goals.
- **Adverse circumstances.** Students of all socioeconomic backgrounds may face adverse circumstances, such as illness, bullying, neighborhood violence, family difficulties, social alienation or racism, moving to a new school, and so on. It can be challenging to maintain focus and direction toward long-term goals in the face of such obstacles.

While these categories are not meant to be exhaustive, they begin to point to the types of supports that students will need as they face big goals. Here we discuss two dimensions—cultural and tangible resources.

Supportive and rigorous learning environment culture. The National Research Council 2003 report *Engaging Schools: Fostering High School Students' Motivation to Learn* includes an extensive review of the research literature on how to set up learning environments to support motivation for the nation's most vulnerable students. According to this report, cultures are supportive when they have the following characteristics: (1) they promote beliefs about competence, (2) they promote relevant values and goals, and (3) they promote social connectedness and belonging. Key principles are as follows:

- Students will persist more when they perceive that they are treated fairly and with respect and adults show they care about them.
- Students will persist more when teachers, administrators, and others in the school environment have high expectations for their success and hold them to high standards. These expectations can be conveyed explicitly or implicitly. When remedial support is necessary, it is provided in ways that do not feel punitive or interfere with opportunities to engage in other interest-driven activities.
- Evaluation of student performance should be carefully designed not to undermine perceptions of competence and future expectations. However, rather than indiscriminately meting out unearned praise, those giving feedback should base it on clearly defined criteria, provide specific and useful comments, and ensure that students have opportunities to demonstrate competence in different ways.
- Extrinsic rewards and punishments that undermine intrinsic motivation should be avoided.
- Authoritarian discipline policies that limit students' options and opportunities for self-expression undermine intrinsic motivation and persistence.

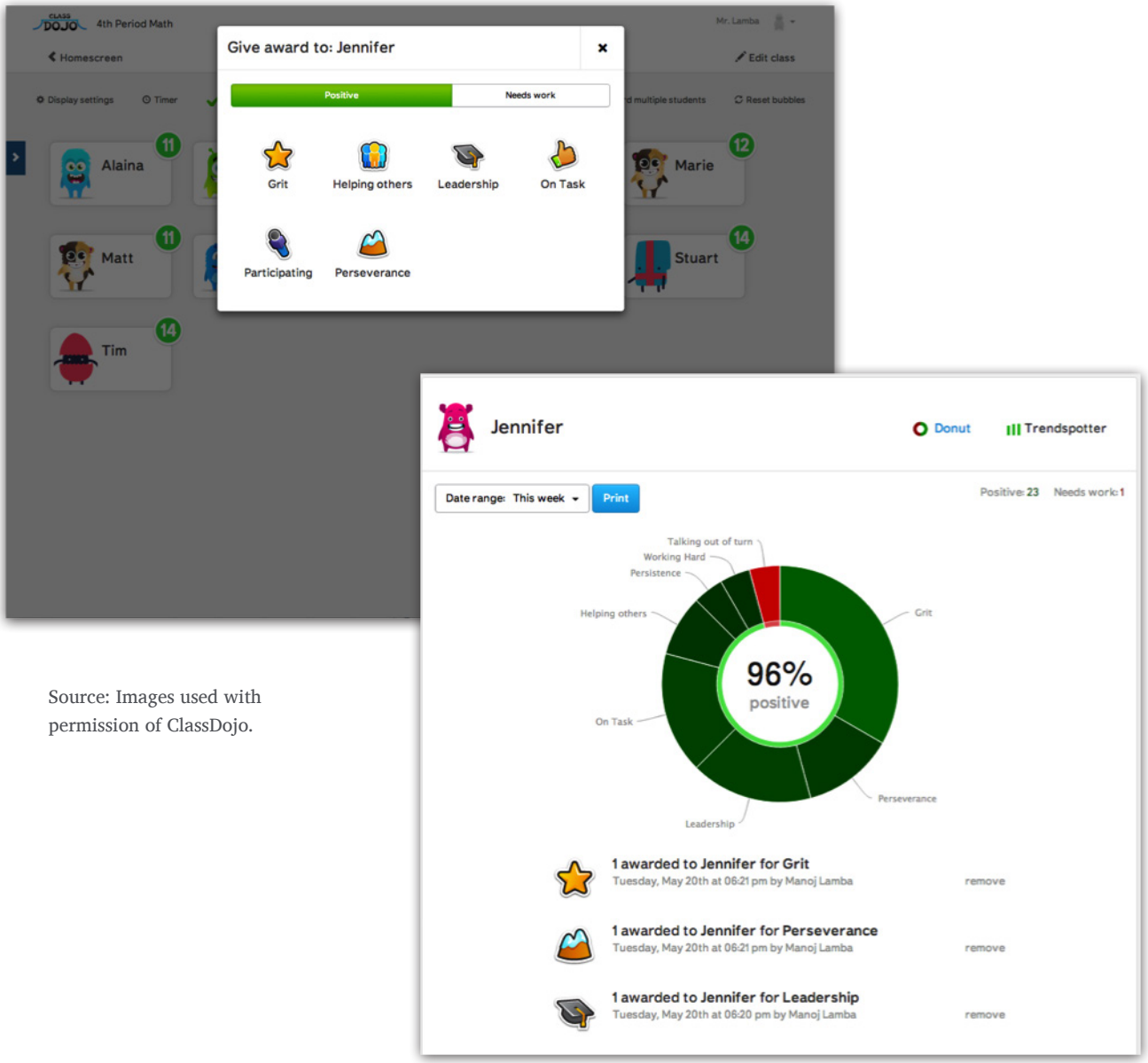
Although general encouragement and supportive relationships with adults are essential, research shows that they alone are typically not enough to foster perseverance. Specific attention to the growth mindset—"My ability and competence grow with my effort, strategies, and help from others"—along with strategies specific to the challenges at hand are essential to promoting students' perseverance. Many of the approaches discussed in Chapter 4 have begun to do this. For example, some schools are using models that provide explicit opportunities for practice, feedback, and/or reflection on mindsets and skills that support perseverance. Other models provide extensive real-world projects that require planning and persistence to complete and provide opportunities for iteration and continued improvement. Other models promote skills that support resilience, particularly for at-risk students and communities exposed to adverse circumstances. Exhibit 7 shows an example of an online tool designed to support teachers in some of these practices.

Tangible resources. Students are also more likely to persevere in learning environments that provide the tangible resources—material, human, and time—necessary to overcome challenges and accomplish their goals. Depending on the type of goals, materials can include access to particular programs, technology, rigorous curriculum, equipment or materials to complete projects, course tuition, or physical facilities where students can do their work. Human resources can include mentoring, tutoring, peer guidance, teachers with particular training, or special services. Time can also be a precious resource—when engaged in optimally challenging tasks, students need to have adequate time to grapple with their difficulties, reflect, get feedback, iterate, and try new approaches.

Particularly in high-poverty urban areas, many of these tangible resources may be lacking. Teachers may not have adequate materials or professional development, or they may have to handle so many students that they simply do not have time to support individual students—in many urban schools teachers have more than 150 students a day. As we will discuss later, new and emerging technologies that support adaptive and personalized learning have the potential to fill some of these gaps.

Exhibit 7. Screen shots from teacher tool ClassDojo

ClassDojo (http://www.classdojo.com/) is an online classroom management tool that helps teachers maintain a supportive learning environment and keep students persisting on task in the classroom. Features allow teachers to track and reinforce good behaviors for individual students and get instant reports to share with parents or administrators. Shown here is the profile for student Jennifer and the types of awards the teacher can give for her behavior.



Source: Images used with permission of ClassDojo.

Psychological Resources That Can Promote Grit, Tenacity, and Perseverance

We turn now to the psychological resources within students that support their perseverance, examining the three major categories in the model—academic mindsets, effortful control, and strategies and tactics. Of course, it is not all up to the student—learning environments need to be designed to promote these resources.

Academic Mindsets

Academic mindsets are the psychological resources necessary for students to productively frame themselves as learners, their learning environment, and their relationships to the learning environment. These include beliefs, attitudes, dispositions, values, and ways of perceiving themselves. As discussed below, compelling evidence from a variety of sources suggests that mindsets can have a powerful influence on academic performance in general and in particular for how students behave and perform in the face of challenge.

The research literature on academic mindsets can be divided into three main categories, parallel to those that characterize supportive learning environments: (1) beliefs about competence, (2) values and goals, and (3) beliefs about social connectedness and belonging. In our hypothesized model in Exhibit 5, building on the work of Farrington et al. (2012), we represent mindsets across each of these categories as first-person statements from the point of view of a student. Here we discuss the commonsense notions that each of these beliefs represents and the availability of research to back the belief's potential influence on academic performance and/or persistence. For more detail, see literature reviews that have examined the relationships between mindset and academic performance (e.g., Dweck et al., 2011; Farrington et al., 2012; Snipes et al., 2012; Yeager & Walton, 2011; Yeager & Dweck, 2012).

- **I can succeed at this.** When students have strong self-efficacy (belief in their ability to learn and to perform well) and high expectations for success, they are more likely to persevere in the face of challenge (e.g., Bandura, 1997; Schunk & Pajares, 2009). These beliefs can be stronger predictors of success than measured levels of actual ability and prior performance.

- **My ability and competence grow with my effort, strategies, and help from others.** Beliefs about ability and expectations for success can be fragile, especially when students face a new challenge they have never encountered before. Research by Dweck and colleagues points to the importance of a "growth mindset," the belief that ability is malleable and can be increased with effort and learning (Dweck & Leggett, 1988). This is contrasted with a "fixed mindset," the belief that ability is a fixed quantity that one either possesses or does not. When faced with academic tasks that are routine and do not entail challenge, students with fixed and growth mindsets tend to exert similar effort. When tasks become challenging, however, students with growth mindsets are more likely to persist. Studies have also shown that these mindsets themselves can be malleable and that, when students are taught to have a growth mindset, they can become more successful academically (e.g., Blackwell, Trzesniewski, & Dweck, 2007).

- **Challenge is inevitable for success.** Part of developing resilience in the face of challenge is understanding that challenges are inevitable and not an indication of personal failure. A theme that came up in some of our interviews is that many students, both higher and lower achieving,

experience a breakdown when they encounter some of the inevitable challenges of schooling—such as increasing difficulty and abstractness of concepts, decreasing structure in the middle grades, and need for new strategies for success. Intervention studies have shown that students can be taught to attribute challenge to external factors that are bumps in the road rather than limitations in their own level of ability (e.g., Wilson & Linville, 1985; Walton & Cohen, 2007; Cohen et al., 1999).

- **This work is in line with my interests, values, or goals.** As discussed above, an extensive body of research shows that students will persevere more in the face of challenge when tasks have value for them—they find them interesting or see them as serving short- or long-term goals that are important to them. Students may need support in knowing how to connect the dots between the work they are doing and the purposes it may serve in their lives or support in discovering and fostering interests or values. For example, research suggests students show greater persistence when educators can promote a mindset that their work is meaningfully connected to a beyond-the-self purpose—a goal that a learner sees as relevant and important to the self and as having some potential prosocial impact in the world (Yeager, Henderson et al., 2013).

- **I belong in this academic community.** Extensive research shows that when students feel a sense of belonging in their school and classrooms—through relationships with peers, teachers, and other adults—they are more likely to engage in schooling. Students' sense of belonging is closely tied to their perceptions of competence and autonomy, intrinsic motivation, and willingness to adopt established norms and values (e.g., Oyserman, Johnson, & Bybee, 2000). Students are especially at risk of being undermined by a lack of sense of belonging when they are a part of a minority group within a given context. For example, minority or female engineering students can feel not only that they personally do not belong there, but also that people like them do not belong there. Also, consensus is growing that the nature and quality of students' relationships with their teachers and peers play critical roles in engaging students to learn (Wentzel, 2009; Ladd, Herald-Brown, & Kochel, 2009). Feelings of lack of trust, respect, or fairness from teachers or alienation and rejection from peers can be a strong determinant of disengagement from school. Research on mindsets has also shown that promoting a growth mindset about personality qualities—that these, too, are subject to growth and change—can help lower adolescents' aggression and stress in response to peer victimization or exclusion, thus contributing to enhanced achievement (Yeager & Dweck, 2012).

While these mindsets are important for all student populations, as we discuss above, traditionally underserved students may be at particular risk of having unproductive mindsets regarding competency, growth, and belonging. In Chapter 4, we discuss several interventions that target the development of productive mindsets for various student populations.

Effortful Control

In their study of National Spelling Bee champions, Angela Duckworth and colleagues (2010) summed up the findings as follows:

> Deliberate practice—operationally defined in the current investigation as the solitary study of word spellings and origins—was a better predictor of National Spelling Bee performance than either being quizzed by others or engaging in leisure reading. With each year of additional preparation, spellers devoted an increasing proportion of their preparation time to deliberate practice, despite rating the experience of such activities as more effortful and less enjoyable than the alternative preparation activities. Grittier spellers engaged in deliberate practice more so than their less gritty counterparts, and hours of deliberate practice fully mediated the prospective association between grit and spelling performance (p. 178).

In essence, the most successful competitors were those whose passion for the long-term goal of the National Spelling Bee championship led them to persist with less intrinsically rewarding but more effective practice strategies (Duckworth et al., 2011).

Of course, throughout the course of education and into adulthood, students constantly face tasks that are important for long-term goals but that in the short term may not seem desirable or intrinsically motivating, especially relative to other ways they could spend their time. Even the most thoughtfully designed, inquiry-based, emotionally supportive learning environment will have its share of homework assignments that need to supersede, for example, playing games with friends. Duckworth and colleagues point out that as far back as 1899, William James asserted that some school work will be "repulsive and cannot be done without voluntarily jerking back the attention to it every now and then" (p. 179).

Duckworth has written extensively about psychological resources that enable students to persist at such tasks and that are predictive of academic success—self-discipline and self-control. While colloquial and research definitions of these vary widely, they can be boiled down to some key facets. Duckworth (2009) conceptualizes self-discipline as

> the ability to marshal willpower to accomplish goals and uphold standards that one personally regards as desirable. That is, self-discipline isn't the capacity to do what other people order you to do; rather, it is the capacity to do what you want to do. It's knowing how to manage your emotions and thoughts, and knowing how to plan your behavior so you can reach your goals (p. 536).

She conceptualizes self-control in terms of executive functions—the ability to control and regulate attention in the face of distractions and the ability to inhibit inferior but strong impulses (e.g., surfing the Internet) to act on superior goals (e.g., completing homework assignments) (Duckworth, 2011). Similarly, she includes delay of gratification in the conceptualization of self-control (Duckworth & Kern, 2011).

While self-discipline and self-control can seem like austere qualities, Duckworth emphasizes that they actually contribute to not only greater academic achievement, but also greater well-being in general. For example, she cites the classic "marshmallow studies" by Walter Mischel in which preschoolers chose between eating one marshmallow right away and having two if they could wait. They found that the amount of time preschoolers could delay the impulse to eat a marshmallow placed in front of them was correlated not only with their SAT scores many years later, but also their emotional coping skills in adolescence (Mischel, Shoda, & Rodriguez,

1989). She later replicated the part of the study with preschoolers to confirm that self-control was in fact the driving factor in these salutary effects (Duckworth, Tsukayama, & Kirby, 2013). Moffit and colleagues (2011) showed in a longitudinal study of a cohort of 1,000 children from birth to age 32 that childhood self-control predicted physical health, absence of substance dependence, successful personal finances, and absence of criminal record. Another study showed that for a representative sample of nearly 10,000 American adults, the characteristic of conscientiousness was associated with both objective success (e.g., income and wealth) and subjective success (e.g., life satisfaction and positive affect) (Duckworth, Weir, et al., 2012).

A natural question to ask is to what extent self-discipline and self-control are personality traits that are fairly stable over time or context and to what extent they entail skills that can be developed. This question has been examined from multiple perspectives, ranging from longitudinal studies that track individuals over time or across contexts to studies that have introduced interventions to alter executive function. As for most fundamental personality characteristics, evidence suggests that there can be powerful influences from both individual temperamental tendencies and situational factors and that these capacities can be cultivated. Moffit and colleagues (2011) showed some longitudinal stability of self-control over time. Tsukayama, Duckworth, and Kim (2011) showed that how impulsively individuals act within specific situations may be more closely related to how tempting they find specific impulsive behaviors rather than their general impulsivity. At the same time, as discussed in Chapter 4, there are a number of successful interventions for developing executive functions for children in preschool and elementary school, as well as self-control and self-regulation in adolescents. The book *The Willpower Instinct: How Self-Control Works, Why It Matters, and What You Can Do to Get More of It* summarizes for a nontechnical audience the psychological research on self-control and provides practical research-based advice for how to improve it (see McGonigal, 2012).

Strategies and Tactics

No matter how productive their mindsets and focused their attention, students are more likely to persevere when their psychological resources include a toolkit of specific strategies and tactics to deal with challenges and setbacks. Moving into adulthood, such a toolkit will be important for the 21st-century workplace in which conditions tend to evolve rapidly and require complex, long-term collaborative problem-solving. Individuals need actionable skills for taking responsibility and initiative and for being productive under conditions of uncertainty. For example, in our interview with executive talent developer Denise Brosseau, she emphasized that in the economic downturn in the early 2000s, the entrepreneurs who had the strongest strategies and tactics for dealing flexibly with adversity were the most likely to continue to thrive.

We turn here to the research literature on learning strategies, self-regulated learning, metacognition, and goal-striving. As Farrington et al. (2012) discuss, there is no single agreed-upon model for what the various learning strategies are, how they can be measured, their impacts on learning, or how they should be taught. However, there are many general themes that cut across the literature. For extensive reviews, see the *Handbook of Metacognition in Education* (Hacker, Dunlosky, & Graesser, 2009), the *Handbook of Self-Regulation of Learning and Performance* (Zimmerman & Schunk, 2011), and the *International Handbook of Metacognition and Learning Technologies* (Azevedo & Aleven, 2013).

A general theme in the literature is that learning strategies encompass multiphase processes involving some combination of goal-setting, planning, enacting, monitoring progress, and adjusting enactment. Exhibit 8 lays out

a general four-phase model of learning strategies to support perseverance in the face of challenge. The phases are drawn from Winne and Hadwin's (1998) model of self-regulated learning and are adapted specifically for perseverance, drawing on additional work by Snipes et al. (2012), Farrington et al. (2012), Duckworth, Grant, Lowe, Oettingen, & Gollwitzer (2011), and Gollwitzer (1990). Phases are recursive, not necessarily linearly executed.

Exhibit 8. A general model of learning strategies to support persistence in the face of challenge

Phase	Name	Examples of types of strategies and tactics
1	Definition of task	Construct full definition of the task. Consider what is known and unknown about it. Consider how difficult it will be and potential challenges.
2	Goals and plans	Set specific goal(s). Set specific criteria for knowing when goal(s) are achieved. Formulate specific actionable plans to achieve goal(s). Anticipate obstacles. Formulate tactics for dealing with obstacles.
3	Enactment and monitoring	Structure the environment so that it is favorable for executing plans. Execute plans. Manage time. Seek new information. Organize information and resources. Seek assistance from other people. Monitor progress relative to criteria for meeting goal(s). Adjust course of actions as necessary.
4	Deliberation and adaptation	Deliberate on effectiveness of plans and strategies. Reformulate task, goals, conditions, strategies, plans.

Source: Adapted from Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dunlosky & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 277–304). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Perseverance for any given goal may call for a particular subset of these phases and strategies. For example, in solving a difficult math problem, the task and goals may be well defined already, but monitoring progress and adjusting courses of action may be essential. For a medium-term goal, such as completing a collaborative inquiry-based science project, and longer term goals, such as graduating from high school, many of these steps may be important and need to be revisited in an ongoing manner.

Chapter 4 discusses interventions, both digital and nondigital, that provide structures and supports for students to engage in these types of practices in different contexts. For example, a growing literature shows that students can be taught simple strategies to formulate goals and anticipate obstacles and solutions and that these strategies can significantly affect persistence and achievement (e.g., Duckworth, Kirby, Gollwitzer, & Oettingen, 2013; Gollwitzer, Oettingen, Kirby, Duckworth, & Mayer, 2011; Oettingen, 2012).

Summary of the Hypothesized Model

In summary, the hypothesized model highlights contextual factors in the learning environment and psychological resources within the student that potentially can promote grit, tenacity, and perseverance. It begins with the assumption that students are situated within a particular sociocultural context that strongly influences the types of goals they will value, the types of challenges and setbacks they will face, and the resources they will have access to for supporting perseverance. Within the specific learning environment, the model lays out two hypothesized key factors: (1) students have the opportunity to take on worthwhile long-term or high-order goals that are optimally challenging and in alignment with what they value, and (2) students are provided a rigorous and supportive environment for pursuing these goals in terms of environmental culture and tangible resources (materials, human, and time). Within the student, key hypothesized psychological resources to promote grit, tenacity, and perseverance are (1) academic mindsets that enable students to productively frame themselves as learners, their learning environment, and their relationships to the learning environment; (2) effortful control that enables students to marshal willpower and regulate their attention in the face of competing distractions; and (3) strategies and tactics that help students anticipate and deal with challenges. Learning environments potentially can be designed to teach and/or promote these resources within students.

It is important to emphasize again that this model is *hypothesized* and that further research is necessary to understand these dynamics taken as a whole and in a wide variety of school settings for a diversity of students. Questions remain open about how these factors may play out in different contexts, such as different academic disciplines, different student ages, different goal timescales, and in the face of different sets of obstacles and challenges. Further research is also necessary to understand the developmental pathways for how key psychological resources may be supported or develop internally over the age span. Research is also necessary to examine the *transferability* of these factors and what it may take to provide students with internal psychological resources that they can continue to use beyond the current setting and/or can serve as protective factors to promote resilience in the face of future adversity. Further research is also necessary to understand individual differences among students in which factors are most important to support at which times.

Addressing Potentially Damaging Misconceptions

An important theme that emerged across our data sources is that, while there is little evidence that grit itself can be harmful, some misconceptions exist about what grit is and how it works that could possibly be damaging when applied by even the most well-intentioned educators. Little research has examined this specifically, but some of the issues that surfaced were as follows:

- **Promoting perseverance for goals inappropriate for the student can induce stress and have detrimental long-term effects.** Persevering in the face of challenges or setbacks to accomplish goals that are extrinsically motivated, unimportant in helping the student achieve long-term goals, or in some way inappropriate for the student can induce stress, anxiety, and distraction and have detrimental impacts on students' long-term retention, conceptual learning, and psychological well-being.

- **Being nice to students and encouraging them is important, but promoting perseverance can take more.** Educators acting on the common but misguided assumption that simply encouraging students will promote perseverance often do not produce the desired results. The power of the research on mindsets, effortful control, and learning strategies is that it isolates specific features of programs that can promote persistence and how to address them specifically.
- **Perseverance promoted in performance-oriented cultures can potentially undermine grit.** For example, perseverance that is the result of a culture that places a strong emphasis on punishments and rewards may undermine long-term perseverance. Extrinsic reward and support systems may work in the short run, but when in a different environment without rewards and punishments, students may not have developed the appropriate psychological resources to continue to thrive.
- **Adults could overemphasize the importance of grit as a personality characteristic.** As grit becomes a more popular notion in education, a risk is that poorly informed educators or parents could misuse the idea and introduce what psychologists call the "fundamental attribution error"—the tendency to overvalue personality-based explanations for observed behaviors and undervalue situational explanations. In other words, there is a risk that individuals could overattribute students' poor performance to a lack of grit without considering that critical supports are lacking in the environment.
- **Students may give up on important goals too early if they do not understand that the passion that can drive grit must often develop through hard work.** For example, many college students have the expectation that their decisions about their studies and professional direction must come from an inherent passion—rather than through the effort and work of fully engaging in what they are doing. While a rare few may be driven by specific passions, for many students this expectation is false and can undermine their persistence when they begin to encounter challenges in a chosen direction.
- **Technology by itself does not provide quick fixes for the challenges of promoting perseverance.** Schools are being introduced to a new generation of online digital technologies, from intelligent tutors to massive open online courses to digital curricula that can implemented in blended learning environments. There can be great excitement about and hope for these new approaches, for their potential to support both persistence and achievement. Technologies are providing a range of new opportunities, but they still are only tools and resources that enhance and expand the capabilities of human-centered learning environments.

Careful research in some of these areas may be necessary to help educators learn how to gauge and fine-tune practices and interventions.

Moving Forward

As practitioners, researchers, and policymakers, we have the opportunity and responsibility to develop ways to interrupt negative cycles and provide learning environments that teach and/or promote grit, tenacity, and perseverance for the wide diversity of students and the wide range of challenges they will face. Students may need or benefit from intervention at any or all of these points—opportunities to take on worthwhile goals, a rigorous and supportive learning environment, and/or opportunities to engage or develop supportive psychological resources. The next chapters explore measurement and interventions.

3 Measuring Grit, Tenacity, and Perseverance

> *"[A]s new assessment systems are developed to reflect the new standards in English language arts, mathematics, and science, significant attention will need to be given to the design of tasks and situations that call on students to apply a range of 21st century competencies that are relevant to each discipline. A sustained program of research and development will be required to create assessments that are capable of measuring cognitive, intrapersonal, and interpersonal skills."*
>
> National Research Council 2012 Report on 21st Century Knowledge and Skills (NRC, 2012)

Assessment can be used to support students' perseverance, learning, development, and well-being in a wide variety of ways. It can provide practical tools for educators and learners, tools for program design and evaluation, diagnostic indicators for vulnerable students, and instrumentation needed for research to understand how to promote grit. Measurement poses some broad issues that are simultaneously opportunities and challenges. Historically, much greater attention has been paid to measuring cognitive competencies (e.g., content knowledge) than noncognitive factors. Nevertheless, even though research is perhaps more limited on noncognitive than cognitive measures, there has been tremendous progress in this area. There are rich theoretical and empirical research bases for the various facets of grit, tenacity, and perseverance. A broad spectrum of measurement methods and approaches also exist that provide a rich foundation for implementing and advancing measurement. At the same time, navigating this complex landscape can be challenging, and methods are not always available for specific measurement purposes.

This chapter, geared primarily toward those interested in the design and evaluation of programs and implementation of research, provides an overview of approaches to measuring grit, tenacity, perseverance, and related constructs (see callout box below for definition of *construct* and other essential terminology). It discusses the array of methods that are already available, exploring illustrative examples, advantages, and trade-offs. It also seeks to explore gaps in the field and opportunities for future directions, such as using evidence-centered design (ECD) methods. It concludes with a discussion of legal and ethical considerations for protecting students' and parents' privacy and rights relative to data.

Why Measure Grit, Tenacity, and Perseverance?

Measurement can serve many purposes to inform the support of learners' persistence and learning.[3] While all measures must be grounded in theory, subjected to empirical validation methods, and implemented in an ethical and legal manner, each purpose can have different considerations in terms of practicality of implementation, technical requirements, and consequences of use.

- **Practical tools for educators and learners.** Some measures may be used within learning environments by students or teachers to promote grit, tenacity, and perseverance through personalized actionable feedback or instructional adaptivity that takes into account the student's progress, preferences, challenges, or learning processes. Measures to serve these purposes need to be usable and robust across settings. They need to provide metrics that are readily interpretable and actionable, as well as appropriate to the educational settings in which they are used. Design of instruments must include consideration of educators and learners as end users.
- **Tools for program design and evaluation.** When implementing programs and practices to promote grit, tenacity, and perseverance, it is important to evaluate their impacts empirically (e.g., through examining changes from pretest to posttest). Measures to serve these purposes must be aligned with theories of learning and should be developed in parallel with program developers' logic models for how they expect interventions to lead to specific outcomes.
- **Diagnostic indicators for vulnerable students.** Schools and districts are implementing programs, such as early-warning systems, to identify vulnerable students in need of support. Designers of such systems must follow guidelines from the *Family Educational Rights and Privacy Act* (FERPA; see the

Essential Measurement Terminology

Construct. The concept, characteristic, skill, competency, or attitude that a test is designed to measure.

Operationalization. The process of strictly defining variables into measurable factors.

Validity. The degree to which accumulated evidence and theory support specific interpretations of test scores entailed by proposed uses of a test.

Reliability. The degree to which test scores for a group of test takers are consistent over repeated applications of a measurement procedure and hence are inferred to be dependable and repeatable for an individual test taker; the degree to which scores are free of errors of measurement for a given group.

Adapted from the Standards for Educational and Psychological Testing (AERA, APA, NCME, 2001, pp. 173–184)

3 Note that *accountability* is not a use of assessment considered in this brief. This review examines how information about grit, tenacity, and perseverance can be used to inform the support of learning and persistence, not as high-stakes or consequential metrics to judge student or teacher performance.

end of this chapter for details), be particularly attentive to consequential validity (i.e., evidence from intended and unintended consequences of using the data), and ensure that all assumptions and criteria are explicit and that users can be well-trained in appropriate data use and disclosure.

- **Instrumentation for research.** In laboratory and school-based research to understand grit, tenacity, and perseverance, measures must be clear in their operationalizations so that their interpretations can support new insights into the processes related to these skills. Research projects must undergo internal review by an Institutional Review Board (IRB) that adheres to the Code of Federal Regulations as set forth in 45 CFR 46 (see the end of this chapter). Requirements include, when appropriate, written informed consent to participate in research activities and strict confidentiality processes.

Measurable Constructs Associated with Grit

In Chapter 2, we defined *grit* for the purpose of this brief as *perseverance to accomplish long-term or higher-order goals in the face of challenges and setbacks, engaging the student's psychological resources, such as their academic mindsets, effortful control, and strategies and tactics.* Here we consider measures of the actual perseverance (or tendency to persevere), as well as measures of the contributing psychological resources.

Measurement may target whether and/or how an individual perseveres toward a goal in the face of challenges and setbacks. *An important distinction for measurement purposes is whether perseverance is conceptualized as a disposition or set of processes.* If conceptualized as a *disposition,*[4] the measurement may target perseverance as a general or enduring tendency to persevere. For example, Duckworth et al. (2007) asked individuals to report about their enduring dispositional tendencies for pursuing long-term goals and then examined relationships among self-reported perseverance, academic performance, and goal attainment. These types of measures can be used to understand how these tendencies relate to performance or attainment. If perseverance is conceptualized as a *set of processes*, its measurement may focus on the sequence of behaviors, emotions, physiological reactions, and/or thoughts that unfold over time during the process of learning. For example, researchers such as Shute and Ventura (2013), Feng, Heffernan, and Koedinger (2009), and Arroyo and Woolf (2005) focus on "micro-level" moment-by-moment behaviors in the process of solving problems. These types of measures can be used in classrooms or within digital learning environments to provide feedback to teachers and students during learning. While dispositional and process approaches each tap into perseverance, their underlying constructs are conceptually distinct, have different underlying assumptions, and require different methodologies (e.g., self-report versus log file analysis). An important area for future research is understanding connections between enduring dispositions and micro-level process factors.

Measurement may also target the psychological resources that contribute to and interact with perseverance: academic mindsets, effortful control, and strategies and tactics. Yet these broad categories just scratch the surface. Underlying each is a constellation of multiple skills and/or attributes. Measuring academic mindsets,

4 In this brief, *dispositions* is used to refer to *enduring tendencies* independent of any claims about their origins or malleability. In general, dispositions can be developed from a combination of a range of inherent qualities and personal experiences. The extent to which dispositions are changeable, malleable, or teachable will depend on who the individual is, what the disposition is, and the nature of the experiences the individual encounters.

for instance, could involve assessing beliefs about effort and intelligence, academic goals, or feelings of belonging. Measuring effortful control could involve examining executive functions, self-discipline, self-control, or delay of gratification. Measurement of strategies and tactics would most likely be designed to capture both ability to plan and ability to monitor goals and progress. Many measures also capture the protective factors and positive assets that can contribute to students' resilience in the face of adversity.

Measurement Approaches: Methods, Examples, and Trade-offs

This section reviews the major approaches to measuring these constructs—self-report, informant report, school records, and behavioral task performance. For each approach, we describe the method or methods involved, discuss some illustrative examples, and lay out trade-offs of the approach. There is no general right answer or best approach overall; rather, different methods will be relevant depending on the purposes of measurement, the context of measurement, and the resources available. As each method captures different facets of these constructs and has particular advantages and disadvantages, it can often be expedient to "triangulate" among multiple methods.

Self-Report

Methods. Perhaps the most familiar and widely used measurement approach for noncognitive factors is the self-report. In such measures, participants typically respond independently to a set or sets of items that ask for ratings of their perceptions, attitudes, goals, emotions, and beliefs. Self-report can be used to measure *dispositional* constructs. For example, researchers can examine consistency in participant's ratings to determine the strength of the belief or skill. Self-report can also be used to measure *process* constructs; for example, in the Experience Sampling Method, participants typically carry around a handheld device that beeps them at random intervals, prompting self-report of experiences in that moment (e.g., Hektner, Schmidt, & Csikszentmihalyi, 2007). Such data can be used to make inferences about emotions, thoughts, and behaviors within and across specific situations.

Some example measures. Here we discuss a handful of well-known and well-validated instruments. For comprehensive reviews of self-report instruments in these domains, see Atkins-Burnett, Fernandez, Akers, Jacobson, and Smither-Wulsin (2012), Duckworth and Kern (2011), Hoyle and Davisson (2011), Dweck et al. (2011), and Snipes et al. (2012). As a first example, Exhibit 9 shows Duckworth et al.'s (2007) validated self-report Grit Scale measure. These researchers have examined how a wide range of student and adult populations respond to these types of items, examining correlations with other variables. Exhibit 10 shows Dweck, Chiu, and Hong's (1995) scale to assess an individual's implicit *Theory of Intelligence* as fixed or subject to growth with effort. This scale has been used in many research studies over two decades, demonstrating key differences in how individuals with growth versus fixed mindsets deal with challenges. Another example is the Self-Regulation Questionnaire, a 63-item self-report assessment about facets of strategies and tactics (e.g., formulating a plan, implementing a plan, assessing the effectiveness of a plan) (Brown, Miller, & Lawendowski, 1999).

Methodological trade-offs. Practically speaking, self-report surveys have the advantages of being easy to administer to large numbers of students, and data from them often can be interpreted with conventional statistical methods. Numerous studies show that well-constructed and well-validated self-report instruments can capture facets of dispositions and experiences that are closely aligned with behaviors and other performances. There are, however, several challenges with self-report surveys. Self-report is troubling to many researchers because people are not always valid assessors of their own skills (Jones & Nisbett, 1971; Maki, 1998; Winne et al., 2006). For example, people often claim to have skills that they do not have when the skills are valuable and desirable. Moreover, the explicitness of targeted skills as asked in surveys may compromise an intervention designed to promote these skills. Surveys can be lengthy and disruptive to complete in learning environments. They often contain multiple questions about the same idea for validity and reliability purposes and can interrupt students' thinking if completed midtask. Alternatively, if completed posttask or at the conclusion of an experience or course, they require students to recall their perceptions, potentially introducing failures of memory. Surveys may not be sensitive enough to detect changes over time or across situations, possibly contributing to false assumptions about their relative stability within and/or across contexts. Finally, some surveys may be highly context specific and lead to different responses depending on the context.

Exhibit 9. Items from a self-report measure of grit

Consistency of Interest Scale[a]
1. I often set a goal but later choose to pursue a different one.
2. New ideas and new projects sometimes distract me from previous ones.
3. I become interested in new pursuits every few months.
4. My interests change from year to year.
5. I have been obsessed with a certain idea or project for a short time but later lost interest.
6 . I have difficulty maintaining my focus on projects that take more than a few months to complete.
Perseverance of Effort Scale
1. I have achieved a goal that took years of work.
2. I have overcome setbacks to conquer an important challenge.
3. I finish whatever I begin.
4. Setbacks don't discourage me.
5. I am a hard worker.
6. I am diligent.

[a] Higher score reflects lower consistency of interest; item was reverse-scored to create scale.

Source: Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology, 92*(6), 1087–1101.

Exhibit 10. Items from a self-report measure of Theory of Intelligence (fixed versus growth mindset)

Theory of Intelligence Scale
1. You have a certain amount of intelligence and you really can't do much to change it.
2. Your intelligence is something about you that you can't change very much.
3. You can learn new things, but you can't really change your basic intelligence.

Note: More information is available at www.mindsetonline.com.

Source: Dweck, C. S., Chiu, C., & Hong, Y. (1995). Implicit theories and their role in judgments and reactions: A world from two perspectives. *Psychological Inquiry, 6*(4), 267–285.

Informant Reports

Methods. Informant reports are those made by someone other than the student him or herself. Typically, these are conducted by teachers, parents, or researchers who are visiting or watching video of the classroom. Given the frequent interactions during learning that teachers have with individual students on an ongoing basis, teachers are in a unique position to provide important judgments and feedback about students' grit, tenacity, perseverance, and other psychological resources. Observers can visit the classroom and talk to students, applying specific rubrics and providing the objective perspective of well-trained eyes not involved in the day-to-day routines of the classroom.

Some example measures. Many examples of teacher-report methods emerged in our interviews. For example, KIPP and other character education programs have been developing methods of using explicit teacher feedback to help students gauge their level of grit with respect to specific criteria and to open up conversations among parents, teachers, and students (see Chapter 4 for details about these models). These schools have been implementing a "Character Report Card" on which students receive ratings pooled from multiple teachers on factors such as grit and self-control. Exhibit 11 illustrates what such a report card might look like. It is important that these ratings come from multiple teachers, making them less susceptible to biases of particular relationships. Informant reporting is also a common approach for teachers, parents/guardians, and mental health professionals to assess the social-emotional competencies that serve as protective factors associated with resilience in young children. For example, the Devereux Student Strengths Assessment (DESSA; LeBuffe, Shapiro & Naglieri, 2009) can be used for children in kindergarten through eighth grade (ages 5–14). The DESSA is a 72-item, standardized, norm-referenced behavior rating scale that focuses on student strengths and positive behaviors related to eight dimensions: self-awareness, social awareness, self-management, goal-directed behavior, relationship skills, personal responsibility, decision making, and optimistic thinking. It can be used for screening, monitoring, and detecting change (Hall, 2010).

While we did not find classroom observation protocols that measure grit, tenacity, or perseverance per se for individual students, there are protocols that measure related constructs, such as engagement. An example of a validated classroom observation protocol targeting students' engagement is presented by Skinner, Kindermann, and Furrer (2009). This protocol examines elementary school students' behavior, characterizing it as actively on task, passively on task, or off task. Such a measure could be used during challenging tasks

Exhibit 11. Example of Character Report Card for one hypothetical student

KIPP:CHARACTER REPORT CARD

Jane Smith **Grade: 8**		**KIPP Imagine** **Date: 01/28/11**	**Q2**	**Q2**					
		OVERALL SCORE	**4.30**	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teacher 5	Teacher 6
Zest			4.28						
1	Actively participates		4.50	4	5	5	4	4	5
2	Shows enthusiasm		4.17	5	4	3	4	4	5
3	Invigorates others		4.17	3	4	5	4	5	4
Grit			4.11						
4	Finishes whatever he or she begins		4.00	4	5	3	4	4	4
5	Tries very hard even after experiencing failure		4.17	5	4	4	3	4	5
6	Works independently with focus		4.17	4	4	3	4	5	5
Self Control – School Work			**4.33**						
7	Comes to class prepared		4.50	4	5	5	5	4	4
8	Pays attention and resists distractions		4.50	4	5	4	5	4	5
9	Remembers and follows directions		4.17	4	5	5	4	3	4
10	Gets to work right away rather than procrastinating		4.17	5	4	4	4	3	5
Self Control - Interpersonal			**4.54**						
11	Remains calm even when criticized or otherwise provoked		4.50	4	5	4	5	5	4
12	Allows others to speak without interruption		4.83	5	5	5	4	5	5
13	Is polite to adults and peers		4.50	4	5	4	5	4	5
14	Keeps his/her temper in check		4.33	4	5	4	4	5	4
Optimism			4.25						
15	Gets over frustrations and setbacks quickly		4.33	5	4	4	4	5	4
16	Believes that effort will improve his or her future		4.17	5	4	4	3	4	5
Gratitude			4.25						
17	Recognizes and shows appreciation for others		4.17	4	4	5	4	5	3
18	Recognizes and shows appreciation for his/her opportunities		4.33	5	4	5	3	4	5
Social Intelligence			**4.33**						
19	Is able to find solutions during conflicts with others		4.17	4	4	3	5	4	5
20	Demonstrates respect for feelings of others		4.50	5	4	4	4	5	5
21	Knows when and how to include others		4.33	5	4	4	4	5	4
Curiosity			**4.28**						
22	Is eager to explore new things		4.17	5	4	3	4	5	4
23	Asks and answers questions to deepen understanding		4.50	5	4	5	4	4	5
24	Actively listens to others		4.17	4	4	5	4	5	3

SCALE

1= Very much unlike the student
2= Unlike the student
3= Somewhat like the student
4= Like the student
5= Very much like the student

Source: Retrieved from https://upenn.app.box.com/kippCG.

to examine students' perseverance. Other related instruments are presented in the report *Measuring Student Engagement in Upper Elementary through High School: A Description of 21 Instruments*, released by the Institute of Education Sciences (Fredricks, McColskey, Meli, Mordica, Montrosse, & Mooney, 2011).

Methodological trade-offs. Using classroom observation protocols and reports from teachers or other professionals addresses concerns regarding bias in self-report, and informant reports can be particularly helpful for ascertaining intrapersonal competencies in young children. If observers are able to consistently judge behaviors and interactions, observation protocols can be valuable for evaluating the characteristics of exchanges among students and teachers, how students interact with tools, student affect, or whether they are applying learning strategies or sticking with a task. Collecting and analyzing enough observation data to draw generalizable conclusions is resource intensive because systematic analyses of observation data may require video recording, training of observers to evaluate behaviors and interactions consistently, and time to complete the observations and coding. Observational approaches also can present challenges in capturing information about an individual's mindset, which is less directly observable, and affect, which can be difficult to judge.

School Records

Methods. There are important trends in using technology-supported institutional-level data in early warning systems to identify students who are at risk of dropping out of school (U.S. Department of Education Office of Educational Technology, 2013). For example, records about grades, standardized test scores, attendance, discipline problems, social services used, and so on can provide important indicators for intervention needs. Data at the institutional level are becoming increasingly streamlined and cross-referenced, improving the ability to link student data within and across systems. Notably, any use of schools' record data is subject to guidelines from FERPA which requires that parents and eligible students provide written consent before an educational agency or institution discloses personally identifiable information from students' education records (see the end of this chapter for details).

Some example measures. One example of measures is the set of tools being used by the nonprofit New Visions for Public Schools (http://www.newvisions.org/), which has opened 133 public high schools in New York City since 1993. Combining data from the New York City Department of Education school records, School Snapshot identifies students who are off track for graduation or college entrance requirements. The Ninth Grade Tracker and College Readiness Tracker provide information for parents and students on individual students' standing in terms of graduation and college admission requirements. In partnership with the commercial company DataCation (http://www.datacation.com/), New Visions recently integrated its tools into a web-based format for real-time data delivery to students, parents, and school staff.

Methodological trade-offs. These data can be used to identify students who are not managing to persevere in the face of all the challenges of schooling, as well as inform longitudinal analyses of educational impacts of interventions and policies. However, such records alone are only general indicators of perseverance and do not tell the richer story of an individual's characteristics or how an individual's interactions with features of the learning environment contribute to these outcomes. Such data must be examined with both appropriate informed consent and adequate contextual information to interpret their meaning.

Behavioral Task Performance

Methods. Behavioral task performance measures are the broad set of methods used to capture behaviors consistent with perseverance or lack thereof—and in some cases emotional experiences, physical movements, facial expressions, or physiological responses associated with a particular challenge. These methods primarily provide insight into *processes* associated with perseverance as learning or other challenging tasks unfold. Behavioral task performance can be elicited in a range of contexts, such as a laboratory experiment, the classroom, or a digital learning environment.

While laboratory experiments have examined behavioral task performance for many years, new technological approaches are also emerging (see callout box). *Educational data mining (EDM)* and learning analytics within digital learning environments allow for micro-level analyses of moment-by-moment learning processes. The field of *affective computing* is also emerging, in which researchers are exploring how to gather complex affective data and generate meaningful and usable information to feed back to learners, teachers, and the technology itself.

Some example measures. Behavioral task performance measures are used in multiple settings, offline and online. For example, delay of gratification measures use the amount of time young children can persist in delaying their gratification for a desirable object as an indicator of executive functions and effortful control. These are used in controlled laboratory settings, in which these kinds of performances are easily observable. The first instance of this was the Marshmallow Task, in which preschoolers were given a choice of having one marshmallow immediately or two after a waiting period. Mischel, Shoda, & Rodriguez (1989) showed that the amount of time children were able to wait was correlated many years later with SAT scores and emotional coping skills in adolescents. In an extension of this work, Duckworth, Tsukayama, and Kirby (2013) used an adapted measure with preschool and elementary school students and showed that the wait time triangulated well with other measures of self-control. In a related set of studies, the Preschool Self-Regulation Assessment includes tasks such as the Toy Wrap, in which the child is asked not to peek while a toy is being wrapped, and the Toy Wait, in which the child must wait before touching the wrapped toy (Murray & Kochanska, 2002).

New Methods for Measuring Behavioral Task Performance

Educational data mining (EDM) "develops methods and applies techniques from statistics, machine learning, and data mining to analyze data collected during teaching and learning. EDM taests learning theories and informs educational practice" (U.S. Department of Education, Office of Educational Technology, 2012, p. 9)

Learning analytics "applies techniques from information science, sociology, psychology, statistics, machine learning, and data mining to analyze data collected during education administration and services, teaching, and learning. Learning analytics creates applications that directly influence educational practice" (U.S. Department of Education, Office of Educational Technology, 2012, p. 9).

Affective computing is the study and development of systems and devices that can recognize, interpret, process, and simulate aspects of human affect. Emotional or physiological variables can be used to enrich the understanding and usefulness of behavioral indicators. Discrete emotions particularly relevant to reactions to challenge are interest, frustration, anxiety, and boredom.

Other behavioral task performance measures examine aspects of students' persistence in digital learning environments. For example, many researchers are exploring how to interpret data from students' interactions with intelligent tutoring systems, such as how they may game the system or seek help, and use this information to help students persist (see callout box for more information). As another example, Exhibit 12 shows Shute and Ventura's (2013) model to measure indicators of conscientiousness in a digital learning environment for physics, Newton's Playground. They measure "persistence" specifically through observable indicators such as time on unsolved problems, number of restarts on unsolved problems, and number of revisions to unsolved problems. Other systems examine learning strategies and measure indicators of the metacognitive processes associated with persistence, such as asking for advice about how to overcome challenges (e.g., Conati & Maclaren, 2009; Zhou & Conati, 2003; Winne et al., 2006). Other systems, still exclusively in research settings, make inferences about task persistence and associated experiences based on combinations of measures of eye movements indicating where students focus attention during problem-solving, physiological data that indicate emotional experiences, self-report measures of affect, and data about students' responses to problems (e.g., Conati & Mertins, 2007; Hernandez, Hoque, & Picard, n.d.; Mcquiggan, Lee, & Lester, 2007; Woolf et al., 2009).

Leveraging Data from Students' Interactions with Online Intelligent Tutoring Systems

PERSISTENCE AND GAMING THE SYSTEM

Researchers have identified concrete behaviors in online learning environments that reflect persistence or gaming the system. Persistence in an online learning environment means spending more time on difficult problems as measured by indicators such as time on unsolved problems (controlling for ability) and number of restarts and revisits to unsolved problems (Shute & Ventura, 2013). Time spent on problems has been positively linked to achievement outcomes in some studies, but not always. Thus, the nature of the learning environment and kinds of questions must be considered in interpreting these data. In contrast to behaviors associated with persistence, when students are gaming the system, they are "attempting to succeed in an educational environment by exploiting properties of the system rather than by learning the material and trying to use that knowledge to answer correctly" (Baker et al., 2006). Gaming behavior has been shown to be detrimental to learning (Baker et al., 2004), so it is important to detect and address in the moment as students learn (Baker, Corbett, Roll, & Koedinger, 2008; Baker, D'Mello, Rodrigo, & Graesser, 2010).

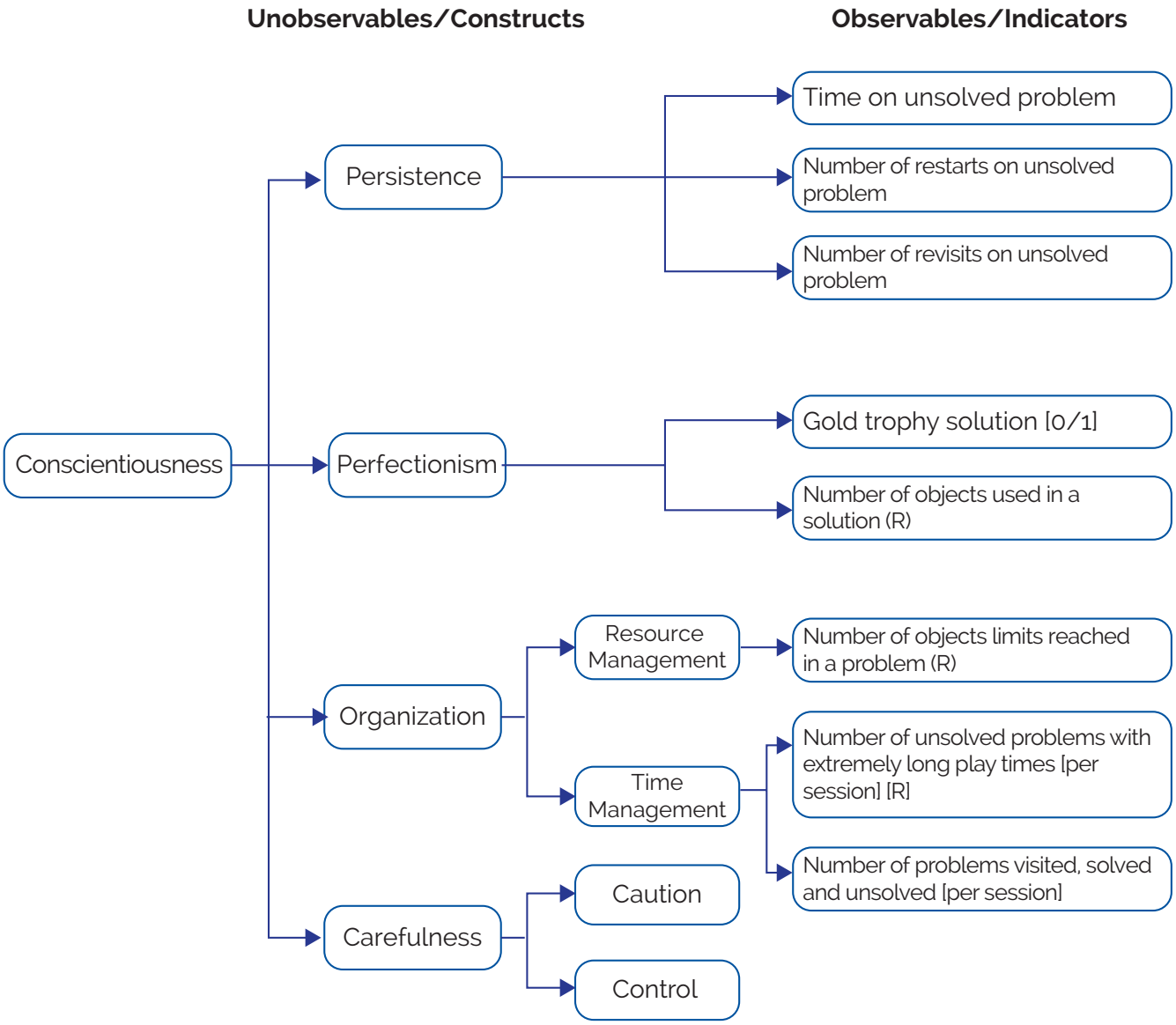
HELP-SEEKING BEHAVIOR

Most cognitive and intelligent tutoring systems include scaffolds and help resources. Researchers are beginning to explore how data from learners' use of such resources can inform inferences about how learners are dealing with challenge and be applied to supporting persistence. Indicators of help-seeking can include identification of the moment when a student asked for help, the amount of help provided, the average number of hints requested per problem, how much time and effort were invested before the student asked for help, the percentage of helped problems, and whether help was requested before or after entering the correct answer (Arroyo & Woolf, 2005). In one study on the Help Tutor students received feedback on their help-seeking behaviors. Students who were provided such feedback made fewer help-seeking errors and learned more (Roll, Aleven, McLaren, & Koedinger, 2011).

Methodological trade-offs. Measures of behavioral task performance hold strong promise for deepening our understanding of the interactions among the cognitive and affective processes underlying persistence. They are minimally "fakable" (Kyllonen, 2005) and typically do not "cue the intentions" of the teacher or researcher (Shute & Ventura, 2013). They do not require participants to have fully developed verbal skills or be able to articulate their own internal processes. Micro-level indicators also have the potential to be seamlessly integrated into a learning environment, and indicators can provide measures of behavior in real time, making it possible to examine and address dynamic changes in student understanding (e.g., how goals and affect change over time in an activity) (U.S. Department of Education, Office of Educational Technology, 2013; Woolf et al., 2009).

These methods also raise many challenges. It is important to recognize the immense effort that goes into interpreting the meaning of student log files, for example, before an intelligent tutor can be designed to "know" what a student's behavior means and be able to offer appropriate scaffolds or feedback. The research into the design of these systems involves multiple observations and/or interviews of students interacting with the learning environment, achieving agreement among raters about how to interpret student behaviors, and using these findings to design the programs that support student learning (e.g., Baker et al., 2008). Another issue with some micro-level indicators is that they are typically impractical for use in school settings. Finally, many of these types of measures depend on the use of highly constrained tasks in digital learning environments, which may be difficult to translate into use in the classroom or informal settings.

Exhibit 12. A model developed by Shute and Ventura to measure indicators of conscientiousness within a digital learning environment, Newton's Playground



Source: Shute, V., & Ventura, M. (2013). *Measuring and supporting learning in games stealth assessment.* White paper for MIT series. MacArthur Foundation. Retrieved from http://myweb.fsu.edu/vshute/publications.html

An Evidence-Centered Design Approach to Measurement

The trade-offs and challenges discussed above illustrate that each of the techniques and approaches for measuring perseverance and facets of mindsets, effortful control, and strategies are imperfect. In fact, assessment in any domain almost always requires making an argument about an individual's or group of individuals' knowledge, skills, abilities, or attributes using imperfect evidence. Fortunately, there are established best practices in measurement and assessment design that can help to address the imperfections in assessment design—or at least make them explicit so that when it comes to interpreting evidence, the limitations of the evidence are transparent.

Evidence-centered design (ECD) is one approach that facilitates systematicity in design and validity of assessments (Mislevy & Haertel, 2006; Mislevy, Steinberg, & Almond, 2003). ECD has been implemented at Educational Testing Service, Cisco Systems, in state assessments for students with significant cognitive disabilities, in the National Assessment of Educational Progress (NAEP), and the Partnership for Assessment of Readiness for College and Careers (PARCC). ECD works especially well for skills, competencies, and attributes that are difficult to assess because it provides structures for laying the foundation of developing an assessment that targets the intended skills or abilities. As discussed above, Shute and Ventura (2013) used ECD to create assessments of conscientiousness, creativity, and physics competency embedded in the digital game Newton's Playground.

There are always assumptions in the development of measures, and these assumptions need to be made explicit so that appropriate inferences about student performances can be made. Drawing from Messick (1994), three questions are helpful in initiating discussion about this: (1) What complex of knowledge, skills, or other attributes should be assessed? (2) What behaviors or performances should reveal those constructs? and (3) What tasks or situations should elicit those behaviors? Assessment design tools, such as *design patterns* and *task templates* (Mislevy & Haertel, 2006; U.S. Department of Education, Office of Educational Technology, 2013) are helpful for responding to these questions. Exhibit 13 shows components of a design pattern with examples from Shute and Ventura and others. A task template would elaborate further task design features as well as the psychometric properties of the assessment.

Exhibit 13. Components of an ECD design pattern for measures of grit, tenacity, and perseverance

Design Pattern Attribute	Questions Assessment Developers Need to Answer	Examples
Focal knowledge, skills, and abilities (focal KSAs)	What core knowledge, skills, and abilities are targeted?	• Behavioral perseverance • Mindsets • Effortful control • Strategies and tactics
Additional knowledge, skills, and abilities	What other knowledge, skills, and abilities may affect students' ability to show what they know about the focal KSAs?	• Knowledge of disciplinary core concepts and skills (e.g., math, science, history) • Reading and writing abilities • Ability to use technology (e.g., manipulate objects, type responses) • Prior experience or coaching on strategies to promote persistence
Observations	What does it look like when a student has a particular skill? What will they be doing?	• Working on a task for a long time • Monitoring and checking performance in relation to goals • Self-report of dispositions
Work products	What does the student produce that will be evaluated for evidence of the focal KSAs?	• Typed responses to items in a task in a technology-based learning environment • Computer log files (to be mined) • Responses to survey questions
Characteristic features of tasks	What are characteristics of the task or learning environment that *must* be present to elicit the focal KSAs?	• Task must be challenging (e.g., so that students can show whether they can persevere). • If task is technology based, student interactions must be logged. • Tasks must be grade-level and age appropriate.
Variable features of tasks	What are ways that the tasks can vary?	• Disciplinary context (e.g., math, science, history) • Task difficulty (e.g., number of steps to solve a problem) • Availability of help tutors or hints • Availability of organizational tools and supports (e.g., to highlight ideas in text, to support note taking, to arrange data) • Adaptability of learning environment to students' interests, emotions, and learning needs • Novelty of problem (e.g., new, similar to other problems played) • Relevance of learning context to student's interests

Legal and Ethical Considerations for Data and Measurement

Researchers and other professionals who collect data from people have ethical and, in many cases, legal obligations to take appropriate actions to ensure privacy, confidentiality, and informed consent for data collection activities.

The *Family Educational Rights and Privacy Act* (FERPA requires that parents and eligible students (i.e., students who have reached 18 years of age or are attending a postsecondary institution at any age) provide written consent before an educational agency or institution discloses personally identifiable information from students' education records. There are several exceptions to FERPA's general consent rule that permit schools to disclose personally identifiable information from education records, such as for certain studies that are conducted for or on behalf of the school. Additionally, FERPA does not apply to student data that have been properly de-identified. In this regard, the educational agency or institution or other party must make a reasonable determination that a student's identity is not personally identifiable because of unique patterns of information about that student, whether through single or multiple releases and taking into account other reasonably available information. More information can be found on the U.S. Department of Education's Family Policy Compliance Office website, http://www2.ed.gov/policy/gen/guid/fpco/.

In addition, research projects must undergo internal review by an Institutional Review Board (IRB) that adheres to the Code of Federal Regulations as set forth in 45 CFR 46. IRB registration with the Office for Human Research Protections (OHRP), within the U.S. Department of Health and Human Services mandates that these regulations be followed for all research involving people. There are also special protections for minors to ensure that parental consent has been given (although this is not required in all circumstances, such as educational studies of school-approved curricula) and also that the minor assents to the research. The consent form must state the specific purpose for the collection of data, how the data will be used, and who will have access to the data. Researchers are charged to keep data confidential, except in the case of harm to self or others. In addition, data collection is limited to the aims of the specific goal of the research.

Also of concern as new forms of data become available are the potential *consequences* of using the data in new ways. Professionals who use data must always carefully consider the impacts of releasing the data and incorporate feedback mechanisms that are valuable, respectful, and serve to support productive mindsets.

Moving Forward

As the field expands the capacity to design and evaluate learning environments that promote and/or teach, grit, tenacity, and perseverance, approaches to validly and reliably measure these factors also need to expand. In this chapter, we explored the many purposes of such measurement and the range measurement approaches—both current and on the horizon. Although there is a strong foundation of work already in this area, there are important next steps remaining. The method of ECD can help measurement designers build strong validity arguments as we advance measurement of these complex variables. As the field advances, legal and ethical considerations must always remain at the forefront.

4 Programs, Approaches, and Technologies

for Learning Environments to Promote Grit, Tenacity, and Perseverance

> *"If classrooms can support positive academic mindsets and help students build effective learning strategies, then classrooms could contribute significantly to increasing students' perseverance in completing school assignments and hence to improving their academic performance. Two potential classroom strategies for influencing academic perseverance are either to "teach" perseverance directly (changing the student) or to influence perseverance indirectly through other mechanisms (changing the context)."*
>
> Camille Farrington, Melissa Roderick, Elaine Allensworth, Jenny Nagaoka, Tasha Keyes, David Johnson, and Nicole Beechum (Farrington et al., 2012, p. 25)

How can learning environments be designed to promote grit, tenacity, and perseverance? As we explored in the hypothesized model in Chapter 2, there are important *contextual factors in the learning environment* and fundamental *psychological resources within the student* that can promote these qualities. While the consensus across the literature review and interviews was that there is still a need for empirical evidence that grit, tenacity, and perseverance can be taught as transferable competencies, a wide range of programs and approaches are already showing promise and positive results in this area—not necessarily by teaching grit directly but through providing an environment with appropriate supports and/or opportunities to develop fundamental psychological resources.

This chapter provides practitioners, researchers, and policymakers a review of approximately 50 programs, approaches, and technologies for promoting different facets of grit, tenacity, and perseverance. This is not intended to be an exhaustive review of all programs available but rather a broad characterization of categories. We begin with an overview, mapping out a set of five conceptual clusters. This is followed by brief descriptions of each cluster, along with illustrative cases.

Overview of Clusters of Programs and Approaches

We developed five conceptual clusters based on targeted age level, learning environment, and which facets of the hypothesized model in Chapter 2 are addressed or leveraged in the program or approach. Brief descriptions of the clusters are followed by Exhibit 14, an advance organizer of programs described in this chapter.

1. **School readiness programs that address executive functions.** These are programs at the preschool and early elementary school levels that help young children develop the *effortful control* necessary for the persistence fundamental to success in formal schooling.

2. **Interventions that address mindsets, learning strategies, and resilience.** These interventions, targeting students in late elementary school and higher, represent the growing body of research demonstrating that relatively brief interventions can significantly impact mindsets and learning strategies that promote perseverance and positive academic outcomes. Included also are programs designed to help students develop protective psychological resources for resilience in the face of difficult life circumstances.

3. **Alternative school models and school-level reform approaches.** These are models for the design or reform of formal school environments that are intended to teach and/or promote grit, tenacity, and perseverance.

4. **Informal learning programs.** These are models for informal learning environments intended to teach and/or promote some aspect of grit, tenacity, and perseverance. One category is programs that promote perseverance to graduate from high school, get into college, graduate from college, and enter the professional workforce. Another category is programs that promote interest and persistence in STEM education and professions.

5. **Digital technologies, online resources, and tools for teachers.** These are technology-based resources that can enhance how learning environments can promote grit, tenacity, and perseverance.

Exhibit 14. Advance organizer of program clusters reviewed in this chapter

This exhibit provides an advance organizer of the clusters of programs and approaches presented in this chapter. It summarizes for each category target age level, setting, aspect of our hypothesized model addressed (see Chapter 2), and the type of evidence that is available about impacts on the basis of programs reviewed. *This chapter is not intended to be an exhaustive review of all types of programs available but rather a broad overview.*

	Age Level					Setting				Focus of Model				Evidence Available*		
Program Clusters and Subcategories	Preschool / K	Elementary School	Middle School	High School	Postsecondary	Lab Based	Formal School	Informal Learning	Teacher PD	Effortful Control	Academic Mindsets	Learning Strategies	Contextual Factors	Noncog. Outcomes	Academic Outcomes	New Programs
1. School Readiness Programs that Address Executive Functions																
Training with games	•	•				•	•			•				•		
Aerobic exercise and sports	•	•					•	•		•				•		
Martial arts and mindfulness	•	•				•	•	•		•				•		
Classroom curricula/teacher PD	•	•					•		•	•	•	•	•	•		
2. Mindsets, Learning Strategies, and Resilience																
Academic mindsets interventions			•	•	•	•	•		•		•		•	•	•	
Learning strategies interventions			•	•	•	•	•					•	•	•	•	
Resilience programs		•	•		•		•			•	•	•		•		
3. Alternative School/Reform Models																
Character education models		•	•	•	•		•		•	•	•	•	•		•	•
Project-based learning and design thinking models			•	•			•				•	•	•			•
School reform programs		•	•	•			•						•		•	•
What Works Clearinghouse Practice Guides				•			•					•	•	•	•	
4. Informal Learning Programs																
College-readiness and support programs			•	•	•			•			•	•	•			•
Programs to trigger STEM interest and persistence		•	•	•				•			•	•	•	•	•	•
5. Digital Technologies and Tools																
Optimal challenge/adaptivity		•	•	•	•	•	•			•		•	•	•	•	
Rigorous and supportive climate		•	•	•			•		•	•	•		•			•
Motivating environment			•	•			•						•		•	
Promote academic mindsets			•	•			•				•			•	•	
Promote learning strategies			•	•	•		•	•				•		•		
Promote effortful control	•	•				•	•		•	•	•	•	•	•		

* The columns refer to three categories of possible available evidence:
1. Noncognitive factor(s) as outcome(s) with field-based evaluation data and/or lab-based data.
2. Primarily academic factor(s) as outcome (with limited, if any, data on isolated impacts of noncognitive factors).
3. New program and/or needs further research; strong anecdotal evidence available.

Program Clusters: A Closer Look

We now take a closer look at each program cluster. For each, we examine the rationale for this type of program, targeted populations and settings, and some examples. More in-depth case studies from each category highlight key points.

1. School Readiness Programs That Address Executive Functions

At the preschool and early elementary ages, when children are transitioning to formal schooling, effortful control and executive functions, fundamental psychological resources necessary for perseverance in the face of challenge, have been shown to be predictive of long-term success. These skills make it possible for children to satisfy expectations for self-regulation, impulse control, focusing attention, compliance with rules, and higher-order thinking that become increasingly necessary in formal schooling. Such factors have been associated with math and reading competence throughout all school years and are likely predictors of success throughout life in career, marriage, and mental and physical health (Diamond & Lee, 2011).

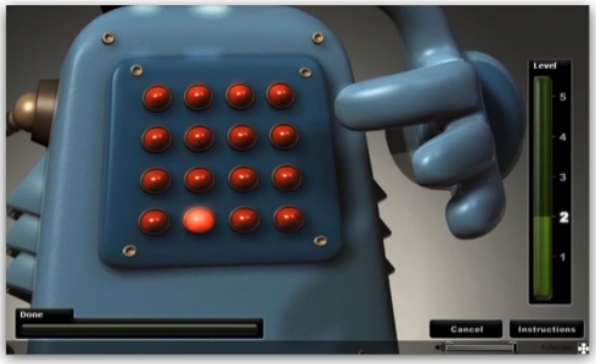
As highlighted in Chapter 1 in the discussion of the challenges of underserved students in the United States, impediments to the development of effortful control and executive functions in the early years may be a significant causal factor in achievement gaps between student populations of high poverty and their lower poverty counterparts. High stress and a lack of opportunity to practice these skills can put high-poverty children at a significant disadvantage during the most critical years for the development of the prefrontal cortex, the part of the brain that most directly regulates executive functions. This can undermine school readiness, becoming manifested in both learning and behavioral difficulties that then can have a negative ripple effect throughout the rest of a child's schooling. School readiness programs, especially those targeting high-poverty student populations and students with learning disabilities such as attention deficit and hyperactivity disorder (ADHD), have begun to focus on explicit development of executive functions.

The following summarizes Diamond and Lee's (2011) review in Science of evidence-based approaches for improving executive functions for children in the early school years. For more information on approaches to improving executive functions, see other literature reviews (e.g., Ursache, Blair, & Raver, 2012; Liew, 2011; Willoughby, Kupersmidt, & Voegler-Lee, 2013). Approaches reviewed by Diamond and Lee included the following:

- **Training with computer and noncomputer games.** Most research has addressed computerized training in which children play computer games that progressively increase demand on functions such as working memory and impulse control. Games such as CogMed (http://www.cogmed.com/), illustrated in Exhibit 15, have demonstrated some success in these areas, although findings suggest that transfer from narrowly focused trained skills to other executive functions was limited. More research is necessary to examine the generalizability of these findings and whether transferability may be increased with more optimal tasks, more training, or older children. Additional research has shown similar effects with noncomputer games.

Exhibit 15. Screen shots from two CogMed games

CogMed includes a series of games for training and improving working memory. The first picture is from the game "Animals" for preschoolers. Animals light up in a series that children then repeat back. The second picture is from "Visual Data Link" for elementary school students. The lights light up in a series that then students repeat back. The games are designed to be played repeatedly for several weeks.



Source: Reproduced from CogMed, copyright 2014.

- **Aerobic exercise and sports.** There is some evidence to show that aerobic exercise can improve prefrontal cortex function and executive function. Most of the findings are with adults, but some are with children. Research is still necessary to determine how much exercise is needed, when it is most beneficial, what its specific cognitive impacts are, and for whom it is most effective.
- **Martial arts and mindfulness practices.** An increasing number of studies suggest that martial arts, which traditionally emphasize self-control and character development, can significantly improve executive functions for 5- to 11-year-olds. Mindfulness training, emphasizing regulating attention to focus in a nonjudgmental way on experiences in the present moment, can significantly improve executive functions. There is some evidence that yoga may also have potential to increase these skills.
- **Classroom curricula and teacher professional development.** Several programs for preschool and elementary school children have demonstrated impacts on executive functions. Tools of the Mind (http://www.toolsofthemind.org/) is a curriculum for preschool and kindergarten based on Vygotskian principles, emphasizing the importance of pretend play (see callout box). Montessori (http://www.amshq.org/) is a school model that emphasizes self-discipline, independence, orderliness, and peacefulness. A randomized controlled trial showed that Montessori children showed better executive functions than peers attending a different school. PATHS (Promoting Alternative Thinking Strategies) (http://www.pathstraining.com/) is a professional development program to train teachers to build children's competencies in self-control, emotion regulation, and interpersonal skills. Teachers are provided strategies to help children deal with their emotions when they are upset by stopping, taking a deep breath, articulating how they feel, and constructing an action plan. The Chicago School Readiness Project (CSRP) (http://steinhardt.nyu.edu/ihdsc/csrp/), another professional development program, provides Head Start teachers with extensive behavioral management training and strategies for reducing their own stress. CSRP classrooms, compared with controls, provide more emotionally supportive classrooms and improved executive functions.

Diamond and Lee (2011) conclude their review with a summary of findings and recommendations for practice and future research for improving executive functions (EFs). The general summary is as follows:

> Stress, loneliness and not being physically fit impair prefrontal cortex function and EFs. The best approaches to improving EFs and school outcomes will probably be those that (a) engage students' passionate interests, bringing them joy and pride, (b) address stresses in students' lives, attempting to resolve external causes and strengthen calmer, healthier responses, (c) have students vigorously exercise, and (d) give students a sense of belonging and social acceptance, in addition to giving students opportunities to repeatedly practice EFs at progressively more-advanced levels. The most effective way to improve EFs and academic achievement is probably not to focus narrowly on those alone, but to also address children's emotional and social development (as do all 4 curricular-based programs that improve EFs) and children's physical development (aerobics, martial arts, and yoga) (p. 7).

Tools of the Mind

Tools of the Mind (http://www.toolsofthemind.org/) was created in 1993 to train teachers to help preschool students develop self-regulation and executive functions using techniques developed by Lev Vygotsky (e.g., Vygotsky,1978). Together, self-regulation and executive functions are responsible for students' ability to control their thinking and behavior, with strong connections to working memory, impulse control, problem solving, and mental flexibility (Chan, Shum, Toulopoulou, & Chen, 2008). Ages 3 to 7 are critical for the development of those abilities and the parts of the brain that control them (Diamond & Lee, 2011). The program is implemented in about 18,000 pre-K and kindergarten classrooms across the United States.

Leaders of Tools of the Mind (often called Tools) believe that learning and early development are best accomplished through play and intensive sustained attention, especially when it is social and students construct information for themselves. One key pedagogic element is dramatic play, which involves planning, sustained attention, and multiple roles for different students. Pretend roles give students rules, often self-created, that they need to apply to their actions. This process is an abstract cognitive task that resembles much of the intellectual work that school entails, such as remembering the rules to capitalize when starting a sentence or to raise a hand instead of speaking out of turn. Yet the play and imaginary aspects make this form of practice more engaging. The use of symbols is another technique that develops abstract thinking. These symbols, an integral part of dramatic play, are classroom objects that become entirely different apparatuses in the student's mind, involving abstract and flexible thinking. Other strategies are self-regulating private speech, which helps students visualize, plan, and strategize, and specific external aids for attention and memory (e.g., pictures representing actions to serve as scaffolds). It is important to emphasize the intensiveness with which students practice their executive functions; significant improvement takes sustained effort.

Tools has been widely recognized as a successful program for promoting executive functioning, although research evidence of its impacts has been mixed. In 2007, Tools was examined in a randomized controlled trial with 85 Tools students and 62 students participating in the urban district's balanced literacy program. Classrooms using the Tools model showed relatively higher improvement on executive functions and inhibitory control, displayed on tasks demanding those capacities (Diamond, Barnett, Thomas, & Munro, 2007). Studies presented at a 2012 conference on educational effectiveness, however, found that students in Tools classrooms did not outperform students in comparison groups on academic outcomes and measures of self-regulation (Lonigan & Phillips, 2012; Wilson & Farran, 2012). Further, some researchers have identified struggles that teachers may have in implementing the program. For example, Tools teachers typically observe the cognitive and social benefits in their classrooms yet also may experience challenges with the content of the program and how to reflect on the program's impact on students (Imholz & Petrosino, 2012).

2. Interventions That Address Mindsets, Learning Strategies, and Resilience

Academic mindsets and learning strategies are another essential set of psychological resources for grit, tenacity, and perseverance. Researchers have been producing significant academic and psychological impacts using short-term mindset interventions that affirm who students are and want to be, mitigate threats to self-esteem, and teach students that ability grows with effort. Interventions are also helping young people develop important strategies so that they can set meaningful goals, make plans to accomplish these goals, rehearse responses to potential problems, manage time, monitor progress, and change course when necessary. Reports from the Stupski Foundation (Snipes et al., 2012) and by Yeager & Walton (2011) provide reviews of interventions that target mindsets and strategies and their available evidence. We also discuss interventions that provide children and adults with toolkits of strategies for solving problems and coping with difficult situations and emotions—key protective psychological factors that support resilience in the face of challenging circumstances.

Academic mindsets. Over the last several years, there has been a movement in social psychology to use empirically based theoretical principles to design short and focused interventions (e.g., 2 to 10 hours) that target specific academic mindsets. Early evidence based on experimentation in school settings suggests that these interventions have the potential for powerful impacts on the psychological resources that can directly affect perseverance, as well as academic achievement. Snipes and colleagues (2012) reviewed several types of mindset interventions:

- **Teaching students the "growth mindset."** These interventions address the mindset, "My ability and competence grow with my effort, strategies, and help from others." The growth mindset is perhaps the most fundamental to grit, tenacity, and perseverance in academic pursuits. Snipes and colleagues reviewed four interventions that address this mindset. Three interventions targeted middle school students and showed positive impacts on academic achievement. In each one, students were explicitly taught that intelligence is malleable and that the brain can grow like a muscle with effort. Training was in several different modalities: a workshop (Blackwell et al., 2007), the interactive software Brainology (Paunesku, Goldman, & Dweck, n.d.) (see more detail below), and a mentoring program (Good, Aronson, & Inzlicht, 2003). An intervention for college students was delivered in the form of a pen pal activity (Aronson, Fried, & Good, 2002).

  More generally, in our interview Stanford University psychologist Carol Dweck emphasized that a fundamental practice for teachers and parents is to praise students for *effort* they put into academic tasks, for their strategies, for their focus, and for their persistence—not for their ability.

- **Shifting students' explanations for academic and social challenges from personal failure to temporary external factors.** With the intention of stopping a common negative cycle of self-blame and doubt that can undermine persistence, these interventions are intended to help students learn to attribute challenge to external factors that are bumps in the road rather than to personal failure or lack of belonging in a rigorous academic community. These interventions address the mindsets, "I can succeed at this," "Challenge is inevitable for success," and "I belong in this academic community." Snipes and colleagues discuss three interventions, all for college-age students. One intervention, using video and school records, was intended to shift freshmen's mindset about setbacks and challenges so

that they attributed them to common experiences in the transition from high school to college, not to their own personal failure (Wilson & Linville, 1985). A second intervention addressed minority students' common feeling that they do not belong. In this research, minority students made speeches (that would ostensibly be delivered to future freshmen) to instill *in themselves* the notions that challenges are common to all students, they do not represent personal failures, and they do not mean that a student does not belong in the academic community (Walton & Cohen, 2007). A third intervention showed that students' persistence was greater in the face of critical feedback when it was delivered with a message that the student was being held to high standards that the evaluator believed the student could meet (Cohen, Steele, & Ross, 1999).

- **Affirmation of personal values.** These interventions address for ethnic minority students the stress they may encounter from stereotype threat, a threat to the self that exerts a felt pressure and anxiety that their poor performance may confirm a negative stereotype about their ethnic group (e.g., Steele, 1997; Steele & Aronson, 1995; see Chapter 1 for more information). The interventions can serve to bolster the mindsets, "I can succeed at this" and "I belong in this academic community." In one study, middle school ethnic minority students were provided the opportunity to write a "values essay," in which they spent 15 minutes writing about a value that was important to them, such as a hobby or relationships with friends. Compared with control students, these students had increased grade point averages. The authors suggested that this short but focused affirmation of the self as an individual with strong values can mitigate the potentially distracting anxiety of stereotype threat (Cohen, Garcia, Apfel, & Master, 2006).

- **Relating course material to students' lives.** Two research-based interventions address the mindset, "This work is in line with my interests, values, or goals." In one study, high school students were asked to write essays connecting what they were learning in science class to their own lives. This intervention increased interest in science and course grades for students who initially reported that they did not expect to do well in science (Hullemen & Harackiewicz, 2009). New research suggests that when making a learning task *interesting* is difficult, it can be made *meaningful* to students by connecting the task to a beyond-the-self purpose—a goal that a learner sees as relevant and important to the self and as having some prosocial impact in the world. In addition, Yeager, Henderson, and colleagues (2013) implemented a short intervention in which high school students were asked to reflect on how they thought the world could be a better place and write brief testimonials to future students about how learning in high school would help them make an impact in the world. Students who did this intervention, which took about 20–30 minutes, had significantly higher STEM GPAs at the end of the semester than students who did a control procedure. Additional studies used to understand this effect showed that the beyond-the-self intervention prevented students from giving up on an increasingly boring task and helped them frame low-level academic actions in terms of broader life goals.

Learning strategies and tactics. Snipes and colleagues (2012) and Yeager and Walton (2011) also reviewed several interventions that provide students with strategies for dealing with challenges and setbacks and improving metacognition and/or self-regulation.

- **Investment in clarifying goals and anticipating potential obstacles and solutions.** Since grit, tenacity, and perseverance are by definition about achieving goals in the face of challenges and setbacks, one approach is to provide students with opportunities to develop clarity about what their goals are, why they are important to them, and what they will do when they face challenges. Three examples follow.
    - *Mental contrasting with implementation intentions.* Researchers have demonstrated how a strategy called "mental contrasting with implementation intentions" (MCII) can improve students' persistence and achievement. MCII is part of "fantasy realization theory" that examines the science behind how people can use their fantasies wisely to achieve the goals they care about (Oettingen, 2012). MCII is a strategy that uses (1) *mental contrasting*, which is thinking through a desired future outcome contrasted against the present reality that is in the way of attaining it, along with (2) *implementation intentions*, which are specific "if… then…" plans that elaborate how the individual will respond to specific obstacles as they arise in the process of goal attainment. For students, this strategy is often called the WOOP exercise, which stands for Wish-Outcome-Obstacle-Plan. Studies have shown that the WOOP exercise helped high school students persist in their PSAT studying and attain higher scores (Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2011); fifth-graders improve their grades, attendance, and conduct (Duckworth, Kirby, Gollwitzer, & Oettingen, 2013); elementary school and middle school students in low-income neighborhoods achieve higher scores in learning foreign language vocabulary; and sixth- and seventh-graders at risk for ADHD improve their self-regulation (Gawrilow, Morgenroth, Schultz, Oettingen, & Gollwitzer, 2013). Building on this research (e.g., Oettingen, 2012; Ottingen & Schwörer, 2013), researchers at New York University have developed an app called "WOOP to and through college" (Exhibit 16) to help students use the WOOP strategy on their way to and through college (http://woopmylife.com/).

Exhibit 16. WOOP to and Through College

WOOP to and Through College is a research-based mobile app for supporting students in formulating goals and accomplishing them. The screen shots show some of the ways the app can support the WOOP process. It can bring to students' attention the kinds of goals they need to accomplish to get into college. Students can pick a wish that is challenging for them and articulate a specific goal. They can track their goals and also set reminders to check in on their progress.

Source: Images used with permission of WOOP to and Through College.

- *Possible Selves exercise.* In Oyserman and colleagues' (2006) series of "Possible Selves" workshops, middle school students imagined themselves as adults and the positive possible selves they could become. They also imagined the positive and negative forces that would help or hinder their progress, timelines for achieving their goals, actions and strategies for achieving their goals, and problem-solving strategies for dealing with obstacles. In a randomized experiment, two years after this intervention, students had higher tests scores and GPAs, fewer incidents of disruptive behavior, and more positive mental health.

- *Online goal-setting program.* Morisano and colleagues (2010) reported on Self Authoring (http://www.selfauthoring.com/), a web-based program for struggling college students that provided eight steps for them to elaborate on their desired futures, specific goals related to those futures, plans for achieving them, and commitment to achieving them. In a randomized experiment, students who used this program had higher GPAs, higher levels of credit accumulation, and more positive emotions and beliefs.

- **Developing general study skills to deal with cognitive demands.** Students may fail to persist when academic material becomes challenging because they do not have appropriate skills to deal with cognitive demands. Jairam and Kiewra (2009) demonstrated that an intervention called SOAR bolstered college students' test scores. SOAR stands for four different types of strategies for note-taking ("selection"), using graphic organizers ("organization"), building new knowledge from what they know ("association"), and testing their mastery of new material ("regulation").

- **Building a robust set of structures for success.** Another program example provides students in grades 5 to 10 with cognitive, social, and self-management skills. In the Student Success Skills (http://www.studentsuccessskills.com/) program (Brigman & Webb, 2007), students work in groups to improve goal-setting, progress monitoring, building a supportive social community, cognitive and memory skills, dealing with pressure and anxiety, and building healthy optimism. This program has been shown to increase reading and math achievement. Researchers at the University of Massachusetts, funded by the Institute of Education Sciences, are conducting an efficacy study of this program in 60 elementary schools in two large school districts in Florida to examine at scale behavioral and academic outcomes (see http://ies.ed.gov/funding/grantsearch/details.asp?ID=1188).

- **Developing content-specific metacognitive skills.** Students also need to develop content-specific metacognitive skills for planning and monitoring to deal with disciplinary-specific challenges. Snipes and colleagues discuss two such interventions. Thinkertools Inquiry Curriculum (http://thinkertools.org/) helps students in grades 7 to 9 learn to monitor and reflect on their progress as they conduct inquiry science projects (White & Frederiksen, 2001). Reading Apprenticeship (http://www.wested.org/cs/ra/print/docs/ra/home.htm) helps students learn metacognitive skills for reading and analyzing texts in specific disciplines through conversations with teachers about their own mental processes, strategies, knowledge resources, motivations, and affective responses to texts. Greenleaf and colleagues (2011) showed that Reading Apprenticeship significantly improved high school biology students' achievement on tests in English language arts, reading comprehension, and biology.

These mindset and strategy interventions point to powerful new opportunities to help students develop the psychological resources to persevere in the face of a variety of types of challenges and setbacks. These interventions target a range of age levels, from middle school through college. Many target underserved student populations or other types of struggling students. The callout box discusses a program for community college students, Pathways to Improvement (http://www.carnegiefoundation.org/developmental-math), which has integrated these types of interventions as an essential aspect of its theory of action.

Pathways to Improvement: Productive Persistence for Developmental Math

Most community colleges require that students take at least one developmental mathematics course to become eligible to enroll in college-credit courses. Yet a majority of students who take developmental math are not successful in completing college-level mathematics courses (Bailey, Jeong, & Cho, 2010). The Pathways model offers alternative instructional sequences to the typical developmental mathematics course sequences. The model integrates developmental and college-level mathematics in a single academic year and includes such components as ambitious learning goals, lessons and assessments, an online learning environment, a teaching component to support the instructor, and rapid analytics to facilitate improvement in teaching. Integral to the instructional system is a socioemotional component, designed by researchers at the Charles A. Dana Center at the University of Texas–Austin, to promote what they call students' "productive persistence." With the aim of students developing "tenacity and strategies to persist despite challenges," lessons and instruction leverage some of the findings from research on short-term psychological interventions. These lessons are attentive to skills and habits for success in college, building social connections with peers and faculty, and developing a growth mindset (Silva & White, 2013). Community College Pathways shows promise; results from the 2012–13 academic year demonstrated higher than usual completion rates for Pathways students relative to other developmental math students (Van Campen, Sowers, & Strother, 2013).

Additional programs promote the development of protective factors for children and adults that support resilience in the face of life challenges. These approaches combine attention to mindsets and strategies with other social-emotional competencies. Durlak, Weissberg, Dymnicki, Taylor, & Schellinger (2011) reported a meta-analysis of social and emotional learning (SEL) programs, many of which promote related protective factors. Across 213 school-based, universal SEL programs involving 270,034 kindergarten through high school students, compared with controls students in SEL programs demonstrated significantly improved social and emotional skills, positive attitudes toward self and others, positive social behavior, and academic performance. The callout box presents three examples of programs to develop resilience.

Research is still necessary to develop and match particular types of interventions to specific needs, to help educators integrate these interventions into their practice, and to examine impacts at scale in a variety of settings and across age levels.

Examples of Programs to Develop Resilience in Children and Adults

PENN RESILIENCE PROGRAM (PRP)

The Penn Resiliency Program (http://www.ppc.sas.upenn.edu/prpsum.htm) is a group intervention designed to teach upper elementary and middle school students to cope with challenging emotions and difficult situations. Based in part on cognitive-behavioral theories of depression, PRP uses several evidence-based factors to improve resilience, including self-awareness and identifying counterproductive thoughts. Students learn assertiveness, self-regulation and how to challenge negative beliefs. PRP is typically delivered in twelve 90-minute lessons or in 18 to 24 60-minute lessons by trained leaders with expertise in psychology, education, or mental health. Students learn resilience concepts in each lesson through skits, role-plays, short stories, and cartoons and are encouraged to apply these skills in their lives as part of their homework each week. Nineteen controlled studies have evaluated the efficacy of PRP, and a meta-analysis of these demonstrated that PRP participants had fewer symptoms of depression than participants in no-intervention control conditions for up to 24 months.

SUCCESS HIGHWAYS (SH)

Success Highways (http://scholarcentric.com/solutions.html/) is a commercially available intervention developed by researchers at the University of Wisconsin for middle and high school students. It offers a curriculum consisting of fifteen 45-minute lessons, teacher training, and an academic resiliency assessment. The SH intervention may occur within a semester or over the course of the school year, and weekly sessions are preferable. SH lessons incorporate personal student resiliency assessments to help students become more cognizant of their behaviors, activities to promote short- and long-term goal setting and intrinsic motivation, decision-making and time-management games, metacognition prompting, strategies for building confidence in academics, opportunities for reflection about connections to peers and teachers, and strategies for reducing stress and promoting well-being. Students create a personal action plan to identify strengths to build on and challenges to address to foster resiliency. Students complete the *Resiliency Skills Assessment Report,* which can be used to help educators identify school, district, and individual student improvement needs and to identify students who are at risk for academic failure or dropping out. SH is used in approximately 175 schools in the United States, and approximately 80,000 students have participated in the intervention since 2006.

Examples of Programs to Develop Resilience in Children and Adults (Continued)

UNITED STATES ARMY MASTER RESILIENCE TRAINER (MRT) COURSE

As described in Reivich, Seligman, & McBride (2011), the U.S. Army Master Resilience Trainer Course (http://www.jackson.army.mil/sites/vu/pages/273) is a 10-day program designed to teach resilience skills to noncommissioned officers (NCOs), who then will teach these skills to their soldiers. MRT focuses on preventing post-traumatic stress syndrome and incorporates key elements from the PRP and from a parallel program called APEX that addresses depression and anxiety in college students (Gillham, Jaycox, Reivich, Hollon, Freeman, DeRubeis, & Seligman, 1991; Reivich, Shatté, & Gillham, 2003). The first eight days are organized into four modules. Module 1 explores factors that contribute to resilience and introduces the core competencies of resilience targeted by the program. Module 2 builds mental toughness by helping soldiers learn to distinguish between activating events and the thoughts, emotions and consequences that follow. They learn patterns of thinking that lead to adaptive outcomes and resilience and strategies for challenging counterproductive beliefs. In Module 3, soldiers complete an online character strengths questionnaire (http://www.authentichappiness.org) that rank orders and defines strengths. They practice using individual and team strengths to meet goals and overcome challenges. Module 4 focuses on strengthening relationships among soldiers and among soldiers and their families through the application of constructive responding, praise, and communication style. The *sustainment component* on Day 9 addresses the application of these skills in a military context, sustaining resilience, and determining when an individual is struggling with resilience. During the enhancement component on Day 10, soldiers learn to identify connections between thoughts, emotions, physiological states, and performance; effective ways to create enthusiasm and optimism; how to articulate actionable plans to attain goals; strategies for attention control in demanding situations; strategies for maintaining optimum energy; and how to use mental imagery techniques to create or recreate successful experiences. Initial evaluations of the program from NCOs have been positive.

3. Alternative School Models and School-Level Reform Approaches

Another set of approaches promote grit, tenacity, and perseverance through alternative school models or reform efforts at the school level. Programs target schools at all parts of the socioeconomic spectrum, in public charter schools, traditional public schools, and private schools. Depending on the approach, these noncognitive factors may be addressed directly and explicitly or more implicitly integrated into a comprehensive educational model.

What each of these approaches has in common is a mission to change in fundamental ways how schools prepare a wide diversity of students to build deep understanding and critical skills for the 21st century. For example, charter school networks like KIPP, Envision, and Mastery were founded between 1994 and 2001 with specific

intentions to raise achievement for disadvantaged student populations. Despite their positive mission and clear evidence of shrinking the K-12 achievement gap, leaders discovered that achievement gains alone were not leading to higher college graduation rates. They were also learning, anecdotally, that the students who were able to get into college and graduate successfully were not necessarily the most intellectually talented but the ones who developed grit and positive academic mindsets. At the same time, leaders in schools with much more diverse student bodies had been coming to recognize that all students benefit from an education that encourages them to strive, not fear failure, and persist and that persistence is more likely in learning environments that are intentionally designed to promote it. Some school reform efforts have sought to restructure the organization and climate of schools to provide students with a more supportive learning environment.

Here we discuss four approaches. Note that our analysis is based on a limited dataset; the analysis should not be considered an exhaustive categorization.

Character education models. These models began in the last several years with collaboration among Principal Dominic Randolph of the New York City private school Riverdale Country School (http://www.riverdale.edu/), David Levin of the KIPP Charter Network (http://www.kipp.org/), and psychologists Martin Seligman, Chris Peterson, and Angela Duckworth (see callout box for more detail on KIPP). They began with the vision of using principles from positive psychology—the science of positive human functioning—to develop a model of schooling that would help students learn how to develop grit as a transferable competency and persist to get into college and graduate. The model has evolved to target both the contextual supports and psychological resources that facilitate grit, tenacity, and perseverance. As we learned in our interview with journalist Paul Tough, who has written extensively about these schools, key features of the model are explicit articulation of learning goals for targeted competencies, clear and regular assessment and feedback of student progress on these competencies (i.e., using the Character Report Card, shown in Exhibit 11 in Chapter 3), intensive professional development to help teachers understand and work with these competencies, and discourse about these competencies infused throughout the school culture and all disciplinary curricula. This model is emerging in other schools as well, such as the Mastery Charter Network (http://www.masterycharter.org/), and it has become a focus of teacher professional development in the Relay Graduate School of Education (http://www.relay.edu/) in New York City.

At the college level, Azusa Pacific University has been developing a model of character education through its Noel Academy for Strengths-Based Leadership and Education (see Schreiner et al., 2009; http://www.apu.edu/strengthsacademy/). The Noel Academy acts as a resource by helping students determine their "innate talents" and how to conscientiously apply them in school so that they become strengths that can contribute to perseverance and overall success and well-being. Commercial products such as the Clifton StrengthsFinder (http://www.strengthsfinder.com) are used to help individuals identify core enduring talents or "signature themes" that can be developed to achieve personal success (Clifton, Anderson, & Schreiner, 2006). These measures emphasize such characteristics as wisdom, courage, humanity, justice, temperance, and transcendence. The Noel Academy also provides professional development to help instructors design learning sequences that take students' strengths and interests into consideration, along with ample opportunity to help students reflect on how they might apply their strengths to learning tasks.

While there is powerful anecdotal evidence for the impacts of character education models, there is still a need for rigorous investigation of transferability of competencies, impacts on learning, and implications for scaling to other settings.

KIPP (Knowledge Is Power Program)

Developed by Teach for America alumni Mike Feinberg and Dave Levin, KIPP started as a middle school model in low-income communities. After establishing many successful middle schools, Feinberg and Levin expanded to elementary and high schools. Overall, KIPP students are 59% African American and 36% Latino/Hispanic; 87% receive free or reduced-price meals.

KIPP made national news in 1999 when KIPP Academy middle school's first graduating eighth-graders had the five highest test scores in all of New York City. However, years later, data on the students graduating from KIPP middle schools would reveal that many struggled academically in non-KIPP high schools and college. According to the website, "As of fall 2011, 36 percent of KIPP students who completed eighth grade at KIPP ten or more years ago have graduated from a four-year college." The high rate of student entry into four-year colleges (84%) and low rate of college graduation (36%) spurred KIPP leadership to evaluate what was missing in their schools. They began to hypothesize that the alumni who succeeded could be characterized as having the intangible skills consistent with important noncognitive factors. KIPP then became strongly influenced by the work of positive psychology researchers, such as Duckworth and Seligman, who were beginning to show that long-term success was just as contingent on noncognitive abilities as intellectual abilities.

For the last several years, KIPP has been developing and implementing a character education model to foster key noncognitive abilities, with a particular emphasis on grit. KIPP schools teach these qualities as skills that can be worked on and improved and strive to create school-wide discourse about character. They emphasize many of the contextual factors and psychological resources in our model. For example, KIPP focuses heavily on goal-setting as a key motivating factor. Mitch Brenner, KIPP New York's administrative lead on character development, runs teacher professional development on goal-setting, with a special emphasis on giving students agency in creating their own goals. KIPP also provides critical supports for students striving to achieve their goals. For example, regarding mindsets, Carol Dweck's "growth mindset" has been taught in KIPP schools for many years, and its messaging resembles the way that KIPP educators talk to students about the malleability of their character skills. Effortful control skills are taught as part of a weekly character class, through dual-purpose lessons with both academic and character objectives, and reinforced by public reminders. For example, students walk around school wearing shirts that read, "Don't eat the marshmallow," a reference to the classic self-control study in which children needed to abstain from eating a marshmallow in order to earn a reward (discussed in Chapter 2 in the section on Effortful Control). The Character Report Cards (see Exhibit 11) are used as formative assessments to help students gauge and work on their own progress with the noncognitive factors.

Evaluation data are not yet available about growth of noncognitive factors. However, data on achievement has been strong and positive. A study by Mathematica in 2010 matched KIPP students with similar peers at local schools and measured their achievement longitudinally. The study found that students attending a KIPP middle school had higher math achievement by .48 standard deviations, the equivalent of 1.2 years of learning or half the black/white achievement gap. The study also found reading achievement in KIPP schools was higher by .28 standard deviations, the equivalent of 0.9 years of learning and a third of the black/white achievement gap.

Project-based learning and design thinking models. These models include schools with an intensive focus on learning strategies for accomplishing long-term goals and an emphasis on feedback and iteration. In *project-based learning* (PBL), students take on real-world problems in any discipline and develop long-term projects on these problems. Connections to the real world provide a motivating context, and long-term projects provide opportunities to develop 21st-century skills such as problem-solving, collaboration, researching, and communication. In particular, students learn important learning strategies and self-regulation skills necessary for perseverance over the long term to achieve the goals of a given project. They may learn skills such as task definition, planning, monitoring, deliberation over findings, and adaptation of approach. *Design thinking* is a pedagogical paradigm that emphasizes the processes necessary for innovative design—brainstorming, using imagination, collaboration, prototyping, feedback, and iterative development (Carroll et al., 2010). *Design thinking* supports perseverance through the development of important mindsets and learning strategies as students learn to "fail early and often" and use feedback to iteratively improve a product.

Some schools are beginning to implement PBL with the intention of fostering grit, tenacity, and perseverance, among other competencies. One such school is Envision Charter School (http://www.envisionschools.org/) in San Francisco. This school serves a diverse student population (78% black and Latino, 60% first-generation college bound, and 61% qualifying for free or reduced-price lunch). A key foundation of the charter is PBL, culminating in a college success portfolio produced during the senior year. Envision's leaders, from its inception, saw the pursuit of long-term goals and all the necessary skills that demands as the most critical elements of learning. Time management and persistence through long-term projects are central in their model. While formal evaluation data are not yet available, Envision reports that 98% of graduates go to college and 91% remain in college.

Quest to Learn (http://q2l.org/) is a network of two schools in Chicago and New York City that share much the same philosophy, strongly emphasizing design thinking. Founded on principles of game design, these schools use the motivating qualities of game play to encourage creativity and deep cognitive engagement. What aligns their philosophy closely with PBL is their view that the best learning happens through a process of trying, failing, and iterating. In fact, there is an expectation at these schools that assignments almost never are turned in just once. The process of getting feedback, from both teachers and peers, before persisting in creative ways to improve one's work, is seen as critical in learning and developing as a student.

Beyond these models are a number of schools throughout the country that are developing their own models. This line of practice is still less than a decade old, and research is still necessary to refine the models and establish whether they are effective, for whom, and under what circumstances.

School reform programs. A third approach is found in reform programs that work with schools to create conditions that are supportive of perseverance. These programs are intended to promote cultures in which the aforementioned mindsets, strategies, and tools can be most effective. Many of these programs operate under assumptions aligned with Darling-Hammond's (2002) 10 principles for redesigning high schools with a "small school" model that works: (1) personalization of instruction, (2) continuous relationships with teachers over time, (3) high standards and performance-based assessment, (4) authentic curriculum that focuses on deep understanding and connections to students' lives, (5) pedagogy adapted to individual learning needs, (6) multicultural and antiracist teaching to support belonging for all students in the school community, (7) knowledgeable and skilled teachers, (8) opportunities for teachers for collaborative planning and professional development, (9) connections to the family and community, and (10) democratic decision making such that all stakeholders have a voice in governance.

Readers are cautioned that some of these programs may not yet address a common misconception about and misunderstanding of the research on mindsets and other aspects of academic motivation. Although general encouragement and supportive relationships with adults are important for children and adolescents, the mindset research shows that they alone are not enough to foster perseverance. Specific attention to the growth mindset—"My ability and competence grow with my effort, strategies, and help from others"—along with strategies specific to the challenges at hand are essential to promoting students' perseverance. Programs that do not explicitly address these aspects of perseverance may show some positive outcomes for students but still fall short of truly promoting perseverance.

We reviewed some highly regarded organizations whose missions are to support schools in enacting many of the "small schools" design principles in their structure and culture, regardless of the size of the school.

- *Coalition of Essential Schools (http://essentialschools.org/).* This program, based in Rhode Island, works with educators, districts, and other entities throughout the country using a guiding philosophy to create "personalized, equitable, and academically challenging schools for all young people." The program facilitates communication among the hundreds of schools in its network, provides professional development and community building, provides informational resources for educators about best practices, and advocates for appropriate resources and conditions at the local, state, and national levels.

- *Turnaround (http://turnaroundusa.org/).* This program works with high-poverty schools in New York City and Washington, D.C. to create school environments that help students overcome obstacles presented by poverty for students' learning and development. The program provides training and support for teachers in research-based, high-leverage instructional practices (e.g., formative assessment, cooperative learning) and classroom management practices that promote a positive school climate, targeted behavioral and academic interventions for high-need students, and other support necessary for school improvement.

- *The Small Schools Workshop (http://smallschoolsworkshop.wordpress.com/).* Based in Chicago, this is a consulting firm that "helps schools and school districts strategize to create smaller, personalized and effective learning communities." It works directly with schools and districts, providing professional development and organizational supports for school improvement.

- *Compassionate Schools Initiative (http://www.k12.wa.us/CompassionateSchools).* This program, located in the state of Washington, focuses on developing school climates and social-emotional competencies that support resilience, particularly among communities exposed to chronic stress and trauma (although it is open to any school seeking training to encourage compassionate classrooms and attitudes among school staff). The program trains and supports school staff in establishing a culture and climate with a strength-based approach that encourages open communication, voice and ownership for all members of the community, flexible accommodations for diverse learners and vulnerable students, compassionate and effective discipline strategies, and strategies for continuous quality improvement.

- *Expeditionary Learning (http://elschools.org/).* Expeditionary Learning applies a whole-school design model, engaging with schools, districts, and charter boards to transform existing schools and open new schools. The program incorporates school-based professional development including curriculum planning, demonstration lessons, classroom observations with debriefing, and team coaching. Instructional practices focus on extended interdisciplinary, real-world investigations that develop

students' critical thinking skills and motivate collaboration with peers and community involvement. Expeditionary Learning schools have outperformed district averages on English language arts and mathematics achievement tests.

While these programs are generally highly regarded, there is still little research on their actual impacts in schools and the extent to which they foster environments that specifically address growth mindsets.

What Works Clearinghouse Practice Guides. Schools can also take their own initiative to implement practices that will target particular aspects of perseverance for their students. The Institute of Education Sciences releases practice guides through the What Works Clearinghouse to provide specific research-based actionable practices for schools. Recommendations for each guide are developed by an expert panel that considers evidence from various sources and uses a specific rubric to rate the quality of evidence for each practice as strong, moderate, or low. Each practice is described in detail, including a summary of the evidence to support it, guidance on how to carry it out, and potential roadblocks and solutions. The callout box highlights two practice guides that present broad recommendations for promoting perseverance to complete high school and navigate the path to college.

What Works Clearinghouse Practice Guides on Promoting Perseverance in High School

The guide on *Dropout Prevention* (http://ies.ed.gov/ncee/wwc/PracticeGuide.aspx?sid=9) (Dynarski et al., 2008) provides six key recommendations:

1. Utilize data systems that support a realistic diagnosis of the number of students who drop out and that help identify individual students at high risk of dropping out
2. Assign adult advocates to students at risk of dropping out
3. Provide academic support and enrichment to improve academic performance
4. Implement programs to improve students' classroom behavior and social skills
5. Personalize the learning environment and instructional process
6. Provide rigorous and relevant instruction to better engage students in learning and provide the skills needed to graduate and to serve them after they leave school.

The guide Helping Students Navigate the Path to College: What High Schools Can Do (http://ies.ed.gov/ncee/wwc/PracticeGuide.aspx?sid=11) (Tierney et al., 2009) provides five key recommendations:

1. Offer courses and curricula that prepare students for college-level work and ensure that students understand what constitutes a college-ready curriculum by ninth grade
2. Utilize assessment measures throughout high school so that students are aware of how prepared they are for college and assist them in overcoming deficiencies as they are identified
3. Surround students with adults and peers who build and support their college-going aspirations
4. Engage and assist students in completing critical steps for college entry
5. Increase families' financial awareness, and help students apply for financial aid.

4. Informal Learning Programs

Learning in its broadest sense takes place in every activity of life, inside and outside school. According to Lemke, Lecusay, Cole, & Michalchik (2012):

> [Informal learning] refers specifically to participation in organized activities in face-to-face or online settings (or both) other than formal instruction, in which a number of the following features are especially relevant or salient: voluntary participation, relatively equitable power relations in negotiating goals and means, enjoyment of the learning activity for its own sake, intense engagement with tasks, flexibility of goals and in re-purposing resources, unpredictability of some significant learning outcomes, improvisation and innovation within and concerning the activity, commitment over time in the face of obstacles. (p. 13)

Informal learning that happens in out-of-school settings is usually in a group, where students go on cultural field trips, meet in institutional environments during off hours, or mingle with working professionals. These activities can often have rich technology components. Programs are available for students from elementary school through college, but most are for the older students.

Indeed, there is great potential for informal learning environments to provide essential contextual factors to promote grit, tenacity, and perseverance. While there are many different types of informal learning programs, here we explore two categories of programs intended to promote grit in different ways. We provide well-regarded examples of each.

- **Out-of-school support systems to help students persist through high school, get into college, and enter the professional workforce.** Many programs focus on promoting ambitions to go to college and obtain a job and provide a social network of peers and/or mentors who guide the students through the transitions to high school, college, and career. Program providers often emphasize that their services address a gap in the students' home settings, where students may be among the first in their families to go to college. Some examples are as follows.

    - *The Breakthrough Collaborative (http://www.breakthroughcollaborative.org/).* This program begins working with students in a six-week program in the summer of their seventh-grade year to introduce them to long-term planning for attending college. They receive year-round support and tutoring and structured college preparation activities as they move through a college preparatory high school program. Breakthrough emphasizes long-term and multidimensional support, from the academic to the social.

    - *College Track (http://www.collegetrack.org/main/).* This program engages students from the summer before they start high school through the next eight years to support their goals of going to college and graduating. The focus is on students who are the first in their families to earn a college degree. The program complements high school tutoring and college application and support programs with a Student Life program that engages them in service learning, arts, leadership opportunities, and cultural trips.

    - *KIPP Through College (http://www.kipp.org/ktc).* The KIPP secondary program has expanded to provide a set of academic and organizational services to support college planning, application, and success. These services are offered beginning in middle school and extend through college. The offerings vary by region—Austin, Houston, New York, Los Angeles, the San Francisco Bay Area, and

Washington, D.C. Graduates participate in such activities as weekly or annual alumni events, as-needed support on college or job applications, out-of-school job exploration programs, and tutoring.

- *OneGoal (http://www.onegoalgraduation.org/).* This program calls itself a "college persistence program," and the one goal is college graduation. Led by teachers, the program emphasizes social support with structured planning to address challenges in college application and initial college adjustment. OneGoal offers a conference for high school juniors to introduce them to college preparatory activities, help in planning the college and financial aid application process, campus visits, social support from a peer network, online support and planning activities before students begin their freshman year in college, and a reunion during the first winter break of freshman year. Eventually, successful OneGoal "fellows" offer social support to younger students in the program.

- *Student Success Academy (http://www.studentsuccessacademy.com).* This is an online interactive program that pairs a high school student with a "personal success consultant," a highly successful college student mentor, who can help the high school student navigate through the process of getting into college. The program also includes internship opportunities and a curriculum to help students identify their interests and take actions toward finding and building a satisfying career.

- **Out-of-school programs intended to trigger interest and persistence in STEM pathways.** Many programs are intended to engage the interest and enthusiasm that, over the long term, could promote persistence in STEM studies through to a STEM professional career. Some of the programs are also intended to simply instill academic mindsets that support perseverance in general. Some examples are as follows.

  - *Galileo Learning Science Camps (http://www.galileo-learning.com/).* This organization offers week-long summer camp sessions that inspire exploration of science, art, and history. See the callout box below.

Galileo Learning Science Camps

At Galileo Learning summer camps (http://www.galileo-learning.com/), students use materials, tools, and technologies to create, test, and share their ideas about science, developing mindsets that promote perseverance. The Galileo Innovation Approach emphasizes an "innovation mindset" characterized by five elements: (1) Be Visionary (e.g., "I imagine things that don't yet exist"), (2) Be Courageous (e.g., "I embrace challenges"), (3) Be Collaborative (e.g., "I value the unique perspectives of others"), (4) Be Determined (e.g., "I persevere until I achieve my goal"), and (5) Be Reflective (e.g., "I take time to think about what is and isn't working in my design"). Camp Galileo offers week-long sessions around an imaginative story or theme that inspires exploration of science, art, and history. For example, during one week about the art and science of music, students engineered instruments and created sculptures modeled on Picasso's deconstructed instruments or mixed media collages inspired by artist Romare Bearden. The program for middle school students incorporates technologies in activities such as digital photography, filmmaking, video game design, and LEGO robotics. Galileo Camps were established in 2002 and are available in the San Francisco Bay Area for rising kindergarteners to eighth graders.

- *Girls Inc. (http://www.girlsinc.org/).* This is a national network of affiliates that provides out-of-school programming for girls K-12 who are primarily from low-socioeconomic and underrepresented populations. It encourages all girls to be strong, smart, and bold. Girls Inc. programs address the "whole girl"—personal, interpersonal, academic, health, and fitness. The program Operation SMART develops girls' enthusiasm for and skills in science, technology, engineering, and mathematics. Through hands-on activities, girls explore, ask questions, persist, and solve problems. They also interact with women and men pursuing STEM careers, helping girls come to view these careers as exciting and realistic options for themselves. The STEM programs Build IT and InnovaTE^3 were also designed to encourage girls' persistence in STEM learning and career pursuits.

- *Project Exploration (http://www.projectexploration.org/).* This is a nonprofit science education organization that works to ensure that communities traditionally overlooked by science—particularly minority youth and girls—have access to personalized experiences with science and scientists. Project Exploration targets students who are open-minded and curious, regardless of academic or economic standing, and gives them the opportunity to explore a variety of scientific disciplines alongside scientists in the workforce. Project Exploration students are more likely than their peers to graduate from high school, go to college, and major in science: More than 96% of Project Exploration fieldwork participants graduate from high school. These students are three times more likely to enroll in a four-year college than their peers, and over one third of alumni major in science in college. Participants attributed their persistence to participation in these programs (Chi, Snow, Goldstein, Lee, & Chung, 2010).

5. Digital Technologies, Online Resources, and Tools for Teachers

There is a large and growing array of educational technologies that can be used to support grit, tenacity, and perseverance. Technology by itself does not provide quick fixes for the challenges of promoting perseverance, but it can offer tools and resources to enhance and expand the capabilities of human-centered learning environments. In concert with other high-leverage factors such as quality instruction, social supports, and personal interactions with supportive adults, technology has the potential to significantly influence long-term outcomes. A core recommendation from the experts we interviewed was that technology to support perseverance should be grounded in design principles aligned with the general best practices for fostering these competencies. In fact, we found educational technologies aligned with all aspects of our hypothesized model of grit, tenacity, and perseverance. Here we present some examples from a range of categories aligned with key facets of the model. Note that many of these fit in more than one category or categories previously discussed.

- **Digital learning environments that provide optimal challenge through adaptivity and personalization of instruction.** While students differ in their learning needs and their responses to learning activities, in a typical classroom teachers have too many students to provide a high level of individualized support. As discussed in Chapter 3, digital learning environments provide great potential for collecting complex micro-level data about behavioral task performance that can be used dynamically within a system or provided to teachers to adapt instructional tasks to learner needs. Personalization alone does not necessarily support persistence, but it can be an important contributing factor, especially for students who may otherwise not be provided resources tailored to the challenges they are encountering. Systems such as Cognitive Tutor (http://www.carnegielearning.com/), ASSISTments (http://www.assistments.org/), Wayang Outpost (http://wayangoutpost.com/), Reasoning Mind (http://www.reasoningmind.org/), and Agilix Buzz (http://agilix.com/) are examples of digital learning environments that can analyze students' responses and use this data to inform personalization. Callout boxes below discuss Wayang Outpost and Agilix Buzz.

Wayang Outpost

Wayang Outpost is an intelligent tutor designed to prepare middle school and high school students for geometry and statistics on standardized tests. The system customizes problems and hints to each student's cognitive profile and emotional state (e.g., frustration or boredom). Animated "agents" then respond to the student, for example by sharing some worked out problems if the student is frustrated or by praising effort if the student completed a problem (Woolf et al., 2009). Researchers at the University of Massachusetts are evaluating whether affective agents perceived as caring can increase the likelihood that students will persist through frustrating portions of instruction and exhibit greater mastery of content.

Agilix Buzz

In 2012, Michigan's Education Achievement Authority (MEAA) began an initiative whereby the lowest achieving schools would start to become part of a statewide education system. Changes to the schools include the placement of new principals, more school autonomy, extra funds, the creation of parent committees at each school, and access to new technologies that enable more individualized learning.

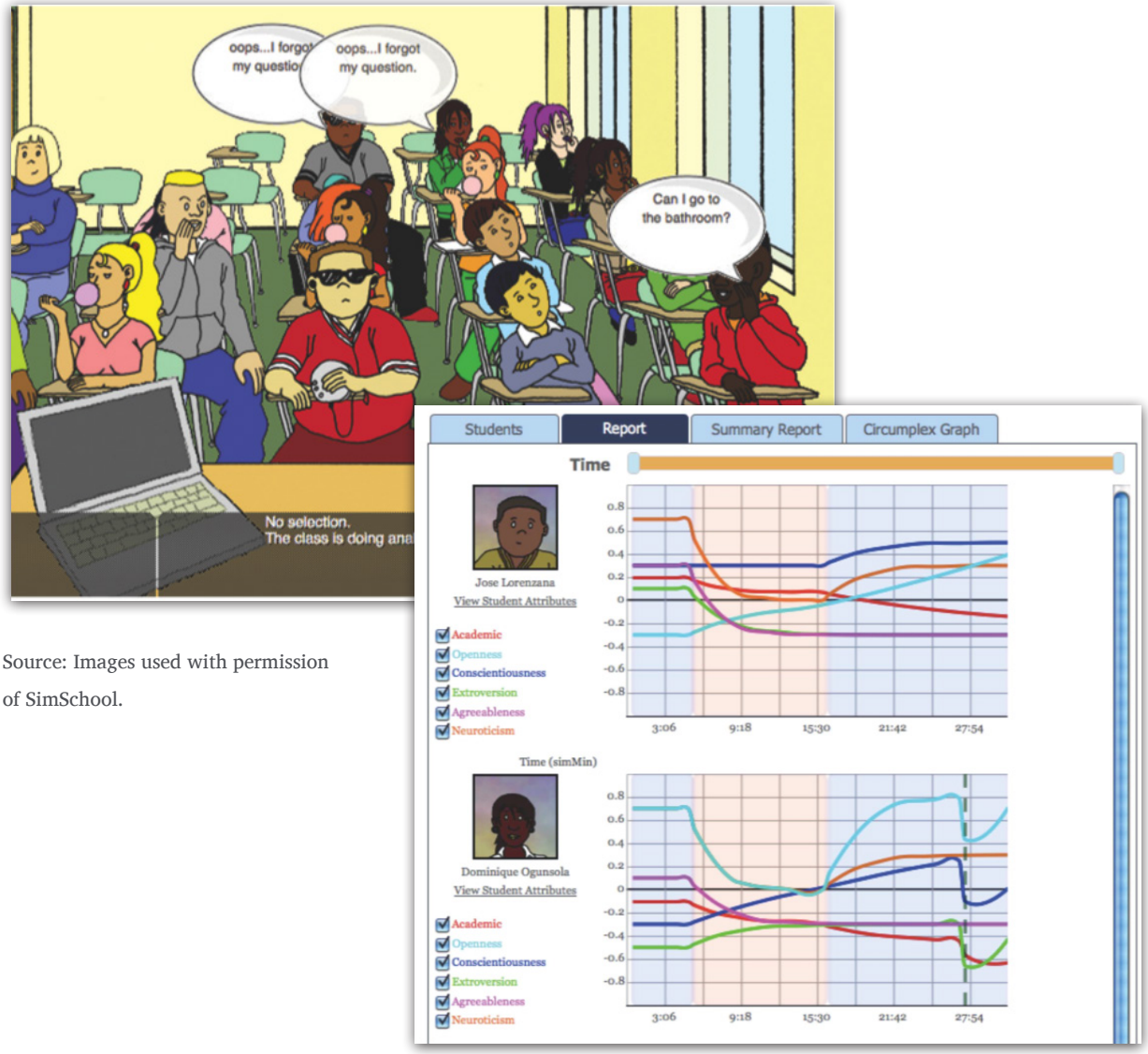
As part of this initiative, the MEAA created a partnership with Agilix, using its Buzz platform to develop what it calls "personalized learning at scale." Buzz provides a digital learning environment supported by teacher intervention. Major design principles are that students are grouped by readiness (not grade level), master content at their own pace, choose their own learning path, provide teachers with real-time feedback about how they are feeling about their academic progress (see screen shot below), participate in a learning community with peers, and get immediate feedback from the system about their productivity and progress. Students work from their own personalized learning plan, following an online interactive curriculum. Teachers receive ongoing and immediate feedback about student progress, productivity, and affective states. Teachers can use this information to intervene quickly with highly individualized strategies.

MEAA is using this approach with approximately 11,000 students at all grade levels and all subjects. For additional information, see the presentation from the White House Educational Datapalooza (http://agilix.com/buzz-white-house/).

- **Digital tools to help educators promote a rigorous and supportive classroom climate.** Several new and emerging digital tools are intended to help teachers promote positive classroom cultures and support perseverance in their classrooms. ClassDojo (http://www.classdojo.com/), pictured in Exhibit 7 in Chapter 2, is a classroom management tool that helps teachers maintain a supportive learning environment and keep students persisting on task in the classroom. Kickboard (http://kickboardforteachers.com/) is an online tool that helps teachers and schools track and report on grades and behavior in real time. In a central repository, teachers can keep a variety of types of data on individual students, including updates on positive behaviors and discipline problems throughout the day, that can be shared instantaneously with all teachers and administrators in the school. SimSchool (http://www.simschool.org/), discussed in the callout box, is a platform used for preservice teacher training that can provide teachers with important critical thinking skills needed to set up a positive learning environment that promotes persistence.

SimSchool

SimSchool provides preservice teachers with simulated classrooms with simulated students based on pertinent attributes of real students (e.g., special education status, introverts, ADHD, disruptive behavior). These preservice teachers work with the simulation to develop and test their pedagogical strategies for differentiating instruction and behavioral interventions matched to the needs of the "student." During a SimSchool simulation, the teachers design and execute lessons that unfold in a virtual classroom. Each virtual student has predispositions that the teacher must accommodate during both planning and execution through altering qualities such as lesson pace, task differentiation, and speaking tone. After a lesson, teachers can analyze and reflect on the academic and psychological impacts of their decisions. Blue and white shading signifies the shifting of student tasks over time. The colored lines trace psychological and academic impacts from records taken every ten seconds. The dotted line shows where the teacher talked to student Dominique and the impact of this interaction on her attitude.



Source: Images used with permission of SimSchool.

- **Digital learning environments that promote grit, tenacity, and perseverance through motivating learning environments.** Video games—which provide opportunities for students to be immersed in simulated worlds, interactive stories, engaging visual environments, playful collaborations with other players, vividly designed avatars and personas, and optimally challenging tasks that are adaptive and provide immediate feedback—are a new learning technology that holds potential for supporting grit, tenacity, and perseverance. Steinkuhler (2011), for example, demonstrated that middle school students who tested well below grade level in reading were willing to persist within an engaging video game to comprehend text several grade levels above their own. See callout box below for example of Quest Atlantis, a research-based game. While video games show potential, there is still extremely limited research evidence to show that video games on their own have substantial impacts on educationally relevant persistence and learning.

Quest Atlantis

Quest Atlantis (QA) (http://atlantisremixed.org/) is a 3-D multiuser computer graphics learning environment that uses a narrative programming toolkit to immerse children ages 9 through 15 in meaningful inquiry tasks. It is intended to engage students in a form of transformational play comprising both online and off-line learning activities, with a storyline inspiring social action. QA's design principles draw from both commercial gaming and important findings in the learning sciences about learning and motivation. Inside the game, students travel to virtual places to engage in educational activities called "quests," in which they become empowered scientists, doctors, reporters, and mathematicians who have to understand disciplinary content to accomplish desired ends. As part of their quests, they also have the opportunity to talk with other students and mentors, and build virtual personae. According to QA's website, more than 65,000 students have participated in the project, and QA has demonstrated learning gains in science, language arts, and social studies. Teachers and students have also reported increased levels of engagement and interest in pursuing the curricular issues outside of school.

- **Digital technologies that promote academic mindsets.** As discussed above, there is a growing set of interventions based in social psychological theory that target the development of productive academic mindsets. While most of the interventions are paper based, these approaches are increasingly being used within digital learning environments. Brainology (http://www.mindsetworks.com/) provides an online interactive workshop that teaches students about the growth mindset. A series of instructional units teach that the brain grows like a muscle with effort and practice. Mindset Works, the developers of Brainology, is currently funded by the Institute of Education Sciences/Small Business Innovation Research to continue to develop this platform and study its promise to enhance teachers' and students' mindset-related beliefs and goals. Recently, some digital learning environments focused on mathematics learning have been structuring activities to promote a growth mindset. The callout box in Chapter 1 describes the examples of Khan Academy and Math 180 in doing this work. Another example is Transforming Engagement of Student Learning in Algebra (TESLA) (http://teslahgse.wordpress.com/),

led by Chris Dede at Harvard University. The project is on a four-day mathematics intervention for students in grades 5 to 8. The research examines multi-user virtual environments (MUVEs), game-like activities in which students are immersed in a three-dimensional virtual environment, either taking on the identity of a science, technology, engineering, or mathematics professional to solve puzzles or vicariously observing others solving the puzzles. In the most interactive MUVE induction, puzzles incorporate cognitive scaffolds related to difficulty and motivational scaffolds to build self-efficacy. Moreover, activities are designed so that successful completion depends on students' perseverance. In addition, the recently launched website This Is Grit (http://thisisgrit.us/) is a social network for individuals to share their personal stories of grit, tenacity, and perseverance to inspire others to persist in the face of challenge or hardship (see Exhibit 1 in Chapter 1).

- **Digital technologies that promote learning strategies.** A number of technologies are emerging that target learning strategies, either as a general skill or embedded within content learning. As discussed above and shown in Exhibit 16, researchers at New York University have developed a mobile app called "WOOP to and through college" (http://woopmylife.com/) to help students use the WOOP strategy (Wish-Outcome-Obstacle-Plan) to articulate the sequence of desired goals, positive outcomes, obstacles, and plans essential to persisting through the challenges to get into college. Studies have shown that the WOOP exercise, done as briefly as 20–30 minutes one time, can have significant impacts on perseverance and achievement across a range of student populations and outcomes (e.g., Duckworth, Grant et al., 2011; Duckworth, Kirby et al., 2013; Gawrilow et al., 2013). Also, Morisano et al. (2010) reported on Self Authoring (http://www.selfauthoring.com), a web-based program for struggling college students that provided eight steps for having students elaborate on their desired futures, specific goals related to those futures, plans for achieving them, and commitment to achieving them. The Learning Kit Project (Winne et al., 2006) (http://www.learningkit.sfu.ca/) developed gStudy, a system with a suite of tools to support self-regulated learning when students engage with any multimedia information (text, diagrams, charts, audio and video clips) regardless of the content domain. gStudy tools support analyzing, classifying, indexing, and evaluating information. Features of the system include annotation capabilities for multiple types of media, a chat tool for structured conversations with peers, and coaches that attend to and give feedback on study techniques and learning strategies. gStudy has been used with elementary, middle school, high school, and undergraduate students. WISE (see callout box) provides a project-based inquiry science learning environment that integrates the development of self-regulated learning and agency with learning of science inquiry skills.

- **Digital learning environments that promote the development of effortful control and other social and emotional skills.** As discussed at the beginning of this chapter, there are a variety of computerized training tools in which children play computer games that progressively increase demand on functions such as working memory and impulse control. One example discussed above is CogMed (http://www.cogmed.com/), which has been demonstrated to be successful for young children. IF… (http://www.ifyoucan.org/) is a new video game designed to teach children emotional skills such as self-awareness, self-management, social awareness, relationship skills, and decision making. Players engage with characters who guide them in using these skills through storytelling and popular game-play mechanics to bring harmony back to the imaginary town of Greenberry. No research is available yet to show its impact or effectiveness.

WISE

The Web-based Inquiry Science Environment (http://www.wiseeducation.org/) is a technology-rich project-based inquiry science learning environment that integrates the development of self-regulated learning and agency with learning of science inquiry skills. It supports the design and implementation of visualizations that provide multiple rich occasions to press students to develop explanations about the real world and personally relevant questions. WISE features reading and writing prompts to promote autonomous engagement in scientific practices. Supporting development of metacognitive skills, hints, and embedded assessments ask students to predict, observe, explain, reflect, and evaluate the work of their peers. Argument organizers and explanation tools, such as Idea Manager, support students in collecting multimedia information and organizing ideas into coherent arguments using evidence. MySystem allows students to illustrate sequences of events and construct models to explain scientific phenomena. Students can create additional representational forms with the WISE Draw & Flipbook Animator.

Teachers are also provided data to help adapt to student learning needs. With WISE teacher tools, such as the Progress Monitor, teachers can view student work in real time and identify students who need additional attention. Teacher grading and feedback tools support autoscoring of embedded assessments, as well as sending personalized feedback to students. Curriculum projects can be customized for particular classroom contexts using the WISE authoring tool.

WISE 4.0 is built on a scalable open source architecture that supports a wide array of learning technologies and extensions to other learning environments. It is optimized for running in web-based environments using lighter weight components (e.g., Flash or Java applets) in technology-challenged settings (Slotta & Aleahmad, 2009). The publicly available website currently contains more than 30 WISE projects spanning Earth, physical, and life sciences for elementary through high school students. For more than two decades, WISE curricula have been tested in middle school and high school classrooms in multiple school districts, and research has shown that these units improve student learning (Linn, Lee, Tinker, Husic, & Chiu, 2006).

Digital technologies provide many different types of resources to support students' perseverance. While several of these programs have demonstrated impacts on both persistence and learning, research is still necessary to evaluate the effects of many of these technologies and for a range of student populations. Educational technology is rapidly evolving. Developers from a broad range of communities nationally and internationally are putting significant resources into developing educational technologies that promote perseverance; there are likely to be significant new developments on the horizon.

Moving Forward

In this chapter, we explored roughly 50 approaches practitioners and researchers are developing and testing to promote and/or teach grit, tenacity, and perseverance—through structuring contextual factors, bolstering psychological resources, or some combination of both. We found programs in both formal and informal learning environments, some of which had integral technology components. Some approaches integrated teacher professional development elements as well. Interventions spanned the age range. Effortful control and executive function interventions were geared primarily for preschool and early elementary school. Mindset and learning strategy interventions were geared toward older students from middle school through postsecondary school. Some of the programs we investigated were designed to promote noncognitive factors themselves, and some programs targeted noncognitive factors embedded in the learning of STEM content. Interventions targeted a range of student populations. Many were intended for special student populations, while many were implemented more universally.

There are substantial data available about impacts of these programs. We can divide these programs into three categories. The first category of programs has research or evaluation data that show impacts with respect specifically to noncognitive factors and, in most cases, academic achievement. These programs include most of the school readiness programs, academic mindset interventions, learning strategy interventions, and many of the digital learning environments. In research on these approaches, researchers' experimental manipulations are the active noncognitive ingredients, so it is possible to make inferences about causality. Most of the alternative school models and some of the digital learning environments had only achievement data available. While such data are important and compelling, these interventions are complex, and it is not possible to isolate the potential impacts of the noncognitive factors themselves. For the rest of the interventions, particularly the out-of-school programs, approaches are relatively new and/or have limited funding and provide only anecdotal evidence of success. While the findings in this chapter do not establish grit, tenacity, and perseverance as transferable competencies, taken as a whole the findings provide a source of optimism about what is possible.

5 Conclusions and Recommendations

Across research, practice, policy, industry, and popular culture, there is an emerging and convergent recognition that grit, tenacity, and perseverance should play an essential role in evolving educational priorities to support success for all students. Success includes the attainment of important educational outcomes, such as strong academic performance and graduation from high school and college, as well as significant life outcomes, such as productive employment, physical and psychological well-being, and making contributions to society. American children in the 21st century need support as they navigate a variety of challenges in school and life. Students in high-poverty areas face particular challenges of stress, limited social support, lack of critical resources, and psychological disempowerment and disenfranchisement. Regardless of socioeconomic conditions, all students can encounter difficult challenges and setbacks throughout their schooling as they learn conceptually complex material, deal with distractions, persist through academic assignments that are important but not necessarily intrinsically interesting, manage competing demands, and prepare themselves for the complex and rapidly changing 21st-century workplace. Conventional educational approaches have tended to focus on intellectual aspects of success, such as content knowledge. However, this is not sufficient. If students are to achieve their full potential, they must have opportunities to engage and develop a much richer set of skills. Indeed, a growing body of research suggests that noncognitive factors such as grit, tenacity, and perseverance can have just as strong an influence on academic performance and professional attainment as intellectual factors.

Digital technology is playing an important role in these shifting priorities. It can offer a wide array of tools and resources to enhance and expand the capabilities of human-centered learning environments. In concert with other high-leverage factors such as quality instruction, social supports, and personal interactions with supportive adults, technology has the potential to significantly impact long-term outcomes.

This is an exciting time of change and progress with a strong need for growing involvement by all educational stakeholders. New and emerging trends in research, policy, programs, and technology are providing unprecedented opportunities. At the same time, a common theme in the literature and across all our interviews is that much still needs to be done if grit, tenacity, and perseverance are to become a pervasive priority in education. *There are no quick fixes;* making significant progress requires the efforts of all communities of educational stakeholders and fundamental paradigm shifts in the culture of education.

This chapter presents specific conclusions and recommendations tailored to the needs and responsibilities of practitioners, researchers, and policymakers.

Conclusions and Recommendations for Practitioners

Findings presented in Chapter 2 on theory and Chapter 4 on the design of learning environments are important for educators and administrators exploring how to promote grit, tenacity, and perseverance in their students. As discussed, these qualities can be promoted both through structuring *contextual factors* in the learning environment and fostering *psychological resources* within the student—academic mindsets, effortful control, and strategies and tactics. Educators can approach promoting perseverance *within the learning environment* and/or as a quality that is a *transferable competency* to be taken beyond the environment.

PRACTITIONER RECOMMENDATION 1: USE RESEARCH-BASED BEST PRACTICES THAT PROVIDE STUDENTS OPPORTUNITIES TO TAKE ON WORTHWHILE LONG-TERM OR HIGHER-ORDER GOALS AND THE RESOURCES AND SUPPORT TO ACCOMPLISH THEM.

The hypothesized model of grit, tenacity, and perseverance presented in Chapter 2 (Exhibit 5) points to potentially actionable best practices. Distilling the findings from each element of the hypothesized model, we present the following practices as promising but not proven; evidence at scale is still limited, and the field still needs coherent methods for integrating these practices into school culture, teaching practices, curriculum, and technology—especially under conditions that present significant barriers.

a. **Educators should provide students with opportunities to take on worthwhile long-term or higher-order goals that are optimally challenging and in alignment with what they value.** Students may take on a wide variety of types of goals, differing in timescale and complexity, depending on students' age, educational needs, the content discipline in which the goals are situated, and so on. One principle is that students find goals worthwhile when they are optimally challenging—they require some perseverance to attain but not so much that they seem overwhelming or impossible, and they still expect to succeed. Another principle is that students find goals worthwhile when they are aligned with what they value—goals have personal importance, are intrinsically enjoyable or interesting, relate well to current and future goals, and/or do not come at a cost that outweighs the benefits. To the extent possible, goals should be designed to promote intrinsic motivation through connections to students' interests, values, and personally relevant goals. In many cases, particularly with unfamiliar material, educators may need to engage students in activities that bridge from their interests and familiar experiences to the learning objectives to help students make personal connections. When practical, providing students with choice and autonomy in selecting goals also can foster intrinsic motivation and perseverance.

b. **Educators should provide students a rigorous and supportive context for pursuing these goals.** As students engage in pursuing long-term and higher-order goals, they may encounter a wide range of different kinds of challenges—for example, conceptual complexity or lack of tactical knowledge, more dominant distractions, boredom, lack of resources, and other adverse circumstances. Students will be more likely to persevere when learning environment cultures (1) promote beliefs about competence, (2) promote relevant values and goals, and (3) promote social connectedness and belonging. As stated in Chapter 2, key principles are as follows:

- Students will persist more when they perceive that they are treated fairly and with respect and adults show they care about them.
- Students will persist more when teachers, administrators, and others in the school environment have high expectations for their success and hold them to high standards. These expectations can be conveyed explicitly or implicitly. When remedial support is necessary, it is provided in ways that do not feel punitive or interfere with opportunities to engage in other interest-driven activities.
- Evaluation of student performance should be carefully designed not to undermine perceptions of competence and future expectations. However, rather than indiscriminately meting out unearned praise, those giving feedback should base it on clearly defined criteria, provide specific and useful comments, and ensure that students have opportunities to demonstrate competence in different ways.
- Extrinsic rewards and punishments that undermine intrinsic motivation should be avoided.
- Authoritarian discipline policies that limit students' options and opportunities for self-expression undermine intrinsic motivation and persistence.

Although general encouragement and supportive relationships with adults are important, research shows that they alone are typically not enough to foster perseverance. Specific attention to the growth mindset, along with strategies specific to the challenges at hand, can be essential to promoting students' perseverance.

c. **To the extent possible, educators should provide the tangible resources—material, human, and time—necessary to overcome challenges and accomplish goals.** Depending on the type of goal, materials can include access to particular programs or educational technologies, rigorous curriculum, equipment, materials to complete projects, course tuition, or physical facilities where students can do their work. Human resources can include mentoring, tutoring, peer guidance, teachers with particular training, or special services. Time also can be a precious resource—optimal challenges require that students have adequate time to grapple with their difficulties, reflect, obtain feedback, iterate, and try new approaches. Particularly in high-poverty urban areas, many of these tangible resources can be lacking.

d. **Educators should support the psychological resources that can promote grit, tenacity, and perseverance.** We identified strategies in each of the major categories of psychological resources:

1. *Academic mindsets.* Mindsets are how students frame themselves as learners, their learning environment, and their relationships to the learning environment. They include beliefs, attitudes, dispositions, values, and ways of perceiving themselves. Productive mindsets to support perseverance are as follows:

    - *I can succeed at this.*
    - *My ability and competence grow with my effort, strategies, and help from others.*
    - *Challenge is inevitable for success.*
    - *This work is in line with my interests, values, or goals.*
    - *I belong in this academic community.*

While these mindsets are addressed in specific programs discussed below, some general practices that can support productive mindsets and their development are:

- To foster a growth mindset, direct praise at effort and strategies—never at ability. Remind students to expect their goals to be challenging and require effort.
- Frame failure as an act of learning and provide opportunities to iterate on and improve work based on constructive feedback.
- Evaluation of performance should be designed to support perceptions of competence and future expectations of success. It should be frequent so that students receive timely and actionable feedback about their performance and growth.
- Provide opportunities for students to reflect on how academic activities connect to their own interests, values, or goals, including those relevant to the self and beyond-the-self purposes. This is especially important for teenagers, who commonly express resistance to adults' attempts to influence their goals and may thus be most productively influenced through their own guided reflections (Yeager, Henderson, et al., 2013).

See Yeager, Walton, and Cohen (2013) for further practitioner guidance on implementing such practices to address achievement gaps.

2. *Effortful control.* Students are constantly faced with tasks that are important for long-term goals but that in the short term may not feel desirable or intrinsically motivating. Successful students, by themselves or with the support of others, marshal willpower and regulate their attention in the face of distractions. While effortful control is addressed in specific programs discussed below, in general students should be provided with structures to help them manage their effortful control and self-discipline. For example, as appropriate for the age level, educators should provide learning spaces free of distraction, help students learn to redirect their attention (e.g., through targeted training, aerobic exercise, mindfulness practices), and make sure students know what actions they can take when they find themselves off track.
3. *Strategies and tactics.* Students are also more likely to persevere when they can draw on specific strategies and tactics to deal with challenges and setbacks. They need actionable skills for taking responsibility and initiative and for being productive under conditions of uncertainty. While effortful control is addressed in specific programs discussed below, in general educators should discuss and support appropriate learning strategies that foster defining tasks, planning, monitoring, reflection, and tactics for dealing with specific obstacles. For example, students can be taught or supported to employ strategies to articulate desired goals, make actionable plans, anticipate obstacles and solutions, reflect on progress, and modify their approach as necessary. Educators should provide students with explicit opportunities to reflect on and discuss their processes and actions, thus fostering metacognition and self-regulation.

Note that while these best practices may be backed by some research evidence, the field still needs coherent methods for integrating these practices into school cultures, teaching practice, discipline-specific curriculum, and technologies. We are well aware that the constraints of traditional school cultures and the resources available in many schools—particularly those intensively focused on accountability and/or dealing with conditions of poverty—can present significant barriers to implementing some of these practices. These will be important issues for researchers, practitioners and policymakers to address as well.

PRACTITIONER RECOMMENDATION 2:
CONSIDER ADOPTING AND ADAPTING ESTABLISHED PROGRAMS, APPROACHES, AND/OR TECHNOLOGIES. SUCH A PROCESS SHOULD INCLUDE MULTIPLE CYCLES OF PROGRAM DESIGN, IMPLEMENTATION, EVALUATION, AND REFINEMENT.

In Chapter 4, we reviewed about 50 approaches and programs that target various contextual factors or psychological resources that promote grit, tenacity, and perseverance. Educators and administrators may consider adopting or adapting in their own context selections from the wide array of programs, approaches, and technologies available. *Note that this review was not intended to be exhaustive, and educators are encouraged to look more broadly before making final decisions on programs.* To organize the possibilities, programs were presented in five conceptual clusters based on targeted age level, learning environment, and the facets of contextual supports and/or psychological resources promoted:

1. **School readiness programs that address executive functions.** These are programs at the preschool and early elementary school levels that help young children develop the *effortful control* and *executive functions* that are necessary for the transition into formal schooling. Programs reviewed included training with computer and noncomputer games, aerobic exercise and sports, martial arts and mindfulness practices, and classroom curricula and teacher professional development. A key conclusion was that the best approaches to improving executive functions address young children's emotional, social, and physical development together in a supportive environment.

2. **Interventions that address mindsets, learning strategies, and resilience.** These interventions comprise the growing body of research demonstrating that relatively brief interventions (e.g., 2 to 10 hours) can significantly impact the *mindsets* and *learning strategies* of students at the middle grade levels and higher. Interventions that address academic mindsets include instruction that teaches students that intelligence grows with effort, shifting students' explanations for academic and social challenges from stable internal causes to temporary external causes, affirmation of personal values, exercises that relate course materials to students' lives, and "super interventions" that incorporate multiple approaches. See Yeager, Walton, and Cohen (2013) for further practitioner guidance on implementing these types of interventions to address achievement gaps. Interventions that address learning strategies include those that foster investment in clarifying goals and anticipating obstacles and planning solutions in advance, development of general study skills to deal with cognitive demands, building a robust set of structures for success, and development of content-specific metacognitive skills. Each of these interventions has been shown to impact mindsets, learning strategies, and/or academic performance. A related class of interventions focuses on the development of protective factors that support *resilience* in the face of life challenges. Such approaches combine attention to mindsets and strategies with other social-emotional competencies.

3. **Alternative school models and school-level reform approaches.** We presented four types of approaches encountered in our interviews with practitioners. The first type is "character education" school models. Key features of those models include explicit articulation of learning goals for targeted competencies, clear and regular assessment and feedback of student progress on these competencies, intensive professional development to help teachers understand and work with these competencies, and discourse about these competencies infused throughout the school culture and all disciplinary curricula. The second is "project-based learning and design thinking" school models. In these models,

students develop competencies through engagement in long-term, challenging, and/or real-world problems that require planning, monitoring, feedback, and iteration. Projects provide opportunities to learn important learning strategies and self-regulation skills necessary for perseverance over the long term to achieve the goals of a given project. Mindsets are addressed inherently in processes of feedback and iteration, and projects are often aligned with students' interests and passions. Both the character education and project-based learning and design thinking models are relatively new. There is strong anecdotal evidence of their success, but further research is needed to determine impacts. The third type of approach is school reform programs. These are organizations independent of schools that provide extensive schoolwide teacher professional development, networks of school communities, strategies to improve school organizational structure, targeted behavioral and academic interventions, and other supports for schoolwide improvement. In evaluating the appropriateness of fit of such a program for specifically addressing perseverance within a particular setting, educators should inquire how the program specifically addresses mindsets and learning strategies relevant to perseverance. Finally, What Works Clearinghouse Practice Guides provide broad recommendations to educators for promoting perseverance to complete high school and navigate the path to college.

4. **Informal learning programs.** We reviewed informal learning programs that provide different kinds of support for students' persistence in schooling through a professional career. Some of these programs provide structured social support networks for students making the transition from high school to college, emphasizing the principles of belonging to a community engaged in the processes of college exploration, application, and initial college adjustment. Some of these programs provide opportunities for students to engage in activities that support interest and persistence in STEM professions. Some are beginning to teach explicitly about grit, drawing on models similar to those discussed in the character education models above. Some provide additional support to transition to the workforce. In most cases, there is strong anecdotal evidence of their success, but further research on impacts is needed.

5. **Digital technologies, online resources, and tools for teachers.** A large and growing array of educational technologies can be used to support grit, tenacity, and perseverance, offering tools and resources to enhance and expand the capabilities of human-centered learning environments. Digital learning environments can provide optimal challenge through adaptivity; help educators promote a rigorous and supportive classroom climate; motivate students through gamification of learning environments; promote productive mindsets, learning strategies, and effortful control; and provide a wealth of resources and interpersonal networking that can enable learners to persist toward goals that, for many, were previously unattainable. Data are available showing the impacts of some of these technologies on both noncognitive factors and academic achievement. In concert with other high-leverage factors such as quality instruction, social supports, and personal interactions with supportive adults, technology has the potential to significantly impact long-term outcomes.

Educators may choose to investigate the utility of these types of programs, approaches, and technologies for their own contexts but should do so carefully in the absence of research establishing the effectiveness at scale, how they address the mindsets and learning strategies research shows are most important for perseverance, how they may be used with students across different ages, and how they can best be integrated into school

culture, teaching practice, and curriculum. The Collaborative for Academic, Social, and Emotional Learning (CASEL) provides guidelines for educational leaders implementing programs that address social and emotional learning. Steps they recommend are (1) establish a steering committee within the school; (2) conduct a needs and readiness assessment and coordinate with other efforts to address social and emotional learning; (3) select a program that can address these needs (again, educators are encouraged to look more broadly than this brief before making final decisions); (4) develop a plan for pilot first-year implementation; (5) review pilot and plan for expansion, with a focus on professional development and supervision; and (6) monitor the implementation process and evaluate program impact (CASEL, 2003). Practitioners should expect to go through multiple cycles of program design, implementation, evaluation, and refinement.

When considering technology specifically, educators and administrators should also evaluate digital learning environments with respect to the degree to which their goals are aligned with the needs of the student population and are grounded in design principles aligned with the research-based best practices discussed above in Practitioner Recommendation 1. Educators should also be aware of the trade-offs in terms of technology requirements and flexibility in design and use by teachers.

PRACTITIONER RECOMMENDATION 3: BE MINDFUL TO ADDRESS POTENTIALLY DAMAGING MISCONCEPTIONS.

As discussed at the end of Chapter 2, educators should be aware that although there is little evidence that grit itself can be harmful, some potential misconceptions about what grit is and how it works exist that could be damaging when applied by even the most well-intentioned educators. This was an issue raised in some of our interviews with expert informants, but little research specifically addresses it.

Practitioners are encouraged to consider some of the realities that surfaced in our interviews with expert informants and literature search:

- Promoting perseverance for goals inappropriate for the student can induce stress and have detrimental long-term effects.
- Promoting perseverance takes more than being nice to students and encouraging them.
- Perseverance promoted in performance-oriented cultures can potentially undermine grit.
- Adults could overemphasize the importance of grit as a personality characteristic.
- Students might give up on important goals too early if they do not understand that the passion that can drive grit must often develop through hard work.
- Technology by itself does not provide quick fixes for the challenges of promoting perseverance.

Educators must consider how to gauge and fine-tune practices and interventions so that they are maximally supportive for students.

Conclusions and Recommendations for Researchers

While there has been extensive work already, there remain critical gaps in the research and unanswered questions. The following sections discuss key emergent conclusions and recommendations for research.

RESEARCHER RECOMMENDATION 1: SEEK TO CLARIFY AND UNIFY CONSTRUCTS (E.G., TEASE APART CRITICAL CONCEPTUAL DISTINCTIONS, CONSTRUCT AND WORK WITH CONSOLIDATED FRAMEWORKS).

As discussed in Chapter 2, one of the greatest challenges encountered by anyone seeking to make progress in this field—researchers, practitioners, and policymakers alike—is the "jingle/jangle" problem. "Jingle" occurs when the same term is used to refer to different concepts, and "jangle" occurs when different terms are used for the same concept. For example, there is a wide range of terms related to grit, such as tenacity, perseverance, persistence, conscientiousness, engagement, autonomy, motivation, self-discipline, self-control, delay of gratification, self-regulation, and so on. In some cases, different terminology may refer to concepts that actually have important differences; in other cases, different terminology may reflect similar ideas but be based in different theoretical traditions (e.g., hope theory has strong overlap with grit); in yet other cases, the same terminology can have different meanings in different communities of practice. Many of the researchers, policymakers, and practitioners interviewed asserted that this lack of consistent terminology presents a barrier to collaboration and progress. The confusing terminology makes it difficult to (1) decide what exactly to address in practice, (2) know how to assess impacts, and (3) synthesize research findings.

Research is needed both to clarify the distinctions that are actually critical for practice and to construct consolidated frameworks that unify concepts and findings. Researchers such as Angela Duckworth are providing greater clarity in the field by examining empirically subtle differences among such constructs as self-discipline and self-control and by conducting studies that tease apart the various subcomponents of conscientiousness. The literature review by the University of Chicago Consortium on Chicago Schools is an example of a unifying framework that moves the field significantly forward in making sense of noncognitive factors as an interrelated network of ideas and practices (see Farrington et al., 2012).

Researchers should seek to (1) tease apart conceptual distinctions that are critical to practice and (2) construct and work within consolidated frameworks that unify concepts and findings. Collaborative partnerships, working groups, professional conferences, and peer-reviewed publications should be geared to identify and work with unifying themes and common definitions.

RESEARCHER RECOMMENDATION 2: DEVELOP MODELS OF PATHWAYS FOR DEVELOPMENT OF GRIT, TENACITY, AND PERSEVERANCE OVER TIME AND IN DIFFERENT CONTEXTS.

One set of critical open questions concern the developmental trajectories of grit, tenacity, and perseverance throughout childhood and into adulthood. There has been considerable research on early childhood and competencies needed for school readiness, for example, effortful control and executive functioning, as well as significant research on mindsets and strategies in middle school, high school, and postsecondary education. However, many of the experts we interviewed emphasized that more longitudinal research is necessary

to establish more coherent models of the developmental pathways of these competencies and how these competencies develop over childhood in different kinds of contexts. Such models would inform researchers and educators in developing learning trajectories and selecting age-appropriate and context-appropriate interventions for students throughout the schooling years.

Similarly, more systematic research is needed to understand how different contexts impact these competencies and to what extent they can be developed as transferable competencies across contexts. For example, how does the same individual student function across different contexts? How can you take a student who may be failing in one setting and turn him or her into someone who is academically tenacious in another? What are the lasting impacts of interventions when students change contexts?

Researchers should conduct, for example, (1) longitudinal studies to develop coherent models of developmental pathways in different kinds of contexts and (2) systematic research examining the same individuals striving to accomplish goals in different contexts.

RESEARCHER RECOMMENDATION 3: INVESTIGATE HOW TO INTEGRATE BEST PRACTICES WITHIN DISCIPLINES.

Across our interviews and the literature, another important recurring theme was the need to integrate best practices in promoting and/or teaching grit, tenacity, and perseverance with discipline-specific content teaching and learning—whether it is within STEM, language arts, social studies, music, and so on. The NRC report on 21st-century competencies, for example, addresses this concern, making explicit recommendations to integrate domain-specific learning with development of intrapersonal and interpersonal competencies (NRC, 2012). Several factors contribute to this need:

- A core national concern for education is perseverance in the face of learning challenging discipline-specific content. Students struggle, for example, with the challenges of conceptual complexity, lack of tactical knowledge about how to study, more dominant distractions, lack of motivation, and boredom.
- A practical consideration for most educational settings is that teachers must cover a large number of content standards, leaving little appetite for the addition of learning objectives for seemingly new and different types of competencies beyond their disciplinary content.
- The mindsets and learning strategies in different disciplines will be deeply intertwined with the practices of each discipline. For example, the first practice standard for the Common Core State Standards for Mathematics is, “Make sense of problems and persevere in solving them.” Practices to do this are specific to mathematics, for example, analyzing the meaning of problems, looking for entry points to a solution, and examining correspondences across multiple representations. In contrast, perseverance in an inquiry science project may require extensive planning and self-monitoring grounded in such practices as designing and conducting investigations and constructing models.
- Hooks to foster perseverance through interest, passion, and connections to students’ everyday lives can differ significantly across disciplines.

When these competencies are effectively integrated into the practice of learning disciplinary content and concepts, there is the potential for learning to be more effective and engaging for students. Researchers should

investigate how to integrate fundamentally with discipline-specific pedagogy, curriculum, assessment, and teaching practices the supports to promote grit, tenacity, and perseverance and key psychological resources (mindsets, learning strategies, and effortful control).

RESEARCHER RECOMMENDATION 4: CONTINUE TO ADVANCE TECHNOLOGIES, ESPECIALLY IN HOW THEY CAN PROVIDE NEW STRUCTURAL SUPPORTS IN UNDERRESOURCED SETTINGS.

Another major theme has been in the roles that new and emerging technologies can play in promoting grit. These are providing opportunities with the potential to advance education far beyond what has been possible before—technologies are increasing the sophistication of assessment and adaptation to individual learning needs, enabling individuals to use for their own purposes an unprecedented wealth of online resources, and providing access to worldwide interpersonal networking. These affordances provide new ways to promote agency and perseverance for individuals—particularly those traditionally with limited access to resources—toward goals that have previously been unattainable.

Such work is most urgently needed in schools that are struggling with resources for students' and teachers' time. In many schools, short school periods are densely packed with many content standards. Students may not have the time to seek assistance, reflect, or iterate on their work. Furthermore, many teachers, particularly in urban districts, have as many as 150 students per day. This can significantly limit teachers' ability to provide the constructive personalized feedback and guidance that can be critical to students' perseverance. New technologies can provide new approaches to promoting grit, tenacity, and perseverance in the face of these structural issues.

Researchers should work closely with technology developers to continue to explore how to integrate best practices into new and emerging digital learning environments that are well positioned to promote grit, tenacity, and perseverance, as well as key psychological resources for a range of purposes.

RESEARCHER RECOMMENDATION 5: CONTINUE TO ADVANCE MEASUREMENT METHODS, ESPECIALLY IN SUPPORT OF ADAPTIVE AND PERSONALIZED LEARNING THAT PROMOTES PERSISTENCE.

As discussed in Chapter 3, assessments of grit, tenacity, perseverance, and associated psychological resources are necessary for a range of purposes—as practical tools for educators and technology developers, as tools for researchers to refine concepts and theory, as tools for program refinement and evaluation, and as diagnostic indicators identifying vulnerable students. There already exists a range of methods—self-report, informant report, school records, and behavioral task performance—to capture these constructs as dispositional tendencies or sets of processes unfolding over the course of learning. Each of these methods has important benefits and also drawbacks to consider.

Within the larger theme of assessment, some subthemes emerged, suggesting important general directions for research in the field:

- The advancement of measurement methods is integral to the field's movement toward conceptual clarity. As discussed above, the field will benefit from research to clarify the many constructs and

definitions in the literature and understand perseverance across different types of goals and academic disciplines, in different types of contexts, and longitudinally across developmental stages. Such research will require evolving measurement methods that can detect and discriminate important constructs.

- Innovation in digital learning provides new opportunities for analyzing the data produced when students work in digital learning environments. Video games also provide an "exhaust stream" of data reflecting all of a student's moves within the game. While many promising methods are emerging, the field is new and there is still considerable work to be done before these become inexpensive and practical for widespread use.
- Evidence-centered design provides a set of methods and tools for building complex assessments with strong validity arguments. Such tools as design patterns and task templates can help assessment designers and technology developers manage the complexity of the competencies they are aiming to assess and the multiple functionalities of the technologies they are using.

As new forms of measurement emerge, so, too, do important ethical considerations. Researchers and other professionals who collect data from people have ethical and legal obligations to ensure that appropriate measures are taken to ensure privacy, confidentiality, and informed consent for data collection activities.

RESEARCHER RECOMMENDATION 6: CONDUCT FIELD-BASED IMPLEMENTATION RESEARCH AT SMALL AND LARGE SCALE.

Another major theme is the need for field-based implementation research and evaluation spanning the pipeline of evidence from initial promise to robust impact at scale (see Institute of Education Sciences, U.S. Department of Education, & The National Science Foundation, 2013). Although there are many programs with strong potential for impacting mindsets, learning strategies, and effortful control, there is still a gap between the research and how practitioners can use these approaches effectively across a wide variety of settings for a diversity of students. A necessary next step for bridging this divide is for research to expand more directly into implementation research and evaluation. Because this work requires expertise in theory, practice, and research methodology, implementation research will require multidisciplinary teams including practitioners as well as researchers. Research methodologies should be grounded in the concerns of everyday practice (e.g., Penuel, Fishman, Haugan Cheng, & Sabelli, 2011), and efficacy, effectiveness, and scale-up research should contribute to evidence of impact and variations across populations and sites (e.g., Clements, 2007).

Implementing the mindset interventions at scale was an important focus of a White House convening in May 2013 entitled "Excellence in Education: The Importance of Academic Mindsets." This meeting brought together diverse experts in practice, policy, and research to produce an action agenda for how to explore what needs to be learned in order to effectively promote academic mindsets in U.S. educational settings. A white paper prepared for this meeting lays out an initial research and development agenda for how to instill productive mindsets at scale—see Yeager, Paunesku, Walton, and Dweck, 2013 for the detailed plan.

RESEARCHER RECOMMENDATION 7:
INVESTIGATE POTENTIAL MISCONCEPTIONS THAT CAN LEAD TO DAMAGING MISAPPLICATIONS.

Practitioner Recommendation 3 urges practitioners to be mindful of addressing potential misconceptions about grit that might be damaging when applied by even the most well-intentioned educators. While the risks are potentially high, little systematic research has investigated this. Careful research in this area will help the field gauge and fine-tune interventions, models, practices, and approaches.

Conclusions and Recommendations for Policymakers

For policymakers who are convinced that promoting grit, tenacity, and perseverance is important and valuable for our nation's young people, the following two actionable recommendations emerged from our interviews with expert informants and the literature.

POLICYMAKER RECOMMENDATION 1:
PROVIDE RESOURCES AND STRUCTURAL SUPPORTS TO ENABLE EDUCATORS TO IMPLEMENT BEST PRACTICES AND EFFECTIVE PROGRAMS.

While the evidence is growing that there are actionable best practices and programmatic approaches to promoting grit, tenacity, and perseverance, in many settings there remain tremendous barriers to implementation. A ubiquitous theme in our interviews and literature review was the need for structural and systemic supports. Some of the major barriers cited in the interviews were as follows:

- *Unsupportive school culture.* Many schools have not implemented and supported practices to promote valuing of grit, tenacity, and perseverance, and some believe that these qualities are the responsibility of the parent rather than the school. Furthermore, some accountability-driven school cultures that prioritize gains on standardized tests above more holistic educational goals may be unintentionally promoting practices inconsistent with those necessary to promote grit, tenacity, and perseverance.
- *Lack of time and resources for students and teachers.* Many teachers feel they already have too many standards to cover without adding what can seem to them to be more content. In many schools, short school periods are densely packed with many content standards. Students may not have the time to seek assistance, reflect, or iterate on their work. Furthermore, many teachers, particularly in urban districts, teach a vast number of students each day. This can significantly limit their ability to provide the constructive personalized feedback and guidance that can be critical to students' perseverance.
- *Lack of access to teacher professional development.* Most teachers do not have access to professional development with explicit guidance for how they should integrate these practices and approaches into their own unique settings with their particular student populations. Most preservice and professional development programs do not currently explicitly address these competencies.
- *Toxic stress in early childhood.* Significant deprivation and neglect are harmful in the early years of life because responsive relationships are necessary to development. Mental and health consequences include disruption of the development of executive functioning and cognitive delays, thereby increasing the risk for learning difficulties that can undermine later in life the development of psychological resources necessary for resilience and perseverance.

State, district, and school leaders should provide resources and structural supports that will enable educators to enact best practices and implementation of programs and models. For example, these may include resources and professional development to implement programs, approaches, or technology that support autonomy in student learning and give students diagnostic feedback about their progress. Such resources can help educators refocus priorities and help teachers and students maximize how they use their time as they persist through academic challenges. Resources also may be devoted to supporting early identification of children at risk and offering preventive care and assistance for families. This may be facilitated by creating opportunities for coordination among schools, child development researchers, policymakers, and health and child care service providers. Outreach and inclusion of families and other community members also can provide important bridges.

POLICYMAKER RECOMMENDATION 2: INVEST IN PROGRAMMATIC PORTFOLIOS OF INTERDISCIPLINARY RESEARCH AND DEVELOPMENT.

Given these research needs, it will be important to invest in programmatic and multidisciplinary portfolios of research and development geared to making quick advances in the field's understanding of how to promote these qualities in a wide diversity of settings—particularly those that are most underresourced and in need of change. The researchers, practitioners, and policymakers we interviewed all indicated the need for a broad spectrum of mutually informing research. The expert informants emphasized the need for research to be multidisciplinary and translational with an eye toward transforming practice in the classroom. Effective research and development in this area will require collaborations among experts in theory, practice, research methods, technology, and assessment. Research should also leverage the vast practical wisdom of expert educators. Informants talked about creating ecosystems of innovation and networks of programs that could unify approaches and allow knowledge to accumulate.

Foundations and federal agencies should invest in programmatic portfolios of research and development on grit, tenacity, and perseverance that investigate mutually informing research questions spanning the range from basic theory to intervention and evaluation research to assessment research. Portfolios should leverage the capacities of multidisciplinary teams and program networks. For maximum impact, sectors of the education enterprise (e.g., government, academy, practice, philanthropy) must work together and coordinate efforts to move this work to a central focus.

A Final Recommendation for All Stakeholders: Get the Word Out

In our interviews with expert informants, we also identified a need to raise awareness of the importance of grit, tenacity, and perseverance across communities. Although grit is a hot topic in many circles, some of these ideas are still unavailable to the majority of individuals in educational communities around the country. To build the momentum to overcome many of the barriers to implementation, a first priority must be awareness-raising so that teachers, administrators, parents, researchers, policymakers, and all others involved in educational communities see these issues as important and become invested in supporting change.

Stakeholders who understand the importance of these issues and are passionate about shifting educational priorities within their own institutions and beyond need to become proactive advocates for change. Researchers

with extensive knowledge about what works and does not work in schools should translate these findings so that the public can understand them, recognize their import, and marshal resources for change. Anderman (2011), for example, provides 10 actionable strategies for how researchers can engage with the broader community (e.g., present research to practitioners via workshops and conferences, assist local administrators, write applied articles for practitioner-oriented journals, work collaboratively with teacher educators, inform legislators of research). It is important to realize the potential impacts of spreading the word and outreach to the community—to gain buy-in, tangible help and support for students as they pursue big goals, financial resources, and political support.

Moving Forward

In this brief, we have investigated grit, tenacity, and perseverance—essential to accomplish success in school and beyond. This is an important and exciting time for the field to take stock of this quickly growing aspect of education with strong potential and promise for significantly increasing success for a variety of students. Findings across interviews with key informants and a broad review of the research literature indicate that there is a strong theoretical and practical base for making powerful and impactful advances.

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