Applications of Psychological Science to Teaching and Learning: Gaps in the Literature

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Abstract
The authors identified gaps in the literature in the course of preparing 10 evidence-based modules for teachers on topics related to cognitive, behavioral and affective dimensions of the teaching and learning process. This document provides a summary of those gaps and suggests potential topics for RFPs, dissertations, or collaborative projects to close the gaps in our knowledge in areas classroom teachers say are important to their practice.

The purpose and process of the project
Teachers adopt psychological principles everyday when making instructional, assessment and classroom management decisions. However, novice teachers, to say nothing of policy makers and the general public, are often unfamiliar with the research that supports these decisions, the context in which the research was conducted, and how the outcomes of research affect different subsets of teachers and students.

Building on APA’s commitment to application of psychological science to high quality instruction at the Pre-K-12 level, APA’s Board of Educational Affairs sponsored a task force on Translating Psychological Science into Classroom Practice. The goals of the work were to:

- Create a product that was teacher friendly (as so much psychological science research is not)
- Use a pragmatic approach, not espousing a particular theory of learning
- Be grounded in the empirical work of psychology.

The task force examined factors that affect learning and found that courses provided to teaching candidates rarely emphasize the interactions between child development, learning theory, motivation, cultural and other individual differences. Members of the task force were selected based on their expertise in several sub-disciplines of psychology including: motivation, development, assessment, behavior management, social psychology, and learning and instruction. Separately and together, members of the task force translated literature from psychological science on 10 topics useful for teachers in schools www.apa.org/ed/schools/cpse/activities/apstl.aspx.

The focus of the work was to integrate developmental and contextual concerns with research on instruction. Based on the task force’s expertise, the available psychological literature, and recent findings from the APA Teacher Needs Survey, http://www.apa.org/ed/schools/coalition/teachers-needs.pdf, the 10 teaching strategies were identified and developed into modules.
Modules on Primarily Cognitive Topics:
- Practice for Knowledge Acquisition (Not Drill and Kill)
- Using Classroom Data to Give Systematic Feedback to Students in order to Improve Learning
- How Do My Students Think: Diagnosing Student Thinking
- How Do I Get My Students Over Their Alternative Conceptions (Misconceptions)?
- Using Praise to Enhance Student Resilience and Learning Outcomes
- Research in Brain Function and Learning

Modules on Primarily Behavioral Topics:
- Classroom Management
- Bullying in School

Modules on Primarily Affective Topics:
- Improving Students’ Relationships with Teachers to Provide Essential Supports for Learning
- Developing Responsible and Autonomous Learners: A Key to Motivating Students

Each module provides information on:
- Why the topic is important
- Recommendations for teachers (Dos and Don’ts)
- Evidence and Explanation (why and how these teaching strategies work)
- Frequently Asked Questions and Answers
- Where teachers can get more information
- References

In the course of preparing each module the authors were able to explore whether there were serious gaps in the literature that, if they were filled, would enhance the effectiveness of these strategies for wider audiences, whether by virtue of age, ethnicity or disability. This document provides a summary of some of the gaps in the literature that Task Force members discovered in the course of module preparation.

Primarily Cognitive Topics

Practice for Knowledge Acquisition (Not Drill and Kill)
(prepared by Mary Brabeck, PhD, New York University)

It is an old adage that “practice makes perfect” and indeed, learning benefits from deliberate practice. Rote repetition or simply repeating a task will not automatically improve performance. Effective practice is deliberate (Ericsson, Krampe, & Clemens, 1993); involves attention, rehearsal and repetition; and leads to new knowledge or skills that can be subsequently developed into more complex knowledge and skills (Anderson, Reder & Simon, 1996). Across subject areas, differences in performance are affected by the amount of deliberate practice in which individuals engage.

Research suggests that teachers should carefully design opportunities for students to practice solving problems by keeping human memory limitations in mind. Our brains have three memory stores: (1) sensory memory (lasts milliseconds), (2) short-term
Memory, also called working memory (lasts less than a minute), and (3) long-term memory (can last indefinite periods of time). Learning occurs when students move information from working memory to long-term memory and practice makes this transition more likely (See module on Research on Brain Functioning and Learning on Research www.apa.org/ed/schools/cpse/activities/apstl.aspx).

Extensive, deliberate practice makes it possible for students to access and apply increasingly complex information without explicitly thinking about it. This process frees working memories to process new information (Kotovsky, Hayes, & Simon, 1985). When information is too concentrated, working memory will fail so learning needs to apply a distributed process (information repeated with time spaces in between) rather than by crammed practice (longer practice times occurring “all at once”) (Bahrick & Hall, 2005).

There are many things teachers can do to enhance the effects of practice on learning. Teachers can increase students’ ability to transfer existing problem-solving knowledge to new problems when they prompt students to reflect on their problem-solving processes. (Rosenshine & Meister, 1992; Stark, Mandl, Gruber, & Renkl., 2002). Reviews and tests can improve learning and can serve as practice activities. These activities are more effective when they are given at spaced intervals and when they are given frequently (Dempster, 1991). Similarly, homework that involves practice is more effective when assignments are shorter, more frequent, and distributed over longer periods of time (Cooper, 2001).

All populations of students benefit from practice. If teachers design appropriate practice activities, students can learn to compensate for special learning difficulties (Merzenich et al., 1996). Cooper’s (2001) examination of homework practice suggests that students with learning disabilities benefit more from short, skill reinforcing, carefully-monitored activities.

Students’ memories and attention spans develop over time (Lechuga, Moreno, Pelegrina, Gomez-Ariza, & Bajo, 2006). That is, older students will have greater attention spans and greater memory capacity than will younger students. This finding may account for developmental differences in the benefits of homework (Cooper, 2001; Muhlenbrook, Cooper, Nye, & Lindsay, 1999) and age differences in the amount of practice learners engage in (Ericsson et al., 1993).

Although research has discovered many of the conditions that enhance learning through practice, there is still much that remains open for study. Gaps, conflicts, and ambiguities include:

- Some have argued that researchers overemphasize the role of practice in expert performance at the expense of other important variables such as ability and critical developmental periods (See Gobet & Campitelli, 2007 for an overview of this debate).
• The empirical research on practice is skewed toward achievement gains that are easier to quantify, such as math problem solving accuracy, athletic performance, and phonemic awareness. More research on the relationship between practice and student achievement in areas such as the humanities and higher level skills in all subjects is needed.

• Though researchers acknowledge that motivation is an important factor for effective practice, they offer few suggestions on how to engage students in practice activities that are not inherently enjoyable. Teachers are encouraged to motivate students with the promise of future performance gains. This suggestion does not address the difficulties classroom teachers face in engaging students in practice activities. More research on what motivates students to practice is needed.

• There is little advice on how to differentiate practice activities. Though researchers point out that demands on working memory associated with a particular task will vary significantly between individual students, they offer little advice on how to design flexible practice activities for differentiated instruction. Because there is a lack of research on specific guidelines for appropriate spacing and duration of practice, teachers must determine the amount and timing of practice most beneficial to learning based on their own assessments.

• Neuro-imaging studies are needed to examine further the optimal conditions for practice to be effective in long term memory gains.

References
Using Classroom Data to Give Systematic Feedback to Students in order to Improve Learning
(prepared by Carol Dwyer, Educational Testing Service)
Research by Dylan Wiliam and his colleagues (e.g., Black, Harrison, Lee, Marshall, & Wiliam, 2003; Black & Wiliam, 2004a, 2004b; Wiliam, 2005) has shown that student learning increases when teachers:

- Clearly delineate the purposes of each lesson that they teach;
- Use lessons to collect evidence on how students learn; and
- Use collected evidence and promptly re-direct students as needed.

Effective feedback is an important way for teachers to collect and improve student learning. Unfortunately, feedback opportunities are scarce in most classrooms (Bransford, Brown, & Cocking, 1999). Teachers can, however, generate more opportunities for effective feedback and use the data collected formatively to improve their students’ learning.

The results or evidence from almost any assessment can be used to great effect, provided they are used to make instructional adjustments – the shorter the teaching-assessment-analysis-reteaching cycle, the more powerful the effect on learning. Wiliam (2005) has identified five key strategies of assessment for learning:

1. For each important new concept or assignment, on a daily basis, teachers should make learning expectations clear and share with students the criteria for meeting those expectations successfully. Revisit these learning intentions and criteria at the end of the class to evaluate the class’s progress toward these goals.
2. Use effective classroom discussions, questions, and learning tasks to revise lessons and activities. Teachers can use classroom techniques that engage all students in discussion, and use evidence of student thinking from these discussions in their planning of future instruction.
3. Provide feedback that identifies clearly and explicitly what needs to be improved to move learners forward and promote students’ thinking about the concept. Teachers use this evidence to adapt instruction in real time to meet students’ immediate learning needs.
4. Encourage students to serve as instructional and learning resources for one another on daily basis.
5. Motivate students to take responsibility for their own learning.
Formative feedback is essential to the assessment process as it allows teachers to collect the evidence they need to address their students’ learning needs immediately. Leahy, Lyon, Thompson, and Wiliam (2005) give a brief, teacher-oriented description of each of these strategies.

Despite the advances in this area of research, important gaps remain. The following are some examples of areas in which more research is needed:

- **Science and mathematics, particularly at the postsecondary level.** There appears to be some promise of decreased drop-out from difficult mathematics and science courses when faculty engage in professional development that is aimed at increasing their pedagogical skills, including the five key strategies identified by Wiliam. Another potential research direction for this work would thus be to conduct larger-scale trials in high schools and in especially difficult mathematics and science post-secondary courses on the use of feedback for effort and strategies.

- **Teacher differences and contexts.** Wiliam and colleagues believe that strategies of formative assessment must be tailored by individual teachers to meet the needs of their students and contexts. For example, teachers can use the “find and fix” technique, in which they ask pairs of students to work together to identify and correct errors on an assessment. Younger students can use this technique only with short assessments, such as two or three problems; older students can use the technique with much longer assessments. Teachers’ knowledge of their students and their students’ needs and contexts is essential, but they currently lack accessible exemplars of how this is done with students like theirs. Developing and field-testing prototypes of such exemplars would be a first step toward scaling up this important aspect of formative assessments.

- **Enhancing students’ motivation and resilience through formative assessments.** Most of the research on formative assessment has focused on teachers’ actions and students academic outcomes. Much remains unknown about how to integrate proven affective and motivational strategies into the formative assessment process. Studies of the most effective use of praise as formative feedback would be a useful step toward enhancing the effects of formative assessment.

**References**


How Do My Students Think?: Diagnosing Student Thinking  
(prepared by Joan Lucariello, City University of New York)

Diagnosing student thinking and knowledge is a critical area of teacher functioning. We know that students come to school with considerable knowledge (pre-instructional knowledge) about the topics they will encounter. Learning depends on and is related to prior knowledge (Bransford, Brown, & Cocking, 2000; Gelman & Lucariello, 2002; Piaget & Inhelder, 1969; Resnick, 1983). Hence, it makes sense for teachers to figure out what students know before beginning instruction on a topic. First, learning processes vary considerably, depending on whether the teacher is confronting student alternative conceptions (misconceptions) or correct (anchoring) conceptions about the concepts or theories to be taught (Carey, 1985; 1986; Posner, Strike, Hewson, & Gertzog, 1982; Strike & Posner, 1985, 1992).

All of us interpret incoming information in terms of our current knowledge and cognitive organizations. Learners try to link new information to what they already know (Resnick, 1983). When the information to-be-taught is consistent with what learners already know, learners can add this information to their knowledge base. This kind of learning is known as assimilation or conceptual growth. However, when new information is inconsistent with what learners already know, it cannot be assimilated. Rather, the learner’s knowledge will have to change or be altered because of the new information and experience. This kind of learning is known as accommodation (of knowledge/mental structures) or conceptual change. There are different instructional strategies to achieve conceptual growth and conceptual change, respectively. Accordingly, teachers need to know what instructional context they are facing and utilize the appropriate respective strategies. Teaching has a greater chance of effectiveness when instructional strategies are informed by students’ current understandings of the concepts and theories to be taught (e.g., Carpenter, Fennema, Peterson, Chiang, & Loe, 1989; Fennema et al., 1996).

Diagnostic teaching strategies are needed, as well, because teacher (pre- and in-service) assessment of student academic skills and prediction of student knowledge may not accurately reflect pupil skill and knowledge (Diakidoy & Iordanou, 2003; Eckert, Dunn, Codding, Begeny, & Kleinmann, 2006).

There has not been a cohesive literature developed on the topic of diagnostic teaching strategies. Rather, researchers from widely different disciplines have developed a strategy or two that meets their own research goals (e.g., developed student questionnaires on
different topics). A comprehensive survey across these literatures has identified several pre-instructional diagnostic strategies found to be successful for getting at pupil knowledge. These appear in a module entitled How Do My Students Think: Diagnosing Student Thinking on the APA Web site www.apa.org/ed/schools/cpse/activities/apstl.aspx and also in Lucariello (2008). They include the following:

- Conduct quizzes (Pretests)
- Learn HOW students are solving problems or arriving at their answers. The ideas and strategies – the means by which students arrive at an answer (be it right or wrong) - can be very informative as to their thinking.
- Give students an opportunity to ask questions and then examine the content of those questions.
- Ask for student definitions of major concepts and analyze any errors for the kind of thinking (the rule) that students follow in making mistakes.
- Use the technique of “differential diagnosis” (Brown & Burton, 1978).
- Use the technique of DFA (difficulty factors assessment) (see Rittle-Johnson & Koedinger, 2005). DFA is a way to identify what features of a problem are causing student difficulty or facilitating the student’s learning.
- Present problems for students to solve where you vary the problems on systematic features (Brown & Burton, 1978).

The following strategies for getting at student thinking are not dependent on student language and verbal skills. They may be most effective for students whose current verbal skills are not strong:

- Give quizzes or ask questions wherein you provide misconceptions among the answer options to choose from (e.g., multiple-choice format).
- Give “implicit-confidence” tests. These tests entail a simple modification of the multiple-choice test (see Klymkowsky, Taylor, Spindler, & Garvin-Doxas, 2006).
- Administer questionnaires in particular subject matter areas
- Administer categorization/sorting tasks – In this activity, one presents the students with some model objects (or pictures of objects) to sort into different categories. One instructs students to “put the things together that go together” or to “put the things that are alike (or “the same kind of thing”) together.
- Have students model (draw, use props) their solutions and analyze these for error patterns, strategies, and solution-kinds.
- Use student memory/recall of problems and definitions as a window into their thinking.

Since these strategies derive from widely different sources and literatures and have mainly been utilized by researchers to ascertain the knowledge state of participants in their experiments, there has been little systematic research on the effects of these strategies in the classroom. Accordingly, future research is needed on links between the use of these strategies and teaching quality and student learning. More specifically:
• Research is needed to ascertain whether teachers’ use of these pre-instructional strategies leads to more effective teaching behaviors or any change in teaching behavior.

• Research is needed to address whether a link can be demonstrated between pupil learning and achievement and teacher understanding (through use of these strategies) of the following:
  o Student knowledge (“preconceptions”)
  o Student learning processes
  o What is hard and easy for students to grasp
  o Common student errors

• The effectiveness of these different diagnostic strategies for getting at student thinking under different contextual conditions needs to be explored. Questions include whether strategy effectiveness varies by the following variables and their interaction:
  o Student developmental level/grade
  o Student achievement level
  o Subject matter (e.g., math, science, language arts)
  o Different populations (e.g., low-SES children)
  o Teacher experience and training

References


How Do I Get My Students Over Their Alternative Conceptions (Misconceptions)?: Achieving Conceptual Change
(prepared by Joan Lucariello, City University of New York)

Students do not come to school as blank slates to be filled by instruction. Children are active cognitive agents who arrive at school after years of cognitive growth (Committee on Science Learning, Kindergarten through Eighth Grade, 2007). They come to the classroom with considerable knowledge based on intuitions, every day experiences, or what they have been taught in other contexts. This type of student knowledge is referred to as preconceptions. A considerable amount of our knowledge is organized by subject areas, such as mathematics, science, etc., so too are preconceptions.

It is important for teachers to know about the preconceptions of their students because learning depends on and is related to student prior knowledge (Bransford, Brown, & Cocking, 2000; Gelman & Lucariello, 2002; Piaget & Inhelder, 1969; Resnick, 1983). Student preconceptions that are consistent with concepts in the assigned curriculum are anchoring conceptions. In cases such as these, where teachers are presenting information that is consistent with what learners already know, learning is a matter of assimilation or conceptual growth. Learners can add this information to their knowledge base.

Student preconceptions that are inconsistent with concepts in the curriculum are known as alternative conceptions or misconceptions. Misconceptions are very typical and both children and adults possess them. Misconceptions interfere with learning for several reasons. Students use these erroneous understandings to interpret new experiences,
thereby interfering with the process of correctly grasping the new experiences. Moreover, misconceptions can be entrenched and tend to be very resistant to instruction (Brewer & Chinn, 1991; McNeil & Alibali, 2005). Hence, for concepts or theories in the curriculum where students typically have misconceptions, learning is of a more difficult kind. Instead of simply adding to student knowledge, learning is a matter of radically reorganizing or replacing student knowledge. Conceptual change or accommodation has to occur for learning to happen (Carey, 1985; 1986; Posner, Strike, Hewson, & Gertzog, 1982; Strike & Posner, 1985, 1992). Teachers will need to bring about this conceptual change, and teaching for such conceptual change requires different strategies than teaching for conceptual growth.

A comprehensive survey across many diverse literatures has identified several instructional strategies found to be successful at achieving conceptual change, that is, at helping students overcome misconceptions. This literature and associated instructional strategies are available in a module entitled “How Do I Get My Students Over Their Alternative Conceptions (Misconceptions)” on the APA Web site www.apa.org/ed/schools/cpse/activities/apstl.aspx and also in Lucariello (2008). They include the following:

- Present the new concepts or theories that you are teaching in a way that students see these concepts or theories as plausible, of high quality, intelligible and generative.
- Use students’ correct conceptions and build on those by creating a bridge of examples to the new concept or theory that students are having trouble learning because of alternative conceptions (misconceptions).
- Use model-based reasoning, which helps students construct new representations that vary from their intuitive theories.
- Use “diverse instruction,” wherein a teacher presents a few examples that challenge multiple assumptions rather than a larger number of examples that challenge just one assumption.
- Help students become aware of (raise their meta-cognition about) their own alternative conceptions (misconceptions).
- Present experiences that cause cognitive conflict in the students’ minds.
  - Experiences that can cause cognitive conflict are those that get students to consider their misconceptions (as in strategy 3 above) side-by-side with or at the same time as the correct concept or theory.
- Engage in Interactive Conceptual Instruction (ICI)
  - Develop students’ epistemological thinking -- beliefs and theories about the nature of knowledge and the nature of learning -- in ways that will facilitate conceptual change. The more naïve students’ beliefs are about knowledge and learning, the less likely they are to revise their misconceptions.
- Help students “self-repair” their misconceptions.
  - Once students have overcome their alternative conceptions (misconceptions), engage them in argument to help strengthen their new knowledge representations.
The research base that has identified these instructional strategies for conceptual change has been limited in range. It has targeted misconceptions mainly in science, and to a lesser extent mathematics, primarily with high school and college students, with a small amount of work conducted on middle school students. Even less work has been conducted with misconceptions held by students in elementary school. Also, in large measure, the research has been conducted on normative, not at-risk, populations of students. Hence, research is needed in the following areas.

- **Research at different developmental levels**
  Much of the research on effective instructional strategies is focused on high school and college students. We need to know whether the same strategies are effective with middle and elementary school children.

- **Research with different populations**
  There are almost no studies on the effectiveness of instructional strategies that challenge misconceptions held by low-SES or ethnically diverse children or low-achieving children. Research needs to be done with these samples of children.

- **Research with different subject-matter domains**
  Most of the research on effective instructional strategies is focused on the domain of science and to a much lesser (and not sufficient) extent on mathematics. Hence we need to do research on the following:
    - Identifying the common student misconceptions in other subject matter areas, including social studies, history, and language arts.
    - Applying these instructional strategies to all other subject matter domains, especially mathematics, and testing their effectiveness.

- **Research to develop more instructional strategies**
  Fewer than ten teaching strategies to overcome misconceptions have been identified (most of which are listed here). Research could be conducted to identify additional effective strategies that teachers can use in this learning circumstance.

- **Research linking teacher knowledge of student misconceptions to effects (or not) on teaching and student learning and achievement.**

**References**


**Using Praise to Enhance Student Resilience and Learning Outcomes (prepared by Carol Dwyer, Educational Testing Service)**

Dweck (1999, 2000, 2006) and others have shown that holding the belief that intelligence is unchangeable (called the “entity theory” of self) leads to withdrawal of effort and avoidance of challenges. “Entity” theories lead to increased probability of academic withdrawal and alienation, and decreased engagement with learning—all of which lead to lower achievement.

In contrast, holding the belief that intelligence can be increased through one’s own efforts (called the “incremental theory” of self) leads to increased effort and seeking out challenging materials. This is part of the development of self-efficacy and resilience, which are important in all facets of life. “Incremental” self theories lead to increased resilience in the face of difficulties and setbacks, and to higher academic achievement.

How we talk to students about their performance and work products affects the self theories they hold: Feedback for intelligence increases “entity” thinking; feedback for effort and strategies decreases it. Fortunately, Dweck and her colleagues have also found that entity theories are susceptible to change with relatively simple interventions related to how praise is given for learning outcomes (e.g., Dweck, 2000; Dweck & Molden,
2005; Kamins & Dweck, 1999). This has been found among a wide age span and a wide range of current academic achievement levels.

Another important discovery derived from this line of research has been that entity theories of intelligence are more prevalent among women and under-represented minorities. Thus, these findings relate to achievement gaps as well. Some of the reasons students drop out of challenging programs or do not hold high educational aspirations are due to their beliefs that they “don’t have what it takes” to succeed. In fact, the problem may be that they need to apply more effort or employ different strategies in order to succeed.

This program of research has demonstrated clearly that holding the mind set that you are smart or that you are not has many negative consequences for learning. Fortunately, teachers can, by being careful about how they give students praise for their work and efforts, alter this mind set so that students view intelligence as something that can be developed. A different mind set is fostered by praising students’ efforts and specific work strategies and outcomes (“process praise”) when they do well, rather than praising them for their intelligence (“person praise”); and by discouraging students from attributing their successes and failures to things over which they have no control such as poor luck, or how smart or “dumb” they are.

A major source of the effectiveness of process praise is that it is clearly commensurate with the student’s effort and achievement. Excessive, non-credible praise has been found to be counterproductive. By affecting students’ beliefs about why they succeed or fail in academic settings, praise for effort and strategies can be expected to lead to increased resilience when students encounter obstacles and setbacks, and to increased learning and higher achievement. Specifically, students whose teachers use praise for effort and strategies rather than praise for intelligence will:

- Apply more effort, not less, when material is difficult for them;
- Seek challenges;
- Set higher goals for themselves;
- Look at failures as opportunities to learn; and
- Learn more.

Despite the strong program of research that has been developed on this topic, there are two areas in which more attention is needed.

- Special needs students. Although exceptionally strong research designs have been used in reaching the conclusions reported here, research has not been conducted with students with special needs such as learning disabilities. Special needs students, including the gifted, are vulnerable to the deleterious effects of person praise, but their learning needs and outcomes may differ from those of other segments of the student population.

- Minority and gender pipeline issues in mathematics and science. Another potential research direction for this work would be to conduct larger-scale trials on the use of feedback for effort and strategies at the postsecondary level in
particularly difficult mathematics and science courses, with the aim of discovering whether appropriate feedback results in lessened attrition from these course, especially among minority and female students, who are more likely to hold entity theories of intelligence.

References


Research in Brain Function and Learning
*prepared by Margaret Semrud-Clikeman, Michigan State University*

The way children learn depends on their age, level of development and brain maturity. Before birth, nerve cells (neurons) travel to their eventual locations within the brain of the fetus. It is not known why some neurons find a home and others do not, but after a neuron settles down it continues to grow and develop within its region of the brain. Some neurons do not find a place and die off. When pruning does not happen or is incomplete, disorders in learning and/or behavior can be the result. Visual and auditory systems are present at birth and continue to develop in the first few months of life as the brain reacts to the environment (Hynd & Willis, 1988; Semrud-Clikeman, 2006). During a healthy child’s preschool years, motor and sensory systems continue to develop, as do auditory and visual skills. Since brain development after birth is influenced by inputs from the environment, and because those inputs are unique to each child, every human brain is unique.

During early elementary years, growing neural networks of connected neurons and fibers are essential to the transmission of information throughout the brain. Skills such as visual-motor coordination, reasoning, language, social understanding and memory, perspective-taking and social interaction are closely tied to development of the tracts of the right hemisphere, as well as to the areas of the brain that are tied to emotional processing (also called the limbic system) (Semrud-Clikeman, 2007). As neural networks form, the child learns both academically and socially. Skills in reading, mathematics and writing become more specialized and developed. During late elementary and middle school years, the child’s brain activity is mostly in the posterior regions where the areas for auditory, visual, and tactile functioning intersect (Semrud-Clikeman & Ellison, 2010). The frontal lobes begin to mature more fully in middle school, and this maturation continues through high school and adulthood. Inferential thinking becomes more emphasized in schools, while rote learning is de-emphasized.
This shift in focus is supported by the increased connectivity in the brain and by chemical changes in the neuronal pathways that support both short and long term memory. These chemical changes can continue for hours, days and even weeks after the initial learning takes place (Gazzaniga, Ivry, & Magnun, 2002). Learning becomes more consolidated, as it is stored in long-term memory.

The refined development of the frontal white matter tracts begins around age 12 and continues into a person’s twenties. This region of the brain is crucial for higher cognitive functions, appropriate social behaviors, and the development of formal operations. For some adolescents, brain development matches our educational expectations. For others, the two do not coincide and there is a mismatch between biology and education. When the transition to more adult behavior is problematic, the difficulty may be due to brain maturation. Some adolescents need more structure while others need more freedom. Teachers and schools are beginning to recognize that smaller groupings and more contact with adults help adolescents learn. These changes are very appropriate and in tune with the social and emotional needs of adolescents - as well as brain maturation - that is occurring at this crucial time.

It would be helpful to have more research in brain function and research in the following areas:

- There are gaps in evaluating brain structure and function in typically developing children as well as those experiencing difficulties.

- The success of interventions is just beginning to be studied to evaluate whether brain changes accompany various learning experiences. Studies that evaluate brain activation prior to intervention and then after intervention would be helpful to determine how neural networks are established and what can be done to encourage such networks.

- In addition, if markers can be identified in children with learning and/or attentional problems that are consistent over development, earlier identification may be possible.

- The technology is just being developed to be able to picture activity in the brain and to also measure the white matter tracts associated with specific activities. Although this is an exciting time, it can also be frustrating as we do not fully understand the development of a typical brain let alone that of a child with delays or with special abilities. It is expected that this literature will increase in the next decade and provide much needed answers to educators and parents.

References
Primarily Behavioral Topics

Classroom Management
(prepared by Thomas R. Kratochwill, University of Wisconsin-Madison)

Although there is no agreed upon definition of classroom management, the framework offered by Evertson and Weinstein (2006) represents a contemporary and widely accepted view. Specifically, they note that classroom management has two distinct purposes: “It not only seeks to establish and sustain an orderly environment so students can engage in meaningful academic learning, it also aims to enhance student social and moral growth” (p. 4).

The Institute of Education Sciences (IES) through the What Works Clearinghouse has offered suggestions on reducing behavior problems in elementary schools (Epstein, Atkins, Cullinan, Kutash, & Weaver, 2008) and is available on the IES website at http://ies.ed.gov/ncee and http://ies.ed.gov/ncee/wwc/publications/practice guides. The practice guide offers five major recommendations for addressing behavior problems along with a corresponding level of evidence. These recommendations are:

1. Identify the specifics of the problem behavior and the conditions that prompt and reinforce it (Moderate evidence).
2. Modify the classroom learning environment to decrease problem behavior (Strong evidence).
3. Teach and reinforce new skills to increase appropriate behavior and preserve a positive classroom climate (Strong evidence).
4. Draw on relationships with professional colleagues and students’ families for continued guidance and support (Moderate evidence).
5. Assess whether school-wide behavior problems warrant adopting school-wide strategies or programs and, if so, implement ones shown to reduce negative and foster positive interactions (Moderate evidence) (Epstein et al., 2008, pp 6-7).

In recent years, classroom management has turned to two issues: preventing discipline problems and intervening with current discipline problems. To address these concerns researchers have established and evaluated systems of services and one such model is

called Positive Behavior Support (PBS) (Crone & Horner, 2003; Crone, Horner, & Hawken, 2004). PBS programs typically involve a school-wide system of evidence-based support for teachers (as noted in point 5 above; see Freiberg & Lapointe, 2006), as well as small group and individualized programs for more serious student discipline concerns (see Robinson & Griesemer, 2006).

PBS is typically set up as a multi-level model of intervention beginning with school-wide systems of support (called universal or primary prevention), small groups or more focused interventions for students who share problems such as aggression (called selected or secondary intervention). It also includes individualized interventions for students who need very focused and more intense services for problematic and disruptive behavior (called indicated or tertiary intervention). Tertiary interventions are typically established for students with a wide range of disruptive behavior and are developed by using a functional analysis of the problematic behavior. Detailed information on establishing systems of positive behavior support can be obtained from Lewis, Newcomer, Trussell, and Richter (2006) and a national assistance center (i.e., the Office of Special Education Programs Technical Assistance Center on Positive Behavioral Interventions & Supports at http://www.pbis.org).

Despite advances in the area of classroom management, gaps in the research literature still exist. Some of the major themes emerging from the Handbook of Classroom Management (Evertson & Weinstein, 2006) portend future research agendas in the field of classroom management. In addition, some of the recent focus on PBS elicits potential research priorities:

- More research is needed on why and how PBS is effective in classroom management, both at a system outcomes and student outcomes level.

- More research attention needs to be devoted to PBS applied in middle and high school settings (Emmer & Gerwels, 2006). Much of the research literature is focused on early elementary school children. Yet, we know that teachers face serious challenges with older students as they progress through school. The need for effective management strategies with the older group is a priority for researchers.

- More research is needed on student background characteristics and how these characteristics influence learning and behavior in inclusive classroom settings (Soodak & McCarthy, 2006). In some of the research on classroom management, information on student characteristics is absent. Traditional information includes only age and grade. Information on students such as minority status, SES, etc. would help shed light on how these characteristics predict responsiveness to school-wide, classroom, and individual interventions in inclusive classroom environments.
• More research is needed on the role of intrinsic rewards in supporting student behavior in instructional settings (Reeve, 2006). Most classroom management programs involve external reward systems to manage student behavior. Other options such as intrinsic reward systems have not been researched as often and deserve attention in the future. Another agenda for researchers is to use both types of reward systems in combination.

• More research is needed on the effects of teacher-pupil relationships on classroom management versus the exclusive focus on behavior management (Pianta, 2006). Similar to the need for more research on intrinsic reward systems, there is great need for research on the role that teacher-pupil relationships have on positive student outcomes in classroom management research.

• Future research needs to focus on identifying the types of supports that could help teachers implement day-to-day classroom management practices that have already been identified in research (Gettinger & Kohler, 2006).

• More research attention should focus on classroom management issues associated with transitioning students with special needs into regular classroom systems (Brophy, 2006). Research that elaborates interventions and management for these transitions is a priority. In this work, it will be important to emphasize the adaptations in classroom management systems that will be necessary for special need students.

References
Bullying in School
(prepared by Sandra Graham, University of California, Los Angeles)

School bullying - also commonly labeled peer victimization or peer harassment - is defined as repeated physical, verbal or psychological abuse of victims by perpetrators who intend to cause them harm (Olweus, 1993). Hitting, kicking, shoving, name-calling, spreading rumors, excluding others and intimidating gestures (e.g., eye rolling) by powerful peers are all examples of behaviors that constitute abuse that is physical, verbal, or psychological in nature. It is estimated that 40% to 80% of school age children experience bullying at some point during their school careers and 10-15% may be chronic victims or bullies (Nansel et al., 2001).

School bullying is associated with a host of adjustment difficulties (see Juvonen & Graham, 2001; Sanders & Phye, 2004). Students who are chronic victims of bullying often are rejected by their peers, have low self-esteem, and feel depressed, anxious and
lonely. In addition to psychological challenges, some victimized youth also have elevated levels of physical symptoms, leading to frequent visits to the nurse, and absenteeism (Nishina, Juvonen, & Witkow, 2005). It is not difficult to imagine the chronic victim who becomes so anxious about going to school that she or he tries to avoid it at all costs. Other research suggests victimization by peers is associated with negative attitudes toward school and with poor school performance, even as early as kindergarten with extension into the adolescent years (e.g., Kochenderfer & Ladd, 1996; Schwartz, Gorman, Nakamoto, & Toblin, 2005).

Although there is now a large literature on the consequences of school bullying, there are at least four major gaps in the literature that require further research.

• There is a critical need for more longitudinal research. Studies of school bullying have not adequately examined the severity and chronicity of experiences with victimization across time (Kochenderfer-Ladd & Waldrop, 2001). We need to know more about what factors place children at risk for being the long term targets of bullying and about the long term consequences of chronic experiences with bullying. Some research suggests that the experience of peer victimization fluctuates from time point to time point; however, not enough is known about continuities and discontinuities in the experience of bullying and how situational factors, like school transitions where there is an opportunity to redefine one’s identity, can alter the course of victimization. We need longitudinal studies that span critical school transitions to address these questions.

• The field needs more intervention research. Although research on school bullying has increased dramatically in the last decade, intervention studies to reduce the prevalence of bullying remain relatively rare. Some intervention strategies are targeted to individuals – either perpetrator or victim – while others take a whole-school approach under the assumption that eliminating victimization is the collective responsibility of students, teachers and administrators. We need more research on both types of intervention that utilize the best principles of intervention research. By best principles, we mean experimental studies with treatment and control groups using random assignment and state of the art statistical techniques. This would help us better determine what works for which students, and under what conditions.

• There is a need for more research that takes a developmental perspective. We know that peer bullying begins as early as preschool (Alsaker & Valkanover, 2001) and that it occurs throughout elementary and secondary school. But the types of bullying that occur at particular developmental periods are quite distinct. For example, physical bullying appears to be much more common in younger children, whereas the more covert and psychological tactics such as social ostracism and rumors become more normative among older children and adolescents (e.g., Archer & Coyne, 2005; Nansel et al., 2001). Until we know more about the type and course of bullying at different ages, we will not be sure about the developmental appropriateness of particular intervention approaches.
School contextual factors that affect bullying merit greater attention. Features of the school context such as size, teacher-student ratio, location and distance from home, racial/ethnic composition, and organizational structure change from childhood to adolescence, but very little is known about the effects of these changes on bullying or its prevention. For example, one might hypothesize that bullying will be more extensive in larger schools where there are more “unowned spaces” with minimal adult supervision; or that students are more likely to be victimized going to and from school when they travel longer distances. It would also be important to know (1) whether small learning communities (e.g., schools within schools) decrease the amount and seriousness of bullying; or (2) whether academic tracking, which limits the mixing opportunities of students, exacerbates bullying behavior during non-tracked classes. Contextual variables that increase students’ sense of belonging are presumed to result in more positive overall climate, including less bullying, (Payne & Gottfredson, 2004), but we still do not know enough about the psychological mechanisms that explain school context effects.

References


Primary Affective Topics

Improving Students’ Relationships with Teachers to Provide Essential Supports for Learning
(prepared by Sara Rimm-Kaufman, University of Virginia)

Improving students’ relationships with teachers has important, positive and long-lasting implications for students’ academic and social development. If a student feels a personal connection to a teacher, experiences frequent communication with a teacher, and receives more guidance and praise than criticism from the teacher; the student is likely to become more trustful of that teacher, show more engagement in the academic content presented, display better classroom behavior, achieve at higher levels academically, and be less likely to drop-out of school (Birch & Ladd, 1997; Croninger & Lee, 2001; Gregory & Ripski, 2008; Hamre & Pianta, 2001; McCombs, 2004; Murray & Malmgren, 2005; Wentzel, 1997, 2002).

Research on teacher-child relationships is typically rooted in either attachment theory or self-system theory. In relation to attachment theory; children use their relationship with adults to organize their experiences (Bowlby 1969). Central to this model, children develop “internal working models” based on their family experiences of how adult-child relationships ought to work. These “working models” become applied to other relationships, beyond those in the home or the classroom, and perpetuate themselves over time. Thus, if a child experiences a close, warm relationship with a teacher, he or she is likely to behave towards this teacher (as well as future teachers) in a way that is consistent with this model. With self-system theory, students come to the classroom with basic psychological needs—competence, autonomy, and relatedness—all of which can be met in a classroom through children’s interactions with teachers and the learning environment (Deci & Ryan, 2002). Competence refers to a student’s need to feel capable of academic work; autonomy suggests a feeling of connectedness between the student’s behavior and his/her person values and goals; and relatedness implies that a student feels socially connected to teachers or peers. It follows that classroom practices that foster feelings of competence, autonomy, and relatedness are likely to produce the engagement and motivation required for academic learning and success. Positive teacher-student relationships help children meet these needs.

Existing research suggests that improving students’ relationships with their teacher alone will not produce children’s gains in achievement. However, in classrooms with high quality academic instruction; those students who have close, positive, and supportive
relationships with their teachers will attain higher levels of achievement (Lee & Smith, 1999).

The literature on teacher-child relationships is growing, particularly in early childhood research. Currently, three gaps in the literature require mention.

- There is surprisingly little in the literature that examines the district-level, school-level and teacher characteristics that contribute to positive teacher-student relationships. The few studies that exist on teacher characteristics find that the personal characteristics of teachers are very important in predicting the quality of their relationships with students. (For example, some teachers have a great deal of conflict with almost all of the children in their classroom.) In fact, little is known about what factors predict whether a teacher is likely to develop a good or bad relationship with students. There is a need for both observational research as well as experimental studies that examine district-level and school-level ecologies and their implications for teacher-child relationships (Rimm-Kaufman & Ponitz, 2009).

- There are relatively few longitudinal studies of teacher-child relationships. A few exceptions include (1) Hamre and Pianta’s (2001) investigation showing that early positive teacher-child relationships contributed to later achievement and positive school behaviors and (2) O’Connor and McCartney’s (2007) research suggesting that when predicting third grade achievement, high quality teacher-child relationships in the early years of school were moderately protective in situations where children had poor attachment relationships with their mothers. Yet, there is enough research on teacher-child interactions to know that they are consequential for children. Understanding these from a longitudinal perspective will give us a richer picture of how a single good teacher does (or does not) have the potential to shift a child’s developmental trajectory as well as the way in which sustained high quality interactions between teachers and children may contribute to children’s growth and development. Further, such longitudinal studies have the potential to identify links between high quality teacher-child relationships and children’s achievement, relationships with peers, and even, relationships with family members.

- Too little research has been conducted on the cultural specificity of behaviors that accompany teacher-student relationship styles. Not all teachers show that they care for their students in the same way and their actual behavior toward their students may be culturally specific and therefore misunderstood.

- There is a need for research focusing on training teachers to reflect and consider the extent to which they have created warm and supportive relationships with students. Some promising tools have been developed, such as the Classroom Assessment Scoring System (Pianta, Hamre, & LaParo, 2007). This resource offers a framework for teachers to think through the nature of the climate they create in the classroom. The Consortium on Chicago School Research surveys
students to assess learning climate and student-teacher relationships (http://ccsr.uchicago.edu/).

References


McCombs, B. L. (2004). The learner-centered psychological principles: A framework for balancing a focus on academic achievement with a focus on social and emotional learning needs (pp. 23-39). In J. E. Zins, R. P. Weissberg, M. C. Wang, & H. J. Walberg (Eds.), *Building academic success on social and emotional learning: What does the research say?* New York: Teachers College Press.


Developing Responsible and Autonomous Learners: A Key to Motivating Students
(prepared by Barbara McCombs, University of Denver)

Strategies to help motivate students to learn by providing autonomy-supportive conditions and appropriate academic choices has been well-researched in recent decades, along with research on how to promote self-regulated learning (e.g., Carver & Scheier, 1991; Ley & Young, 2001; Lin, 2001; McCombs, 1986, 1994; Paris & Paris, 2001). Many learning strategies and motivational programs based on sound research are available to teachers for students of various ages and school levels (e.g., Cornelius-White, 2007; Harter, 1999; McCombs, 2001, 2004, 2007; McCombs & Miller, 2007; Meece, Herman, & McCombs, 2004; Schunk & Zimmerman, 1998; Weinstein & Hume, 1995; Zimmerman, 1994, 1995; Zimmerman & Schunk, 2001).

European research in areas relevant to this topic help teachers understand that developing student autonomy and motivation to learn is a complex phenomenon that involves the self system – that is, students’ concepts of their abilities and competencies. For example, Spielberger, (2006) has researched cross-cultural aspects of generalized or trait characteristics that contribute to student learning and Walker, Pressick-Kilborn, Arnold, and Sainsbury (2004) have studied evidence-based practices that help teachers address sociocultural differences in student motivation and tendencies for self-regulation while learning. These studies reveal how contextually-driven best practices are and remind teachers to attend to not only differences in learning among students in different discipline areas, but also differences in students’ perspectives based on their sociocultural backgrounds. This point is also brought home in recent work by Ryan, Ryan, Arbuthnot, and Samuels (2007) in studies of students differences in motivation to learn math concepts and do well on standardized math exams.

The research on autonomous learning spans several areas, including self-regulated learning, learning strategies, and motivation strategies. Research has recently been more integrative as the field has recognized links between motivation, cognition, and metacognition (McCombs, 2001; Zimmerman & Schunk, 2001). Although the research has been growing, there are a number of areas in need of further research.

- Research has found significant relationships between interventions that help students become more autonomous and self-regulated learners and a variety of learning outcomes. Very little research exists, however, on the long-term or longitudinal effects of many of these interventions for upper elementary through high school students. It would be expected that effects would increase over time for students exposed to quality intervention strategies.

- As with the previous area, there have been few studies that have systematically examined the specific kinds of approaches to developing learners’ capacities for self-regulated learning that work best with students from various cultural backgrounds and/or genders. This research also needs to focus on the
effectiveness of programs or interventions that address the whole learner from a
cognitive, metacognitive, affective, motivational, and social perspective.

- With interest increasing in ways to reduce the achievement gap for various
economic and ethnic groups, further research on how programs that develop
student autonomy is needed. This research needs to focus on the effectiveness of
different types of programs for helping students become more autonomous and
self-regulated learners in reducing the achievement gap for different economic
and ethnic groups. It is reasonable to assume that the development of better self-
management and self-regulation skills in special populations can help reduce the
achievement gap.

- Finally, there is limited research on the effectiveness of autonomy development
programs for students with special learning needs. This research should
specifically focus on the types of strategies that are most effective for different
kinds of learning needs. It would be expected that this research would provide
useful information for tailoring self-regulation strategies to particular types of
learning needs.

References
Goethals (Eds.), The self: Interdisciplinary approaches (pp. 168-207). New York: Springer-Verlag.
Cornelius-White, J. (2007). Teachers who care are more effective: A meta-analysis of
learner-centered relationships. Review of Educational Research, 77(1), 113-143.
Technology Research and Development, 49(2), 93-103.
and Development, 49(1), 23-40.
Contemporary Educational Psychology, 11, 314-332.
promoting self-regulated learning and performance. In H. F. O’Neil, Jr., & M.
Drillings (Eds.), Motivation: Research and theory (pp. 49-69). Hillsdale, NJ: Lawrence Erlbaum.
McCombs, B. L. (2001). Self-regulated learning and academic achievement: A
phenomenological view. In B. J. Zimmerman & D. H. Schunk (Eds.), Self-
Regulated learning and academic achievement: Theory, Research, and Practice
McCombs, B. L. (2004). Learner-centered principles and practices: Enhancing
motivation and achievement for children with learning challenges and disabilities.
International Review of Research in Mental Retardation, 28, 85-120.
McCombs, B. L. (2007). Balancing accountability demands with research-validated,
learner-centered teaching and learning practices. In C. E. Sleeter (Ed.), Educating
Conclusion:
A great deal of psychological science exists that can guide teaching practices in ways that are likely to enhance teaching and pupil learning. Nevertheless, much more focused research is needed to provide evidence that the strategies described here effectively impact learning with students at various developmental, ability/achievement and SES levels, as well as children from culturally diverse backgrounds in US classrooms. This document suggests potential lines of research to fill the gaps in our knowledge in 10 areas identified by classroom teachers as being important to their practice.