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ARTICLE

Implications for educational practice of the science of learning and development

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ABSTRACT

This article draws out the implications for school and classroom practices of an emerging consensus about the science of learning and development, outlined in a recent synthesis of the research. Situating the review in a developmental systems framework, we synthesize evidence from the learning sciences and several branches of educational research regarding well-vetted strategies that support the kinds of relationships and learning opportunities needed to promote children's well-being, healthy development, and transferable learning. In addition, we review research regarding practices that can help educators respond to individual variability, address adversity, and support resilience, such that schools can enable all children to find positive pathways to adulthood.

Introduction

As knowledge regarding human development and learning has grown at a rapid pace, the opportunity to shape more effective educational practices has also increased. Taking advantage of these advances, however, requires integrating insights across multiple fields—from the biological and neurosciences to psychology, sociology, developmental and learning sciences—and connecting them to knowledge of successful approaches that is emerging in education. This article seeks to contribute to this process by drawing out the implications for school and classroom practices of an emerging consensus about the science of learning and development (SoLD), outlined in a recent synthesis of the research (Cantor, Osher, Berg, Steyer, & Rose, 2018; Osher, Cantor, Berg, Steyer, & Rose, 2018).

Using these articles as a foundation, we synthesize evidence from the learning sciences and several branches of educational research about well-vetted strategies that support the kinds of relationships and learning opportunities needed to promote children's well-being, healthy development, and transferable learning. In addition, we review research regarding practices that can help educators respond to individual variability, address adversity, and support resilience, such that schools can enable all children to learn and to find positive pathways to adulthood.

This work is situated in a relational developmental systems framework that looks at the "mutually influential relations between individuals and contexts" (Lerner & Callina, 2013, p. 373). This framework makes it clear how children's development and learning are shaped by interactions among the environmental factors, relationships, and learning opportunities they experience, both in and out of school, along with physical, psychological, cognitive, social, and emotional processes that influence one another—both biologically and functionally—as they enable or undermine learning (Fischer & Bidell, 2006; Rose, Rouhani, and Fischer, 2013). Although our society and our schools often compartmentalize these developmental processes and treat them as distinct from one another—and treat the child as distinct from the many contexts she experiences—the sciences of learning and development demonstate how tightly interrelated they are and how they jointly produce the outcomes for which educators are responsible.

Key insights from the science of learning and development are that the brain and the development of intelligences and capacities are malleable, and the "development of the brain is an experience-dependent process" (Cantor et al., 2018, p. 5), which activates neural pathways that permit new kinds of thinking and

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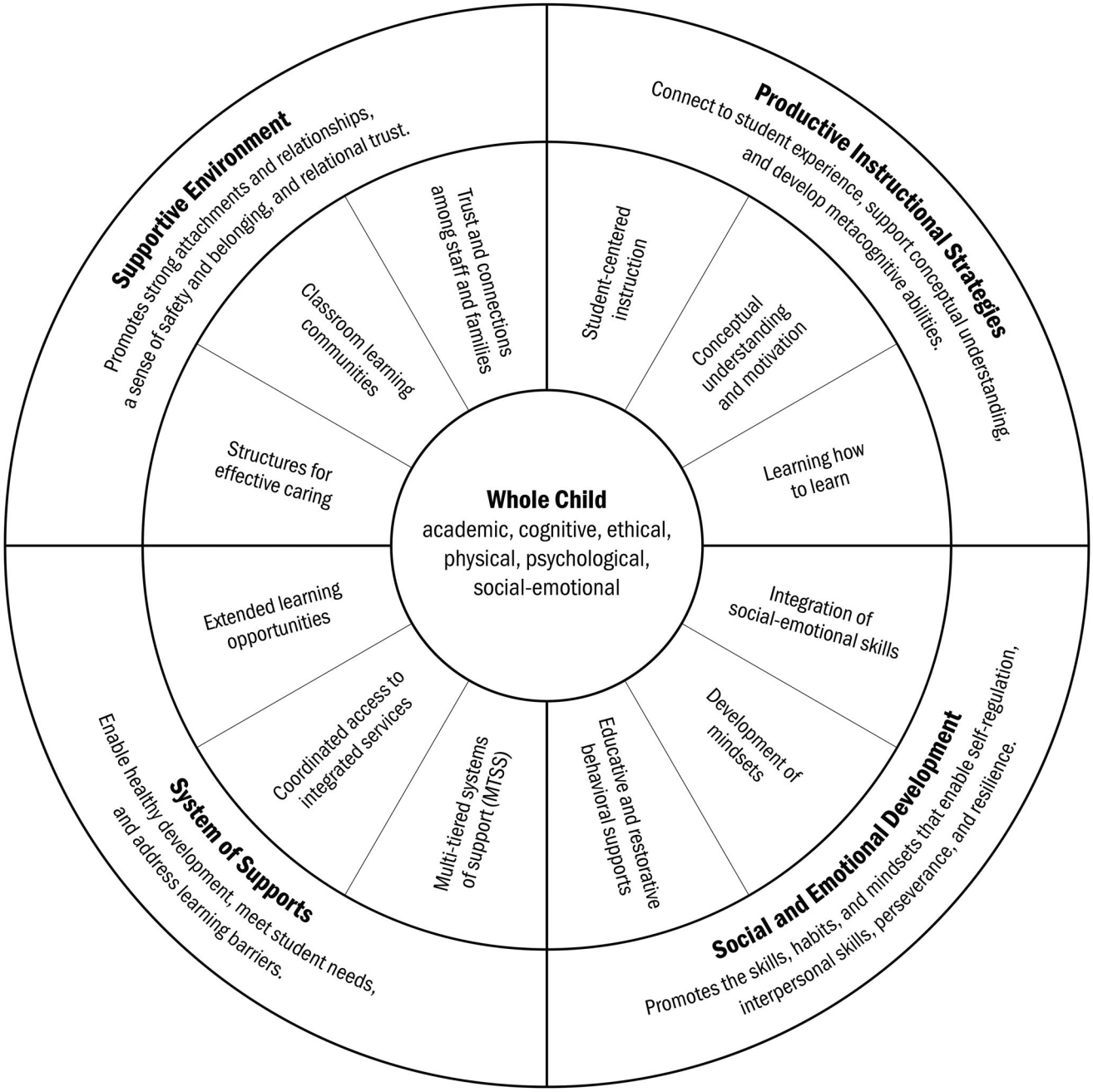

Figure 1. SoLD principles of practice.

performance. As a function of experiences, the brain and human capacities grow over the course of the entire developmental continuum and across the developmental spectrum (physical, cognitive, affective) in interactive ways. What happens in one domain influences what happens in others. For example, emotions can trigger or block learning. Emotions and social contexts shape neural connections which contribute to attention, concentration, and memory, to knowledge transfer and application. Understanding how developmental processes unfold over time and interact in different contexts can contribute to more supportive designs for learning environments.

Furthermore, general trends in development are modified by interactions between unique aspects of the child and his/her family, community, and classroom contexts. As a result, children have individual needs and trajectories that require differentiated instruction and supports to enable optimal growth in competence, confidence, and motivation.

A central implication for educators is that this integrated and dynamic developmental system is optimally supported when all aspects of the educational environment support all of the dimensions of children's development. This calls for a deeply integrated

approach to practice that supports the whole child in schools and classrooms that function coherently and consistently to build strong relationships and learning communities; support social, emotional, and cognitive development; and provide a system of supports as needed for healthy development, productive relationships, and academic progress. This holistic approach must necessarily connect with family and community contexts: developing strong, respectful partnerships to understand and build on children's experiences and, as needed, to strengthen any aspects of the developmental system where there are challenges to children's health and well-being.

In what follows, we describe the implications for practice of these interrelated systems that address major developmental needs: the need for strong, supportive relationships that enable students to take advantage of productive learning opportunities in cognitive, social, and emotional domains, plus additional supports (physical, social, emotional, and/or academic) needed to address individual circumstances that need attention at a moment in time to maintain a positive developmental trajectory. We stress that all of these are interactive and interrelated and that these aspects of education must be designed to work together in a tightly integrated fashion. Figure 1 illustrates the four areas that structure the remainder of this review:

1. Supportive environmental conditions that foster strong relationships and community. These include positive sustained relationships that foster attachment and emotional connections; physical, emotional, and identity safety; and a sense of belonging and purpose;
2. Productive instructional strategies that support motivation, competence, and self-directed learning. These curriculum, teaching, and assessment strategies feature well-scaffolded instruction and ongoing formative assessment that support conceptual understanding, take students' prior knowledge and experiences into account, and provide the right amount of challenge and support on relevant and engaging learning tasks;
3. Social and Emotional Learning that fosters skills, habits, and mindsets that enable academic progress, efficacy, and productive behavior. These include self-regulation, executive function, intrapersonal awareness and interpersonal skills, a growth mindset, and a sense of agency that supports resilience and productive action;
4. System of supports that enable healthy development, respond to student needs, and address learning barriers. These include a multi-tiered system of academic, health, and social supports that provide personalized resources within and beyond the classrom to address and prevent developmental detours, including conditions of trauma and adversity.

Within this framework, we address the following questions: Given what we know about human development and learning, and what is known from multiple domains of educational research, what school and classroom practices can create environments that support students in all of the areas of their development? In what ways can educators help students acquire transferable knowledge, skills, habits, and mindsets that support ongoing learning? And what kinds of changes are needed within our education system as a whole to reflect what we know about development, since our current system was not designed with this knowledge in mind?

We focus primarily on K–12 schools, although the principles we articulate are generally applicable to early childhood as well. As we answer these questions, we emphasize the whole child within a whole school and a whole community context. From an ecological systems framework, the school serves as an immediate context shaping children's learning and development through instruction, relationships with teachers and peers, and the school culture. Connections between home and school are critical to provide aligned supports for children.

As we describe these components and their implications for educational practice, we both describe optimal practices for all children in schools and specific interventions that are needed when children have experienced adversities that require redress and when schools have been structured in ways that do not yet permit developmentally supportive experiences at all times and in all the contexts of school life. Where we describe specific programmatic interventions, we do so with the goal of informing a whole school approach that will eventually incorporate these elements into the regular features of educational settings.

The research presented in this article builds on the literature presented in the earlier syntheses on learning and development and maps the key findings to other research on school and teaching practices that have well-developed evidence associated with these goals. We tap reviews of research, meta-analyses, and handbook chapters that have synthesized evidence, as well as individual studies that represent a broader body of evidence represented in other research.

Developmental outcomes we seek and the experiences needed to support them

For more than two decades, researchers, educators, policymakers, and business leaders have emphasized the need to support "twenty-first century" skills in a context where knowledge is rapidly expanding and technologies and work processes are rapidly changing. These abilities include critical thinking and problem solving skills; the capacity to find, analyze, synthesize, and apply knowledge to novel situations; interpersonal skills that allow people to work with others and engage effectively in cross-cultural contexts; self-directional abilities that allow them to manage their own work and complex projects; abilities to competently find resources and use tools; and the capacity to communicate effectively in many ways.

Scholars in the learning sciences have emphasized that developing these kinds of skills requires a different kind of teaching and learning than that emphasized in prior eras of education when learning was conceptualized as the acquisition of facts and teaching as the transmission of information to be taken in and used "as is." The National Research Council's (NRC) review (Pellegrino, Hilton, & National Research Council, 2012), for example, indicates that the kind of learning supporting these higher order thinking and performance skills is best developed through inquiry and investigation, application of knowledge to new situations and problems, production of ideas and solutions, and collaborative problem-solving. These tasks, in turn, require strong self-regulation, executive functioning, and metacognitive skills; resourcefulness, perseverance, and resilience in the face of obstacles and uncertainty; the ability to learn independently; and curiosity, inventiveness, and creativity. To become productive citizens within and beyond the school, students also need positive mindsets about self and school, along with social awareness and responsibility (Stafford-Brizard, 2016).

The SoLD synthesis, along with related research on school improvement, suggests that the ability of schools to help achieve these outcomes requires environments, structures, and practices attuned to students' learning and developmental needs, including,

As part of a supportive environment:

- A caring, culturally responsive learning community, where students are well-known and valued and can learn in physical and emotional safety;
- Structures that allow for continuity in relationships, consistency in practices, and predictability in routines that reduce anxiety and support engaged learning;
- Relational trust and respect between and among staff, students, and parents.

As part of productive instructional strategies:

- Meaningful work that builds on students' prior knowledge and experiences and actively engages them in rich, engaging tasks that help them achieve conceptual understanding and transferable knowledge and skills;
- Inquiry as a major learning strategy, thoughtfully interwoven with explicit instruction and well-scaffolded opportunities to practice and apply learning;
- Well-designed collaborative learning opportunities that encourage students to question, explain, and elaborate their thoughts and co-construct solutions;
- Ongoing diagnostic assessments and opportunities to receive timely and helpful feedback, develop and exhibit competence, and revise work to improve;
- Opportunities to develop metacognitive skills through planning and management of complex tasks, self- and peer- assessment, and reflection on learning.

As part of social and emotional learning opportunities:

- Explicit instruction in social, emotional, and cognitive skills, such as intrapersonal awareness, interpersonal skills, conflict resolution, and good decision making;
- Infusion of opportunities to learn and use social-emotional skills, habits, mindsets throughout all aspects of the school's work in and outside of the classroom;
- Educative and restorative approaches to classroom management and discipline, so that children learn responsibility for themselves and their community.

As part of a system of supports:

- Access to integrated services (including physical and mental health and social service supports) that enable children's healthy development;
- Extended learning opportunities that nurture positive relationships, support enrichment and mastery learning, and close achievement gaps;
- Multi-tiered systems of support to address learning barriers both in and out of the classroom based on a shared developmental framework uniting a capable and stable staff with families and support providers.

Research finds that the presence of these features produces stronger gains in outcomes for those students who typically experience the greatest environmental challenges. This is consistent with developmental science findings that children who experience adversity "may be more malleable—and stand to benefit most—in the context of supportive, enriched environmental supports and interventions" (Cantor et al., 2018, p. 9).

Accomplishing this work clearly requires an intensive focus on adult development and support, so that educators can design for and enact the practices that enable them to put these features into place. We take up the research about adult learning for developmentally supportive practice in a separate companion article that builds upon this one. In the following vignette, we illustrate how the four principles of practice (shown in Figure 1) can be brought together by a skilled practitioner who has been well-prepared to use the science of learning and development.

Science of Learning and Development in Practice

In Ted Pollen's fourth grade classroom at Midtown West school in New York city, a diverse group of 27 students is deeply engaged in a mathematics inquiry focused on understanding the concepts of range, mean, median, and mode. Some are seated around tables, while others are in pairs or trios on the rug in the classroom meeting area. While some teachers might introduce the three terms with definitions and rules for calculating them, and give students a worksheet of problems to fill out, Ted's class has been conducting a study that provides them with the data they are now analyzing: They measured and recorded the height of everyone in their own classroom and all the children in one of the kindergarten classrooms who are their "reading buddies." Each then figured out how to display the data distributions with bar graphs they constructed individually, so as to be able to figure out the mean, median, and mode for each class and compare them. Working in teams, they use various tools, such as manipulatives and calculators, as they advise and query one another about what to do.

Ted moves unobtrusively among groups, watching the process and occasionally asking questions to help move students to the next level of understanding. It is clear that he is thinking about students' zones of proximal development as he chooses his questions. Ted says to one group: "Think about your design. What's the best way of displaying the data so you can make an actual comparison?" In another, he asks, "Can someone give me the range for kindergarten? Our range? Are there any outliers?" This led to a realization that there was little overlap between the two groups, but there were a few relatively short fourth graders and one very tall kindergartner. A student said proudly, pointing to that data point: "That's my reading buddy!"

In yet another group Ted observes to one of the boys, "You're having the same problem that she's having," pointing to a tablemate to encourage the two of them to work together. They begin counting and calculating to solve the problem jointly. Ted never gives away the answer, but he assists the problem-solving process with questions that carefully scaffold student understanding. He watches over a student with autism who is doing her work with a one-on-one aide. The student sings to herself periodically while she is doing the work, but continues to make progress. In the hubbub of the classroom, her singing is not a distraction to the others, as they all focus intently on communicating to find solutions to this highly motivating puzzle. Every single student has made significant progress in developing a deep understanding of these key statistical concepts that often elude students much older than themselves.

Around the hard-working groups of children, student work covers the walls: Especially prominent are student accounts of their lives as slaves in New Amsterdam and New York: 1621–1680, along with fractions posters illustrating various problems they have tackled and solved, including how they have split sub sandwiches among various odd numbers of people. A classroom constitution that was collectively developed and signed by each student and teacher is displayed, along with a "Problem Parking Lot" with stickies listing various problems and questions the class has agreed to return to.

On the back shelves, one set of tubs offers manipulatives for mathematics. Another set of tubs includes books labeled by type, all connected to current topics of study: Authors who have been studied by the class each merit a tub, as do African-American Biographies; Slavery; Other Biographies; Ted's favorites; and more. Hand-made globes and a time line string with chronological date cards of important events hang from the ceiling. The meeting area in front of a whiteboard is covered with a rug that is a map of the world.

Also on the wall are many posters reminding students about their routines. One summarizes the rules for "Book Club." Another asks "What is figurative language?" clarifying that it is "when words mean something other than their literal meaning." The poster defines what most would think of as high school terms: simile, metaphor, hyperbole, personification, alliteration, onomatopoeia, idiom, allusion, and oxymoron, offering concrete examples of each.

Other posters developed by students and teacher include a "Writing workshop conferencing protocol," "Poetry guidelines," "Persuasive essays," "Jobs in a reading conference" (enumerated for both the student and the teacher), and "Elements of a news magazine article." These are often in the students' own words, codifying their learning so they can share it and go back to it as needed. Another poster enumerates, "What we know about maps," while still another describes "Multiplying 2-digit by 1-digit numbers: The traditional algorithm."

Invisible in this moment are the school supports that make this productive hubbub possible: free breakfasts for all children; free transportation for children who live in temporary housing; a Family Center that offers educational workshops, cultural connections, and family support services; extended afterschool time and services; twice annual student-family-teacher conferences; and a set of children's rights that include: "I have a right to be happy and to be treated with compassion in this school." "I have a right to be myself in this school. This means that no one will treat me unfairly." And "I have the right to be safe in this school." Community building and conflict resolution are explicit school-wide efforts. Although the school is overcrowded, it is welcoming in every respect.

Source: Podolsky and Darling-Hammond, (2019); Midtown West Handbook: http://www.midtownwestschool.org/school-handbook.html

This short vignette illustrates how Ted's class and Midtown West Elementary School are grounded in the science of learning and development which supports strong, trusting relationships; collaboration in the learning process; connections to prior experience; inquiry interspersed with explicit instruction where appropriate; and support for individualized learning strategies as well as collective learning. Authentic, engaging tasks with real-world connections motivate student effort and engagement, which is supported through teacher scaffolding and a wide range of tools that allow for personalized learning and student agency. Other scaffolds—such as the charts reminding students of their learning processes and key

concepts—support self-regulation and strategic learning while reducing cognitive load, in order to facilitate higher order thinking and performance skills. These also enable student self-assessment, as well as peer and teacher feedback that is part of an ongoing formative assessment process. Routines for reflection on and revision of work support the development of metacognition and a growth mindset.

Meanwhile, students' identities as competent writers, scientists, and mathematicians are also reinforced as their work dominates the walls of the classroom and is the focus of the learning process. All students feel they belong in this room, where they are learning to become responsible community members, critical thinkers, and problem solvers together. A range of culturally connected curriculum units and materials supports that sense of inclusion, while a wide array of school supports reinforces that inclusion by addressing student and family needs in multiple ways while including families as partners in the educational process.

Supportive environmental conditions

What the science of learning and development tells us

Warm, caring, supportive student-teacher relationships, as well as other child–adult relationships, are linked to better school performance and engagement, greater emotional regulation, social competence, and willingness to take on challenges (Osher et al., 2018). Strong relationships have biological as well as affective significance. Brain architecture is developed by the presence of warm, consistent, attuned relationships; positive experiences; and positive perceptions of these experiences (Center on the Developing Child, 2016). Such relationships help develop the emotional, social, behavioral and cognitive competencies foundational to learning.

Students need a sense of physical and psychological safety for learning to occur, since fear and anxiety undermine cognitive capacity and short circuit the learning process. A meta-analysis of 99 studies found that the affective quality of teacher-student relationships was significantly related to student engagement (average effect sizes of .32 to .39) and to achievement (average effect sizes of .16 to .19). Students deemed at higher levels of risk for poor outcomes—children from low-income families, students of color, and those with learning difficulties—were more harmed by negative teacher affect and benefitted more from positive relationships with teachers (Roorda, Koomen, Spilt, & Oort, 2011).

Positive adult relationships can support student development and welfare, especially when these are culturally sensitive and responsive (Hammond, 2016). Students learn best when they can connect what happens in school to their cultural contexts and experiences, when their teachers are responsive to their strengths and needs, and when their environment is "identity safe" (Steele & Cohn-Vargas, 2013), reinforcing their value and belonging. This is especially important given the societal and school-based aggressions many children, especially those living under adverse conditions, experience. For all these reasons, and because children develop through individual trajectories shaped by their unique traits and experiences, teachers need to know students well to create productive learning opportunities.

Principles for practice

These insights from the science of learning and development suggest the following principles for practice in this domain, which we discuss further below:

1. School and classroom structures should be designed to create and support strong attachments and positive, long-term relationships among adults and children that provide both academic and social-emotional support for cultivating developmentally-appropriate skills, emotional security, resilience, and student agency.
2. Schools and classrooms should be developed as physically and psychologically safe, personalized learning communities where students feel they belong and teachers engage in practices that help them know their students well so that they can respond to children's specific needs, interests, readiness for learning, and opportunities for growth.
3. School practices should be designed to strengthen relational trust and promote cultural competence among educators, school staff, and families to provide deeper knowledge regarding children and greater alignment between the home and school.

School structures that support strong attachments and positive relationships

Personalizing the educational setting so that students can be well-known by adults and their needs can be better met is a powerful lever that can change student

outcomes. Although some currently use the term "personalized learning" to denote computer-based instruction, we use the term in its more traditional sense as educators' ability to gear instruction and supports to the needs and interests of individual children. While this kind of personalization may sometimes include uses of technology, that is not its main goal or only tool.

As we detail in this section, smaller learning environments and structures that allow for stronger, adult-child relationships can improve attendance, attachment, achievement, and attainment. Often, it is because of close adult-student relationships that students who are placed at risk for a variety of negative outcomes like dropping out are able to attach to school and gain the academic and other kinds of help they need to succeed. Research suggests that students are more likely to attend and graduate from school, attach to learning, and succeed academically when they have strong, trusting, supportive connections to adults, including at least one intensive relationship with a close advisor or mentor (Friedlaender et al., 2014; Lee, Bryk, & Smith, 1993).

Developing these relationships in schools can be difficult where organizational structures minimize opportunities for extended personalized relationships, as is often the case in "factory-model" schools designed a century ago for efficient batch processing of masses of students (Tyack, 1974). These schools were not designed based on knowledge of how people learn and develop optimally. Unlike schools in many countries, where teachers often stay with their students for two or three years in primary school and have more extended relationships in secondary school, U.S. schools adopted the Prussian age grading model that typically moves students to another teacher each year and to as many as 7 or 8 teachers daily in secondary schools. Secondary teachers may see 150 to 200 students per day in short 45 minute blocks, and, despite their best efforts, are unable to know all of their students or their families well. This reduces the extent to which teachers can build on personal knowledge in meeting their needs. Counselors are assigned to attend to the 'personal needs' of hundreds of students, also an unmanageable task, and students who experience adversity may have no one to turn to for support (Eccles & Roeser, 2009; Juvonen, Le, Kaganoff, Augustine, & Constant, 2004).

The design of most U.S. secondary schools is particularly at odds with the needs of adolescents, as high schools de-emphasize personal connections with adults and engage in intense evaluation and competitive ranking of students (e.g., in academic tracking, try-outs for clubs and activities) just as young people are most sensitive to social comparisons and most need to develop a strong sense of belonging, connection, and personal identity (Eccles & Roeser, 2009). Depersonalized contexts are most damaging when students are also experiencing the effects of poverty, trauma, and discrimination without supports to enable them to cope and become resilient. Unless mediated by strong relationships and support systems, these conditions interfere with learning, undermine relationships and impede opportunities for youth to develop skills to succeed (Osher & Kendziora, 2010).

Ecological changes that create personalized environments with opportunities for stronger relationships among adults and students can create more productive contexts for learning. For example, small schools or small learning communities with personalizing structures—such as advisory systems, teaching teams that share students, or looping with the same teachers over multiple years—have been found to improve student achievement, attachment, attendance, attitudes toward school, behavior, motivation, and graduation rates (Bloom & Unterman, 2014; Darling-Hammond, Ross, & Milliken, 2006; Felner, Seitsinger, Brand, Burns, & Bolton, 2007).

School Size. Reviews of research about school size have consistently found that students benefit when they are in smaller settings where they can be well known, and these effects are strongest for students with the greatest economic and academic needs (Darling-Hammond et al., 2006). These settings include smaller schools as well as small learning communities created within large school buildings, where staff and students work in together in smaller units that function as close-knit communities. More intimate settings allow educators to more easily develop shared norms and practices, to create a community within the school where caring is a product of individuals knowing each other in multiple ways; such environments also allow more students to be engaged in a variety of extracurricular activities and to take on leadership opportunities, which promotes greater confidence and agency (Lee et al., 1993).

Optimum size varies by student needs and school design, with high school sizes below 900 having been found more conducive to student success than larger schools, all else equal. For high-need students, school sizes of 300 to 400 have been found most supportive in increasing attendance, grades, and graduation rates, as they enable strong relationships, support systems,

and trust among teachers and students (Darling-Hammond et al., 2006).

Many studies in high-poverty urban areas have found strong improvements in student outcomes in small schools. In a study of 143 high schools in Chicago, for example, Wasley et al. (2000) found that, after controlling for race, socioeconomic status, student mobility, and prior achievement, students in schools of 400 or fewer had better attendance, lower rates of violence, greater parent and student participation and satisfaction, lower dropout rates, and higher graduation rates than similar students in larger schools. An MDRC study that examined the results of New York City's small high schools initiative using a series of naturally occurring randomized lotteries found that small high schools consistently increased high school graduation rates by 9.5 percentage points, on average, over large high schools and significantly increased Regents exam scores in English language arts (Bloom & Unterman, 2014).

Personalizing Structures. Small size alone is not enough to produce these effects, however. For example, in a study of 820 high schools, Lee and Smith, (1995) found that student achievement and engagement were higher in smaller schools and those that use more "communal" practices – such as shared responsibility, personalized instruction tailored to the needs and interests of the students, flexible scheduling, cooperative learning, and a collegial environment for all members of the school community. Similarly, in a set of studies of redesigned schools, including randomized controlled trials, quasi-experiments, and case studies, Felner and colleagues (2007) found that small learning communities stimulate positive outcomes for students, with the greatest benefits in larger schools with more students from high risk backgrounds. These researchers identified consistent findings about the features of successful small learning communities that affect both student opportunities to learn and teachers' opportunities to teach, including small school and class size, advisories, and block scheduling.

In effective ***advisory systems***, each teacher advises and serves as an advocate for a small group of students (usually 15–20) over two to four years. Teachers facilitate an advisory class that meets regularly to support academic progress, teach social-emotional skills and strategies, and create a community of students who support one another. In a distributed counseling function, advisors support students on academic and nonacademic issues that arise and serve a point person with other faculty teaching the same student. The advisor functions as a bridge between student, school, and home so that students are provided the supports they need in a coherent way that allows them to navigate school in a productive and positive manner. Many studies finding positive effects of small schools or learning communities note the importance of advisories in enabling these effects (Darling-Hammond et al., 2006; Felner et al., 2007).

Block scheduling is the practice of having fewer, longer, class periods in a given day to reduce teachers' overall pupil load and lengthen time for instruction. For example, instead of six 45 minute class periods, schools might schedule only three 90-minute classes each day. Each teacher sees half as many students, and students see fewer teachers. This smaller pupil load allows teachers to provide more attention to each student and to engage in more in-depth teaching practices. Block scheduling has been found to support improved behavior and achievement for students, including higher grades and higher rates of course completions (Felner et al., 2007; Woronowicz, 1996), especially when courses continue for a full year and teachers use the longer class periods to implement teaching strategies that support inquiry, help students obtain directed practice, and personalize instruction.

In addition, Felner et al., (2007) point to the importance of ***interdisciplinary teaming*** with common planning time for teachers. This structure allows teachers to share their knowledge about students in planning curriculum to meet student needs, while creating more continuity in practices and norms, which supports students emotionally and cognitively. As the authors note:

> Effective interdisciplinary teaming reduces the levels of developmental hazard in educational settings by creating contexts that are experientially more navigable, coherent, and predictable for students. Interdiscipinary teaming can also create enhanced capacity in schools for transformed instruction through enabling the coordination and integration of the work of teachers with each other, including in instruction, and as ongoing sources of professional development and support for each other (p. 216).

When teachers develop a greater sense of efficacy to jointly solve problems of practice they also develop a sense of collective responsibility that reduces attributions of low student achievement to student-related factors such as family poverty, lack of ability, or low motivation and improves achievement (Lee & Loeb, 2000).

To accomplish this, schools need structures and practices that allow staff to develop collective expertise about their students as well as to develop trust with

them. Continuity of relationships is a key principle in this regard, especially important for children who have minimal continuity outside of school. Strategies found effective in this regard include looping from grade to grade, and longer grade spans at the school level. These organizational designs create sustained relationships, reduce cognitive load and anxiety for students when they do not need to learn new systems and reestablish their identity, and expand learning time because staff carry their knowledge about students and families forward from year to year.

Looping, through which teachers stay with the same students for more than one year, can occur when teachers teach the same students in fourth and fifth grade, for example, or when a secondary teacher has the same students for 9th and 10th grade English. In the International High Schools, a successful school model for new English learners, an interdisciplinary team of teachers stays with a group of 75–100 students for two years (Darling-Hammond, Ancess, & Ort, 2002). The strong relationships and deep knowledge of student learning supported by these longer relationships between adults and children can substantially improve achievement, especially for lower-achieving students (Bogart, 2002; Hampton, Mumford, & Bond, 1997) and can also boost student and teacher attendance while lowering disciplinary incidents and suspensions, grade retention rates, and special education referrals (Burke, 1997; George & Alexander, 1993). Teachers in such settings report a heightened sense of efficacy, while parents report feeling more respected and more comfortable reaching out to the school for assistance.

Reducing ***class sizes*** can also help personalize instruction. The largest benefits for achievement are often found below a threshold size of 15 to 18 and are often found to be most pronounced for young children, children of color, those from low-income families, and children who have been lower-achieving (for reviews, see Glass & Smith, 1979; Mosteller, 1995; Kim, 2006). Positive benefits of class size reduction are based on a continuing threshold of teacher quality (Stecher & Bohrnstedt, 2002).

Schools with ***longer grade spans*** (e.g. K–8 or 6–12), which allow closer, longer-term relationships are also found to be more effective in supporting student outcomes, as they help to establish and build upon close relationships among school members with students and families. Many studies have found that school transitions have a negative effect on student achievement; in particular, a transition to middle school at fifth or sixth grade sharply increases the odds of dropping out, while decreasing achievement in reading and math (e.g., Rockoff & Lockwood, 2010; Schwerdt & West, 2013; Simmons & Blyth, 1987). These results are consistent across multiple states, as well as urban, surburban, and rural areas.

Discontinuity in relationships is, in itself, stressful and can be counterproductive – especially for young people who have little continuity in their home and community environments. Furthermore, at a vulnerable time in young adolescence, when children should be developing greater competence and confidence to support their growing autonomy, they can flounder when placed into an environment that reduces opportunities for attachment and introduces comparisons among students that include negative attributions about competence, intelligence, and other talents. A growing body of evidence notes that low-income students are not the only ones at risk during this time: unusually high rates of maladaptive behaviors are found among affluent youth beginning around seventh grade, including substance abuse, eating disorders, and even suicide attempts (Luthar, Barkin, & Crossman, 2013). These are thought to be a function of high rates of stress associated with a culture of competition and peer pressure, coupled with inattentive or permissive parenting in the context of depersonalized school settings.

Middle schools that seek to strengthen relationships—by using teams of teachers who work with shared groups of students over time and by reducing the total number of teachers students see through block scheduling—mediate the negative effects of the secondary school transition and have better outcomes than those that leave students without means to develop relationships and secure help (Eccles & Roeser, 2009; Irvin, 1997). Similarly, high schools that create ninth grade transition supports can improve outcomes, as Chicago schools did, by providing data to monitor student progress and supports for students to pass their courses, raising graduation rates from 64% to 82% over 4 years (Roderick, Kelley-Kemple, Johnson, & Beechum, 2014).

Structures are important to set the stage for the kinds of coherent, consistent, continuous relationships children need to support their development, but the nature of those relationships and the resulting educational experiences are not a given. They depend on the attitudes, beliefs, skills, and capacity of staff; the school climate, including norms for interactions; and the practices and procedures that are adopted for instruction, classroom management, school discipline, and more. We turn to these important elements next.

School and classroom communities that offer safe, personalized settings for learning

Learning is a transactional process in which both students and teachers learn how to understand and communicate with each other, and in which trust creates conditions for reduced anxiety, as well as greater striving and motivation (Felner et al., 2007). Research suggests that relationships are most beneficial when they are attuned to children's emotional needs, when they are consistent and overtime, and when they support children's cognitive engagement (Bergin & Bergin, 2009).

Practices reflecting these principles are well represented in schools that are successful with students who are typically marginalized and underserved. These include the development of an intentional community that ensures a sense of belonging and safety, with shared norms represented in all of the school's activities. In addition, a culture of participation encourages student agency and leadership in the context of a culturally responsive curriculum that values diverse experiences. Educative and restorative practices teach students responsibility and allow them to exercise it in contributing to the school and local community (Hamedani, Zheng, Darling-Hammond, Andree, and Quinn, 2015; Noguera, Darling-Hammond, & Friedlaender, 2017).

Classroom design and management. In developmentally-grounded schools, classroom management is approached as something that is done *with* students and not *to* them. Productive classrooms are organized not around a compliance regimen that emphasizes the recognition and punishment of misbehavior, but on the promotion of student responsibility through the development of common norms and routines with the participation of students (LePage, Darling-Hammond, & Akar, 2005). Students may help develop the classroom rules and norms—often in a classroom constitution that is posted—and take on specific tasks, ranging from materials manager or librarian to leading activities in the classroom to organizing special events, which allow them to be responsible and contributing members of the community.

An effective classroom learning community develops respectful relationships between teachers and students, and also among the students themselves, as students are taught to develop social competence. Teachers take time to socialize students to their roles as community members (Brophy, 1998). Teachers and students together create common norms for how to behave in various situations, so that students can learn how to interact respectfully, take turns, voice their needs and thoughts appropriately, and solve problems that occur. The teacher's active role in co-regulating children's behavior helps scaffold the child's development toward self-regulation by providing them with a repertoire of words and strategies to use to manage different situations.

A recent meta-analysis of 54 classroom management programs found that while all of the approaches had modest positive effects (overall ES = .22) the interventions focused on the social-emotional development of students were the most effective (Korpershoek, Harms, de Boer, van Kuijk, & Doolaard, 2016).

One well-researched example of such a developmentally-grounded approach is *Consistency Management and Cooperative Discipline*, which builds shared responsibility for learning and classroom organization between teachers and students. The teacher creates a consistent learning environment by working with students in establishing a cooperative plan for classroom rules, procedures, use of time, and academic learning that governs the classroom. Students become "citizens" of the classroom as they create a constitution and take responsibility for dozens of activities in the classroom that teachers might otherwise do themselves. As they are taught citizenship skills and given multiple chances for leadership, students gain the experiences necessary to become self-disciplined. All adults in the school learn to work with children in consistent ways, and home/community involvement is encouraged. In a set of evaluations in urban public schools, researchers found increases in student and teacher attendance; a reduction in discipline referrals; and improvements in classroom climate, time to learn, and long-term student achievement (Freiberg, Huzinec, & Templeton, 2009; Freiberg & Brophy, 1999).

The development of a classroom learning community helps teachers to manage the classroom, both because children feel more connected and because peers offer greater assistance and collaboration, gaining in competence and agency. Developing community practices that strengthen relationships is critical. These practices may include classroom meetings, "check-ins" about how students are doing at the beginning of class, and routines for how to work in groups productively, engage in respectful discussions, or resolve conflicts. They may also include regular student-teacher conferences. In collaborative communities, members feel personally connected to one another and committed to each other's growth and learning.

Identity Safe Environments. As we have noted, healthy development and learning require both physical and psychological safety. One aspect of this safety is protection from physical bullying or trauma, accomplished by explicitly teaching students how to interact with each other and addressing challenges immediately. Equally important is that teachers create environments where students are affirmed and equitably supported. Teachers play a key role in shaping student learning through their own beliefs and the feedback they provide to their students. Their perceptions of students shape expectations that often predict student achievement apart from prior ability (Dweck 2000; Ladson-Billings, 1995, 2009).

Unfortunately, there is evidence that many teachers attribute inaccurate characterizations of academic ability and behavior to students based on race and ethnicity (Irvine, 2003; Kaplan, Gheen, & Midgley, 2002). On average, teachers have lower expectations of Black and Latino students and interact with them less positively than White students (Tenenbaum & Ruck, 2007); they are more likely to label black students as "troublemakers," punishing them more harshly for the same offense (Okonofua & Eberhardt, 2015). While the vast majority of teachers enter the profession with a passion for fostering children's learning, growth, and development, implicit bias can nonetheless color how they interact with their students.

This type of bias can lead to negative expectations, which often triggers the behaviors that teachers want to avoid (Kaplan et al., 2002) The way students are treated in school can trigger social identity threat if they feel they are at risk of being stigmatized by characteristics such as race, language background, economic background, gender or other traits. Social identity threat leads to significant stress, release of cortisol and adrenaline, symptoms of anxiety and depression, and sometimes, challenging behavior that results from an attempt to protect one's identity from perceived attack (Major & Schmader, 2018). If students come to expect bias, this expectation also influences their behaviors (Sheets & Gay, 1996).

Teachers need to understand how their attitudes toward their students can shape their treatment of students and what students ultimately learn. Affirming attitudes that convey confidence in students' abilities, for example, have been shown to support students' achievement (Ladson-Billings, 2009; Nieto, 2002) and to counteract stereotype threat the social identity threat that occurs when someone fears being judged in terms of a group-based stereotype (Steele, 1997; 2011). When triggered, stereotype threat induces stress and reduction in working memory and focus, leading to impaired performance (Schmader & Johns, 2003).

Stereotype threat can be mitigated by how teachers frame the purpose of assignments and assessments—as diagnosing current skills that can be improved, rather than measuring ability (Aronson, 2002)—and by how they give constructive feedback to students about their work, noting that the feedback reflects the teacher's high standards and a conviction that the student can reach them, along with an opportunity to revise the work (Cohen, Steele, & Ross, 1999). When the threat is lifted, through affirmations that the student is seen as competent and valued, many dozens of studies have shown that performance on tests, grades, and other academic measures improves significantly in ways that are frequently maintained over time (Steele, 2011).

Affirming attitudes can make a substantial difference in outcomes, which is suggested by the growing number of studies finding that students of color achieve at higher levels, attend school more regularly, feel more cared for in the classroom, and are less likely to be suspended when they have teachers of the same race (Cherng & Halpin, 2016; Egalite, Kisida, & Winters, 2015; Egalite & Kisida, 2017). One recent study found that having at least one black teacher in third through fifth grades reduced a black student's probability of dropping out of school by 29% and by 39% for low-income black boys. The odds of both boys and girls planning to attend college also increased sharply (Gershenson, Lindsay, & Papageorge, 2017).

All teachers can convey affirming attitudes by exposing students to an intellectually demanding curriculum and supporting them in mastering it, conveying their confidence that students can learn; teaching students strategies they can use to monitor and manage their own learning; encouraging children to excel; and building on the individual and cultural resources they bring to the school, ranging from social knowledge of the community and its history to mathematically rich pasttimes such as chess and sports to expressive understanding of language use and popular culture. Strategies that convey respect and concern for students become the basis for meaningful relationships and positive academic results (Carter & Darling-Hammond, 2016; Gay, 2000; Irvine, 2003; Ladson-Billings, 2009).

These elements of an "identify safe" classroom promote student achievement and attachments to school (Steele & Cohn-Vargas, 2013). In addition to the cultivating the classroom features already described,

teachers who create identity safe settings cultivate diversity as a resource for teaching through regular use of materials, ideas, and teaching activities that draw on referents to a wide range of cultures and exhibit high expectations for all students.

Creating an identity safe classroom by engaging in culturally responsive pedagogy relies on teachers understanding the views and experiences children bring to school, including, for example, how students communicate in their communities (Lee, 2017). Geneva Gay (2000) suggests that such teaching uses "the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them. It teaches *to and through* the strengths of these students" (p. 29), developing classroom practices that capitalize on the funds of knowledge that are abundant in children's households and communities (Moll, Amanti, Neff, & Gonzalez, 1992; Nasir, Rosebery, Warren, & Lee, 2014). This approach counters the deficit narrative of "poor" children with little social capital by recognizing and building upon the wealth of knowledge and "repertoires of practice" (Gutierrez & Rogoff, 2003) that exist in children's families and extended social networks.

This recognition can support stronger student learning. As one example, a recent study of teachers of Latino students found that teachers' beliefs and reported behaviors about the role of Spanish in instruction, use of students' funds of knowledge, and teachers' own critical awareness were positively related to students' reading outcomes. For teachers reporting the highest level of each dimension, reading gains were significantly higher at the end of the year (.85 *SD*, for those who valued Spanish; .60 *SD* for those using students' funds of knowledge; and 1.70 *SD* for those who exhibited a critical awareness) (López, 2016).

Practices and dispositions associated with culturally responsive pedagogy include (a) recognizing students' culturally-grounded experiences as a foundation on which to build knowledge; (b) cultural competency in interacting with students and families; (c) an ethic of deep care and affirming views of students; and (d) a sense of efficacy about learning and creating changes to promote equity that is consciously transmitted to students (Carter & Darling-Hammond, 2016; Villegas & Lucas, 2002). When teachers view students' experiences as an asset and intentionally bring students' voices into the classroom, they create a safe and engaging atmosphere for learning to take place.

Teachers can learn about the strengths and needs of students as well as their families' funds of knowledge through regular check-ins and class meetings, conferencing, journaling, close observation of students and their work, and connections to parents as partners. These practices can foster trust and alignment among students, parents, and staff, as described in the following section.

Practices to strengthen relational trust and family engagement

Recent research shows that relational trust among teachers, parents, and school leaders is a key resource for schools that predicts the likelihood of gains in achievement and other student outcomes where instructional expertise is also present. Trust derives from an understanding of one another's goals and efforts, along with a sense of mutual obligation, grounded in a common mission. As Bryk & Schneider, (2002, p. 144) put it: "Relational trust constitutes the connective tissue that binds … indviduals together around advancing the education and welfare of children." They identify five features that foster relational trust, including 1) small school size that fosters interpersonal relationships; 2) stable school communities; 3) voluntary associations where there is at least some choice for staff and students; 4) skillful school leaders, who actively listen to concerns of all parties and avoid arbitrary actions; and 5) authentic parent engagement, grounded in partnerships with families to promote student growth.

Principals can nurture relational trust among staff members by creating time for staff collaboration focused on curriculum planning and school improvement, supporting teachers' growth and development through asset-based feedback and learning systems, distributing leadership for many functions throughout the school, and involving staff in decision making. These practices have been found to retain teachers in schools, contributing to staff stability, and to increase teaching effectiveness and gains in student achievement (Podolsky, Kini, Bishop, & Darling-Hammond, 2016).

Schools can nurture strong staff-parent relationships by building in time and supports for teachers and advisors to engage parents as partners with valued expertise, by planning teacher time for home visits, positive phone calls home, school meetings and student–teacher–parent conferences scheduled flexibly around parents' availability, and regular exchanges between home and school (Darling-Hammond,

Ramos-Beban, Altamirano, & Hyler, 2016; Darling-Hammond et al., 2002).

Building strong relationships between the school and the family increases academic outcomes for students. In a series of meta-analyses examining the impact of parent involvement, Jeynes (2012, 2017) found consistent positive effects of parent involvement on academic achievement for children from pre-K through 12th grade. A meta-analysis of 51 studies found an effect size of .30 for a broad population of urban students (Jeynes, 2012). Another meta-analysis of 28 studies found parent involvement associated with better school outcomes for Latino students (ES = .52; Jeynes, 2017). The largest effect sizes were for programs that encouraged parents to engage in shared reading with their children, including strategies in which teachers offered questions that parents could ask about the readings; those that involved parents and teachers working together as partners to develop common strategies, rules, guidelines, and expectations for children; those that increased communication between parents and teachers; and those that involved parents in checking students' homework (Jeynes, 2012).

Similary, the Consortium on Chicago School Research found parent involvement a key component of 100 Chicago elementary schools with steep improvements in achievement: Controlling for other variables, students were 10 times more likely to achieve substantial gains in mathematics and have increased student motivation and participation in schools with strong parental involvement (Bryk, Sebring, Allensworth, Easton, & Luppescu, 2010).

In a research synthesis of 51 studies that included experimental, quasi-experimental, and correlational studies with statistical controls, Henderson & Mapp, (2002) found that schools that succeeded in engaging families from diverse backgrounds focused on building trusting relationships where power and responsibility are shared. They found lasting effects on achievement when students feel supported both at home and in school. Students with involved parents have more self-confidence, feel school is more important, earn higher grades and attend college. In a longitudinal study conducted in 71 Title I elementary schools, higher achievement was stimulated by teacher outreach to parents through face-to-face meetings, sending materials home, and phone calls home on a routine basis. The overall effect size between parent involvement and students' academic achievement was approximately .30 (Fan & Chen, 1999).

Other research finds that African-American youths' experiences of their family's support for them, sense of control over their own academic outcomes, and their feelings of self-worth and emotional security—in part a result of positive racial socialization—predict their engagement in school beyond the influence of SES (Connell, Spencer, & Aber, 1994; Spencer, 2008). Creating strong, respectful relationships among families and staff can create the resonance and coherence between home and school that reaps long-term benefits for students' learning.

Summary. In sum, schools can support student development by creating structures that enable teachers to know their students well and develop strong relationships, ranging from smaller classes and school units to advisory systems, looping, teaching teams, and longer grade spans. Teachers can create classroom communities in which students are affirmed, enabled to belong, and taught social responsibility. And schools can involve families as partners, aligning home and school practices, and capitalizing on their cultural assets. These multiple approaches to developing strong relationships promote the trust, safety, and sense of belonging necessary for students' productive engagement in all aspects of school.

Productive instructional strategies

Having created a supportive environment for learning, what are the curriculum designs, instructional approaches, and assessment practices that will enable students to deeply understand disciplinary content and develop skills that will allow them to solve complex problems, communicate effectively, and, ultimately manage their own learning?

What the science of learning and development tells us

Modern learning theory emphasizes the situated and social nature of meaning making, by which "mind, behavior, perception and action are wholly integrated" (Jonassen & Land, 2012, p. vi). Children are natural learners and inherently seek to learn things that matter in their immediate everyday world. To support children's learning, adults make connections between new situations and familiar ones, focus children's attention, structure experiences, and organize the information children receive, while helping them develop strategies for intentional learning and problem solving (Bransford, Brown, Cocking, and National Research Council [NRC], 2000).

The science of learning indicates that humans learn more effectively when they are not anxious, fearful, or

distracted by other pressing concerns; when the learning is connected to their prior knowledge and experience; when they are actively engaged; and when they have a reason to care about the content they are learning and can use it to deepen their understanding and to solve real questions or problems. Finally, as Cantor and colleagues (Cantor et al., 2018) note: "There is no single 'ideal' developmental pathway for everyone; instead there are multiple pathways to healthy development, learning, academic success, and resilience" (p. 9).

The NRC's (2000) report on *How People Learn* outlines three fundamental principles of learning that are particularly important for teaching:

> 1. Students come to the classroom with prior knowledge that must be addressed if teaching is to be effective. Students are not tabula rasa. If what they know and believe is not engaged, learners may fail to grasp the new concepts and information that are taught, or they may learn them superficially but not be able to apply them elsewhere. This means that teachers need to understand what students are thinking and how to connect with their prior knowledge if they are to ensure learning. Students come to school with different experiences, so they present distinct preconceptions, knowledge bases, cultural and linguistic capital that teachers should learn about and take into account in designing instruction. Successful teachers provide carefully designed "scaffolds" to help students take each step in the learning journey with appropriate assistance. These vary for different students depending on their learning needs, approaches, and prior knowledge. Teachers' success with diverse learners is enhanced by their ability to address students' different ways of learning, knowing, and communicating.
>
> 2. Students need to organize and use knowledge conceptually if they are to apply it beyond the classroom. To develop competence in an area of inquiry, students need to understand facts and ideas in the context of a conceptual framework, so that they can organize knowledge in ways that facilitate its application. This means that teachers should structure the material to be learned in ways that help students fit it into a conceptual map and teach it in ways that allow application and transfer to new situations. The teaching strategies that allow students to do this integrate carefully designed direct instruction with hands-on inquiries that actively engage students in using the material, incorporate problem solving of increasing complexity, and assess students' understanding for the purpose of guiding instruction and student revisions of their work.
>
> 3. Students learn more effectively if they understand how they learn and how to manage their own learning. A "metacognitive" approach to instruction can help students take control of their own learning using a set of personalized learning strategies, defining their own learning goals, and monitoring their progress in achieving them. Teachers need to know how to help students self-assess their understanding and how they best approach learning. Through modeling and coaching, teachers can teach students how to use a range of learning strategies, including the ability to activate background knowledge, plan ahead, and apportion time and memory; to create explanations in order to improve understanding and to note confusion or failures to comprehend; as well as to evaluate their own work, seek out additional insights, and revise and improve it.

In what follows, we use these three principles to organize this section on curriculum, instruction, and assessment, and we infuse additional insights from research grounded in a sociocultural perspective, including a section on motivation. While enormously helpful in synthesizing knowledge from the learning sciences up to that point, the *How People Learn* report did not fully examine the sociocultural contexts of learning and the social-emotional factors affecting it. The National Academy of Sciences is currently producing a second edition of *How People Learn* intended to address these issues.

Among these additional insights are that students' beliefs and perceptions about intelligence and ability—both generally and in relation to themselves personally—affect their cognitive functioning, confidence, and learning. These perceptions can be shaped by teachers' and peers' expectations, statements, and behaviors. While negative emotions like anxiety and distress can block learning, emotion also triggers learning as it affects excitement and attention (Immordino-Yang & Damasio, 2007) and thus should be considered in designing instruction that is mentally engaging. At the same time, consistent structures, supports, and affirmations that allow the student to know what to expect and how to be successful reduce cognitive load and free up the mind for learning other challenging material (Paas, Renkl, & Sweller, 2003).

Finally, as we have noted, there are different kinds of learning which call for different kinds of teaching. Educational goals increasingly emphasize the problem-solving and interpersonal skills needed for 21st century success, which cannot be developed through passive, rote-oriented learning focused on the memorization of disconnected facts. Today's goals require paths to deeper understanding supporting the transfer of skills and use of knowledge in new situations (Goldman & Pellegrino, 2015; NRC, 2012).

Principles for practice

With these goals and insights in mind, the science of learning and development suggests the following principles for instructional practice:

1. Teaching should *build on and expand children's prior knowledge and experiences*, both to scaffold learning effectively as it expands to new areas of content and skills and to inform practices that are individually and culturally responsive. Given what each child is ready to learn, teachers should structure appropriately challenging activities that balance what a child already knows with what he wants and needs to learn, while introducing other rich experiences to support ongoing learning.
2. Teaching should support *conceptual understanding, engagement, and motivation,* by designing relevant, problem-oriented tasks that combine explicit instruction about key ideas – organized around a conceptual map or schema of the domain being taught – with well-designed inquiry opportunities that use multiple modalities for learning.
3. To enable students to manage their own learning and transfer it to new contexts, teaching should be designed to develop students' *metacognitive capacity, agency, and the capacity for strategic learning.* This requires opportunities for self-direction, goal-setting and planning, and formative assessment with regular opportunities for reflection on learning strategies and outcomes, feedback, and revision of work.

Building on and expanding children's knowledge and experiences

Jean Piaget was the first student of learning to lay out a set of developmental stages that he observed children move through as independent learners. This concept of development was fairly static, suggesting that students would be ready for certain kinds of learning at certain ages, for example. However, Russian teacher and psychologist Lev Vygotsky (1978) recognized that individual capacities develop in social contexts where they are supported, shaped by language and cultural exchanges, and that experiences can influence what children are ready to learn, especially when they have the help of a more expert other within their "zone of proximal development" (ZPD). Futhermore, experiencing a sense of disequilibrium in light of new situations or unfamiliar ideas can trigger the need to resolve puzzlement through exploration, which itself sparks more learning, especially when the right supports are in place to help the student make meaning of what he or she is experiencing.

The learning sciences point to the importance of 1) teaching students within the zone of proximal development, and scaffolding their learning so that they can advance to more complex skills; 2) drawing on students' prior experiences; 3) creating a rich environment for learning, including opportunities for collaboration with others, which expand the range of experiences each can encounter; and 4) providing cognitive supports. We treat each of these in the following sections.

Teaching and Scaffolding in the Zone of Proximal Development. The ZPD represents the learning space between what a child can do in a particular area on his or her own and what he or she can do with some assistance from more capable peers, teachers, or others. Children internalize the help they receive from others, which becomes part of their repertoire to guide future problem-solving. Well-designed instruction helps nudge the child to a new level of understanding within the ZPD by providing the right kind of experiences and supports. This "scaffolding" refers to the guidance that allows students to more readily master a task that is beyond their existing skill set or knowledge base. Scaffolding includes both affective and cognitive elements: In addition to providing assistance and timely feedback, scaffolding involves communicating reassurance; helping students understand the habits of mind necessary to become proficient; and helping students understand the task's relevance and how their personal trajectory toward competence could unfold (Nasir et al., 2014).

Children's developmental and learning trajectories vary as a product of the interactions of their attributes and social contexts as well as over time (Fischer & Bidell, 2006; Rose et al., 2013). Furthermore, each student functions within multiple zones of development that vary from one domain to the next. A student may need one kind of assistance as she completes a long division problem, and yet another kind of assistance as she writes a short story. Careful observation, questioning, assessment of work, and one-on-one interactions with students provide the kinds of information teachers need to determine what level and type of assistance a student may need to advance in his or her understanding.

Drawing on Students' Prior Experiences. Part of successful teaching is learning what students already know, where they already demonstrate competence, and how they can bring that knowledge into the

classroom context. As Nasir and colleagues (2014, p. 491) point out, "Often, people can competently perform complex cognitive tasks outside of school, but may not display these skills on school-type tasks." Or, their displays might not be recognized as demonstrating competence according to normative standards based on assumptions that those who differ from middle-class norms operate at a deficit. For example, complex statistical calculations used on the basketball court may not initially carry into the mathematics class, unless teachers are alert to support the transfer by building on this kind of real-world knowledge.

As Lee (2007) demonstrated, a bridge between students' experiences and school content can be built using a cultural modeling approach that draws on the familiar to make the structure of a domain visible and explicit to students. Lee illustrated symbolic meanings in literature by beginning with rap songs and texts the students knew, and carried their insights into study of more formal canonic texts. Similarly, Boaler's (2002) study of the outcomes of inquiry-based instructional practices in mathematics classrooms serving low-income students found that linguistic, ethnic and class inequalities were reduced when teachers contextualized problems and made them relevant to students' lives, introducing new concepts through discussion and asking students to explain and discuss their thinking. These teachers achieved stronger outcomes by seeking to understand and support students' thinking and inquiry in the context of rich, collaborative learning experiences, rather than narrowing the curriculum to rote-oriented algorithms, as often happens for students who have had less prior experience with the content. A broader body of research has documented similar strategies for building classroom communities that support successful mathematics learning (e.g., Walshaw & Anthony, 2008).

In addition to building on students' prior knowledge, teachers may also need to confront prior knowledge to address misconceptions. In the area of historical thinking, for example, studies reveal that young people come to historical topics with experiences and encounters developed outside of the classroom through media or their families' accounts of historical events. Thus, teachers need to surface students' beliefs and judgments while helping them develop skills for evidence-based inquiry. Curriculum that teaches students to interrogate and use primary source documents builds on expert studies of historians' practices and helps teachers guide whole class discussions and design inquiry projects that are appropriate for younger readers with less background knowledge (Monte-Sano & Reisman, 2015; Wineburg, Martin, & Monte-Sano, 2011).

Creating Rich, Collaborative Environments for Learning. As the aforementioned examples illustrate, learning abilities are developed by access to rich experiences that stimulate the brain. One of earliest studies on the effect of the environment on brain development was the work of William Greenough and his colleagues (Greenough et al., 1987), who compared the brains of rats raised in "complex environments" containing toys and obstacles with those housed individually or in small cages without toys. They found that rats raised in complex environments performed better on learning tasks, liked learning to run mazes, and had 20–25% more synapses per neuron in the visual cortex. Many studies since have shown that brain development is experience-dependent.

"Rich environments" that support brain development provide numerous opportunities for social interaction, direct physical contact with the environment, and a changing set of objects for exploration (NRC, 2000, p. 119). Similarly, rich classroom environments provide interactions with others in the classroom and community, hands-on experiences with the physical world, and frequent, informative feedback on what students are doing and thinking. Ted Pollen's classroom described at the beginning of this article is a good example of such an environment, with different work areas for different kinds of activities, a rich assortment of readily accessible books, blocks, and other manipulatives, a physical timeline overhead with historical date cards frequently added, regularly used posters reminding students of how to engage in varied reading and writing activities, and opportunities for collaboration with other students.

Ted's classroom also illustrates how teachers can set up instructional conversations that support student learning. Vygotsky noted, and learning scientists have since demonstrated, that social interactions using language in support of thinking enable more strategic learning (Tharp et al., 2000). Neuroscientists have also demonstrated that the development of neural pathways is associated with exposure to and generation of language (Kuhl, 2000). Students sharpen their thinking as they converse about their reasoning and inquire into what they don't yet understand. When they are able to articulate concepts, use them in a task, see or hear other models of thinking, and get feedback, they learn more deeply.

Substantial research identifies benefits of social learning in well-managed groups (Barron & Darling-Hammond, 2008), and the capacity to work well in

groups is an increasingly valued outcome of schooling. Collaborative learning is an important classroom tool that can be used to provide students with learning assistance from peers within their zone of proximal development, opportunities to articulate their ideas, and opportunities to develop metacognitive skills like self-regulation and executive function, as they learn to manage themselves to interact productively with others and seek out help from teachers and peers. These skills are both exhibited and developed through social processes that teachers foster (Tharp et al., 2000).

Cooperative small group learning is one of the most studied pedagogical interventions in educational research, with hundreds of studies and many meta-analyses finding significant achievement benefits for students when they work together on learning activities. For example, a meta-analysis of 158 studies, 70% of which involved random assignment, demonstrated that cooperative learning promotes higher achievement compared to individualistic efforts. Effect sizes range from .18, at the low end, to 1.03 for the most impactful program (Johnson, Johnson, & Stanne, 2000). In addition to cognitive gains, a review of 36 studies using experimental or quasi-experimental designs found positive outcomes of collaborative learning on measures such as student self-concept, social interaction, time on task, and liking of one's peers, as well as academic outcomes, with moderate effect sizes (Ginsburg-Block, Rohrbeck, & Fantuzzo, 2006).

Researchers have identified a number of social processes that help to explain why small group work supports individual learning. These include opportunities to share original insights, resolve differing perspectives through argument, explain one's thinking about a phenomenon, provide critique, observe the strategies of others, and listen to explanations (Barron & Darling-Hammond, 2008). There is evidence that collaborators can generate strategies and abstract problem representations that are extremely unlikely to be observed when individuals work alone, suggesting that there are unique benefits of joint thinking (Schwartz, 1995).

While well-managed group work can enhance student learning, it requires group-worthy tasks in which all must engage for the work to be successfully accomplished, support for students to learn to work together, and sophisticated questioning and scaffolding skills on the part of teachers. For example, in Complex Instruction classrooms—a much-researched approach that uses cooperative learning to teach at a high academic level using carefully-constructed, interdependent group tasks—students are taught to undertake different roles (e.g., materials manager, timekeeper, task minder, and others). To support productive collaboration, the teacher orchestrates tasks, relationships, and supports, and disrupts status hierarchies that might develop based on students' personalities, developed abilities, language backgrounds, or other factors.

Teachers equalize interactions between high and low-status students by structuring tasks to help them recognize and use their multiple abilities, as students draw on different competencies to accomplish a group task. Teachers can also "assign competence" to a student by recognizing the student's contributions to the group task through public statements conferring a positive evaluation on to the students' effort, thus boosting participation of low-status students without restraining the participation of high-status students. These moves produce strong learning gains and reduce achievement gaps among student groups (Cohen & Lotan, 2014).

In successful use of cooperative approaches, teachers often help students structure roles within the group and provide questions and tasks that guide the group's discussion. For example, in a review of 94 studies which focused on the conditions for high quality discussion in science teams, the authors concluded that:

> A successful stimulus for students working in small groups to enhance their understanding of evidence has two elements. One requires students to generate their individual prediction, model or hypothesis which they then debate in their small group. The second element requires them to test, compare, revise or develop that jointly with further data provided (Hogarth et al., 2004).

Teachers play an active role in constructing the tasks and questions that help students learn to coordinate their work and frame their ideas in terms that reflect the modes of inquiry in the discipline. These efforts support the development of social, cognitive and academic skills while also developing student agency and the ability to reflect on and evaluate ideas.

Providing Cognitive Supports. Teachers can also support student learning by being aware of how cognitive development unfolds. At the heart of all learning is meaning making that involves connecting what we already know to new information. The central role of background knowledge is well documented in cognitive research. As just one example, research on reading has long demonstrated that comprehension depends on prior knowledge about the topic that

permits sense-making as much as it does on decoding skills (Pearson, Cervetti, & Tilson, 2008).

When students have not had particular experiences or have not acquired certain kinds of background knowledge, teachers can in fact create experiences for them to develop that knowledge. The kind of classroom described above, which constructs rich experiences for students and provides extensive information on the topics that are the subject of deep inquiry, helps to do that. One way to build background knowledge is to ensure a broad curriculum in history, social studies, science, and the arts, as well as reading and math, and engage students in field trips as educators have long advocated. Finally, teachers can set the stage with information regarding the context and topics of a shared text, before they began with the students.

The fact that background knowledge is important for higher level problem solving does not mean that "basic skills" must be taught by rote before children engage in inquiry. In fact, allowing for discovery and exploration can help set the stage for explicit instruction. In an approach called "inventing to prepare for future learning," Bransford and Schwartz (1999) found that posing challenges to learners and introducing inquiries into questions created more contextualized understanding and ultimately led to better recall and use of information presented later than did approaches that simply taught novices the relevant facts or formulas.

Teachers can also support student learning by providing strategies and tools that reduce cognitive load and free the mind's attention for higher order thinking and problem solving. Cognitive load theory (CLT) addresses techniques for managing working memory load in order to facilitate the learning of complex cognitive tasks (Paas, Renkl, & Sweller, 2003). Working memory is our capacity to simultaneously keep in mind multiple pieces of information, and it is highly influenced by how information is perceived and connected to concepts, schemas, and scripts that are already familiar. These forms of background knowledge influence what is noticed, how easily new knowledge can be kept in mind and previous information remembered.

Prior knowledge allows for a cognitive process referred to as "chunking," reducing a larger set of items into smaller units that allow for pattern recognition and fit within the constraints of working memory. Teachers can support learning by chunking information in manageable ways and supporting students to become proficient in the use of new material by attaching ideas to one another and to a common schema of the domain under study that makes the material more meaningful (rather than asking students to remember disconnected pieces of information), and by giving students opportunities to practice skills so that they become automatic, freeing up bandwidth for new material and more complex applications.

Educators can also help students reduce cognitive load to free up their minds for problem solving by using tools for adapting to working memory limitations, from using notes to digital tools such as calculators or computers that can be used to offload computational or memory-heavy tasks during problem solving sessions. This view of cognition casts intelligence as distributed among minds, material artifacts, cultural tools, and interacting partners (Pea, 1987).

In the classroom we visited at the beginning of this article, the teacher, Ted, had worked with students to create many memory assists that were posted all over the classroom: posters illustrating fractions problems the classroom had tackled and solved, a classroom constitution with shared norms, the rules for "Book Club", the definitions of figurative language, a "Writing workshop conferencing protocol," "Poetry guidelines," "Persuasive essays," "Jobs in a reading conference" (enumerated for both the student and the teacher), "Elements of a news magazine article," "What we know about maps," and "Multiplying 2-digit by 1-digit numbers: The traditional algorithm." These were often in the students' own words, codifying their learning so they could share it and go back to it as needed. All of these both helped reduce cognitive load and support student independence and confidence in building on their prior learning.

In light of the need for students to learn to find, curate, and use information, rather than just remember it, educators can help students learn to use tools that improve their performance. Furthermore, assistive technologies such as audio-books, electronic readers that can adjust the size and type of font, recording tools, dictation strategies, and other supports can help students with particular kinds of disabilities in working memory, auditory or visual processing become successful in managing their learning and developing their performance capabilities, rather than suffering from deficit frameworks that limit the advances they can make.

Pedagogies are ways to coordinate cognitive processes and systems. For example, learning to read requires developing the capacity to decode text, which in turn is facilitated by earlier phases of language development that involve hearing words in meaningful contexts and understanding that they can

correspond to written symbols. Working memory, background knowledge, and opportunities for elaboration all come into play as children work to develop both decoding and strategies for meaning making.

Research on reading makes it clear that both explicit instruction in decoding and immersion in meaningful, interesting, and varied texts are needed to become fluent in reading, along with sustained engagement with a larger community of readers who support skills and interest development (Pearson, Cervetti, & Tilson, 2008). Learning how to make strategic meaning of the text is centrally important: As readers use reading clues and background knowledge to make sense of text (and the knowledge of others in their community), they are also acquiring more background knowledge for the future from the text and their peers.

Similarly, learning is supported by techniques that lead to the elaboration of material, such as self-explanation, peer teaching, and representing information in multiple modalities. These deepen conceptual understanding, strengthen mental models, and improve the capacity to recall and use information. In mathematics for example, asking students to represent quantitative information in multiple forms, such as with graphs and verbal explanations, can support robust understanding. More generally, asking students to integrate abstract concepts and concrete examples in their explanations can deepen their comprehension while simultaneously providing richer data to teachers for assessment.

Specific pedagogical moves that support these learning processes include:

- Choices of tasks that have the right amount of challenge with supportive guidance;
- Well-chosen questions as scaffolds that support student thinking, guide their inquiry, and help them consolidate their understanding;
- Use of multiple and varied representations of concepts that allow students to "hook into" understanding in different ways;
- Design of instructional conversations that allow students to discuss their thinking and hear other ideas, developing concepts, language, and further questions in the process;
- Encouragement for students to elaborate, question, and self-explain;
- Instruction and curriculum that use apprentice-style relationships in which knowledgeable practitioners or older peers facilitate students' ever-deeper participation in a particular field or domain (Donovan & Bransford, 2005).

Supporting conceptual understanding, engagement, and motivation

Cognitive science indicates that we learn more effectively when we see how ideas are conceptually connected to one another, when our minds are fully engaged, and when the tasks we encounter are motivating because they are interesting and accessible. Productive learning within different subjects is shaped by the unique structures of the disciplines and their particular modes of inquiry. In what follows, we discuss how teachers can shape understanding by 1) organizing and representing knowledge conceptually; 2) developing an inquiry-based curriculum that integrates explicit instruction appropriately; 3) designing environments and tasks that support motivation; and 4) providing for interest-based learning opportunities.

Organizing and Representing Knowledge Conceptually. As we have noted, learning is enhanced when learners have a cognitive map or schema for particular concepts and relationships among concepts within a domain, into which they can place and connect what they are learning so that it adds up to a meaningful whole. For school-based learning, a central set of organizers are the structures of the disciplines. All subject areas have structures that reveal the ways their core ideas are connected with one another (Goldman et al., 2016), including a code of patterns and regularities that organize content fields (Schwab, 1978; Shulman, 1992). Understanding the structure of a domain helps people learn things more efficiently. For example, teaching vocabulary based on the underlying semantic and syntactic structure of the language enables students to learn rules for broader application. When students learn that words can be analyzed into meaningful parts (for example, that "photo" refers to light and "hydro" to water), they then may be able to figure out the meanings of words like photosynthesis and hydrotherapy. Similarly, when learning a language, knowing the structure of verb conjugations enables transfer.

Cognitive scientists have found that organizing knowledge in schemas facilitates retrieval and use of material from long-term memory. More complex schemas can combine elements of less complex organizations of information that are processed with more automaticity, reducing the burden on working memory (Paas, Renkl, & Sweller, 2003). Organizing knowledge and automating access to this knowledge in long-term memory supports meaningful learning in complex cognitive domains.

Teachers can help students understand the structure of concepts within a domain by providing an

overarching conceptualization of the big ideas and then locating specific facts or information in relation to these. In a discipline like history, for example, students may consider how societies organize themselves to engage in government and commerce, and how they distribute power and manage conflicts. If students understand these core concepts, they can look at different societies and different nations over time and see patterns and discontinuities, generalizations, and connections (NRC, Donovan & Bransford, 2005).

Each discipline also has a different manner of posing questions and solving problems: for example, scientific investigation through scientific methods, historical inquiry, literary analysis, and mathematical modeling. These *central modes of inquiry*, knowledge-finding tools, and means of using evidence (Schwab, 1978) are also critical to curriculum design. If students learn to use these modes of inquiry, they will be training their minds in distinctive ways (which was the original rationale for introducing the disciplines) and more able to engage in disciplined forms of deep learning. The structures of the disciplines, which can be used to organize the curriculum to engage students around these core ideas and modes of inquiry, also pave the way for transfer to other ideas, subjects, and real-life problems inside and outside of school (Shulman, 1992).

It is important for educators at the state, district, and school level to have knowledge of how to select high-quality curriculum materials that support a conceptual organization and understanding of the disciplines and offer thoughtful guidance for productive engagement with the materials through useful representations of ideas, means to connect those ideas to students' experiences, approaches to discussions that can engage multiple approaches and explanations, and disciplinary inquiries. Many well-grounded curricular designs—including carefully researched professional learning processes to help teachers understand the underlying concepts and teaching strategies—have been supported by extensive research (see, e.g., Cobb & Jackson, 2011 re: mathematics; Penuel & Fishman, 2012 re: science; Wineburg et al., 2011 re: history).

While this review cannot fully explore the many bodies of research on learning within the content domains, we note here that significant evidence demonstrates that effective teaching is content-specific, and not based on a toolbox of generic teaching techniques. As the NRC (2005) review of *How Students Learn History, Mathematics, and Science* observed: "Expert teachers have a deep understanding of the structure and epistemologies of their disciplines, combined with knowledge of the kinds of teaching activities that will help students come to understand the discipline for themselves" (p. 163). This involves particular pedagogies related to the discipline's rules of evidence for its particular modes of inquiry. Instruction helps students participate in the forms of thinking, reasoning, and doing that resemble those of a skilled historian, geographer, scientist, mathematician, writer, or artist.

For example, students develop a deeper understanding of history when they examine historical evidence and learn how it can be interpreted based on the type of evidence and its source, and when it is placed in the context of a larger schema (Wineburg et al., 2011). Learning to look for and understand structures and patterns in mathematics, to reason quantitatively as a form of sense-making, and to explore multiple solution strategies produces deeper learning in mathematics (Boaler, 2002). Learning to form hypotheses, experiment, observe, collect evidence, and frame conclusions, while seeking to understand the principles that are at work in a phenomenon helps students begin to think scientifically (Penuel & Fishman, 2012). These and other disciplines have their own modes of discourse as well as investigation strategies (Darling-Hammond et al., 2008).

Inquiry-Based Curriculum that Appropriately Integrates Explicit Instruction. The argument that student inquiry is critical to transferable learning is based on insights from cognitive theories about how people learn and the importance of students making sense of what they are learning and processing content deeply so that they truly understand it (Bransford, Brown, Cocking, Donovan, & Pellegrino, 2004). Inquiry approaches to learning require students to take an active role in knowledge construction to solve a problem or probe a question. Inquiry may take place in a single day's lesson or a long-term project, centered around a question or problem that requires conjecture, investigation, and analysis, using tools like research or modeling. The key is that—rather than just receiving and memorizing pieces of information—inquiry provokes active learning and student agency through questioning, consideration of possibilities and alternatives, and applications of knowledge.

The family of approaches that can be described as inquiry-based includes problem-based learning, design-based learning, and project-based learning, among others. The success of well-designed and managed problem and project-based curriculum has been

documented across many schools and experimental interventions. Typically studies find that students exposed to this kind of curriculum do as well as or better than their peers on traditional standardized test measures but significantly better on measures of higher order thinking skills that transfer to new situations, as well as stronger motivation, problem solving ability, and more positive attitudes toward learning (Barron & Darling-Hammond, 2008; Boaler, 2002; Bransford et al., 2004). Similarly, meta-analyses of studies of medical students have found that those who are enrolled in problem-based curricula, in which they have to work on diagnostic inquiries regarding patients and their treatment, score higher on items that measure clinical problem solving and actual ratings of clinical performance (Albanese & Mitchell, 1993).

Inquiry-based approaches to learning develop social and emotional skills, habits, and mindsets as well as academic skills as students learn to set goals, plan their work, reflect on what they have learned and what more they need to know to solve a problem, overcome obstacles, and communicate what they have found (Barron & Darling-Hammond, 2008).

Inquiry challenges need to be carefully planned and well-supported so that students in fact learn, rather than wandering aimlessly through discoveries that confuse rather than enlightening them. Research syntheses have documented the advantages of inquiry-based learning over expository forms of instruction for the transfer of learning to new contexts, and have also found that the benefits for achievement are greater for students who have received useful guidance from their teachers (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011 [d = .30]; Furtak, Seidel, Iverson, & Briggs, 2012 [d = .65]). One meta-analysis of 72 studies found several types of guidance equally effective at promoting stronger outcomes for inquiry-based teaching as compared to expository learning. These forms of guidance defined the learning task, provided prompts, scaffolds, and explanations to support aspects of the task, and made task progress and learning visible to the learners (Lazonder & Harmsen, 2016 [d = .66 for effects of guidance on learning activities; d = .71 for effects on performance success; and d = .50 for effects on learning outcomes.])

The literature on pedagogies for inquiry indicates that effective inquiries are guided by clearly defined learning goals, well designed scaffolds, ongoing assessment, and rich informational resources. Good inquiry tasks allow multiple methods for reaching solutions. They also allow repeated exposure to concepts and provide opportunities for feedback. An effective teacher in this approach is one who designs tasks and processes for engaging them that are clear and support understanding, and who plays an active role in making thinking visible, guiding group processes and participation, and asking questions to solicit reflections. The goal is to model good reasoning strategies and support students to take on these roles themselves (for a review, see Barron & Darling-Hammond, 2008).

Effective teachers also offer strategic feedback that takes students to the next stages of learning. Teachers provide direct instruction at critical junctures, offering explanations or directing students to resources that are crafted and timed to support inquiry (Hmelo-Silver, 2004; Moreno, 2004). Direct instruction to provide information and develop a conceptual schema may be especially helpful when students are new to a topic or when they have entered a new domain through an inquiry-based approach and have developed key questions that motivate them to use new information that is now contextualized in their experience (Bransford & Donovan, 2005).

Students' needs for teacher support change as they become more cognitively engaged and develop expertise. Teachers need to gauge how much scaffolding to provide as individual learners become more knowledgeable and proficient. However, at any stage of development, learners benefit from strategically placed direct instruction, feedback, and critical questions that guide their learning (Hmelo-Silver, 2004). When teachers give explanatory feedback, rather than corrective feedback, student performance improves (Moreno 2004).

In addition, instructional designers need to think about learner's level of prior knowledge and expertise in order to determine what types of information and activities can facilitate learning outcomes. A common misconception is that reducing cognitive load is uniformly beneficial. However, it is the source, rather than the level of the load, that matters. Extraneous load, such as that caused by stress or trauma, negatively affects learning. However, germane load, such as that created when curiosity is piqued and sparks exploration, increases relevant mental activities and positively affects learning (Paas, Renkl, & Sweller, 2003). Tasks should be engaging and challenging, so that germane cognitive load is as high as possible. What is helpful for an advanced learner, though, could overwhelm a novice. Knowing about the learner allows educators to design tasks and pose questions at the right level to enhance their learning.

Teachers can reduce extraneous load by providing increased guidance for developing conceptual understanding during discovery learning. This can be accomplished by providing explanations of central ideas and relationships at key junctures, offering useful texts, scaffolding the tasks by sequencing them from less to more complex, chunking the inquiry into discrete steps with instructions and information at each step, or having students write hypotheses, conjectures, or summaries that are the basis for conceptual discussion. The amount of guidance needed will vary across developmental levels and from learner to learner.

Developing metacognition, agency, and the capacity for strategic learning

A critical component of learning for understanding is thinking about one's prior knowledge, connecting that knowledge to other ideas within a conceptual framework, and processing that knowledge so that it is available for application to new contexts or problems. The process of metacognition, or "thinking about one's own thinking," (Georghiades, 2004) allows more strategic learning and deeper conceptual understanding of content.

Metacognition is part of a broader concept of self-regulated learning through which students are able to respond positively to feedback, set goals, and manage their progress towards these goals, which enhances their sense of agency. Metacognition is especially important as it moves students out of the role of passive receptors of information to active learners where they are aware of and monitoring their own understanding during the learning process (Flavell, 1979). In order to enable transferable learning that is increasingly independent, teaching should be designed to support metacognition, so that students can learn to accomplish their goals.

The use of metacognitive strategies has been found to distinguish between more and less competent learners. Strong learners can explain their learning process and articulate reasons why they decided to take certain steps or how they arrived at a particular conclusion, shich is an important element of engaging deeply in the learning process (Chi, Bassok, Lewis, Reimann, & Glaser, 1989). A substantial body of research has found that students who employ metacognitive strategies, including self-regulated learning and goal-setting, are better able to engage in cognitive processes, remember information, and maximize learning (Farrington et al., 2012).

We discuss here three pathways teachers can use to develop students' metacognitive skills: 1) teaching metacognition and learning strategies directly; 2) providing feedback followed by practice and revision; and 3) employing mastery assessment that allows students to continue to make progress in their learning that they themselves can help to guide.

Teaching Metacognition and Strategic Learning. As Donovan and Bransford (2005) note in *How People Learn: Examples in History, Mathematics, and Science,* learning well depends on (a) how prior knowledge is incorporated in building new knowledge, (b) how knowledge is organized, and (c) how well learners can monitor and reflect on their learning.

Educators can develop metacognitive skills within the classroom through modeling of thinking, explicit strategy instruction, scaffolds for self-monitoring of thinking and actions, and regular opportunities for student self- and peer assessment. Opportunities for students to reflect on their strengths and areas of growth, and for students to self-correct errors can be incorporated into the curriculum within content areas, so that monitoring of understanding is tied to domain-specific knowledge and expertise (NRC, 2012).

In reading, for example, considerable work has been done to teach students to monitor their understanding in the process of reading and take steps to shore up their comprehension as needed (for an overview, see Pearson, Cervetti, & Tilson, 2008). The development of what Pearson and colleagues call "mindful engagement" on the part of students involves this strategic monitoring that supports comprehension, connection-making, and critique (Afflerbach, Pearson, & Paris, 2008; Duke & Pearson, 2002).

Among the many strategies that have been found effective in stimulating mindful engagement in reading are Reciprocal Teaching and Transactional Strategies Instruction, which variously include strategies that ask students to think aloud as they are reading, construct images, create themes, predict, question, clarify, make connections, summarize, and read for specific literary elements (see Duke & Pearson, 2002). In these and similar methods, teachers scaffold the process and turn over responsibility for choosing the strategies and managing the discussions to student groups as soon as possible. Reviews of experimental and quasi-experimental studies have found these strategic approaches produce positive effects for text comprehension (see, e.g., Pressley, 1998; Rosenshine & Meister, 1994).

Duke and Pearson (2002) identified a set of steps that typically occur when teachers engage in explicit strategy instruction, including: naming and describing the strategy—why, when, and how it should be used; modeling the strategy in action—either by teacher, student, or both; using the strategy collaboratively—in a sort of group think-aloud; guiding practice using the strategy with gradual release of responsibility; finally, students using the strategy independently, with no teacher guidance, either individually or in small student-led groups.

These steps reinforce Baker's (2002) point that: "[T]here is a sequence of development from other-regulation to self-regulation. This notion provides the framework for virtually all instructional programs in which the goal is to enable students to take responsibility for their own learning" (p. 78). Instructional supports and scaffolding should not only be focused on higher achievement, but also on qualitative changes in the ways "students view themselves in relation to the task, engage in the process of learning, and then respond to the learning activities and situation," supporting their increasing self-direction, which, in turn, increases their skills along the way (Ames, 1992, p. 268). The goal is that teachers and students have a shared understanding and ownership of the learning process, and students are increasingly able to reflect on and self-monitor their own improvement. As scaffolding fades, students should internalize standards and take responsibility for their own learning (Tharp et al., 2000).

Studies have documented how the explicit teaching of metacognitive strategies can improve learning for a wide range of students across multiple subject areas. Some of this research studies the thought processes of experts and then organizes these so that they can be taught to novices engaged in that work. Following Vygotsky's (1978) notion that talking things through—internally or aloud—helps people to learn by helping them to organize and manage their thought process, many strategies involve teaching students to think aloud.

Studies of writers have found that they engage in an internal (and sometimes external) dialog about what they are doing and why, which helps them think through their writing process (Pearson, Cervetti, & Tilson, 2008). This research has led to strategies for teaching writing that help novice writers learn to engage in this kind of self-talk and self-monitoring as they go through similar processes. A year-long study of a set of urban elementary classrooms where half the students were identified as learning disabled found that, when teachers of fourth and fifth grade students taught students these approaches as they analyzed texts and modeled the writing process, students engaged in more self-regulating metacognitive strategies, were more able to explain their writing process, and achieved at higher levels in reading and writing than a matched group of comparison students. The learning disabled students in these classes were just as able to describe and use the writing strategies as were the regular education students in the comparison group. Sometimes, the learning disabled students who had received this strategy instruction even outscored the regular education students (Englert, Raphael, & Anderson, 1992; Pearson, Cervetti, & Tilson, 2008). A review of research on learning of argumentative writing reinforces the importance of teaching these kinds of cognitive processes to students while also engaging them in social discourse about their writing (Newell, Beach, Smith, & VanDerHeide, 2011).

An example from science used the metacognitive strategy of self-explanation. In one controlled experiment, for example, a group of eighth-grade students used a "think aloud" protocol while reading about the human circulatory system from an often-used biology textbook (Chi, 2000; Chi et al., 1994). The students read a line of text silently and were then prompted to explain to themselves, out loud, what the text meant. A control group (nonprompted) was asked to read the line of text silently twice to approximate the same amount of time dedicated to learning the material by both groups. The researchers found that self-explaining raised the posttest score of both high and low achieving students, with those who explained the most showing the greater gains from pre-to post-test. Furthermore, the results for the more difficult questions—those that required students to integrate knowledge of what they had just learned with prior knowledge—indicated even greater gains for the prompted students. One explanation for these gains was that the prompted students utilized their prior knowledge to a greater degree.

Another form of metacognition is self-regulation of motivation. Students can learn to regulate their own motivation by, for example, creating conducive conditions for study, using learning strategies that are more effective for them, studying with peers, or even rewarding themselves when they have accomplished something. Use of strategies for increasing motivation has been found to improve grades and other measures of achievement (Wolters, 2011). Furthermore, when students have opportunities for self-regulation, including setting their own goals, developing study skills,

and taking ownership of their own learning, they are more likely to succeed after high school (Conley, 2011). These co-cognitive skills appear to be better predictors of long-term success than academic skills alone (Lerman, 2008).

Computer-based tools can assist productive collaborative exchanges that support self-regulation and metacognition. One of the most documented examples originated as the Computer-Supported Intentional Learning project, now known as Knowledge Forum, which allows students to collaborate on learning activities through a communal database with text and graphics capabilities. Within this networked multimedia environment, students can engage in dialogs through their notes about topics they are studying and conversations about formulating and testing conjectures. The tools support knowledge building as a community activity. Students at the elementary, secondary, and higher education levels—across all achievement levels—do better on achievement tests and portfolio measures and show greater depth in their explanations than those in other classrooms (Scardamalia, Bereiter, & Lamon, 1994).

Knowledge forum aims to support creative work with ideas while keeping agency in the hands of the students, enabling more varied interactions among students and between students and ideas. This facilitates self-organization at both the social and conceptual levels, along with better-informed metacognitive control of knowledge production processes that is supported by a collaborative environment which requires articulating explanations and strategies (Bereiter & Scardamalia, 2014). This kind of technology can also assist the classroom teacher: observing a group's interactions can provide a substantial amount of information about the degree to which the work is productive, as well as an opportunity for formative feedback and the provision of support for aligning understandings and goals among group members.

Thoughtful Feedback and Revision. Regular, well-designed feedback on students' work is a critical component of strategic learning. One of the oldest findings in psychological research is that feedback facilitates learning (Thorndike, 1931). Without feedback about conceptual errors or an inefficient backstroke, the learner is likely to persist in making the same mistakes. In a meta-analysis of 131 studies, Kluger and DeNisi (1996) reported an average effect size on learning due to feedback of .40; however, they also found large variation across studies. In identifying characteristics of effective feedback, the authors found that neither nonspecific praise nor negative comments supported learning. Instead, gains were most likely to occur when feedback focused on features of the task and emphasized learning goals.

It is insufficient for teachers merely to give feedback about whether answers are right or wrong. Instead, to facilitate learning, it is equally important that feedback be linked explicitly to clear performance standards and that students be provided with strategies for improvement (Hattie & Gan, 2011). Rubrics are an important tool that allows performance to be judged in relation to well-defined criteria (rather than globally or in comparison to other students), so that feedback focuses on particular qualities of a student's work and provides guidance about what to do to improve, along with immediate opportunities to apply the feedback. Research has found that this approach to feedback fosters a mastery orientation on the part of the students where they seek not only to develop an understanding of the content and improve their skills, including their own learning strategies, but also come to recognize personal relevance and meaningfulness in the work itself (Ames, 1992; Hattie & Gan, 2011). Furthermore, students' sense of agency and motivation are enhanced when they can strive for and demonstrate improvement.

Revision of work is a critical aspect of the learning process, supporting reflection and metacognition about how to approach a particular kind of content or genre of tasks in future learning. Unless students have opportunities to incorporate the feedback as they revise their work or performance (e.g., rework math problems; retry jump shots or musical efforts; reread a tough passage; rewrite sentences, paragraphs and essays; retake tests; revamp products), they cannot benefit optimally from the feedback that teachers or their peers often take considerable time and effort to produce. A long line of research shows that expert performance is related to opportunities for *deliberate practice*, which is coached through the provision of immediate feedback for a performance, opportunities to evaluate and problem-solve, and repeated attempts to refine the behavior or skill (Ericsson, 2006). As individuals become more expert, they can self-evaluate and identify strategies for improvement with less outside feedback.

Opportunities for regular revision also help students develop a sense of confidence and competence as they see the improvements in their work, and a growth mindset that can carry into other contexts. For deliberate practice and revision to occur, feedback should occur during the learning process, not at the end when teaching on that topic is finished, and

teacher and students should have a shared understanding that the purpose of feedback is to facilitate learning. Given that teachers cannot frequently meet one-on-one with each student, classroom practices should allow for students to display their thinking so the teacher will be aware of it, and for students to learn to become increasingly effective critics of their own and each other's work as they use rubrics and other tools to engage in self- and peer-assessment.

Research shows that this kind of assessment carried out during the instructional process for the purpose of improving teaching or learning can be a powerful tool in targeting instruction so as to move learning forward. A landmark research review by Black and Wiliam (1998) found that focused efforts to use formative assessment routinely produced learning gains greater than one standard deviation, which is equivalent to raising the score of an average student from the 50th to the 85th percentile. These large gains were seen when concrete, specific feedback was provided without any grade and when it was followed by opportunities to revise the work.

Formative assessment is more than data gathering. It is a model for supporting learning that is designed to advance a student within his or her zone of proximal development. The assessment step in the formative assessment model – which answers the student's question, "where am I now?" provides the insight needed to enable effective support. That support should ideally be informed by an understanding of learning progressions, which are the next steps likely to support advancement in the domain. A complete formative model, which clarifies goals and provides the means to get there, is synonymous with instructional scaffolding.

Mastery-oriented assessment

To manage the formative feedback and learning process, teachers benefit from being able to draw on a range of assessment strategies and tools such as observations, student conferences, portfolios, performance tasks, prior knowledge assessments, rubrics, peer assessments, and student self-assessments. They can then combine rich evidence of student learning with their own deep understanding of the learning process so that they can use insights from assessment to plan and revise instruction and to provide feedback that explicitly helps students see how to improve (Stiggins & Chappuis, 2005).

A mastery-focused approach to assessment that emphasizes learning goals has been found to help sustain achievement-directed behavior over time and to orient learners toward a focus on improving competence and deeply understanding the work they produce (Ames, 1992). In addition, assessments that place value on growth rather than on scores earned at one discrete moment have been found to create higher motivation, greater agency, and higher levels of cognitive engagement, as well as stronger achievement gains (Blumenfeld, Puro, & Mergendoller, 1992; Stiggins & Chappuis, 2005). In contrast, researchers have found that evaluative, comparison oriented testing focused on judgments about students leads to students' decreased interest in school, distancing from the learning environment, and a lowered sense of self-confidence and personal efficacy (Eccles & Roeser, 2009).

Many schools that have been particularly successful in reducing opportunity and achievement gaps for traditionally marginalized students—producing high graduation and college success rates—have adopted mastery-oriented performance-based assessments that build higher order thinking and performance skills, collaboration and communication skills, motivation and engagement, and a host of co-cognitive skills such as self-regulation, executive function, resilience, perseverance and growth mindset (Darling-Hammond, Ancess, & Ort, 2002; Huberman, Bitter, Anthony, & O'Day, 2014; Noguera, Darling-Hammond, & Friedlaender, 2017). In these schools, assessments of projects, papers, portfolios, and other products are evaluated through rubrics that clearly describe dimensions of quality. When these are coupled with opportunities for feedback and revision, the assessments promote learning and mastery, rather than seeking to rank students against each other. These practices are consistent with research indicating the importance of explicitly expressing high expectations for students that are enacted though meaningful challenges, with opportunities to develop competence, so that students know they are capable of strong achievement (Osher & Kendziora, 2010; Steele, 2011).

Many of these schools require portfolios of rigorous work in each discipline that are presented before committees of teachers and outside jurors, rather like a dissertation defense. The work typically includes social science research papers, science experiments, literary essays, and mathematical models or projects that require in-depth study, extensive writing, and oral presentation (Darling-Hammond & Adamson, 2014). The work may also include problem-based interdisciplinary projects, sometimes grounded in internships in the community. Research suggests that knowledge that is applied to relevant problems and situations is

retained and later used at higher rates, and that students who learn modes of disciplined inquiry within and across content areas are better able to successfully tackle complex problems and learn on their own (Bransford, Brown, Cocking, Donovan, & Pellegrino, 2004).

Performance assessments that encourage higher order thinking, evaluation, reasoning, and deep understanding are themselves tools for learning (Darling-Hammond & Adamson, 2014). In addition to knowledge, the assessments build students' metacognitive and co-cognitive skills, such as planning, organizing, and other aspects of executive functioning; resilience and perseverance in the face of challenges; and a growth mindset. Performance assessments can also provide multiple entry points for diverse learners, including English language learners and students with special needs, to access content and display learning (Abedi, 2010).

The use of curriculum-embedded assessments strengthens teaching by providing teachers with models of good curriculum and assessment practice, enhancing curriculum equity within and across schools – as all students have access to the educative tasks, and allowing teachers to see and evaluate student learning in ways that can inform instructional and curriculum decisions. Such assessments can build students' capacity to assess and guide their own learning, and, through ownership in the learning process, strengthen their interest and motivation.

Motivation and learning

Closely related to the developmental and cognitive processes we have previously reviewed is the issue of motivation for learning. Students will work harder to achieve understanding and will make greater progress when they are motivated to learn something. However, motivation is not just inherent in the individual; it can be developed by skillful teaching.

Motivating Tasks. Researchers have found that student motivation in the classroom is fostered by three major considerations about the tasks and conditions students confront: 1) the nature of the ***task*** and its value to the student; 2) the nature of the ***learner*** and his or her expectations of success; and 3) the nature of the ***learning environment*** and the extent to which it emphasizes learning goals and provides support (Blumenfeld et al., 1992).

First and foremost, motivation is about the learner's perceptions of the task. As Lee (2017) notes, the learner implicitly asks: "What am I being asked to do?"; "Am I capable of tackling these tasks?"; "Is this task meaningful to me?"; "What supports are available to me to wrestle with this task?"; "Do I feel safe in attempting to wrestle with this task?"; and "How do I weigh any risks or competing goals?"

A learning task will have more value to students if they believe it is important, if it is relevant to their lives, can be connected to events they have experienced or care about, or focuses on problems that are interesting and realistic (Eccles, 2005). It is helpful if the task offers choices of topics, research strategies, or modes of presentation that allow students to make a connection to their interests. A motivating task is also approachable (i.e., within the zone of proximal development) and structured to provide evidence of progress along the way, so that it offers ongoing incentives to continue. Students are more likely to value learning when intrinsic reasons for learning are emphasized, as when the task potentially benefits others and/or results in products or performances that have an audience beyond the teacher (Ryan & Deci, 2000).

Students need to believe they can be successful if they are going to try. Their expectations for success influence their willingness to apply effort toward learning (Eccles, 2005). These expectations depend on students' perceptions of the task and their likelihood of success, as well as on their inclinations to undertake new learning, tackle difficult tasks, and take risks. These inclinations, in turn, are related to self-perceptions of ability and mindsets. Students with confidence in their abilities to succeed at a task work harder and persist longer, which leads to better performance (Eccles & Roeser, 2009; Stipek, 1996).

Among the factors shaping this sense of efficacy are students' beliefs about intelligence and their capacity to improve their intellectual abilities. If students believe that intelligence is a fixed trait and that there is nothing they can do to expand their capacity to learn tend to think that no amount of effort will be worthwhile when they encounter a difficult task. Those who believe that intelligence is "incremental" and can be cultivated tend to be willing to try new things and to work harder when they encounter an obstacle, rather than giving up (Dweck, 2000).

Students' sense of academic identity also matters. If a student feels he is "not good at math," or a "bad reader," it will negatively affect his attention, motivation, and learning. Conversely, if a student sees herself as a mathematician, a reader, a scientist, or a writer, she will be more likely to engage and adopt a growth mindset in that domain. In addition, students

who have received societal or school-delivered messages that they are less capable as a function of their race, ethnicity, gender, income, or other status will often translate those views into self-perceptions of ability affecting their performance on school tasks or tests (Steele, 1997).

Schools foster these beliefs to the extent that they group or track students in ways that convey messages about perceived ability, deliver stereotypic messages associated with group status, or emphasize ability rather than effort (e.g., "smartness" vs. "hard work") in their judgments about students and attributions of causes of success (Dweck, 2000). In the classroom, teachers should avoid labeling students and instead provide positive affirmations about individual and group competence, emphasize the importance of effort, and encourage students to understand that through effort they will indeed improve. Teachers can also acknowledge improvements through their feedback and the ways their assessment and grading systems credit growth.

To make challenging tasks motivating and enhance expectancies of success, teachers can organize their lessons to connect them to issues relevant to students' lives, scaffold the learning process, and ensure that there are many ways for students to learn and represent their understanding (Blumenfeld et al., 1992).

The learning environment supports motivation when learning and mastery goals are emphasized, rather than grades or performance goals. Learning goals are encouraged when scaffolding and support are provided, effort and improvement are recognized, mistakes are treated as learning opportunities, students have the opportunity to revise their work, evaluation emphasizes learning, individual competition and comparison are minimized, and students are grouped by topic, interest, or choice rather than by their performance (Blumenfeld et al., 1992).

These classroom features enhance intrinsic motivation, which more often results in high-quality learning and creativity. In contrast, extrinsic motivation based on external rewards that are used to control students' behavior can reduce students' intrinsic motivation for the task as well as the quality of performance on the task (Ryan & Deci, 2000). Although extrinsic rewards are sometimes useful to create incentives for a new behavior or practice, their use should be minimal and reduced over time as the desired behavior become commonplace.

Interest-Driven Learning. As we have noted, one driver of intrinsic motivation is interest in a topic, object, or activity. Ecological views of learning and development have focused attention on interest-driven learning, which is particularly important for development because it requires self-regulation, defining and pursuing goals, and reflection on how well one is doing (Barron, 2006). Neurological data, longitudinal ethnographic studies, naturalistic observational research, and experiments converge to provide evidence of the short and long term benefits of interest for learning (Renninger & Hidi, 2017). In the short term, interest is cognitively energizing and it increases attention, leads the learner to generate questions, and sustains engagement in learning activities. In the longer term, interest can catalyze a consequential series of choices that over time accumulate and help launch pathways to future jobs, educational opportunities, and careers. Interests can also support academic resiliency, for example, in overcoming challenges in processing text or persevering in difficult tasks.

In the four-phase model of interest development (Hidi & Renninger, 2006), earlier phases of interest are dependent on the social environment. As interests become more deeply connected to values, purpose, meaning, and identity, they become increasingly self-sustaining. Choices to learn might include initiating a new project activity, pursuing opportunities for mentoring, deciding to enroll in a formal class, or using technology to engage in personal learning excursions (Barron, 2006; Wigfield & Cambria, 2010). At the same time, consistent with a contemporary understanding of the science of learning and development, interest in any domain is dynamic and can exhibit continuities and discontinuities depending on access to resources, such as welcoming affinity groups, relevant technologies and tools, role models, learning opportunities, and time (Azevedo, 2018, Cantor et al., 2018).

In this ecological view, the origins and evolution of interests are connected to both contextual and individual variables. They are simultaneously socially grounded (Osher et al., 2018) and influenced by personal relevance based on unique experience, sense of purpose, and goals for the future (Eccles, 2005; Harackiewicz & Hulleman, 2010). Teachers have a significant role to play in developing interests by customizing assignments and offering choices, providing material that sparks curiosity, expressing their own enthusiasm for a topic, designing activities that support exploration and are relevant to student identities, and connecting students with peers and mentors that share interests. When teachers consider the longer term trajectories of learning and development, they are better positioned to help broker future learning

opportunities in addition to directly influencing learning through guiding, modeling, and explaining. In this view, interest is both a cause and a consequence of learning.

Interests can develop over long periods of time linked to activities that take place both in and outside of school (Azevedo, 2013). Homes, libraries, museums, camps, and a range of digital environments provide social and material resources for interest-driven learning (Barron & Bell, 2015). Teachers can help parents support interests by sharing ideas about ways to collaborate, learn from, or broker opportunities for their children. Meanwhile, parents can share with teachers what they have observed when their children are at home and have free time to explore activities on their own. They are uniquely suited to notice and support a child's nascent interests.

Digital technologies provide an important catalyst for interest-driven learning, as they can be leveraged for learning across time and settings, with interests launched at school leading to informal learning at home, in summer camps, or in community based contexts (Barron, 2006, 2010). The self-sustaining nature of interest-driven learning with technologies represents an important dimension of personalized learning. For example, technology is expanding opportunities for young people to gain experience with design-oriented activities like movie making, programing, and fabrication. In addition, as the NRC (2000) noted in *How People Learn,* interactive computer technologies can help people visualize difficult-to-understand concepts, give users feedback while they are learning, and learn about students' approaches to learning so as to personalize opportunities to learn.

While many uses of technology have been found ineffective, uses that support student interests have been found to support achievement. A recent review of 70 studies ranging from large-scale experimental and quasi-experimental designs to smaller case studies noted that most studies found no effect on learning. Ineffective uses of technology featured "individualized" progression through workbook-type activities; phonics, grammar and punctuation exercises; drill on math items; and practice with multiple-choice test questions. Effective uses, on the other hand, featured simulations, games, data analysis, and writing that was part of interactive learning, where the technology was used to engage with data, explore and create, express ideas, and develop presentations of learning; and where peer discussions and teacher-led activities were also part of instruction (Darling-Hammond, Zielezinski, & Goldman, 2014).

An example highlighted in the review illustrates the importance of combining interest-driven learning with the use of technology. Educators in Talladega County, Alabama introduced one-to-one computing through a project-based learning program in which students conducted in-depth research projects, recorded podcasts, developed multi-media presentations, and designed and produced publications about their work. The initiative dramatically improved high school graduation and college-going rates (Darling-Hammond, Zielezinski, & Goldman, 2014).

Deep engagement in interest-driven experiences is associated with *psychological assets* like a sense of confidence in creating novel ideas, confidence in learning about computing, a projected future of continued learning, or feelings of expertise with professional tools; *social dispositions*, marked by an increased likelihood of teaching others what one knows; and *choices to learn more* as reflected in efforts to sustain learning, including starting new projects in school or at home, choosing to take elective classes to advance one's skills, finding mentors or peer-based learning partners, and locating informational resources in books or online (Barron & Martin, 2016). These types of choices creating generative learning can help students learn to learn independently and set the stage for lifelong learning.

Summary. The research we have reviewed suggests that, to support student learning, curriculum and instruction should be designed so that it helps build mental schema or models that connect ideas central to the discipline or domain. These goals should be pursued in a thoughtful sequence through authentic tasks and understandable representations that build on students' prior knowledge and capture the key aspects of the content to be learned. To facilitate deep understanding and transfer, teachers should combine explicit instruction with guided inquiry that allows students to engage in problem solving in real-world contexts and should promote agency by asking students to evaluate, analyze, and create ideas, products, or solutions (Donovan & Bransford, 2005).

Finally, to enable increasingly effective learning and the development of productive habits and mindsets, curriculum and assessment should support the acquisition of metacognitive skills, offer feedback throughout the learning process, encouraging students to revise their work so that they can internalize standards and perceive evidence of their growing competence that

supports a growth mindset. Providing opportunities for revision along with timely, constructive feedback on a regular basis encourages a mastery oriented approach to learning. Combined with a learning environment that supports individual needs, helping students develop the capacity to monitor their own learning promotes a sense of agency and ownership over their work, which in turn fosters motivation. All of these strategies are designed to help students become more self-sufficient and capable learners.

Support for the development of social, emotional, and cognitive skills, habits, and mindsets

As we have noted, academic learning is tightly intertwined with social and emotional skills, mindsets, and decisions. Some of these are reinforced by instructional approaches that reduce anxiety and support a growth mindset, for example. Yet, more is needed to ensure that students fully develop these abilities to manage their emotions and mental focus, to work well with others, to persevere in the face of obstacles, and to make productive and socially responsible decisions. In this section, we treat the intentional development of the social, emotional, and cognitive skills, beliefs, and mindsets that support academic and life success.

What the science of learning and development tells us

The SoLD synthesis builds on rich developments over the past two decades in social and emotional learning (SEL) (Osher et al., 2016). *Cognitive skills* such as problem-solving, responsible decision making, and perspective taking interact with *emotional skills* such as emotion recognition, empathy, and emotion regulation, and with *social skills* including cooperation, helping, and communication (Cantor et al., 2018). Attitudes, beliefs, and mindsets also matter for school and life success. Holding a growth mindset and connecting academic endeavors to personal values support learning. These capacities are influenced by input from teachers and other adults, and, in turn, they inform higher order skills across cognitive, emotional, and social domains. Social, emotional, and other conditions of cognitive engagement influence the affective salience of instruction, how safe students feel, and how they focus their attention and make decisions (Osher & Kendziora, 2010).

Principles of practice

Acknowledging the importance and the interaction of these capacities, the science of learning and development suggests the following principles for educational practice:

1. Schools and classrooms should explicitly teach and provide regular opportunities to integrate social, emotional, and cognitive skills into academic curricula and throughout the school day.
2. Students should receive guidance and support to develop habits and mindsets that promote perseverance, resilience, agency, and self-direction (e.g., executive function, self-regulatory routines, stress management, growth mindset).
3. Schools should offer educative and restorative behavior supports that teach students skills which enable positive behaviors, encourage them to take responsibility, and, as needed, make amends to restore relationships and community health.

All of these practices support and derive from a school culture that aims to develop strong relationships, trust, positive interactions, and thoughtful development of student agency.

Promoting social emotional learning with students

Developing social-emotional skills. The Collaborative for Academic, Social, and Emotional Learning (CASEL) identifies five main areas of social-emotional competence: *self-awareness* involves identifying emotions and accurate self-perceptions; *self-management* includes managing stress and controlling impulses, which includes aspects of executive function; *social awareness* entails perspective taking, empathy, and appreciation for diversity; *relationship skills* involving communication and cooperation are about establishing and maintaining healthy relationships; and *responsible decision making* focuses on skills like identifying problems, evaluating, reflecting, and acting with consideration for the well-being of oneself and others.

Some approaches to fostering students' academic, social, and emotional learning are delivered through stand-alone instruction, while others focus on integration of skills within the core academic curriculum. Formal programs teaching SEL have shown considerable success. A meta-analysis of 213 controlled studies of SEL programs, representing more than 270,000 students from urban, suburban, and rural schools, found participating students showed greater improvements than comparison students in their social and emotional skills; attitudes about themselves, others, and

school; social and classroom behavior; test scores and school grades, including an aveage 11 percentile point gain in achievement, with an overall mean effect size of .27 for academic performance and .57 for SEL skills. Students also experienced reductions in misbehavior, aggression, stress and depression (Durlak et al., 2011). Benefits of SEL interventions on skills, attitudes, behavior, and academic performance have been found to endure and serve as a protective factor (e.g., preventing conduct problems and drug use) on follow-up measures collected 6 months to 18 years later (Taylor, Oberle, Durlak, & Weissberg, 2017).

Effective SEL programs provide instruction that is sequential, active, focused, and explicit (Durlak et al., 2011). SEL programing is more effective when conducted by school personnel who themselves have opportunities to support and deepen their own skills (Weissberg, Durlak, Domitrovich, & Gullotta, 2015). This highlights the critical need for ongoing professional development around educators' social-emotional skills as a vital element for promoting these capacities in students. Outcomes can also be enhanced when SEL is embedded throughout the school day, and integrated into other subject matter rather than introduced as stand-alone curriculum (Jones & Bouffard, 2012). More integration allows for strengthening of skills and transfer of learning by capitalizing on teachable moments and opportunities to reinforce and practice skills throughout the school day. Mindfulness practice, which cultivates greater awareness of one's experience infused with kindness (Kabat-Zinn, 1994), and related contemplative practices have also been linked to more prosocial behavior and reductions in implicit bias (Kang, Gray, & Dovidio, 2014; Lim, Condon, & DeSteno, 2015).

Implementing SEL Practices in Schools. An agenda to develop these critically important skills may begin by implementing efficacious SEL programs and other specific interventions, such as those included in guides provided by Center for Academic, Social, Emotional Learning (CASEL, 2013) and the U.S. Department of Education. Identifying common ingredients that are shared across effective programs and integrated into schools' normal routines (e.g., class meetings) and daily pedagogical practice can support a more integrated approach (Jones & Bouffard, 2012). For example, the American Institutes for Research identified 10 instructional strategies that teachers use throughout the school day that can affect students' social and emotional skills. Examples include the kind of language teachers use, cooperative learning, and student-centered discipline (Yoder, 2014), all practices we treat elsewhere in this article.

In studies of high schools organized to develop socially and emotionally competent students, researchers found that student engagement, achievement, and positive behavior (being collaborative and supportive of their peers, resilient, employing a growth mindset, valuing opportunities to help others) were associated with infusion of social and emotional learning opportunities in every aspect of the school. This ranged from curriculum focused on perspective-taking and empathy in history and English language arts to community and social problem solving in social studies, math, and science; community service projects; and the teaching of specific conflict resolution strategies and the use of restorative practices (Hamedani, Zheng, Darling-Hammond, Andree, & Quinn, 2015). A whole school approach imbued with a social justice orientation, underscoring themes of interdependence and social engagement in daily activities, enabled students to act as agents of change, which enhanced their motivation and sense of agency, increased achievement and attainment, and reduced educational inequality.

Developing habits, beliefs, and mindsets

A wide range of habits, beliefs, and mindsets influence emotions and learning, shaping how children approach and engage with the world, how they interpret the messages they receive, and how they respond to opportunities and challenges. Here we discuss those related to cultivating executive functions, developing productive mindsets, and reducing stress and trauma.

Cultivating executive functions (EFs). Among the habits important for school success are those associated with the executive functions, which operate in four interrelated executive domains – attentional control, cognitive flexibility, goal setting, and information processing, which operate in an integrative manner to enable "executive control" (Anderson, 2002). Children are engaged in exercising EF throughout the school day: to focus on their assignment and not get sidetracked by distracting thoughts, to follow multi-step instructions and make adjustments as necessary, and to take turns during play, to name a few examples. Although explicit development of executive functions has often been restricted to special education settings, most children need support to develop these skills optimally.

Teachers can offer explicit opportunities to learn executive functions by providing tools and modeling to help students learn to organize themselves, think

ahead, plan their actions, and decide on what behaviors they will pursue, rather than reacting impulsively. As we discussed earlier, these are skills and habits that are reinforced by the development of metacognitive skills, which allow children to reflect on and evaluate their plans and decisions. As teachers assign and scaffold complex work, they are building executive functioning and metacognitive skills.

A well-scaffolded environment with strong organizational routines can help promote EF as students learn to model approaches to tasks that can become part of their own organizational structures and self-management later. These reliable approaches to tasks—ranging from organizing one's notebook to engaging in instructional conversations or collaborative tasks—can reduce cognitive load and promote learning as executive functions develop, while modeling strategies that can become part of the EF repertoire if teachers are explicit about their reasons for different structures and if they gradually reduce scaffolding over time.

Executive functions have been shown to improve through repeated practice coupled with increased challenge via games, aerobics, martial arts, yoga, mindfulness, and school curricula (Diamond & Lee, 2011). Executive functions training can also be part of broader SEL programs, and has been found to be beneficial to young children from the preschool years to pre-adolescence (Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008; Diamond & Lee, 2011). Although explicit EF training is often targeted toward younger students, brain development spurts in adolescence enable young people to think abstractly and become more deeply reflective. Explicitly fostering higher order executive skills at this age can lead to the greater levels of self-direction needed as students enter secondary school and, later, college and careers.

Developing Productive Mindsets. Students' beliefs and attitudes have a powerful effect on their learning and achievement. Four key mindsets have been identified as conducive to perseverance and academic success for students: 1) a belief that one belongs at school, 2) belief in the value of the work, 3) belief that effort will lead to increased competence, and 4) sense of self-efficacy and the ability to succeed (Farrington, 2013). The types of messages conveyed by teachers and schools and corresponding attitudes may be especially relevant with adolescents for whom the explicit skills training approaches that work for younger children tend to be less beneficial. Effective programs that promote stronger learning for adolescents involve creating climates in which adolescents feel respected and affirmed, and giving them challenging work on which they are enabled to improve (Dweck, 2017; Yeager & Walton, 2011).

The belief that effort will lead to increased competence constitutes a growth mindset, which has been found to foster greater achievement and well-being across academic, emotional, and social domains (Dweck, 2000, 2017). The core principle, that skills can always be developed, is consistent with the science of neuroplasticity: that the brain is constantly growing and changing in response to experience. Learning this fact alone has been found to help change students' perspectives on their learning. Providing feedback focused on effort and process encourages students to adopt a growth mindset, whereas feedback that focuses on traits (e.g., "smarts") depresses student motivation and achievement. Providing students with meaningful learning challenges, supports, and a clear sense of progress leading to mastery helps students develop a growth mindset (Dweck, 2017).

Students from groups that experience discrimination face particular challenges in feeling confident that their efforts will produce positive outcomes. Teachers can reduce student self-doubt and bolster confidence by showing that they value students. For example, affirmation interventions that guided students to share their personal goals for learning with their teachers in notes to which teachers responded were found to reduce the effect of stereotype threat among middle-school students, resulting in higher academic performance for Black students with gains in grades sustained as long as two years later (Cohen et al., 2009). Shaping productive mindsets can set into motion a cascade of effects that accumulate over time to result in more positive school outcomes; for example, increasing school affiliation and self-concept, resulting in higher levels of academic engagement that becomes self-reinforcing (Yeager & Walton, 2011). A positive racial identity can also buffer societal negative stereotypes (Yip, 2018).

Reducing the effects of stress and trauma. When children or adults are distracted by concerns that flow from their lives outside the classroom or social dynamics within the classroom, their capacity to focus on learning can suffer (Center on the Developing Child, 2016). Traumatic or strongly emotional events can simultaneously influence the regulation of affect (for example, feelings of depression or anxiety), physical phenomena (such as heart rate or adrenaline production), and cognition (for example, executive functioning and working memory). Chronic stress due to trauma affects cognition and working memory.

Cognitive load in the classroom is exacerbated by a lack of safety and belonging.

Teachers' abilities to maintain a supportive, culturally responsive environment with consistent routines support student learning by reducing hyper-vigilence, anxiety, and extraneous cognitive load. School support systems that offer counseling and social supports when children experience adversity, described in the Educative and Restorative Approaches to Behavior section, are also important to enable children to manage their emotions and improve their circumstances so that they are able to learn.

Researchers have also investigated mindfulness as a tool to reduce stress and cultivate calmness and attention. Mindfulness practice strengthens internal and external awareness by bringing deliberate attention to all of one's experience, including breath, body, thoughts, feelings, and the surrounding environment (Kabat-Zinn, 1994). The practice of mindfulness promotes neural integration, and may be particularly helpful during the period of adolescent brain remodeling, contributing to higher capacities for regulation (Siegel, 2013). The use of mindfulness strategies for monitoring and redirecting attention has begun to show benefits for learning at all ages. A meta-analysis of 24 studies investigating mindfulness training with children in school settings found positive effects, with moderate effect sizes, on cognitive performance (particularly attention), stress reduction, and resilience (Zenner et al., 2014).

Educative and restorative approaches to behavior

A developmentally appropriate approach to behavior management recognizes students' behaviors as demonstrations of a developmental need and as a set of skills that need to be taught and developed, not demanded. Explicit teaching of self-regulation, conflict resolution, and other skills creates a virtuous circle of responsible behavior. Studies have found, for example, that even in elementary school, when students learn and practice skills of conflict resolution, they become more inclined to work out problems among themselves before the problems escalate (Johnson, Johnson, Dudley, & Acikgoz, 1994). Students who have been aggressive benefit especially from learning specific skills for managing conflicts peacefully that differ from what they have previously learned at home or from peers (Tyrrell, Scully, & Halligan, 1998). The results of such teaching are increased social support, improved relations, higher self-esteem, increases in personal control, and higher academic performance (Deutsch, 1992).

Research also finds that coercive discipline, in which teachers manage student behavior largely through punishments, inhibits the students' development of responsibility, ultimately increasing misbehavior, as students increasingly abandon their own self-responsibility for their learning and behavior and develop resistance and opposition to school (Lewis, 2001; Mayer, 1995), while exacerbating discriminatory treatment of students (Townsend, 2000).

A punitive environment undermines learning by heightening anxiety and stress, placing extra demands on working memory and cognitive resources, which drains energy available to address classroom tasks (e.g., Pennington, Heim, Levy, & Larkin, 2016). By contrast, an educative approach supports learning, as teachers's proactive and positive responses create a safe and empowering classroom environment through reinforcing and reminding language (including verbal and nonverbal cues), approaching students in a nonthreatening manner, presenting students with problem-solving options as a means of deescalating potentially explosive situations, and using nonpunitive, restorative consequences (Turnaround for Children, 2016).

Students who learn in such supportive communities have higher levels of self-understanding, commitment, performance, and belongingness, and fewer discipline problems (Sergiovanni, 1994). These settings reduce the likelihood of disruptive behavior occurring in the first place. Authoritative approaches that strengthen interpersonal supports and connections, establish structures for fair processes, and encourage student voice are especially responsive to the developmental needs of adolescents and in line with a style that is known to be beneficial for parenting, as well as teaching (Gregory, Clawson, Davis, & Gerewitz, 2016).

Educative approaches are also important for addressing the excessive reliance on exclusionary discipline in many schools, which persists in spite of evidence that punishment and exclusion do not work and often have harmful effects (Mayer, 1995; Osher, Bear, Sprague, & Doyle, 2010). This is particularly the case for many students of color, who are not only disproportionately removed from class and school, but also are removed for longer terms, with disproportionalities being the largest in subjective offenses that are more likely to be affected by implicit as well as explicit bias. Exclusionary discipline does not teach students new strategies they can use to interact and solve problems, nor does it enable teachers to

understand how they may unintentionally trigger or escalate problem behavior (Losen, 2015).

School discipline policies that exclude students through suspension and expulsion create a range of dysfunctional consequences: The more time students spend out of the classroom, the more their sense of connection to the school wanes, both socially and academically. This distance promotes disengaged behaviors, such as truancy, chronic absenteeism, and antisocial behavior (Hemphill et al., 2006), which, in turn, exacerbates a widening achievement gap. The frequency of student suspensions is linked to academic declines and an increased likelihood of dropping out (Raffaele Mendez, 2003).

Many schools have started to reduce their suspension and expulsion rates by adopting restorative practices that focus on reflection, communication, community building, relational-based discipline, and making amends instead of relying on punishment (Karp & Breslin, 2001; Skiba, Arredondo, & Rausch, 2014). Restorative discipline is an approach to dealing with conflict built on relational trust, with systems—including peace circles and peer or adult mediation—by which students reflect on any mistakes, repair damage to the community, restore relationships, and get counseling and other supports where needed. Restorative practices also include universal interventions such as daily classroom meetings, discussions of how to manage feelings, and conflict resolution strategies.

Syntheses of research suggest that restorative practices result in fewer and less racially disparate suspensions and expulsions, fewer disciplinary referrals, improved school climate, higher quality teacher-student relationships, and improved academic achievement across elementary and secondary classrooms (Fronius, Persson, Guckenburg, Hurley, & Petrosino, 2016; Gregory, Clawson, Davis, & Gerewitz, 2016). The more comprehensive and well-infused the approach, the stronger the outcomes. For example, a continuum model including proactive restorative exchanges, affirmative statements, informal conferences, large group circles, and restorative conferences, substantially changed school culture and outcomes rapidly in one major district, as disparities in school discipline were reduced every year for each racial group, and gains were made in academic achievement across all subjects in nearly every grade level (Gonzalez, 2015). Creating an environment in which students learn to be responsible and are given the opportunity for agency and contribution can transform social, emotional, and academic behavior and outcomes.

Summary. Student learning and behavior benefit from explicit teaching of social-emotional skills and opportunities to practice those skills throughout the day. As teachers infuse skills such as self-management, empathy, collaboration, and responsible decision making into instruction, and explicitly cultivate executive functions that support SEL through classroom routines and habits, they strengthen students' abilities to focus and persevere in their learning. Teachers also play an important role in shaping students' beliefs about their own abilities, their sense of belonging, and their academic mindset. Self-efficacy is enhanced by a student's confidence that effort increases competence. A growth mindset enables students to engage more productively in academic pursuits and to persevere in the face of challenges. All of these are supported by an inclusive school environment that uses educative and restorative approaches to support behavior rather than relying on punitive methods that exclude and discourage students.

System of supports

As schools develop supportive environments for all children's learning, they must also be prepared to address individual needs that can create barriers to learning and development. These may be the result of academic challenges or adverse childhood experiences, such as physical or mental illness, abuse, neglect, food or housing insecurity, exposure to violence, divorce, loss of a parent, or other difficulties. School environments that are trauma-sensitive incorporate a personalized approach to identify and address each child's developmental needs and provide children with psychological safety, adult alertness and responsiveness, and necessary supports.

What the science of learning and development tells us

Cognitive, social and emotional competencies develop within a complex system of contexts, interactions and relationships, all of which matter for children's outcomes. Adversity and trauma occur in all communities, as does healthy development. In the context of adverse childhood experiences, excessive stress at home, school or in other aspects of the community can undermine brain development and learning, and have profound effects on children's well-being. Well-designed supports, including strong relationships as

well as specific programs that prevent or buffer children against excessive stress, can reduce vulnerability (Spencer, 2007) and enable resilience and success even for children who have faced serious adversity and trauma (Cantor et al., 2018; Osher et al., 2018). Teachers and other adults should be trained to work with children who have been traumatized and supported in the development of their skills and the management of their own stress so that their actions can be experienced by students as being helpful and compassionate (Osher, Kidron, DeCandia, Kendziora, & Weissberg, 2016).

Principles of practice

To address children's needs as they occur, the science of learning and development suggests the following principles for practice:

1. Schools should create a collaborative multi-tiered system of supports to meet student needs and address learning barriers both in and out of the classroom based on a shared developmental framework uniting staff, families, and support providers.
2. Schools should develop internal student support structures (e.g., counseling and student support teams) and coordinate access to integrated services (including physical and mental health and social service supports) that enable children's healthy development, via on-site supports and partnerships with community providers.
3. Extended learning opportunities should be designed to support personalized instruction and mentoring that nurture positive developmental relationships, support mastery learning, and close achievement gaps.

Multi-tiered systems of support to address student needs

A key aspect of creating a supportive environment is a shared developmental framework among all of the adults in the school, coupled with procedures for ensuring that students receive additional help for social-emotional or academic needs when they need them, without costly and elaborate labeling procedures standing in the way. Multi-tiered systems of support include multi-disciplinary student support teams, on site pupil services personnel (e.g., social workers, school psychologists, counselors, and nurses) who are skilled in culturally competent academic and behavioral assessment, care coordination, and family engagement with support teams.

Most such systems include three tiers of support involving, first, promotion and prevention, then selective intervention, and intensive intervention (Adelman & Taylor, 2008). The first tier is universal—everyone experiences it. Ideally, teaching strategies are grounded in universal designs for learning that are broadly successful with children who learn in different ways, as well as positive behavioral support strategies that are culturally and linguistically competent (Osher, Kidron, Brackett, et al., 2016). Tier 2 services and supports address the needs of individuals who are at some elevated level of risk or who need some additional support in particular areas. The risk may be demonstrated by behavior (e.g., number of absences), by academic struggles (e.g., difficulty reading), or by having experienced a known risk factor (e.g., the loss of a parent). Tier 2 services could include academic supports (e.g., Reading Recovery, math tutoring, extended learning time) or family outreach, counseling, and behavioral supports. Tier 3 services involve intensive interventions for individuals who are at particulary high levels of risk or whose needs are not sufficiently met by Tier 2 interventions. Tier 3 services might include wraparound services and effective special education.

Interventions are tiered, not students, and supports can and should be provided in normative environments. Students are not "tier 2 or 3 students"; they receive services as needed for as long as needed but no longer. Providers should recognize that student have strengths in many areas and build upon student assets, not just focus on deficits. It is particularly important that Tier 2 and 3 services be implemented in a child- and family-driven manner that is culturally competent. This can maximize engagement and minimize errors that occur when students, families, or teachers are not asked about their context and needs. Interventions should minimize removal from the mainstream classroom or extracurricular environments and learning. These supports often benefit from collaboration with local service agencies and community-based organizations with communication feedback loops to school-based staff. The key is that a whole child approach is taken whereby students are treated in connected, rather than fragmented ways and care is personalized to the needs of individuals.

Helping staff and parents better understand child development is critical so that they can use information about children in productive ways to foster their deeper attachment and growth. When staff and

parents work together from a developmentally informed framework, substantial improvements occur for children. The School Development Program (SDP) is an example of this approach and illustrates how to enact many of the other SoLD principles (Darling-Hammond, et al. 2018). Building upon relationships and school culture to address 6 developmental pathways—social-interactive, psycho-emotional, ethical, cognitive, linguistic and physical—the program establishes collaborative working relationships among principals, parents, teachers, community leaders, and health-care workers, teaching them about child development and grounding collective action in a shared developmental framework for multi-tiered supports (Darling-Hammond et al., 2018). Research on the SDP shows that it helps reduce absenteeism and suspension, improves school climate and relationships among students and teachers, increases student self-competence and self-concept, and strengthens achievement (for reviews, see Darling-Hammond et al., 2018; Lunenburg, 2011).

Integrated student services

Awareness of the pervasiveness of student toxic stress across the income spectrum as well as growth of child poverty in economically traumatized communities has created additional demands for health, mental health, and social service supports that are needed for children's healthy development and to address barriers to learning. A number of approaches have emerged to creating integrated student services, also called wraparound services, which link schools to a range of academic, health, and social services. ISS programs address the reality that children whose families are struggling with poverty—and the housing, health and safety concerns that often go with it—cannot learn most effectively unless their nonacademic needs are also met. The goal is to remove barriers to school success by connecting students and families to service providers in the community, or bringing those services into the school.

Examples include Schools of the Twenty-First Century in New Haven, Connecticut, the Children's Aid Society in New York City, the West Philadelphia Improvement Corps, and Communities in Schools programs in 25 states, all of which have brought social services to schools through community partnerships for over 30 years. These and other models provide on-site child care and early childhood development; job training, transportation, and housing assistance for parents; health care and mental health services, child nutrition, and food assistance programs. A social worker or community school coordinator conducts needs assessments, partners with agencies outside the school, and tracks program data (Moore & Emig, 2014).

A research synthesis that examined 11 experimental and quasi-experimental studies of ISS models found significant positive effects on student progress in school, attendance, mathematics and reading achievement, and overall grade point averages. These studies also found measurable decreases in grade retention, dropout rates, and absenteeism (Moore & Emig, 2014). A study of the Massachusetts Department of Elementary and Secondary Education Wraparound Zones program, which set up partnerships with community groups to improve school climate and address students' nonacademic needs, found student outcomes on state English language arts and math assessments in wraparound schools were significantly better than those in matched schools (Gandhi, et al., 2015).

Many of these features come together in well-designed community school models. Community schools represent a place-based school improvement strategy in which "schools partner with community agencies and resources to provide an integrated focus on academics, health and social services, youth and community development, and community engagement" (Coalition for Community Schools, 2018, p. 1). Many operate year-round, from morning to evening, serving both children and adults. A recent review of 125 studies of community schools and their components, which include integrated services, family engagement, expanded learning time, and collaborative partnerships, found significant evidence for the benefits of these approaches for student outcomes ranging from attendance and behavior to student achievement and graduation (Oakes et al., 2017). In these models, schools draw on a wide range of community and cultural resources to strengthen trust and build resilience as children have more support systems and people working together to help address the adversities they may face.

Extended learning time

Given the plasticity of the brain, and its experience dependency, the amount and consistency of cognitive stimulation matters. By high school, as much as two-thirds of the difference in achievement between affluent and low-income students is the cumulative result of summer learning loss for those who lack year-round enrichment and learning opportunities

(Alexander, Entwisle, & Olson, 2001), and lose about one month of achievement on average during the summer (Cooper et al., 1996).

Extending learning time is one way to address these gaps. Before and after school and summer programs can expand learning opportunities for students. Examples of out-of-school time (OST) enrichment activities include additional academic instruction, mentoring, and hands-on learning experiences, in music, art, and athletics. Research consistently documents the benefits of such programs, with the greatest academic gains associated with frequent attendance in longer duration programs with high quality instruction (Oakes et al., 2017).

In a meta-analysis of 93 summer programs, Cooper et al. (2000) found positive impacts on knowledge and skills for middle- and low-income students from programs focused on both remediation and enrichment, with an average effect size of 0.25. The strongest effects were found for smaller programs and those that provided more individualized and small-group instruction. However, even the largest programs showed positive effects. Other reviews show similar effects (McCombs et al., 2011), and a review of effects for "at-risk" students found stronger outcomes for longer programs and those with both social and academic foci than for those that were academic alone (Lauer et al., 2006). Furthermore, as in other contexts, programs featuring tutoring in a content field such as reading had substantial effects.

After school programs can also make a difference. A meta-analysis of 68 studies of afterschool programs—ranging from Twenty-First Century Community Learning Centers, programs conducted by Boys and Girls and 4-H Clubs, and others—found positive impacts of participation on self-perception, bonding to school, social behaviors, school grades and levels of academic achievement, as well as significant reductions in problem behaviors, compared with students in a control groups (Durlak, Weissberg, & Pachan, 2010). Notably, the afterschool programs that demonstate the most success implement practices that are consistent with SoLD principles: they build on youth, family, and community assets; build developmental relationships with youth and create a warm and welcoming environment; support skill building, and provide authentic opportunities for youth voice, choice, and leadership (Moroney, Newman, & Osher, 2018).

Summary. A system of supports for students can take many forms, including multi-tiered systems of support, access to an integrated system of services, and extended learning opportunities. These supports

Table 1. Practices aligned with the science of learning and development.

I. Supportive Environment			**II. Productive Instructional Strategies**		
Structures for Effective Caring	Classroom Learning Communities	Connections among staff and families	Student-centered instruction	Conceptual understanding & Motivation	Learning how to learn
• Small schools • Small class size • Advisories • Block scheduling • Looping • Teaching teams • Longer grade spans	• Intentional community-building • Cultural competence • Identity safety • Consistent routines	• Relational trust • Staff collaboration • Home visits • Regular parent conferences • Authentic family engagement	• Building on prior experience • Teaching to readiness • Personalization • Collaborative learning • Cognitive supports	• Conceptual map of the domain • Inquiry + explicit instruction • Motivating tasks with skillful scaffolding • Interest-driven learning	• Teaching metacognition + learning strategies • Formative feedback, practice & revision • Mastery-oriented performance assessment
III. Social and Emotional Development			**IV. System of Supports**		
Integration of Social Emotional Skills	Development of Habits & Mindsets	Educative & Restorative Behavioral Supports	Multi-tiered systems of support (MTSS)	Coordinated access to integrated services	Extended learning opportunities
• Teach intra- and inter-personal skills, empathy, conflict resolution, collaboration, responsibility • Integrate & practice skills throughout the day	• Teach executive functions • Develop growth mindset, self-efficacy, sense of belonging • Use mindfulness, tools for stress management	• Teach students behavioral skills & responsibility • Cultivate community contributions • Repair harm by making amends	• Tier 1: Use universal designs for learning and knowledge of child development • Tier 2: Diagnostically identify additional services needed • Tier 3: Provide intensive interventions	• Wraparound health, mental health and social services • Community partnerships • Family & community engagement	• Before & after school enrichment, mentoring, and academic support • Summer learning opportunities • Tutoring

aim to remove barriers to school success by reaching all students with the kind of support needed. Importantly, they connect students and families to services that promote holistic development, including children's physical and mental health, as well as needed opportunities to learn, as these capacities are vital to social and academic success.

Conclusion

The foundational knowledge provided by the sciences of learning and development, coupled with decades of insights from educational research, provides a framework for supporting children's welfare across the wide range of contexts they experience. This knowledge base indicates the importance of rethinking institutions designed a century ago based on factory-model conceptions of organizations that privileged standardization and minimized relationships. It indicates how schools can be organized around developmentally-supportive relationships; coherent and well-integrated approaches to supports, including home and school connections; well-scaffolded instruction that intentionally supports the development of social, emotional, and academic skills, habits, and mindsets; and culturally competent, personalized responses to the assets and needs that each individual child presents. A summary of the four principles of practices with examples of each facet is provided in Table 1.

Implementing the breadth of practices covered here depends upon policies that enable schools to address the scale of re-organization required. Challenges to implementation include limitations of curriculum available to address the range of goals articulated here and the breadth of knowledge that teachers need to learn to adapt such curricula in ways that address students' needs; limitations of current assessments for addressing learning aimed at transfer and higher order thinking and performance skills; and insufficient supports for teachers and administrators at the school, district and state levels to develop the requisite knowledge base and dispositions to carry out the quality of teaching and organization of schools suggested here.

However, evidence from successful strategies and programs illustrates that it is possible to support productive learning and development for all young people. Analyses of ambitious, integrated approaches to education at the school, district, state, and national levels have shown that with intensive preparation, purposeful curriculum systems, and equitable resources, educators can create supportive environments for children and youth that enable healthy development and powerful learning, even for those who experience the adverse effects of poverty (see, for example, Darling-Hammond, 2010). These examples make it clear that broader application of this knowledge base cannot be the responsibility of teachers and principals alone. Adequate support and preparation for educators alongside the development of thoughtful curriculum and assessments, as well as sound resource policy based on students' needs, is required to achieve these goals at scale.

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References

Abedi, J. (2010). Performance assessment for English language learners. In L. Darling-Hammond & F. Adamson (Eds.), *Beyond the bubble test: How performance assessments support 21st century learning*. San Francisco, CA: John Wiley & Sons.

Adelman, H. S., & Taylor, L. (2008). School-wide approaches to addressing barriers to learning and teaching. In B. Doll & J. Cummings (Eds.), *Transforming school mental health services: Population-based approaches to promoting the competency and wellness of children*. Thousand Oaks, CA: Corwin Press.

Afflerbach, P., Pearson, P. D., & Paris, S. (2008). Clarifying differences between reading skills and reading strategies. *The Reading Teacher*.

Albanese, M. A., & Mitchell, S. A. (1993). Problem-based learning: A review of literature on its outcomes and implementation issues. *Academic Medicine: Journal of the Association of American Medical Colleges*, *68*(1), 52–81.

Alexander, K. L., Entwisle, D. R., & Olson, L. S. (2001). Schools, achievement, and inequality: A seasonal perspective. *Educational Evaluation and Policy Analysis*, *23*(2), 171–191.

Alfieri, L., Brooks, P. J., Aldrich, N. J., & Tenenbaum, H. R. (2011). Does discovery-based instruction enhance learning? *Journal of Educational Psychology*, *103*(1), 1–18.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, *84*(3), 261.

Anderson, P. (2002). **A**ssessment and development of executive function (EF) during childhood. *Child Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and Adolescence*, *8*(2), 71–82.

Aronson, J. (2002). Stereotype threat: Contending and coping with unnerving expectations. In J. Aronson (Ed.),

Improving academic achievement: Impact of psychological factors on education (pp. 279–301). New York: Academic Press

Azevedo, F. S. (2013). The tailored practice of hobbies and its implication for the design of interest-driven learning environments. *The Journal of the Learning Sciences*, *22*(3), 462–510.

Azevedo, F. S. (2018). An inquiry into the structure of situational interests. *Science Education*, *102*(1), 108–127.

Baker, L. (2002). Metacognition in comprehension instruction. In C. Block & M. Pressley (Eds.), *Comprehension instruction: Research-based best practices* (pp. 77–95). New York: The Guilford Press.

Barron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development*, *49*(4), 193–224.

Barron, B. (2010). Conceptualizing and tracing learning pathways over time and setting. *National Society for the Study of Education Yearbook*, *109* (1), 113–127.

Barron, B., & Bell, P. (2015). Learning environments in and out of school. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 323–336). London, UK: Routledge.

Barron, B., & Darling-Hammond, L. (2008). How can we teach for meaningful learning? In *Powerful learning: What we know about teaching for understanding*. San Francisco: Jossey-Bass.

Barron, B., & Martin, C. K. (2016). Making matters. A framework for the assessment of digital media citizenship. In K. Peppler, E.R. Halverson, & Y. Kafai (Eds.), *Makeology: Makers as learners* (pp. 45–71). New York: Routledge.

Bereiter, C., & Scardamalia, M. (2014). Knowledge building and knowledge creation: One concept, two hills to climb. In S. C. Tan, H. J. So, J. Yeo (Eds.), *Knowledge creation in education* (pp. 35–52). Singapore: Springer.

Bergin, C., & Bergin, D. (2009). Attachment in the classroom. *Educational Psychology Review*, *21*, 141–170. Retrieved from https://doi.org/10.1007/s10648-009-9104-0

Bierman, K. L., Nix, R. L., Greenberg, M. T., Blair, C., & Domitrovich, C. E. (2008). Executive functions and school readiness intervention: Impact, moderation, and mediation in the Head Start REDI program. *Development and Psychopathology*, *20*(3), 821–843.

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment and Education: Principles, Policy and Practice*, *5*(1), 7–75.

Bloom, H. S., & Unterman, R. (2014). Can small high schools of choice improve educational prospects for disadvantaged students? *Journal of Policy Analysis and Management*, *33*(2), 290–319.

Blumenfeld, P. C., Puro, P., & Mergendoller, J. (1992). Translating motivation into thoughtfulness. In H. H. Marshall (Ed.), *Redefining student learning* (pp. 207–241, p. 209). New York: Ablex Publishing Corporation.

Boaler, J. (2002). Learning from teaching: Exploring the relationship between reform curriculum and equity. *Journal for Research in Mathematics Education*, *33*(4), 239–258.

Bogart, V. (2002). The effects of looping on the academic achievement of elementary school students. East Tennessee State University.

Bransford, J. D., Brown, A. L., Cocking, R. R., Donovan, M. S., & Pellegrino, J. W. (2004). *How people learn*. Washington, D.C.: National Academy Press.

Bransford, J. D., & Schwartz, D. L. (1999). Rethinking transfer: A simple proposal with multiple implications. In A. Iran-Nejad & P. D. Pearson (Eds.), *Review of research in education* (vol. 24, pp. 61–100). Washington, DC: American Educational Research Association.

Brophy, J. (1998). Classroom management as socializing students into clearly articulated roles. *Journal of Classroom Interaction*, *33*(1), 1–4.

Bryk, A., & Schneider, B. (2002). *Trust in schools: A core resource for improvement*. New York: Russell Sage Foundation.

Bryk, A. S., Sebring, P. B., Allensworth, E., Easton, J. Q., & Luppescu, S. (2010). *Organizing schools for improvement: Lessons from Chicago*. Chicago, IL: University of Chicago Press.

Burke, D. L. (1997). Multi-year teacher/student relationships are a long-overdue arrangement. *Phi Delta Kappan*, *77*(5), 360–361. EJ 516 053.

Cantor, P., Osher, D., Berg, J., Steyer, L., & Rose, T. (2018). Malleability, plasticity, and individuality: How children learn and develop in context. *Applied Developmental Science*, 1. doi:10.1080/10888691.2017.1398649

Carter, P., & Darling-Hammond, L. (2016). Teaching diverse learners. In D. H. Gitomer & C. Bell (Eds.), *Handbook of research on teaching* (5th ed., pp. 593–638). Washington, DC: American Educational Research Association.

Center on the Developing Child. (2016). *From best practices to breakthrough impacts: A science-based approach to building a more promising future for young children and families*. Cambridge, MA: Harvard University, Center on the Developing Child.

Cherng, H.-Y. S., & Halpin, P. F. (2016). The importance of minority teachers: Student perceptions of minority versus White teachers. *Educational Researcher*, *45*(7), 407–420.

Chi, M. T. H. (2000). Self-explaining expository tests: The dual process of generating inferences and repairing mental models. In R. Glaser (Ed.), *Advances in instructional psychology* (pp. 161–238). Mahwah, NJ: Lawrence Erlbaum Associates.

Chi, M. T., Bassok, M., Lewis, M. W., Reimann, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. *Cognitive Science*, *13*(2), 145–182.

Chi, M. T. H., De Leeuw, N., Chiu, M.-H., & Lavancher, C. (1994). Eliciting self-explanations improves understanding. *Cognitive Science*, *18*(3), 439–477.

Coalition for Community Schools. (2018). *What is a community school?*. Washington, D.C.: Coalition for Community Schools. http://www.communityschools.org/aboutschools/what_is_a_community_school.aspx

Cobb, P., & Jackson, K. (2011). Towards an empirically grounded theory of action for improving the quality of mathematics teaching at scale. *Mathematics Teacher Education and Development*, *13*(1), 6–33.

Cohen, G. L., Garcia, J., Purdie-Vaughns, V., Apfel, N., & Brzustoski, P. (2009). Recursive processes in self-affirmation: Intervening to close the minority achievement gap.

Science, *324*(5925), 400–403. Retrieved from https://doi.org/10.1126/science.1170769

Cohen, E. G., & Lotan, R. A. (2014). *Designing groupwork: Strategies for the heterogeneous classroom*. New York: Teachers College Press.

Cohen, G. L., Steele, C. M., & Ross, L. D. (1999). The mentor's dilemma: Providing critical feedback across the racial divide. *Personality and Social Psychology Bulletin*, *25*(10), 1302–1318.

Collaborative for Academic, Social, and Emotional Learning (CASEL). (2013). 2013 CASEL guide: Effective social and emotional learning programs – Preschool and elementary school edition. Chicago, IL.

Conley, D. (2011). Building on the common core. *Educational Leadership*, *68*(6), 16–20.

Connell, J. P., Spencer, M. B., & Aber, J. L. (1994). Educational risk and resilience in African-American youth: Context, self, action, and outcomes in school. *Child Development*, *65*(2 Spec No), 493–506.

Cooper, H., Charlton, K., Valentine, J. C., Muhlenbruck, L., & Borman, G. D. (2000). Making the most of summer school: A meta-analytic and narrative review. *Monographs of the Society for Research in Child Development*, *65*(1), 1–127.

Cooper, H., Nye, B., Charlton, K., Lindsay, J., & Greathouse, S. (1996). The effects of summer vacation on achievement test scores: A narrative and meta-analytic review. *Review of Educational Research*, *66*(3), 227–268.

Darling-Hammond, L. (2010). *The flat world and education: How America's commitment to equity will determine our future*. New York: Teachers College Press.

Darling-Hammond, L., & Adamson, F. (2014). *Beyond the bubble test: How performance assessments support 21st century learning*. San Francisco, CA: John Wiley & Sons.

Darling-Hammond, L., Cook-Harvey, C., Flook, L., Gardner, M., & Melnick, H. (2018). With the Whole *Child in Mind: Insights from the Comer School Development Program*. Alexandria, VA: ASCD.

Darling-Hammond, L., Ancess, J., & Ort, S. W. (2002). Reinventing high school: Outcomes of the coalition campus schools project. *American Educational Research Journal*, *39*(3), 639–673.

Darling-Hammond, L., Barron, B., Pearson, P. D., Schoenfeld, A. H., Stage, E. K., Zimmerman, T. D., & Tilson, J. L. (2008). *Powerful learning: What we know about teaching for understanding*. San Francisco: John Wiley & Sons.

Darling-Hammond, L., Cook-Harvey, C., Flook, L., Gardner, M., & Melnick, H. (2018). *With the whole child in mind: Insights and lessons from the comer school development program*. Alexandria, VA: ASCD.

Darling-Hammond, L., Ramos-Beban, N., Altamirano, R. P., & Hyler, M. E. (2016). *Be the change: Reinventing school for student success*. New York: Teachers College Press.

Darling-Hammond, L., Ross, P., & Milliken, M. (2006). High school size, organization, and content: What matters for student success? *Brookings papers on education policy*, *2006*(9), 163–203. Washington, DC: Brookings Institution Press.

Darling-Hammond, L., Zielezinski, M. B., & Goldman, S. (2014). *Using technology to support at-risk students' learning*. Washington, DC: Alliance for Excellent Education.

Deutsch, M. (1992). The effects of training in conflict resolution and cooperative learning in an alternative high school. Summary Report. Columbia University, New York: Teachers College International Center for Cooperation and Conflict Resolution.

Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, *333*(6045), 959–964. Retrived from https://doi.org/10.1126/science.1204529

Donovan, S. & Bransford, J. (2005). *How students learn History, Mathematics, and Science in the classroom*. Washington, DC: National Academy Press.

Duke, N., & Pearson, P. D. (2002). Effective practices for developing reading comprehension. In A. Farstrup & J. Samuels (Eds.), *What research has to say about reading instruction* (3rd ed., pp. 205–242). Newark, DE: International Reading Association

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development*, *82*(1), 405–432. Retrieved from https://doi.org/10.1111/j.1467-8624.2010.01564.x

Durlak, J. A., Weissberg, R. P., & Pachan, M. (2010). A meta-analysis of after-school programs that seek to promote personal and social skills in children and adolescents. *American Journal of Community Psychology*, *45*(3–4), 294–309.

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality, and development*. London, UK: Psychology Press.

Dweck, C. S. (2017). *Mindset* (2nd ed.). New York: Brown, Little Book Group.

Eccles, J. S. (2005). Subjective task value and the Eccles et al. model of achievement-related choices. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105–121). New York: Guilford Press.

Eccles, J. S., & Roeser, R. W. (2009). Schools, academic motivation, and stage-environment fit. *Handbook of adolescent psychology*. New York: Wiley Publishing.

Egalite, A. J., & Kisida, B. (2017). The effects of teacher match on students' academic perceptions and attitudes. *Educational Evaluation and Policy Analysis*, *40*(1), 59–81.

Egalite, A. J., Kisida, B., & Winters, M. A. (2015). Representation in the classroom: The effect of own-race teachers on student achievement. *Economics of Education Review*, *45*, 44–52.

Englert, C. S., Raphael, T. E., & Anderson, L. M. (1992). Socially mediated instruction: Improving students' knowledge and talk about writing. *The Elementary School Journal*, *92*(4), 411–449.

Ericsson, K. A. (2006). The influence of experience and deliberate practice on the development of superior expert performance. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 683–703). New York, NY: Cambridge University Press.

Fan, X., & Chen, M. (1999). *Parental involvement and students' academic achievement: A meta-analysis*. Arlington, VA: National Science Foundation, National Center for Education Statistics. ED430048.

Farrington, C. (2013). *Academic mindsets as a critical component of deeper learning*. University of Chicago: Consortium on Chicago School Research.

Farrington, C. A., Roderick, M., Allensworth, E., Nagaoka, J., Keyes, T. S., Johnson, D. W., & Beechum, N. O. (2012). *Teaching adolescents to become learners. The role of noncognitive factors in shaping school performance: A critical literature review*. Chicago, IL: University of Chicago Consortium on Chicago School Research.

Felner, R. D., Seitsinger, A. M., Brand, S., Burns, A., & Bolton, N. (2007). Creating small learning communities: Lessons from the project on high-performing learning communities about "what works" in creating productive, developmentally enhancing, learning contexts. *Educational Psychologist*, *42*(4), 209–221.

Fischer, K. W., & Bidell, T. R. (2006). Dynamic development of action, thought, and emotion. In W. Damon & R.M. Learner (Eds.), *Theoretical models of human development, Handbook of child psychology* (6th ed., Vol. 1, pp. 319–399). New York: Wiley.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. *American Psychologist*, *34*(10), 906.

Freiberg, H. J., & Brophy, J. E. (1999). *Beyond behaviorism: Changing the classroom management paradigm*. Boston, MA: Allyn and Bacon.

Freiberg, H. J., Huzinec, A. C., & Templeton, S. M. (2009). Classroom management: A pathway to student achievement: A study of 14 innercity elementary schools. *Elementary School Journal*, *110*(1), 63–80.

Friedlaender, D., Burns, D., Lewis-Charp, H., Cook-Harvey, C. M., Zheng, X., & Darling-Hammond, L. (2014). *Student-centered schools: Closing the opportunity gap*. Stanford, CA: Stanford Center for Opportunity Policy in Education.

Fronius, T., Persson, H., Guckenburg, S., Hurley, N., & Petrosino, A. (2016). *Restorative justice in U.S. Schools: A research review*. San Francisco: WestEd.

Furtak, E. M., Seidel, T., Iverson, H., & Briggs, D. C. (2012). Experimental and Quasi-experimental studies of inquiry-based science teaching: A meta-analysis. *Review of Educational Research*, *82*(3), 300–329.

Gandhi, A., Slama, R., Park, S., Russo, P., Bzura, R., & Williamson, S. (2015). *Focusing on the whole student: Final report on the Massachusetts wraparound zones*. Waltham, MA: American Institutes for Research.

Gay, G. (2000). *Culturally responsive teaching: Theory, research, and practice*. New York, NY: Teachers College Press.

George, P., & Alexander, W. (1993). Grouping students in the middle school. In *The exemplary middle school* (2nd ed., pp. 299–330). Orlando, FL: Harcourt Brace.

Georghiades, P. (2004). From the general to the situated: Three decades of metacognition. *International Journal of Science Education*, *26*(3), 365–383.

Gershenson, S., C.M.D, H., Lindsay, C. A., & Papageorge, N. W. (2017). *The long-run impacts of same-race teachers*. IZA Institute of Labor Economics. Retrieved from http://ftp.iza.org/dp10630.pdf.

Ginsburg-Block, M. D., Rohrbeck, C. A., & Fantuzzo, J. W. (2006). A meta-analytic review of social, self-concept, and behavioral outcomes of peer-assisted learning. *Journal of Educational Psychology*, *98*(4), 732–749.

Glass, G. V., & Smith, M. (1979). Meta-analysis of class size and achievement. *Educational Evaluation and Policy Analysis*, *1*(1), 2–16.

Goldman, S. R., Britt, M. A., Brown, W., Cribb, G., George, M., Greenleaf, C. … Project READI. (2016). Disciplinary literacies and learning to read for understanding: A conceptual framework for disciplinary literacy. *Educational Psychologist*, *51*(2), 219–246.

Goldman, S., & Pellegrino, J. (2015). Research on learning and instruction: Implications for curriculum, instruction, and assessment. *Policy Insights from the Behavioral and Brain Sciences*, *2*(1), 33–41.

Gonzalez, T. (2015). Socializing schools: Addressing racial disparities in discipline through restorative justice. In D. J. Losen (Ed.), *Closing the discipline gap*. Columbia, NY: Teachers College Press.

Greenough, W., Black, J. E., & Wallace, C. S. (1987). Experience and brain development. *Child Development*, *58*(3), 539–559.

Gregory, A., Clawson, K., Davis, A., & Gerewitz, J. (2016). The promise of restorative practices to transform teacher-student relationships and achieve equity in school discipline. *Journal of Educational and Psychological Consultation*, *26*(4), 325–353.

Gutierrez, K., & Rogoff, B. (2003). Cultural ways of learning: Individual traits or repertoires of practice. *Educational Researcher*, *32*(5), 19–25.

Hamedani, M. G., Zheng, X., Darling-Hammond, L., Andree, A., & Quinn, B. (2015). *Social emotional learning in high school: How three urban high schools engage, educate, and empower youth*. Stanford, CA: Stanford Center for Opportunity Policy in Education.

Hammond, Z. (2016). *Culturally responsive teaching and the brain: Promoting authentic engagement and rigor among culturally and linguistically diverse students*. Thousand Oaks, CA: Corwin.

Hampton, F., Mumford, D., & Bond, L. (1997). Enhancing urban student achievement through family-oriented school practices. Education Research Service.,

Harackiewicz, J. M., & Hulleman, C. S. (2010). The importance of interest: The role of achievement goals and task values in promoting the development of interest. *Social and Personality Psychology Compass*, *4*(1), 42–52.

Hattie, J., & Gan, M. (2011). Instruction based on feedback. In R. E. Mayer & P. A. Alexander (Eds.), *Handbook of research on learning and instruction* (pp. 249–271). New York and London: Routledge.

Hemphill, S. A., Toumbourou, J. W., Herrenkohl, T. I., McMorris, B. J., & Catalano, R. F. (2006). The effect of school suspensions and arrests on subsequent adolescent antisocial behavior in Australia and the United States. *Journal of Adolescent Health*, *39*(5), 736–744.

Henderson, A. T., & Mapp, K. L. (2002). *A new wave of evidence: The impact of school, family, and community connections on student achievement*. National Center for Family & Community Connections with Schools. Retrieved from https://www.sedl.org/connections/resources/evidence.pdf

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, *41*(2), 111–127.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, *16*(3), 235–266.

Hogarth, S., Bennett, J., Lubben, F., & Campbell, B. (2004). A systematic review of the use of small-group discussions in science teaching: Review summary. In *Research Evidence in Education Library*. EPPI Review Group for Science, Department of Educational Studies, University of York.

Huberman, M., Bitter, C., Anthony, J., & O'Day, J. (2014). *The shape of deeper learning: Strategies, structures, and cultures in deeper learning network high schools. Report #1 Findings from the Study of Deeper Learning*: Opportunities and Outcomes. Washington, DC: American Institutes for Research.

Immordino-Yang, M. H., & Damasio, A. (2007). We feel, therefore we learn: The relevance of affective and social neuroscience to education. *Mind, Brain, and Education*, *1*(1), 3–10.

Irvin, J. L. (1997). *What current research says to the middle school practitioner*. Columbus, OH: National Middle Schools Association.

Irvine, J. J. (2003). *Educating teachers for diversity: Seeing with a cultural eye*. NY: Teachers College Press.

Jeynes, W. H. (2012). A meta-analysis of the efficacy of different types of parental involvement programs for urban students. *Urban Education*, *47*(4), 706–742.

Jeynes, W. H. (2017). A meta-analysis: The relationship between parental involvement and Latino student outcomes. *Education and Urban Society*, *49*(1), 4–28.

Johnson, D. W., Johnson, R., Dudley, B., & Acikgoz, K. (1994). Effects of conflict resolution training on elementary school students. *The Journal of Social Psychology*, *134*(6), 803–817.

Johnson, D. W., Johnson, R. T., & Stanne, M. E. (2000). *Cooperative learning methods: A meta-analysis*. Cooperative Learning Center website. Retrieved from: www.clcrc.com.

Jonassen, D., & Land, S. (Eds.). (2012). *Theoretical foundations of learning environments*. London: Routledge.

Jones, S. M., & Bouffard, M. B. (2012). Social and emotional learning in schools: From programs to strategies. *Social Policy Report*, *26*(4), 1–33. Society for Research in Child Development.

Juvonen, J., Le, V. N., Kaganoff, T., Augustine, C. H., & Constant, L. (2004). Focus on the wonder years: Challenges facing the American middle school. Rand Corporation.

Kabat-Zinn, J. (1994). *Wherever you go, there you are: Mindfulness meditation in everyday life*. New York: Hyperion.

Kang, Y., Gray, J. R., & Dovidio, J. F. (2014). The nondiscriminating heart: lovingkindness meditation training decreases implicit intergroup bias. *Journal of Experimental Psychology. General*, *143*(3), 1306–1313. Retrieved from https://doi.org/10.1037/a0034150

Kaplan, A., Gheen, M., & Midgley, C. (2002). Classroom goal structure and student disruptive behaviour. *The British Journal of Educational Psychology*, *72*(Pt 2), 191–211.

Karp, D. R., & Breslin, B. (2001). Restorative justice in school communities. *Youth & Society*, *33*(2), 249–272.

Kim, J. (2006). The relative influence of research on class-size policy. *Brookings Papers on Education Policy*, *2006*(1), 273–295. Washington, DC: Brookings Institution Press.

Kluger, A. N., & DeNisi, A. (1996). Effects of feedback intervention on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, *119*(2), 254–284.

Korpershoek, H., Harms, T., de Boer, H., van Kuijk, M., & Doolaard, S. (2016). A meta-analysis of the effects of classroom management strategies and classroom management programs on students' academic, behavioral, emotional, and motivational outcomes. *Review of Educational Research*, *86*(3), 643–680.

Kuhl, P. (2000). *A new view of language acquisition*. Washington, DC: National Academy of Sciences.

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, *32* (3), 465–491.

Ladson-Billings, G. (2009). *The dreamkeepers: Successful teachers of African American Children* (2nd Ed.). San Francisco: Wiley Publishers.

Lauer, P. A., Akiba, M., Wilkerson, S. B., Apthorp, H. S., Snow, D., & Martin-Glenn, M. L. (2006). Out-of-school-time programs: A meta-analysis of effects for at-risk students. *Review of Educational Research*, *76*(2), 275–313.

Lazonder, A. W., & Harmsen, R. (2016). Meta-analysis of inquiry-based learning: Effects of guidance. *Review of Educational Research*, *86*(3), 681–718.

Lee, C. D. (2007). *Culture, literacy, and learning: Taking bloom in the midst of the whirlwind*. New York, NY: Teachers College Press.

Lee, C. D. (2017). Integrating research on how people learn and learning across settings as a window of opportunity to address inequality in educational processes and outcomes. *Review of Research in Education*, *41*(1), 88–111.

Lee, V. E., Bryk, A. S., & Smith, J. B. (1993). The organization of effective secondary schools. *Review of Research in Education*, *19*, 171–267.

Lee, V. E., & Loeb, S. (2000). School size in Chicago elementary schools: Effects on teachers' attitudes and students' achievement. *American Educational Research Journal*, *37*(1), 3–31.

Lee, V. E., & Smith, J. B. (1995). Effects of high school restructuring and size on early gains in achievement and engagement. *Sociology of Education*, *68*(4), 241–270.

LePage, P., Darling-Hammond, L., & Akar, H. (2005). Classroom management. In L. Darling-Hammond & J. Bransford, (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 327–357). San Francisco, CA: Wiley.

Lerman, R. (2008). Are skills the problem? Reforming the education and training system in the United States. In T. Bartik & S. Houseman (Eds.), *A future of good jobs? America's challenge in the global economy* (pp. 17–80). New York: Upjohn Publishers.

Lerner, R. M., & Callina, K. S. (2013). Relational developmental systems theories and the ecological validity of

experimental designs: Commentary on Freund and Isaacowitz. *Human Development*, *56*(6), 372–380. doi: 10.1159/000357179

Lewis, R. (2001). Classroom discipline and student responsibility: The students' view. *Teaching and Teacher Education*, *17*(3), 307–319.

Lim, D., Condon, P., & DeSteno, D. (2015). Mindfulness and compassion: An examination of mechanism and scalability. *PloS One*, *10*(2), e0118221. Retrieved from https://doi.org/10.1371/journal.pone.0118221

López, F. A. (2016). Culturally responsive pedagogies in Arizona and Latino students' achievement. *Teachers College Record*, *118*(5), EJ1089538.

Losen, D. J. (2015). *Closing the discipline gap*. Columbia, NY: Teachers College Press.

Lunenburg, F. C. (2011). The comer school development program: Improving education for low-income students. *National Forum of Multicultural Issues Journal*, *8*(1), 1–14.

Luthar, S. S., Barkin, S. H., & Crossman, E. J. (2013). I can, therefore I must: fragility in the upper-middle classes. *Development and Psychopathology*, *25*(4 Pt 2), 1529–1549.

Major, B., & Schmader, T. (2018). Stigma, social identity threat, and health. In *The Oxford Handbook of Stigma, Discrimination, and Health*. Oxford, UK: Oxford University Press.

Mayer, G. R. (1995). Preventing antisocial behavior in the schools. *Journal of Applied Behavior Analysis*, *28*(4), 467–478.

McCombs, J. S., Augustine, C. H., Schwartz, H. L., Bodilly, S. J., McInnis, B. I., Lichter, D. S., & Cross, A. B. (2011). *Making summer count: How summer programs can boost children's learning*. Santa Monica, CA: RAND Corporation.

Moll, L. C., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory into Practice*, *31*(2), 132–141.

Monte-Sano, C., & Reisman, A. (2015). Studying historical understanding. In L. Corno & E. Anderman (Eds.), *Handbook of educational psychology* (3rd ed., pp. 281–294). Mahwah, NJ: Erlbaum.

Moore, K. A., & Emig, C. (2014, February). *Integrated student supports: A summary of the evidence base for policymakers*. Bethesda, MD: Child Trends.

Moreno, R. (2004). Decreasing cognitive load for novice students: Effects of explanatory versus corrective feedback in discovery-based multimedia. *Instructional Science*, *32*(1/2), 99–113.

Moroney, D., Newman, J., & Osher, D. (2018). Out of school time programs. In D. Osher, D. Moroney, & S. Williamson (Eds.), Creating Safe, Equitable, Engaging Schools: A Comprehensive, Evidence-Based Approach to Supporting Students (pp. 121–134). Cambridge, MA: Harvard Education Press.

Mosteller, F. (1995). The Tennessee study of class size in the early school grades. *The Future of Children*, *5*(2), 113–127.

Nasir, N. S., Rosebery, A. S., Warren, B., & Lee, C. D. (2014). Learning as a cultural process: achieving equity through diversity. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 686–706). New York: Cambridge University Press.

National Research Council (NRC). (2000). *How people learn: Brain, mind, experience, and school, Expanded edition*. J.D. Bransford, A.L. Brown, and R.R. Cocking (Eds.), Washington, DC: National Academy Press.

National Research Council (NRC). (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. J.W. Pellegrino & M.L. Hilton (Eds.), Washington, DC: The National Academies Press.

Newell, G. E., Beach, R., Smith, J., & VanDerHeide, J. (2011). Teaching and learning argumentative reading and writing: A review of research. *Reading Research Quarterly*, *46*, 273–304. doi:10.1598/RRQ.46.3.4

Nieto, S. (2002). *Language, culture, and teaching: Critical perspectives for a new century*. Mahwah, NJ: Erlbaum.

Noguera, P., Darling-Hammond, L., & Friedlaender, D. (2017). Equal opportunity for deeper learning. In R. Heller, R. Wolfe, & A. Steinberg (Eds.), *Rethinking readiness: Deeper learning for college, work, and life* (pp. 81–104). Cambridge: Harvard Education Press.

Oakes, J., Maier, A., & Daniel, J. (2017). *Community schools: An evidence-based strategy for equitable school improvement*. Boulder, CO: National Education Policy Center and Palo Alto, CA: Learning Policy Institute.

Okonofua, J. A., & Eberhardt, J. L. (2015). Two strikes: Race and the disciplining of young students. *Psychological Science*, *26*(5), 617–624.

Osher, D., Bear, G., Sprague, J., & Doyle, W. (2010). How we can improve school discipline. *Educational Researcher*, *39*(1), 48–58.

Osher, D., Cantor, P., Berg, J., Steyer, L., & Rose, T. (2018). Drivers of human development: How relationships and context shape learning and development. *Applied Developmental Science*, 1. DOI: 10.1080/10888691.2017.1398650

Osher, D., & Kendziora, K. (2010). Building conditions for learning and healthy adolescent development: Strategic approaches. In B. Doll, W. Pfohl, & J. Yoon (Eds.), *Handbook of youth prevention science*. New York: Routledge.

Osher, D., Kidron, Y., Brackett, M., Dymnicki, A., Jones, S., & Weissberg, R. P. (2016). Advancing the science and practice of social and emotional learning: Looking back and moving forward. *Review of Research in Education*, *40*(1), 644–681.

Osher, D., Kidron, Y., DeCandia, C. J., Kendziora, K., & Weissberg, R. P. (2016). Interventions to promote safe and supportive school climate. In K. R. Wentzel & G. B. Ramani (Eds.), *Handbook of social influences in school contexts* (pp. 384–404). New York: Routledge.

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory: Instructional implications of the interaction between information structures and cognitive architecture. *Instructional Science*, *32*(1/2), 1–8.

Pea, R. D. (1987). Cognitive technologies for mathematics education. In A. Schoenfeld (Ed.), *Cognitive science and mathematics education* (pp. 89–122). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Pearson, P. D., Cervetti, G. N., & Tilson, J. L. (2008). Reading for understanding. In *Powerful learning: What*

we know about teaching for understanding. San Francisco: Jossey-Bass.

Pennington, C. R., Heim, D., Levy, A. R., & Larkin, D. T. (2016). Twenty years of stereotype threat research: A review of psychological mediators. *PLoS One*, *11*(1), e0146487. Retrieved from https://doi.org/10.1371/journal.pone.0146487.

Penuel, W. R., & Fishman, B. J. (2012). Large-scale science education intervention research we can use. *Journal of Research in Science Teaching*, *49*(3), 281–304.

Podolsky, A., & Darling-Hammond, L. (2018, forthcoming). *A living laboratory of deeper learning: The case of Bank Street School of Education*. Cambridge: Harvard Education Press.

Podolsky, A., Kini, T., Bishop, J., & Darling-Hammond, L. (2016). *Solving the teacher shortage: How to attract and retain excellent educators*. Palo Alto, CA: Learning Policy Institute.

Pressley, M. (1998). Comprehension strategies instruction. In J. Osborn & F. Lehr (Eds.), *Literacy for all: Issues in teaching and learning* (pp. 113–133). New York: Guilford Press.

Raffaele Mendez, L. M. (2003). Predictors of suspension and negative school outcomes: A longitudinal investigation. In J. Wal & D. J. Losen (Eds.), *Deconstructing the school-to-prison pipeline* (pp. 17–34). San Francisco: Jossey-Bass.

Renninger, K., & Hidi, S. (2017). *The power of interest for motivation and engagement*. New York: Routledge.

Rockoff, J. E., & Lockwood, B. B. (2010). Stuck in the middle: Impacts of grade configuration in public schools. *Journal of Public Economics*, *94*(11–12), 1051–1061.

Roderick, M., Kelley-Kemple, T., Johnson, D. W., & Beechum, N. O. (2014). Preventable Failure Improvements in Long-Term Outcomes when High Schools Focused on the Ninth Grade Year. In *Consortium on Chicago School Research*.

Roorda, D. L., Koomen, H. M., Spilt, J. L., & Oort, F. J. (2011). The influence of affective teacher–student relationships on students' school engagement and achievement: A meta-analytic approach. *Review of Educational Research*, *81*(4), 493–529.

Rose, T., Rouhani, P., & Fischer, K. W. (2013). The science of the individual. *Mind, Brain, and Education*, *7*(3), 152–158.

Rosenshine, B., & Meister, C. (1994). Reciprocal teaching: A review of research. *Review of Educational Research*, *64*(4), 479–530.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55* (1), 68–78.

Scardamalia, M., Bereiter, C., & Lamon, M. (1994). The CSILE project: Trying to bring the classroom into the world. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory & classroom practice*. (pp. 201–228). Cambridge, MA: MIT Press.

Schmader, T., & Johns, M. (2003). Converging evidence that stereotype threat reduces working memory capacity. *Journal of Personality and Social Psychology*, *85*(3), 440–452.

Schwab, J. (1978). Education and the structure of the disciplines. In J. Westbury & N. Wilkof (Eds.), *Science, curriculum,and liberal education*. Chicago: University of Chicago Press.

Schwartz, D. L. (1995). The emergence of abstract representations in dyad problem solving. *Journal of the Learning Sciences*, *4*(3), 321–354.

Schwerdt, G., & West, M. R. (2013). The impact of alternative grade configurations on student outcomes through middle and high school. *Journal of Public Economics*, *97*, 308–326. Retrieved from https://doi.org/10.1016/j.jpubeco.2012.10.002

Sergiovanni, T. J. (1994). *Building community in schools*. San Francisco: Jossey-Bass.

Sheets, R. H., & Gay, G. G. (1996). Student perceptions of disciplinary conflict in ethnically diverse classrooms. *NASSP Bulletin*, *80*(580), 84–94.

Shulman, L. (1992, September-October). Ways of seeing, ways of knowing, ways of teaching, ways of learning about teaching. *Journal of Curriculum Studies*, *23*(5), 393–396.

Siegel, D. J. (2013). *Brainstorm: The power and purpose of the teenage brain*. New York, NY: Penguin Putnam.

Simmons, R. G., & Blyth, D. A. (1987). *Moving into adolescence: The impact of pubertal change and school context*. Hawthorne, NY: Aldine.

Skiba, R. J., Arredondo, M. I., & Rausch, M. K. (2014). *New and developing research on disparities in discipline. Bloomington, IN: The Equity Project at Indiana University*.

Spencer, M. B. (2007). Phenomenology and ecological systems theory: Development of diverse groups. In *Handbook of child psychology*. New York: Wiley, American Cancer Society. Retrieved from https://doi.org/10.1002/9780470147658.chpsy0115

Spencer, M. B. (2008). Lessons learned and opportunities ignored since Brown v. Board of education: Youth development and the myth of a color-blind society. *Educational Researcher*, *37*(5), 253–266.

Stafford-Brizard, K. B. (2016). *Building blocks for learning: A framework for comprehensive student development*. New York: Turnaround for Children.

Stecher, B.M. & Bohrnstedt, G.W. (Eds.). (2002). *Class size reduction in California: Findings from 1999–00 and 2000–01*. Sacramento, CA: California Department of Education.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist*, *52*(6), 613–629.

Steele, C. M. (2011). *Whistling Vivaldi: How stereotypes affect us and what we can do*. New York: W.W. Norton & Company.

Steele, D. M., & Cohn-Vargas, B. (2013). *Identity safe classrooms: Places to belong and learn*. London, UK: Corwin Press.

Stiggins, R., & Chappuis, J. (2005). Using student-involved classroom assessment to close achievement gaps. *Theory into Practice*, *44*(1), 11–18.

Stipek, D. J. (1996). Motivation and instruction. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 85–113). New York: Macmillan.

Taylor, R. D., Oberle, E., Durlak, J. A., & Weissberg, R. P. (2017). Promoting positive youth development through school-based social and emotional learning interventions:

A meta-analysis of follow-up effects. *Child Development*, *88*(4), 1156–1171.

Tenenbaum, H. R., & Ruck, M. D. (2007). Are teachers' expectations different for racial minority than for European American students? A meta-analysis. *Journal of Educational Psychology*, *99*(2), 253–273.

Tharp, R. G., Estrada, P., Dalton, S., & Yamaguchi, L. A. (2000). *Teaching transformed: Achieving, excellence, fairness, inclusion, and harmony*. Boulder, CO: Westview Press.

Thorndike, E. L. (1931/1968). *Human learning*. New York: The Century Co.

Townsend, B. (2000). The disproportionate discipline of African American learners: Reducing school suspensions and expulsion. *Exceptional Children*, *66*(3), 381–392.

Turnaround for Children. (2016). Classroom and Behavior Management (CBM) Unit Overview.

Tyack, D. B. (1974). *The one best system: A history of American urban education* (Vol. 95). Cambridge, MA: Harvard University Press.

Tyrrell, F., Scully, T., & Halligan, J. (1998). Building peaceful schools. *Thrust for Educational Leadership*, *28*(2), 30–33.

Villegas, A. M., & Lucas, T. (2002). *Educating culturally responsive teachers: A coherent approach*. Albany, NY: State University of New York Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Walshaw, M., & Anthony, G. (2008). Creating productive learning communities in the mathematics classroom: An international literature review. *Pedagogies: An International Journal*, *3*(3), 133–149. DOI: 10.1080/15544800802026595

Wasley, P. A., Fine, M., Gladden, M., Holland, N. E., King, S. P., Mosak, E., & Powell, L. C. (2000). *Small schools: Great strides, A study of new small schools in Chicago*. New York, NY: Bank Street College of Education.

Weissberg, R. P., Durlak, J. A., Domitrovich, C. E., & Gullotta, T. P. (2015). Social and emotional learning: Past, present, and future. In J. A. Durlak, C. E. Domitrovich, R. P. Weissberg, & T. P. Gullotta (Eds.), *Handbook of social and emotional learning: Research and practice* (pp. 3–19). New York: Guilford.

Wigfield, A., & Cambria, J. (2010). Students' achievement values, goal orientations, and interest: Definitions, development, and relations to achievement outcomes. *Developmental Review*, *30*(1), 1–35.

Wineburg, S., Martin, D., & Monte-Sano, C. (2011). *Reading like a historian: Teaching literacy in middle and high school history classrooms*. New York: Teachers College Press. See also curriculum materials at https://sheg.stanford.edu/.

Wolters, C. A. (2011). Regulation of motivation: Contextual and social aspects. *Teachers College Record*, *113*(2), 265–283.

Woronowicz, S. (1996). *Block scheduling in the high school. Researchers digest*. Princeton, NJ: Educational Research Service.

Yeager, D. S., & Walton, G. M. (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research*, *81*(2), 267–301.

Yip, T. (2018). Ethnic/racial identity: A double-edged sword? Associations with discrimination and psychological outcomes. *Current Directions in Psychological Science*, *27*(3), 170–175.

Yoder, N. (2014). Teaching the whole child: Instructional practices that support social-emotional learning. American Institutes for Research.

Zenner, C., Herrnleben-Kurz, S., & Walach, H. (2014). Mindfulness-based interventions in schools: A systematic review and meta-analysis. *Frontiers in Psychology*, *5*, 603.