MIND, BRAIN, AND EDUCATION

Science Supports Education: The Behavioral Research Base for Psychology's Top 20 Principles for Enhancing Teaching and Learning

Joan M. Lucariello[1], Bonnie K. Nastasi[2], Eric M. Anderman[3], Carol Dwyer[4], Heather Ormiston[5], and Russell Skiba[5]

ABSTRACT— Psychological science has much to contribute to preK-12 education because substantial psychological research exists on the processes of learning, teaching, motivation, classroom management, social interaction, communication, and assessment. This article details the psychological science that led to the identification, by the American Psychological Association's Coalition for Psychology in Schools and Education, of the "Top 20 Principles from Psychology for PreK-12 Teaching and Learning." Also noted are the major implications for educational practice that follow from the principles.

Psychological science is a foundational science in understanding the processes of teaching and learning. This is because teaching and learning are influenced by many behavioral and social factors, including human development, cognition, motivation, social interaction, communication, and assessment. Although the role of behavioral science in education is recognized in various ways, such as the existence of textbooks in educational psychology, an effort to raise its visibility and make more cogent its role was undertaken. The most important principles from psychology, the "Top 20," that would be of greatest utility in the context of PreK-12 classroom teaching and learning were identified.

This initiative was pursued by a coalition of psychologists, known as the Coalition for Psychology in Schools and Education (The Coalition) that is supported by the American Psychological Association (APA). The Coalition is an ideal group for translating psychological science for classroom use because its members collectively represent a wide spectrum of subdisciplines in psychology.

METHODOLOGY

To identify the "Top 20," the Coalition operated on the National Institutes of Health Consensus Panel model and conducted a series of thought exercises. First, each member was called upon to identify two constructs or "kernels" (Embry & Biglan, 2008) from psychology he/she considered to be most essential in achieving successful teaching and learning in the classroom. This initial exercise led to the identification of approximately 45 kernels/principles.

To categorize, validate, and consolidate these principles, further steps were taken. The first entailed clustering the 45 principles into key domains of classroom application. This clustering process was iterative and occurred across several meetings of the Coalition. Next, a procedure to validate the 45 principles was undertaken. Many national blueprint publications on teaching were analyzed to assess whether

[1]City University of New York, Graduate Center
[2]Department of Psychology, Tulane University
[3]The Ohio State University
[4]Educational Testing Service, Emerita
[5]Indiana University School of Education, Counseling and Educational Psychology

Address correspondence to Joan M. Lucariello, City University of New York, Graduate Center, New York, NY 10016; e-mail: Joan.Lucariello@guttman.cuny.edu

each of these principles also had been identified as important to instructional practice and learning by other sources. This cross-checking analysis was conducted using the following documents: APA's standards for high school curriculum in psychology (Benassi, Overson, & Hakala, 2014; Whitlock, Fineburg, Freeman, & Smith, 2005), the PRAXIS Principles of Learning and Teaching examination from the Educational Testing Service, the National Council for the Accreditation of Teacher Education (NCATE) writings, InTASC (The Interstate Teacher Assessment and Support Consortium) Standards (Council of Chief State School Officer's Interstate Teacher Assessment and Support Consortium [InTASC], 2011), a popular educational psychology textbook (Woolfolk, 2013), and the National Association of School Psychologist's Blueprint for Training and Practice (Ysseldyke et al., 2006). There was support for all principles in one or more documents. Hence, all were retained for the next step in the validation process.

To wean the most important of the 45 principles/kernels, a modified Delphi process was used (following a 2004 report from the Institute of Medicine entitled *Improving Medical Education: Enhancing the Behavioral and Social Science Content of Medical School Curricula*). Four Coalition members rated each principle using a 1–3 scale system denoting high, medium, or low priority. Mean scores for each item were calculated and, using these, low-priority principles were discarded. This process left 22 principles, which were then analyzed in relation to each other and synthesized into the final 20.

These "Top 20" were then placed into five areas of psychological science and functioning that mapped onto the key domains of classroom functioning defined earlier in the process. (Please see http://www.apa.org/ed/schools/cpse/top-twenty-principles.pdf.) The principles and the science behind them are presented below, along with the top educational implications associated with each.

PRINCIPLES 1–8: HOW DO STUDENTS THINK AND LEARN?

Among the Top 20 Principles are eight based in the science of teaching and learning. Seven will be discussed in this article.

Principles 1, 2, 3

Three of these eight, presented first, are rooted in the overarching cognitive theory of *constructivism* whereon the cognitive system is active. Acquisition/assimilation of new knowledge and cognitive structures are affected by current knowledge/structures. These, in turn, undergo change/accommodation by virtue of assimilative activity (Bartlett, 1932; Bransford & Johnson, 1972; Piaget, 1952, 1954).

Principle 1: Students' Beliefs or Perceptions about Intelligence and Ability Affect Their Cognitive Functioning and Learning

Student knowledge about intelligence itself can vary and affect how students process or interpret cognitive tasks (Dweck, 2006). One conceptualization, the *incremental* or *growth* mindset, characterizes intelligence as malleable and not fixed and hence able to increase or grow. Students with a growth mindset generally focus on learning goals and are more willing to take on challenging tasks in an effort to test and expand their intelligence or ability. Hence, they rebound more easily from negative feedback and failure and perform better on a variety of cognitive tasks and in problem-solving situations.

A second and opposite conceptualization, the *entity* theory, views intelligence as a fixed trait. Students operating with this theory tend to focus on performance goals and tend to believe they need to continually demonstrate and prove their intelligence. Such makes them more hesitant to take on highly challenging tasks and more vulnerable to negative feedback than students holding an incremental view.

The most significant educational implication emanating from this principle is that teachers can foster student beliefs that their intelligence and ability can be developed through effort and experience. In so doing, teachers are encouraging higher motivation, aspirations, and achievement (Blackwell, Trzesniewski, & Dweck, 2007). For example, teachers can communicate that failure at a task is not due to lack of ability and that performance can be enhanced, particularly with added effort or through the use of different strategies.

Principle 2. What Students Already Know Affects Their Learning

Principle 2 is another illustration of the constructivist view of cognitive development and learning. Students come to school with knowledge that is based on their everyday experiences, social interactions, intuitions, and what they have been taught in other settings and in the past. This prior knowledge affects how they will incorporate new learning because what students already know interacts with the material being learned. Accordingly, learning consists of either adding to existing student knowledge, known as *conceptual growth*, or transforming or revising that knowledge, known as *conceptual change* (Carey, 1985, 1986). Learning as conceptual growth occurs when student knowledge is consistent with material to be learned; conceptual change is required when student knowledge is inconsistent or erroneous with respect to correct information to be acquired. In the latter case, students have "misconceptions" or "alternative conceptions" that need to be overturned or corrected (for a description of many common misconceptions, see Lucariello & Naff, 2015).

Alternative conceptions impede learning for several reasons (e.g., Brewer & Chinn, 1991; Chi, 2005). First, students generally are unaware that their knowledge is wrong. Moreover, misconceptions can be very entrenched in thinking and are also resistant to instruction. Finally, experiences are interpreted through these erroneous understandings, thus interfering with the ability to correctly grasp new information (Chinn & Malhotra, 2002).

The most significant educational implication of this principle is that teachers can be instrumental in achieving both *conceptual growth* and *conceptual change* in students. If student knowledge is consistent with the curricular concepts to be taught, teachers can facilitate *conceptual growth* by engaging students in meaningful, thoughtful interaction with the to-be-learned information. These activities would include reading, defining, summarizing, synthesizing, applying concepts, and participating in hands-on activities related to the material to-be-learned. When students have misconceptions, use of other, specific instructional strategies will be required to induce conceptual change. Many of these entail precipitating cognitive disequilibrium or conflict in the minds of students by helping make students aware of the discrepancy between their own thinking and correct curricular material or concepts (Chinn & Brewer, 1998; Eryilmaz, 2002; Hynd, 2001; Piaget, 1952). For example, teachers can have students play an active role in predicting solutions or processes and then show these predictions to be faulty (see Lucariello & Naff, 2015, for a description of relevant instructional strategies).

Principle 3. Students' Cognitive Development and Learning Is Not Limited by General Stages of Development

The knowledge that underlies learning can be organized into domains or contexts, which include knowledge domains, and cultural and interpersonal practices. Reasoning is generally more advanced in domains/contexts for which children have familiarity or competence (e.g., Donaldson, 1978). This accounts for cognitive growth being uneven and not stage-like.

Early competency domain-based accounts of cognitive development show infants to have early, possibly native biologically based, competencies in certain domains (see Bransford, Brown, & Cocking, 2000, for review). These domains include knowledge of the physical world (e.g., Baillargeon, 1995), biological causality (e.g., Spelke, 1990), and numbers/numeracy (Wynn, 1992a, b). *Knowledge-based* accounts of cognition generally point to the prevalent types of knowledge organizations that are involved in cognitive processing. For example, children (and adults) have a knowledge structure, known as schemas (i.e., mental representations), which guide their understanding when encountering text and events (Bartlett, 1932; Bransford & Johnson, 1972; Nelson, Fivush, Hudson, & Lucariello, 1983; Schank & Abelson, 1977).

Contextualist approaches reveal that cognition can be interpersonally based such that student reasoning can be spurred to more advanced levels when students interact with more capable others and/or with more advanced materials. These interactions with others and materials are especially effective when they are pitched at some moderate distance that is not too near or too far from current level of functioning, as captured in *the zone of proximal development* notion (Vygotsky, 1978). *Situated cognition,* a version of contextualism, shows knowledge to be linked to societal practices (e.g., Lave & Wenger, 1991; Rogoff, 2003). Learning is conceived as participation in communities of practice, with children progressively acquiring situated actions (such as involved in learning a craft). Formal schooling itself is understood as a practice.

The most central educational implication of this principle is that teachers' estimation of what material should be presented, and the method of presentation, are more effective when they can take into account the domain-relevant and contextual knowledge of their students.

Principles 5 and 7

Two principles of the eight that are based in the science of teaching and learning are rooted in the literature on the processes and strategies that learners can use to facilitate learning.

Principle 5. Acquiring Long-Term Knowledge and Skill Is Largely Dependent on Practice

What people *know* (their knowledge base) is inscribed in long-term memory. Most information, particularly when related to academic content and highly skilled activities (e.g., sports; artistic, endeavors such as playing a musical instrument), must be processed in some way before being stored in long-term memory. The transfer of information from short-term to long-term memory is accomplished through different strategies and *practice* is key to this transfer process (see http://www.apa.org/education/k12/practice-acquisition.aspx). Deliberate practice has been found to be a necessary (though not sufficient) condition to achieve mastery (Campitelli & Gobet, 2011).

Learning is enhanced through rehearsal and deliberate practice by (1) increasing the likelihood of learning being long term and retrievable (Anderson, 2008); (2) enhancing student ability to apply elements of knowledge automatically and without reflection, which frees up cognitive resources for addressing more challenging tasks (Brown & Bennett, 2002; Moors & De Houwer, 2006); and (3) increasing likelihood of transfer of practiced skills to new and more complex problems in childhood (Glover, Ronning, & Bruning, 1990)

and in adult years (Li et al., 2008). Moreover, deliberate practice plays a role in acquisition of expert performance (Ericsson, Krampe, & Tesch-Romer, 1993).

Educational implications surround making practice more effective in the classroom (for review see Birnbaum, Kornell, Bjork, & Bjork, 2013; Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013). Using tests as practice is beneficial (Butler & Roediger, 2007; Roediger & Karpicke, 2006a). Brief tests with open-ended questions are particularly effective because they require that students not only recall information from long-term memory but also generate new information from that retrieval (Roediger & Karpicke, 2006b). The value of testing or any kind of practice exercise is enhanced by conducting them at spaced intervals (*distributive practice*) and giving them frequently (Dempster, 1996; Pavlik & Anderson, 2005; Rohrer, 2009; Underwood, 1970; see Pavlik & Anderson, 2008, on computing optimal schedule of practice). Another effective approach to practice is presenting students with a schedule of repeated opportunities (*interleaved practice*) to rehearse and transfer skills or content by practicing with tasks that are similar to the target task or using several methods for the same task (Birnbaum et al., 2013; Hatala, Brooks, & Norman, 2003; Helsdingen, van Gog, & van Merrienboer, 2011; Kornell & Bjork, 2008; Rohrer, 2009; Taylor & Rohrer, 2010).

Principle 7. Students' Self-Regulation Assists Learning and Self-Regulatory Skills Can Be Taught

Self-regulatory skills can facilitate learning. These skills include setting goals for learning; planning, (such as knowing what strategies will be needed and how to implement them) monitoring progress toward goal attainment; and self-reflection, which consists in making evaluative judgements about performance and about self-efficacy in reaching the goals (Pintrich, 2000; Zimmerman, 2000, 2002). Another aspect of self-regulation is the regulation of motivation, which describes students' efforts to control their own motivation or motivational processing (Wolters, 2011). Motivation regulation, according to Wolters, includes students' knowledge, monitoring, and active management of their motivation or motivational processing. Self-regulatory skills can be taught or enhanced specifically through processes such as direct instruction, modeling support, scaffolding, and classroom organization and structure (e.g., Driscoll, 2005; Wolters, 2011).

This leads to significant educational implications in that teachers can teach these skills directly to learners, for example, by modeling these strategies or coaching on their effectiveness. Teachers can also provide opportunities for learners to set goals and manage their attainment and for self-appraisal. A reflective community also can be established by teachers (see Driscoll, 2005 for review).

Principles 4, 6, 8

The final set of 3 principles, of the eight based on cognitive science, relate to the kinds of things instructors can do to facilitate learning and cognitive development. The eighth, that student creativity can be fostered, will not be discussed here.

Principle 4. Learning Is Based on Context, So Generalizing Learning to New Contexts Is Not Spontaneous, but Rather Needs to Be Facilitated

Learning is context or domain based, as noted in Principle 3. Hence, for learning to be more effective or powerful, it needs to generalize to new contexts and situations. Student transfer or generalization of knowledge and skills is not spontaneous or automatic. Moreover, it becomes progressively more difficult the more dissimilar the new context is from the original learning context. Notably, transfer or generalization of student knowledge can be facilitated and supported.

The most significant educational implication deriving from this principle is that teachers can support student transfer of knowledge and skills across contexts—from highly similar to highly dissimilar contexts (see Alexander, 2006, for review of the following strategies). This is best done by identifying and building on strengths that students bring to a learning situation and thereby making connections between students' current knowledge and the teachers' learning goals. Teachers can also teach a topic or concept in multiple contexts, help students compare and contrast contexts to assist recognition of contextual similarities, focus on deep, underlying concepts in a domain to promote learning by understanding, and by helping students to see the application of their knowledge to the real world.

Principle 6. Clear, Explanatory, and Timely Feedback to Students Is Important for Learning

Student learning can be increased when students receive regular, specific, explanatory, and timely feedback on their work (see Brookhart, 2008, for review). With respect to specificity, feedback that is occasional and perfunctory (e.g., saying "good job") is neither clear nor explanatory and does not increase student motivation or understanding (Leahy, Lyon, Thompson, & Wiliam, 2005). Clear learning goals help to increase the effectiveness of feedback to students because the comments and feedback that teachers offer is most effective when it provides students with specific information about their current state of knowledge and performance as related to learning goals (Ambrose, Bridges, DiPietro, Lovett, & Norman, 2010; Leahy et al., 2005; Minstrell, 2001).

On the timing of feedback, providing feedback that is timely assists learning and is usually more effective than delayed feedback, particularly in the classroom

setting (Dihoff, Brosvic, Epstein, & Cook, 2004; Kulik & Kulik, 1988).

Feedback on quizzes and practice tests is helpful to students and appears to improve classroom performance in the future (McDaniel & Fisher, 1991). This is particularly true after incorrect responses (Pashler, Cepeda, Wixted, & Rohrer, 2005).

PRINCIPLES 9–12: WHAT MOTIVATES STUDENTS?

Among the Top 20 Principles are four based in the science around motivation.

Principle 9: Students Tend to Enjoy Learning and Perform Better When They Are More Intrinsically Than Extrinsically Motivated

Psychologists and educators for decades have noted that motivation can be conceptualized as intrinsic and extrinsic in nature. Learners who are intrinsically motivated engage in academic tasks for the pure enjoyment of such engagement. Intrinsic motivation is tied to a particular task or domain. Thus, a learner may be intrinsically motivated to learn chemistry (i.e., to learn all there is to know about chemistry); and the learner may be motivated to learn about a very specific aspect of chemistry (e.g., the chemistry of a particular drug). Learners who are extrinsically motivated engage in tasks in order to receive a reward or avoid a punishment. Thus, a learner may be extrinsically motivated to learn chemistry simply because she wants to get into veterinary school, and she knows that getting a good grade in chemistry will help her achieve that goal.

There are strong theoretical and research bases supporting the distinctions between intrinsic and extrinsic motivation. In terms of academic motivation, learners achieve at higher levels and are more likely to continue to engage with activities in the future when they are intrinsically motivated (see Schunk, Meece, & Pintrich, 2013, for a review). Moreover, motivation researchers generally agree that extrinsic incentives may undermine intrinsic motivation (e.g., Deci, Koestner, & Ryan, 1999). There are a number of theoretical perspectives on intrinsic and extrinsic motivation, although this has been debated in the literature; whereas some argue that these fall along a continuum (e.g., Deci & Ryan, 2012), others note that individuals can be both intrinsically and extrinsically motivated simultaneously. For example, students who achieve at high levels often get good grades (extrinsic motivation), but also enjoy what they are learning (intrinsic motivation).

With respect to educational implications, intrinsic motivation overall is related to effective learning. Students who are intrinsically motivated persist longer at tasks, experience low levels of anxiety, and develop positive competence beliefs, whereas those low in intrinsic motivation are at risk for a number of problematic long-term educational outcomes (e.g., Gottfried, Gottfried, Morris, & Cook, 2008). Educators can facilitate intrinsic motivation in their students by de-emphasizing high-stakes tests, by allowing students to engage in projects that allow them to explore areas of deep interest, by encouraging students to take academic risks (e.g., to take on a challenging task), and by allowing students to have enough time to engage with tasks.

Principle 10: Students Persist in the Face of Challenging Tasks and Process Information More Deeply When They Adopt Mastery Goals Rather Than Performance Goals

A similar albeit somewhat different perspective on academic motivation involves students' goal orientations. A goal orientation is a general goal-like approach to learning. Most of the time, goal orientations refer to the reasons why learners engage with specific academic tasks, although sometimes they also can refer to the overall subject domains (e.g., math, music, etc.). There are two general types of goals discussed in the literature: mastery goals (i.e., the goal is to develop competence) and performance goals (i.e., the goal is to demonstrate one's ability). Research also indicates that both mastery and performance goals can be distinguished using approach and avoid dimensions (see Anderman & Wolters, 2006, for a review).

Significant educational implications follow from this scientific principle. Although there is debate about the relations of performance goals to academic outcomes, research consistently and clearly indicates that the adoption of mastery goals is related to beneficial educational outcomes. When students adopt mastery goals, they are likely to use effective and more complex cognitive strategies, to persist at challenging tasks, to report being intrinsically motivated toward the task, and to report feeling efficacious (e.g., Ames & Archer, 1988). The adoption of mastery goals also is often related to enhanced achievement (Linnenbrink-Garcia, Tyson, & Patall, 2008); moreover, performance-approach goals also appear to be beneficial when coupled with mastery goals (e.g., Pintrich, 2000).

The adoption of mastery and performance goals is largely determined by the instructional practices that are used by teachers. When teachers emphasize test scores, ability differences, and competition, students are likely to adopt performance goals; in contrast, when teachers emphasize effort, self-improvement, and taking on challenges, students are likely to adopt mastery goals. Moreover, when test scores and grades are presented publicly (e.g., on a chart or a publicly displayed honor roll), students will be encouraged to focus on performance goals (i.e., these public displays of performance emphasize to students that relative performance is valued in the classroom or school). Mastery goals are more

likely to be adopted when grades and test scores are shared privately and not compared across individuals.

Principle 11: Teachers' Expectations About Their Students Affect Students' Opportunities to Learn, Their Motivation, and Their Learning Outcomes

The study of expectancy effects has a long history, rooted in social psychology (e.g., Rosenthal & Jacobson, 1968). In classroom settings, teachers' expectations for students' successes and failures influence student achievement and motivation. In general, when educators hold high expectations for their students, youth often rise to the occasion and achieve at high levels (provided that they also receive the necessary supports); in contrast, when educators hold low expectations for success, students may come to believe that they lack skills and abilities, and thus confirm the teachers' expectations (often referred to as a self-fulfilling prophecy).

Complexity arises because teachers' expectations are not always based on accurate or completely reliable information. Teachers form their beliefs about students' abilities based on the students' prior achievement. Nevertheless, whereas some indicators of prior achievement are reliable, others may not be. Regardless of how these expectations are formed, they have effects on student achievement, although effects are greater when examining teachers' assessments of student achievement compared to standardized test scores (Jussim & Eccles, 1992). Specifically, teachers may interact differently and provide differential instruction to students based on their expectations for each student's success or failure (Marshall & Weinstein, 1986).

Principle 12: Setting Goals That Are Short Term (Proximal), Specific, and Moderately Challenging Enhances Motivation More Than Establishing Goals That Are Long Term (Distal), General, and Overly Challenging

Goal setting is the process by which an individual sets a standard of performance (e.g., "I want to learn 25 new words per week"). Goal setting is important for motivation because students with a goal and adequate self-efficacy are likely to engage in the activities that lead to achievement of that goal. Self-efficacy is also increased as students monitor their progress toward their goals, particularly when acquiring new skills in the process (Schunk & Pajares, 2009).

Three properties of goal setting are important for motivation. First, short-term or proximal goals are more motivating than long-term or distal goals. This is because it is easier to assess progress toward proximal goals. From a developmental perspective, at least until middle adolescence, students tend to be less adept at thinking concretely with respect to the distant future. Second, specific goals (e.g. "I will finish 20 math problems with complete correctness") are preferable to more general goals (e.g., "I will try to do my best") because it is easier to quantify and monitor specific goals. Third, moderately difficult goals, compared to very hard or very easy goals, are the most likely to motivate students because they will be perceived as challenging but also attainable. Research has documented the benefits of proximal, specific, and moderately challenging goals on achievement outcomes (e.g., Austin & Vancouver, 1996; Locke & Latham, 2002; Schunk, 1990, 2003).

Several educational implications follow from this principle. Sometimes students set their own goals, whereas at other times goals are set for students, either by teachers or parents. The types of goals that students have are powerful motivators, if set appropriately. Research indicates that the most effective goals for most students in most contexts are short-term, slightly challenging goals (Morisano & Locke, 2013).

Proximal goals are powerful motivators because students' self-efficacy for tasks and intrinsic motivation are increased when they experience success at proximal goals (Bandura & Schunk, 1981; Manderlink & Harackiewicz, 1984; Schunk, 1990). Consider an early adolescent learning a foreign language. A teacher might establish the following goal for first year Spanish students on the first day of class: *Your goal is to be able to converse with a native speaker for five minutes by the end of the year*. Given that foreign language teachers generally introduce only brief lessons on grammatical structures and vocabulary words during the first year of instruction, progress toward achieving this goal will be slow. If students do not feel that they are achieving this goal as time goes on, they may become less motivated and less engaged in Spanish class. However, another goal might be the following: *Your goal is to be able to count to 20 and to do math problems using the numbers 1–20 in Spanish by the end of next week*. This is a goal that may be somewhat challenging, but it is certainly one that can be achieved with effective instruction. If students are given opportunities to practice numbers daily, their self-efficacy toward using numbers in Spanish will increase, and ultimately most students will achieve the goal by the end of the two weeks. When students achieve a proximal goal, motivation is enhanced, and they will subsequently be motivated to set and achieve new goals.

PRINCIPLES 13–15: WHY ARE SOCIAL CONTEXT, INTERPERSONAL RELATIONSHIPS, AND EMOTIONAL WELL-BEING IMPORTANT TO STUDENT LEARNING?

Among the Top 20 Principles are three that address this question.

Principle 13

Learning is situated within multiple social contexts.

Principle 14
Interpersonal relationships and interpersonal communication are critical to both the teaching–learning process and the social–emotional development of students.

Principle 15
Emotional well-being influences educational performance, learning, and development.

These principles are interrelated and are represented in theory and research relevant to schools as systems that support psychological (social and emotional) well-being as well as cognitive development and academic learning. The overarching framework is based on Bronfenbrenner's (1989, 1999) developmental–ecological theory and the concept of school connectedness (Centers for Disease Control & Prevention, 2009); these are explored first in this section. Within that framework, research on the importance of interpersonal relationships for promoting learning and psychological well-being is discussed. Finally, the relationship between psychological well-being and learning is examined. The integration of the three aforementioned principles forms the basis for recommendations to promote a system of connectedness and educational programming to facilitate the development of social–emotional and cognitive–academic competencies.

According to developmental–ecological theory, the child or learner is best viewed as embedded within multiple social contexts or ecosystems (e.g., school, family, neighborhood, peer group), that influence learning. At the center of each ecosystem is the microsystem in which reciprocal social interactions occur (e.g., student–teacher, and student–student) that influence the individual's learning and development. The microsystem is embedded within a larger exosystem (e.g., school) that indirectly influences the teaching–learning interaction (e.g., within the classroom). For example, the school policies and norms influence the teaching–learning process. In addition, interactions occur between and within ecosystems that in turn influence the teaching–learning process. For example, the interactions between school and family influence the teacher's interactions with the students. Finally, the ecosystem is embedded within a larger macrosystem, which reflects the culture of the society (e.g., beliefs, norms, and values). The macrosystem in turn influences the exosystem, mesosystem, and microsystems. For example, societal norms and government policies influence the nature of education and the behavioral expectations of teachers and students. Furthermore, according to cognitive-developmental theories (e.g., Vygotskian theory), learning is a result of social constructions resulting from interactions with adults and peers. Such interactions are also responsible for the construction of cultural knowledge, beliefs, values, and behavioral norms that are critical to functioning within one's ecological system (Nastasi et al., 2015). Thus, cognitive constructions and behaviors relevant to academic and social–emotional functioning result from interactions with significant others (teachers, parents, peers) across the various microsystems.

Evidence to support the importance of the school as a system comes from the extensive body of research on school climate (Lee & Stewart, 2013; Thapa, Cohen, Higgins-D'Alessandro, & Gaffey, 2012) and connectedness (Centers for Disease Control & Prevention, 2009). School climate is defined as the patterns of school experiences that reflect "norms, goals, values, interpersonal relationships, teaching and learning practices, and organizational structures" (Thapa et al., 2012, p. 2), consistent with the aforementioned interactions across the student's complex ecological system. A review of 206 studies on school climate (Thapa et al., 2012) documented the relationship between positive school climate and the promotion of safety, healthy relationships, engaged teaching and learning, school connectedness, school completion; and reduction of social–emotional and behavioral problems, absenteeism, suspension, and dropout. School connectedness has been defined as the "belief by students that adults (and peers) in the school care about their learning as well as about them as individuals" (Centers for Disease Control & Prevention, 2009, p. 3). A review of research (Centers for Disease Control and Prevention, 2009) documents the relationship between school connectedness and promotion of healthy behavior, school engagement, attendance, academic success; and reduction of absenteeism, risky behavior such as drug use or risky sexual practices, emotional distress, and suicidal thoughts and attempts. Furthermore, school connectedness is influenced by support from adults (e.g., teachers), positive peer relationships, a safe school environment (i.e., school climate), and the commitment of adults and students to education. Consistent with an ecological system perspective, research supports the importance of family involvement in education and the school-family relationship in promoting academic success (Sheridan & Kratochwill, 2007).

The importance of interpersonal relationships and interactions for development of cognitive, academic, social, and emotional competence is well documented (e.g., Collaborative for Academic, Social, and Emotional Learning (CASEL), 2012; Durlak, Weissberg, Dymnicki, Taylor, and Schellinger, 2011; Johnson, Johnson, & Stanne, 2000; Pianta & Stuhlman, 2004). A meta-analysis of 194 students of cooperative learning provides support for its effectiveness in promoting academic learning and achievement, compared to individual or competitive learning. Of course, critical to effective "cooperation" are communication and interpersonal skills related to listening, speaking, integration of ideas, and conflict resolution. These interpersonal skills are also critical to effective social interactions and

development of healthy social relationships. Thus, cooperative learning experiences in school can provide opportunities for developing cognitive–academic and social–emotional competence. The meta-analysis by Johnson et al. (2000) supports the importance of the teacher as facilitator of cooperative learning. In particular, the teacher's conceptual understanding that permits adaptation of techniques to student needs was especially important to the effectiveness of cooperative learning. Thus, professional development is best focused on fostering a conceptual framework for cooperative learning rather than teaching specific techniques devoid of a strong conceptual foundation.

School provides an opportune context for promoting social and emotional competence (i.e., psychological well-being) of students. Research (summarized by Collaborative for Academic, Social, and Emotional Learning [CASEL], 2012) provides strong support for the effectiveness of social–emotional learning (SEL) programs for promoting psychological well-being and academic success (see also Hagelskamp, Brackett, Rivers, & Salovey, 2013: Jain, Buka, Subramanian, & Molnar, 2012; Jones, Aber, & Brown, 2011). Such research has resulted in an array of evidence-based SEL programs that can be implemented in classrooms by teachers for the purpose of developing social–emotional competence of all students.

PRINCIPLES 16–17. HOW CAN THE CLASSROOM BEST BE MANAGED?

Among two of the Top 20 Principles are those related to the science around classroom management.

Principle 16

Expectations for classroom conduct and social interaction are learned and can be taught using proven principles of behavior and effective classroom instruction.

Principle 17

Effective classroom management is based on (1) setting and communicating high expectations, (2) consistently nurturing positive relationships, and (3) providing a high level of student support.

In every school and classroom, the correspondence between expectations, rules, and consequences allows students to learn each classroom's unique social curriculum and allows teachers to develop classroom climates that maximize the engagement of student learners and minimize conflict and disruption. Classroom and school rules should be positively stated, concrete, observable, posted, explicitly taught, frequently reviewed, and positively reinforced (Simonsen, Fairbanks, Briesch, Myers, & Sugai, 2008). Classrooms structured to offer students multiple opportunities to respond (Simonsen et al., 2008) facilitate the development of quality teacher–student relationships, in turn leading to fewer classroom behavior problems and increased academic performance (O'Connor, Dearing, & Collins, 2011). Instruction that incorporates SEL for students is effective in reducing problem behaviors, increasing prosocial behaviors, and increasing academic achievement (Durlak et al., 2011).

Students at risk for classroom disruption may need more attention to relationship-building in order to develop and maintain connections in the classroom. *Check & Connect*, a program designed to provide at-risk/disengaged students with adult mentors, has been shown to improve school engagement and academic achievement (Anderson, Christenson, Sinclair, & Lehr, 2004). For students engaging in consistent disruptive behavior, the technology of functional behavioral assessment (FBA) provides a means of understanding the functions and setting events that cause and maintain student behavior (Horner, 1994). A sound FBA enables the teacher to understand what is driving the behavior, to identify replacement or competing behaviors, and to develop an individualized behavior intervention plan.

Culturally responsive classroom management is a goal for classroom management. The key features that can increase the cultural responsiveness of classroom management (CRCM) have been identified (Weinstein, Curran, & Tomlinson-Clarke, 2003). Culturally responsive classrooms actively engage students (Cartledge & Kourea, 2008) by offering a curriculum relevant to students' lives, and teachers demonstrate a willingness to learn about important aspects of their students' lives and create a physical environment that is reflective of students' cultural heritage (Weinstein, Tomlinson-Clarke, & Curran, 2004). Understanding one's ethnocentrism involves bringing to consciousness the values, beliefs, and biases about behavior from his or her own culture (Weinstein et al., 2004). Recognizing that there are perspectives, cultures, and belief systems different from one's own (Cartledge & Kourea, 2008) decreases the likelihood of misinterpreting the behavior of a student that may otherwise lead to the use of inequitable disciplinary practices.

Culturally responsive teachers understand the ways in which schools "reflect and perpetuate discriminatory practices of the larger society" (Weinstein et al., 2003, p. 270) and are characterized as *warm demanders* (Vasquez, 1988)—"strong yet compassionate, authoritative yet loving, firm yet respectful" (Weinstein et al., 2004, p. 34). Caring classrooms also utilize *mutual interdependence*, in which one individual has to rely upon another individual in order to achieve a goal, to increase positive academic and social benefits for all students, including reduced prejudice and stereotyping (Aronson, 2008). Strategies such as restorative

practices shift the focus of classroom management from blame and punishment to a climate characterized by problem-solving, relationship-building, and respect (Gregory, Bell, & Pollock, 2014).

Classroom management is a fundamental, bedrock set of procedures and skills that establish a climate for instruction and learning. Sound procedures for classroom management have been linked to improved on-task behavior, lower disruption, and improved achievement. Effective classroom management is far more than simply controlling student behavior. Rather, the strategies described here constitute an instructional approach that establishes a positive climate in which student learning is maximized and disruption minimized. The growing literature on culturally responsive classroom management adds to that knowledge base, and helps teachers in developing positive and caring classroom climates for all students.

Several significant implications for educational practice follow from the science around classroom management. For example, when used consistently, a wide range of empirically validated behavioral principles from praise to differential reinforcement to correction to planned consequences can provide a framework that consistently teaches and reminds students of classroom expectations. Moreover, building strong relationships with students can help prevent the occurrence of behavior problems, while strategies such as functional behavior assessment or restorative practices provide a problem-solving approach to addressing conflict or misbehavior after its occurrence. Finally, a high ratio of positive statements/rewards to negative consequences, and nurturing an atmosphere of respect for all students and their heritage, builds trust in the classroom that can prevent behavioral conflict.

PRINCIPLES 18–20: HOW TO ASSESS STUDENT PROGRESS?

Among the Top 20 Principles are three that are rooted in the science around assessment.

Principle 18. Formative and Summative Assessments Are Both Useful, but They Require Different Approaches

Formative assessments are used to guide instruction in the classroom. *Summative assessments* produce an overall judgment about student learning or the effectiveness of educational programs. Formative assessments are carried out during instruction and are aimed at improving learning in the immediate setting. Summative assessments measure learning at a given point in time, usually at the end of some period of instruction. By design, they are limited in their ability to influence teaching and learning as they occur. The goal of both formative and summative assessments is essentially the same—producing valid, fair, useful, and reliable information for decision making.

Formative assessments often include discussion, collaboration, self- and peer-assessment, and descriptive feedback. Summative assessments are meant to evaluate progress against a benchmark, so they are more likely to be high-stakes, standardized, large-scale assessments that provide an overall score or performance-level categorization.

Formative and summative assessments are both more useful to teachers who understand basic measurement concepts. Teachers can also use their understanding of assessment data to consider whether they adequately covered the material that they intended to cover, or to judge how effectively they met the goals that they set for student learning (Sheppard, 2006).

Principle 19. Students' Skill and Knowledge Should Be Assessed With Processes That Are Grounded in Psychological Science and That Have Provided Well-Defined Standards for Quality and Fairness

Today's educators are immersed in an environment in which assessments are a constant topic of discussion and debate. In this highly charged environment, it is important to remember that clear standards exist for judging the quality of all types of assessments. (See American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014). Valid and reliable assessments enable test users to make appropriate and useful inferences about what students are learning.

To understand the *validity* of any assessment, we need to consider four essential questions:

1. How much of what you intended to measure is actually being measured?
2. How much of what you did not intend to measure actually ended up being measured?
3. What consequences, either intended or unintended, occurred with the assessment?
4. Do you have solid evidence to support your answers to the first three questions?

It is important to remember that the validity of assessments is not simply a number. Validity is a judgment, over time and across a variety of situations, about what inferences can legitimately be drawn from the test data, and the consequences, for better or worse, of using the test. For example, test users need to be able to infer from a test score that it accurately reflects student learning and not other, unrelated factors. If test takers are not motivated to show what they are actually capable of, test users cannot tell what has actually been measured: the degree of effort that students put into taking the test, or actual student learning.

Fairness is integral to validity. Valid assessment entails specifying what an assessment is and is not supposed to measure. It requires evidence of this for all the intended test takers. If this requirement is met, then tests that show real, relevant differences will be fair; tests that show differences unrelated to the test's purpose will not be. Teachers can improve assessment quality by closely aligning teaching and testing; being mindful that tests that are valid for one use or setting may not be valid for another; ensuring that high-stakes decisions be based on multiple measures, not on a single test; and examining outcomes for any consistent discrepancies in performance among different cultural groups.

Principle 20. Good Use of Assessment Data Depends on Clear, Appropriate, and Fair Interpretation

The quality of assessment outcomes depends upon clear, appropriate, and fair interpretation (American Psychological Association, 2000). As a general rule, scores from any assessment should be used only for the explicit and specific purposes for which they were designed. For example, tests meant to rank-order students for a competition may be appropriate for this purpose. The same tests would likely be misleading, however, for determining the strengths and weaknesses of an individual student with respect to specific learning goals.

Effective teaching depends heavily on teachers being informed consumers of educational research, effective interpreters of data for classroom use, and good communicators to students and their families about assessment data and decisions that affect them (Brookhart, 2011).

Valid and useful interpretation of assessments entails teachers' addressing the following fundamental questions: (1) What was the assessment intended to measure? (2) On what are comparisons of the assessment data based? Are students being compared to one another? Or, are responses being directly compared to samples of acceptable and unacceptable responses? (3) Are scores being classified using a standard or cut point, such as letter grades, or another indicator of satisfactory/unsatisfactory performance? How were these standards set?

Educators should also consider tests' appropriateness for individuals from a variety of backgrounds and educational circumstances, and the intended and unintended consequences of administering and using assessments. Both formative and summative assessments can have a significant impact on students' lives and well-being, so careful interpretation is needed for any type of test (American Educational Research Association et al., 2014).

Awareness of the strengths and limitations of any assessment is critical. Such awareness enables teachers to make others aware of important caveats, such as the imperfect reliability of scores and the importance of using multiple sources of evidence for high-stakes decisions.

CONCLUSIONS

Identifying and disseminating the psychological science that contributes to PreK-12 education is of great value. This translational research is much needed by current practitioners. It is also useful for preparation of teachers and leaders because psychology is very often taught to these candidates in just a course or two and disconnected from their clinical experiences.

Acknowledgments—The authors thank Dr. Rena Subotnik of the American Psychological Association (APA) and APA's Education Directorate and Coalition for Psychology in Schools and Education for their great support of the "Top 20 Principles" initiative, which emanated from these sources and was assisted by them.

REFERENCES

Alexander, P. A. (2006). *Psychology in learning and instruction*. Upper Saddle River, NJ: Pearson Education.

Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C., & Norman, M. K. (2010). *How learning works: Seven research-based principles for smart teaching*. San Francisco, CA: Jossey-Bass.

American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (2014). *Standards for educational and psychological testing*. Washington, DC: American Educational Research Association.

American Psychological Association (2000). *Appropriate use of high-stakes testing in our nation's schools*. Washington, DC: Author. Retrieved from http://apa.org/pubs/info/brochures/testing.aspx

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology*, *80*, 260–267. doi:10.1037/0022-0663.80.3.260

Anderman, E. M., & Wolters, C. A. (2006). Goals, values, and affect: Influences on student motivation. In P. A. Alexander, P. H. Winne, P. A. Alexander, & P. H. Winne (Eds.), *Handbook of educational psychology* (pp. 369–389). Mahwah, NJ: Lawrence Erlbaum.

Anderson, J. R. (2008). *Learning and memory: An integrated approach* (2nd ed.). New York, NY: John Wiley.

Anderson, A. R., Christenson, S. L., Sinclair, M. F., & Lehr, C. A. (2004). Check & Connect: The importance of relationships for promoting engagement with school. *Journal of School Psychology*, *42*, 95–113.

Aronson, E. (2008). *The social animal* (10th ed.). New York, NY: Worth.

Austin, J. T., & Vancouver, J. B. (1996). Goal constructs in psychology: Structure, process, and content. *Psychological Bulletin*, *120*, 338–375. doi:10.1037/0033-2909.120.3.338

Baillargeon, R. (1995). Physical reasoning in infancy. In M. S. Gazzaniga (Ed.), *The cognitive neurosciences* (pp. 181–204). Cambridge, MA: MIT Press.

Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal

self-motivation. *Journal of Personality and Social Psychology*, *41*, 586–598. doi:10.1037/0022-3514.41.3.586

Bartlett, F. C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge, UK: Cambridge University Press.

Benassi, V. A., Overson, C. E., & Hakala, C. M. (2014). *Applying the science of learning in education: Infusing psychological science into the curriculum*. Retrieved from http://teachpsych.org/ebooks/asle2014;index.php

Birnbaum, M. S., Kornell, N., Bjork, E. L., & Bjork, R. A. (2013). Why interleaving enhances inductive learning: The roles of discrimination and retrieval. *Memory and Cognition*, *41*, 392–402.

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, *78*, 246–263.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academies Press.

Bransford, J. D., & Johnson, M. K. (1972). Contextual prerequisites for understanding: Some investigations of comprehension and recall. *Journal of Verbal Learning and Verbal Behavior*, *11*, 717–726.

Brewer, W. F., & Chinn, C. A. (1991). Entrenched beliefs, inconsistent information, and knowledge change. In L. Birnbaum (Ed.), *The International Conference of the Learning Sciences: Proceedings of the 1991 conference* (pp. 67–73). Charlottesville, VA: Association for the Advancement of Computing in Education.

Bronfenbrenner, U. (1989). Ecological systems theory. In R. Vasta (Ed.), *Annals of child development* (Vol. *6*, pp. 187–249). Greenwich, CT: JAI Press.

Bronfenbrenner, U. (1999). Environments in developmental perspective: Theoretical and operational models. In S. L. Friedman & T. D. Wachs (Eds.), *Measuring environment across the life span: Emerging methods and concepts* (pp. 3–28). Washington, DC: American Psychological Association.

Brookhart, S. M. (2008). *How to give effective feedback to your students*. Alexandria, VA: Association for Supervision and Curriculum Development.

Brookhart, S. (2011). Educational assessment knowledge and skills for teachers. *Educational Measurement: Issues and Practice*, *30*(1), 3–12.

Brown, S. W., & Bennett, E. (2002). The role of practice and automaticity in temporal and nontemporal dual-task performance. *Psychological Research*, *66*(1), 80–89. doi:101007/S004260100076

Butler, A. C., & Roediger, H. L. (2007). Testing improves long-term retention in a simulated classroom setting. *European Journal of Cognitive Psychology*, *19*, 514–527.

Campitelli, G., & Gobet, F. (2011). Deliberate practice: Necessary but not sufficient. *Current Directions in Psychological Science*, *20*(5), 280–285. doi:10.1177/096372141142922

Carey, S. (1985). *Conceptual change in childhood*. Cambridge, MA: MIT Press.

Carey, S. (1986). Cognitive science and science education. *American Psychologist*, *41*, 1123–1130.

Cartledge, G., & Kourea, L. (2008). Culturally responsive classrooms for culturally diverse students with and at risk for disabilities. *Exceptional Children*, *74*, 351–371.

Centers for Disease Control & Prevention. (2009). *School connectedness: Strategies for increasing protective factors among youth*. Atlanta, GA: U.S. Department of Health and Human Services. Retrieved from http://www.cdc.gov/HealthyYouth

Chi, M. T. H. (2005). Commonsense conceptions of emergent processes: Why some misconceptions are robust. *Journal of the Learning Sciences*, *14*, 161–199.

Chinn, C. A., & Brewer, W. F. (1998). An empirical test of a taxonomy of responses to anomalous data in science. *Journal of Research in Science Teaching*, *35*, 623–654.

Chinn, C. A., & Malhotra, B. A. (2002). Children's responses to anomalous scientific data: How is conceptual change impeded? *Journal of Educational Psychology*, *94*, 327–343.

Collaborative for Academic, Social, and Emotional Learning (CASEL). (2012). *CASEL guide: Effective social and emotional learning programs: Preschool and elementary school edition*. Chicago, IL: Author. Retrieved from http://www.casel.org

Council of Chief State School Officer's Interstate Teacher Assessment and Support Consortium (InTASC). (2011). *Model core teaching standards: A resource for state dialogue.* Retrieved from http://www.ccsso.org/Documents/2011/InTASC_Model_Core_Teaching_Standards_2011.pdf

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, *125*, 627–668. doi:10.1037/0033-2909.125.6.627

Deci, E. L., & Ryan, R. M. (2012). Self-determination theory. In P. M. Van Lange, A. W. Kruglanski, E. T. Higgins, P. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories of social psychology* (Vol. 1, pp. 416–436). Thousand Oaks, CA: Sage Publications Ltd. doi:10.4135/9781446249215.n21

Dempster, F. N. (1996). Distributing and managing the conditions of encoding and practice. In R. A. Bjork & E. L. Bjork (Eds.), *Memory* (pp. 317–344). New York, NY: Academic Press.

Dihoff, R. E., Brosvic, G. M., Epstein, M. L., & Cook, M. J. (2004). Provision of feedback during preparation for academic testing Learning is enhanced by immediate but not delayed feedback. *Psychological Record*, *54*, 207–231.

Donaldson, M. (1978). *Children's minds*. New York, NY: W. W. Norton.

Driscoll, M. P. (2005). *Psychology of learning for instruction*. Boston, MA: Pearson Allyn and Bacon.

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, *14*(1), 4–58.

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*, 405–432.

Dweck, C. S. (2006). *Mindset: The new psychology of success*. New York, NY: Random House.

Embry, D. D., & Biglan, A. (2008). Evidence-based kernels: Fundamental united of behavioral influence. *Clinical Child and Family Psychology Review*, *11*(3), 75–113.

Ericsson, A. K., Krampe, R. T., & Tesch-Romer, C. (1993). The role of deliberate practice in the acquisition of

expert performance. *Psychological Review*, *100*, 363–406. doi:10.1037/0033-295X.100.3.363

Eryilmaz, A. (2002). Effects of conceptual assignments and conceptual change discussions on students' misconceptions and achievement regarding force and motion. *Journal of Research in Science Teaching*, *39*, 1001–1015.

Glover, J. A., Ronning, R. R., & Bruning, R. J. (1990). *Cognitive psychology for teachers*. New York, NY: Macmillan.

Gottfried, A. E., Gottfried, A. W., Morris, P. E., & Cook, C. R. (2008). Low academic intrinsic motivation as a risk factor for adverse educational outcomes: A longitudinal study from early childhood through early adulthood. In C. Hudley, A. E. Gottfried, C. Hudley, & A. E. Gottfried (Eds.), *Academic motivation and the culture of school in childhood and adolescence* (pp. 36–69). New York, NY: Oxford University Press. doi:10.1093/acprof:oso/9780195326819.003.0003

Gregory, A., Bell, J., & Pollock, M. (2014). *How educators can eradicate disparities in school discipline: A briefing paper on school-based interventions*. Bloomington, IN: The Equity Project. Retrieved from http://www.indiana.edu/~atlantic/wp-content/uploads/2014/12/Disparity_Intervention_Full_121114.pdf

Hagelskamp, C., Brackett, M. A., Rivers, S. E., & Salovey, P. (2013). Improving classroom quality with the RULER approach to social and emotional learning: Proximal and distal outcomes. *American Journal of Community Psychology*, *51*, 530–543. doi:10.1007/s10464-013-9570-x

Hatala, R. M., Brooks, L. R., & Norman, G. R. (2003). Practice makes perfect: The critical role of mixed practice in the acquisition of ECG interpretation skills. *Advances in Health Sciences Education*, *8*, 17–26.

Helsdingen, A. S., Van Gog, T., & Van Merrienboer, J. J. G. (2011). The effects of practice schedule and critical thinking prompts on learning and transfer of complex judgment task. *Journal of Educational Psychology*, *103*, 383–398. doi:10.1037/a0022370

Horner, R. H. (1994). Functional assessment: Contributions and future directions. *Journal of Applied Behavior Analysis*, *27*, 401–404.

Hynd, C. R. (2001). Refutational texts and the change process. *International Journal of Educational Research*, *35*, 699–714.

Jain, S., Buka, S. L., Subramanian, S. V., & Molnar, B. E. (2012). Protective factors for youth exposed to violence: Role of developmental assets in building emotional resilience. *Youth Violence and Juvenile Justice*, *10*, 107–129. doi:10.1177/1541204011424735

Johnson, D. W., Johnson, R. T., & Stanne, M. B. (2000). *Cooperative learning methods: A meta-analysis*. Minneapolis: University of Minnesota. Retrieved from http://www.tablelearning.com/uploads/File/EXHIBIT-B.pdf

Jones, S. M., Aber, J. L., & Brown, J. L. (2011). Two-year impacts of a universal school-based social-emotional and literacy intervention: An experiment in translational developmental research. *Child Development*, *82*, 533–554.

Jussim, L., & Eccles, J. S. (1992). Teacher expectations: II. Construction and reflection of student achievement. *Journal of Personality and Social Psychology*, *63*, 947–961. doi:10.1037/0022-3514.63.6.947

Kornell, N., & Bjork, R. A. (2008). Learning concepts and categories: Is spacing the "enemy of induction"? *Psychological Science*, *19*, 585–592.

Kulik, J. A., & Kulik, C. C. (1988). Timing of feedback and verbal learning. *Review of Educational Research*, *58*, 79–97.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York, NY: Cambridge University Press.

Leahy, S., Lyon, C., Thompson, M., & Wiliam, D. (2005). Classroom assessment, minute by minute, day by day. *Educational Leadership*, *63*(3), 19–24.

Lee, P. C., & Stewart, D. E. (2013). Does a socio-ecological school model promote resilience in primary schools? *Journal of School Health*, *83*, 795–804.

Li, S.-C., Schmiedek, F., Huxhold, O., Röcke, C., Smith, J., & Lindenberger, U. (2008). Working memory plasticity in old age: Practice gain, transfer, and maintenance. *Psychology and Aging*, *23*, 731–742. doi:10.1037/a0014343

Linnenbrink-Garcia, L., Tyson, D. F., & Patall, E. A. (2008). When are achievement goal orientations beneficial for academic achievement? A closer look at main effects and moderating factors. *Revue Internationale De Psychologie Sociale*, *21*(1–2), 19–70.

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist*, *57*, 705–717. doi:10.1037/0003-066X.57.9.705.

Lucariello, J., & Naff, D. (2015). *How do I get my students over their alternative conceptions (misconceptions) for learning*? Retrieved from http://www.apa.org/education/k12/misconceptions.aspx

Manderlink, G., & Harackiewicz, J. M. (1984). Proximal versus distal goal setting and intrinsic motivation. *Journal of Personality and Social Psychology*, *47*, 918–928. doi:10.1037/0022-3514.47.4.918

Marshall, H. H., & Weinstein, R. S. (1986). Classroom context of student-perceived differential teacher treatment. *Journal of Educational Psychology*, *78*, 441–453. doi:10.1037/0022-0663.78.6.441.

McDaniel, M. A., & Fisher, R. P. (1991). Tests and test feedback as learning sources. *Contemporary Educational Psychology*, *16*, 192–201.

Minstrell, J. (2001). The role of the teacher in making sense of classroom experiences and effecting better learning. In S. M. Carver & D. Klahr (Eds.), *Cognition and instruction: Twenty-five years of progress* (pp. 121–150). Mahwah, NJ: Lawrence Erlbaum.

Moors, A., & De Houwer, J. (2006). Automaticity: A theoretical and conceptual analysis. *Psychological Bulletin*, *132*, 297–326. doi:10.1037/0033-2909.132.2.297

Morisano, D., & Locke, E. A. (2013). Goal setting and academic achievement. In J. Hattie & E. M. Anderman (Eds.), *International guide to student achievement* (pp. 45–48). New York, NY: Routledge.

Nastasi, B. K., Schensul, J. J., Schensul, S. L., Mekki-Berrada, A., Pelto, B., Maitra, S., … Saggurti, N. (2015). A model for translating ethnography and theory into culturally constructed clinical practice. *Culture, Medicine and Psychiatry*, *39*, 92–120. doi:10.1007/s11013-014-9404-9

Nelson, K., Fivush, R., Hudson, J., & Lucariello, J. (1983). Scripts and the development of memory. In M. T. H. Chi (Ed.), *Trends in memory development research* (Vol. *9*, pp. 52–70). Basel, Switzerland: S. Karger.

O'Connor, E. E., Dearing, E., & Collins, B. A. (2011). Teacher-child relationship and behavior problem trajectories in elementary school. *American Educational Research Journal*, *48*(1), 120–162.

Pashler, H., Cepeda, N. J., Wixted, J. T., & Rohrer, D. (2005). When does feedback facilitate learning of words? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *31*, 3–8.

Pavlik, P. I., Jr., & Anderson, J. R. (2005). Practice and forgetting effects on vocabulary memory: An activation based model of the spacing effect. *Cognitive Science*, *29*, 559–586.

Pavlik, P. I., Jr., & Anderson, J. R. (2008). Using a model to compute the optimal schedule of practice. *Journal of Experimental Psychology: Applied*, *14*, 101–117.

Piaget, J. (1952). *The origins of intelligence in children*. New York, NY: International University Press.

Piaget, J. (1954). *The construction of realty in the child*. New York, NY: Basic Books.

Pianta, R. C., & Stuhlman, M. W. (2004). Teacher-child relationships and children's success in the first years of school. *School Psychology Review*, *33*, 444–458.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 452–502). New York, NY: Academic Press.

Roediger, H. L., & Karpicke, J. D. (2006a). The power of testing memory: Basic research and implications for educational practice. *Perspectives on Psychological Science*, *1*, 181–210.

Roediger, H. L., & Karpicke, J. D. (2006b). Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science*, *17*, 249–255.

Rogoff, B. (2003). *The cultural nature of human development*. New York, NY: Oxford University Press.

Rohrer, D. (2009). The effects of spacing and mixing practice problems. *Journal for Research in Mathematics Education*, *40*, 4–17.

Rosenthal, R., & Jacobson, L. (1968). *Pygmalion in the classroom: Teacher expectation and pupils' intellectual development*. New York, NY: Holt, Rinehart & Winston.

Schank, R. C., & Abelson, R. P. (1977). *Scripts, plans, goals, and understanding*. Hillsdale, NJ: Lawrence Erlbaum.

Schunk, D. H. (1990). Goal setting and self-efficacy during self-regulated learning. *Educational Psychologist*, *25*, 71–86. doi:10.1207/s15326985ep2501_6

Schunk, D. H. (2003). Self-efficacy for reading and writing: Influence of modeling, goal setting, and self-evaluation. *Reading and Writing Quarterly: Overcoming Learning Difficulties*, *19*(2), 159–172. doi:10.1080/10573560308219

Schunk, D. H., Meece, J. R., & Pintrich, P. R. (2013). *Motivation in education: Theory, research, and practice*. Boston, MA: Pearson.

Schunk, D. H., & Pajares, F. (2009). Self-efficacy theory. In K. R. Wenzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 35–53). New York, NY: Routledge.

Sheppard, L. A. (2006). Classroom assessment. In R. L. Brennan (Ed.), *Educational Measurement* (4th ed., pp. 623–646). Westport, CT: American Council on Education/Praeger.

Sheridan, S. M., & Kratochwill, T. R. (2007). *Conjoint behavioral consultation: Promoting connections and interventions* (2nd ed.). New York, NY: Springer.

Simonsen, B., Fairbanks, S., Briesch, A., Myers, D., & Sugai, G. (2008). Evidence-based practices in classroom management: Considerations for research to practice. *Education and Treatment of Children*, *31*, 351–380.

Spelke, E. S. (1990). Principles of object perception. *Cognitive Science*, *14*, 29–56.

Taylor, K., & Rohrer, D. (2010). The effects of interleaved practice. *Applied Cognitive Psychology*, *24*, 837–848.

Thapa, A., Cohen, J., Higgins-D'Alessandro, A., & Gaffey, S. (2012). *School climate research summary: August 2012.* New York, NY: National School Climate Center.

Underwood, B. J. (1970). A breakdown of the total-time law in free-recall learning. *Journal of Verbal Learning and Verbal Behavior*, *9*, 573–580.

Vasquez, J. A. (1988). Context of learning for minority students. *Educational Forum*, *56*, 6–11.

Vygotsky, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Weinstein, C. S., Curran, M., & Tomlinson-Clarke, S. (2003). Culturally responsive classroom management: Awareness into action. *Theory Into Practice*, *42*(4), 269–276.

Weinstein, C. S., Tomlinson-Clarke, S., & Curran, M. (2004). Toward a conception of culturally responsive classroom management. *Journal of Teacher Education*, *55*, 25–38.

Whitlock, K. H., Fineburg, A. C., Freeman, J. E., & Smith, M. T. (2005). *National standards for high school psychology curricula*. Retrieved from http://www.apa.org/about/policy/high-school-standards.pdf

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

Woolfolk, A. (2013). *Educational psychology*. Old Tappan, NJ: Prentice Hall.

Wynn, K. (1992a). Addition and subtraction by human infants. *Nature*, *358*, 749–750.

Wynn, K. (1992b). Evidence against empirical accounts of the origins of numerical knowledge. *Mind and Language*, *7*, 209–227.

Ysseldyke, J., Burns, M., Dawson, P., Kelley, B., Morrison, D., Ortiz, S., Rosenfield, S., & Telzrow, C. (2006). *School psychology: A blueprint for training and practice III.* Retrieved from http://www.nasponline.org/resources/blueprint/finalblueprintinteriors.pdf

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). San Diego, CA: Academic Press.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice*, *41*(2), 64–70.