WELCOME TO THE ELECTRONIC RESERVES COURSE READINGS

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CHAPTER 8

Learners and Learning[1]

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Introduction

A teacher fulfills many roles. One important role is instruction about academic content to promote in students the development of knowledge about the world and the personal intelligence to use that knowledge for problem solving and creative efforts. In order to carry out this role, teachers draw on their own conceptions, or personal theories, about how learning is fostered in classrooms. In order to help beginning teachers construct such theories and think about their instructional responsibilities, teacher educators may draw on a large and emerging knowledge base about learners, learning, and classroom instruction. The following two chapters describe that knowledge base. The focus of this chapter is the cognitive characteristics of learners and the nature of learning; the second chapter is about instruction in classroom settings.

These chapters are based on two premises: First, teachers hold conceptions of learning and instruction that function as personal theories to guide decisions about teaching practice; and second, teacher educators can (and should) influence the development of those conceptions through the curriculum for teacher education. As used here, *conceptions* represent interconnected cognitive systems of knowledge and beliefs that influence perceptions and reasoning. All adults hold conceptions about the phenomena they encounter regularly and they draw on these conceptions to explain their interpretations of the world.

It is argued in these two chapters that there is a formal knowledge base that can and should be an important influence on a preservice or beginning teacher's conceptions of learning and instruction. In particular, the two chapters assert that cognitive, "constructivist" theories of learning and instruction are the centerpiece of this knowledge base, at least at this point in time. Accordingly, one goal of teacher education curriculum should be the development of cognitive, constructivist conceptions of learning and instruction by preservice teachers. The two chapters describe the research and formal theories that form the knowledge base that can support the development of such conceptions.

Preservice teachers, like other adults, have spent many years observing learning and instruction in both formal educational settings and in everyday life. Because these are familiar phenomena that sometimes prompt the need to predict, explain, or control, all adults develop some conceptions of learning and instruction. This means that prospective and beginning teachers bring with them to teacher education their own conceptions of learning and instruction (entering conceptions), and they draw on these whenever they must act as a teacher. These entering conceptions are formed in the absence of coursework about more formal theories. Sometimes these conceptions of learning and instruction are maintained even when they conflict with formal, data-based theories that are presented in preservice coursework. This is not surprising. Mere presentation of the knowledge base is not sufficient to change prospective teachers' basic ways of thinking about learning and instruction.

If teacher educators wish to have a significant impact on preservice and beginning teachers' most basic conceptions, they must seriously consider not only what is the knowledge base but also how to organize it for presentation in a manner that results in significant con-

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ceptual change toward a cognitive, constructivist perspective. It is argued in these two chapters that the knowledge base should be conceptualized and presented as a small set of organizing ideas about learners, learning, and instruction. Beginning teachers should have meaningful understanding of these few main ideas and how they can be used to describe, explain, and predict appropriate instructional actions in a variety of contexts. (It is certainly insufficient for beginning teachers to understand these ideas only as declarative knowledge; they also must hold related procedural and conditional knowledge about them.) Beginning teachers should also understand how the organizing ideas are related to one another in order to integrate them into a coherent personal conception of learning and instruction.

Preservice teachers typically encounter content about learners, learning, and instruction in educational psychology courses. Often the content is presented as topics that reflect the organization of the discipline of educational psychology (e.g., development, learning, instruction, social psychology, or individual differences, with a variety of theoretical perspectives presented for each topic). An alternative organization of the knowledge base is recommended here to cut across topics as they are more typically presented in educational psychology courses. This alternative organization is more likely to influence the development of preservice teachers' conceptions of learning and instruction than is one based on psychologists' views of the structure of their field.

Research on teaching for conceptual change suggests that bombarding students with unrelated information (or information in which relationships among ideas are not apparent to the learners) is unlikely to effect significant learning. Instead, students (in this case, the preservice teachers) need opportunities to engage in extended, in-depth examination of a few core, critical ideas that are likely to form the basis of a personal theory or conception. One framework for some core, organizing ideas that can be derived from the current knowledge base about learners, learning, and classroom instruction is presented here.

The Knowledge Base for Educating Teachers about Learners and Learning

Recent research and theory supports a particular view of learners and learning: learners are characterized as active, constructive problem solvers, and, consequently, learning is a learner-mediated process. That is, learning occurs when the learner acts upon incoming information, relating it to existing knowledge and thus imposing organization and meaning on experience. When teachers hold this view of learning they are likely to teach differently than if they hold a view in which learning is simply a function of receptivity to information that is accrued by the learner without modification. These two contrasting conceptions of learning will be referred to here as the *cognitive–mediational* view and the *receptive–accrual* view. (These conceptions do not correspond exactly to formal theories of learning offered in the psychological literature. They do, however, represent two types of common personal theories held by teachers and other adults. The formal theories of cognitive psychology support the cognitive–mediational conception and some elements of behavioral theory support the receptive–accrual conception, although it includes other elements not addressed by behavioral learning theory.)

The Cognitive–Mediational Perspective

Why should beginning teachers adopt cognitive—mediational conceptions of learners and learning? Consider how a teacher who holds this perspective might approach a typical instructional episode. All students in a sixth grade social studies class are expected to learn about the countries of South America by reading from their textbook and preparing for a class discussion. Today the topic is Colombia and its people's life-styles. A cognitive–mediational view suggests that learning from this task will be dependent on the students' cognitive activity: processing the reading material through active, selective attention; relating new information to prior knowledge and forming new knowledge; and monitoring understanding in order to know when to reread, when to seek clarification, and when to stop reading because one is prepared for the discussion.

In almost any class there are students who are not likely to succeed in this task without further assistance. Perhaps they do not know how and when to use reading comprehension strategies. Perhaps they have no background knowledge about Colombia or other South American countries, or they may even lack the relevant conceptions that would guide their learning about any country (i.e., learning about a country requires some basic conceptions such as how and why there are political systems, what is an economic system, and how geography and climate affect people's daily lives). Perhaps some students believe that they will fail any task that involves reading from the social studies text and do not even attempt the task.

Each of these examples of possible reasons for failure describe some of the students' entering cognitive characteristics. The particular characteristics just described probably would lead to a student's failure to approach the task as an active, strategic learner, and hence, to learn the content (further reinforcing any notions of incompetence). Note that this consequence would not be due directly to intrinsic, immutable characteristics of the student, but rather to the failure to engage in the cognitive processes critical for learning. This distinction is the essence of the cognitive–mediational perspective on teaching.

When students' failure results from a lack of appropriate cognitive processing rather than intrinsic, immutable characteristics, the teacher's task is to stimulate in those

students the necessary cognitive processes. Consider how a teacher who holds a cognitive–mediational perspective might approach the above social studies topic by thinking about the students' cognitive characteristics and their implications for cognitive processing.

The teacher would first consider the students' knowledge, especially their available conceptions or schemata for thinking about countries: What categories of information will students seek when learning about a country? The text does not explicitly tie "agriculture" to several related concepts (like "ways that Colombians earn a living"), so do students have a schema that will allow them to draw these inferences? If not, what kinds of prereading discussions might help students make sense of that content? How can I help my students activate their existing knowledge so they may draw inferences that aid their comprehension?

Because the task requires that students work independently, the teacher would consider the students' capacity for self-regulation. For example, the teacher would consider the students' metacognitive knowledge and experiences, especially about reading strategies, and institute efforts to help them learn how to make sense of their reading. (This might mean institution of a long-term plan to develop metacognitive skills, or it might mean interacting with students as they read in order to prompt self-questioning.)

The teacher would also consider motivation an important element of self-regulated learning related to the student's expectation of success on a task. A student who does not expect to succeed is not likely to exert effort. Thus, the teacher makes decisions about the characteristics of tasks and task settings that influence learners' perceptions of what constitutes success and how easily it can be attained. This might include judicious use of peer cooperation or involve adjustments in the accountability system for tasks that are initially quite challenging.

When considering motivation, the teacher would also think about student's perceptions of task value. Extra time might be taken to discuss how particular content helps students accomplish other goals. A student who senses a larger purpose than task completion is more likely actively to seek meaning from the content and thus engage in cognitive processes that promote learning.

Each of the major concepts used by the teacher in this example are supported by the knowledge base and are tied together in the teacher's mind by a personal conception of learning and instruction that emphasizes the teacher's role in stimulating learners' cognitive processes.

Rationale for the Cognitive–Mediational Perspective

The argument now turns to the rationale for the cognitive–mediational perspective. How does the use of cognitive–mediational theories in the classroom benefit both teacher and students? First, student learning is enhanced. Students are more likely to leave the lesson with new, meaningful, and usable knowledge when instruction is based on cognitive–mediational theories. (The instructional research reviewed in the next chapter supports this contention.) Perhaps more important, though, are the implications for the teacher's sense of efficacy and the equity of student opportunities to learn.

Efficacy. When teachers hold a receptive–accrual view of learning (the opposite of the cognitive–mediational perspective), certain explanatory mechanisms are usually present in their personal theories of instruction. Learning and success in school are seen as dependent on ability or intelligence (as a fixed, immutable trait) and effort (which is determined by the child's willingness to engage in tasks). This view leads a teacher to attribute a child's failures to his or her inherent inadquacies. For example, a logical conclusion about learning within a receptive–accrual perspective is "some students can't learn and others won't learn." This belief leads to premature cessation of teaching, which leads to perpetuation of school failure by low-achieving students (Brophy & Good, 1974).

Unfortunately, many of our "common sense" notions of psychology reflect this receptive–accrual conception, and they can lead teachers (and others) to place too much emphasis on the constructs of ability and effort and to view both as originating within the learner. From this perspective the teacher's roles are only to provide information and tasks and perhaps incentives to perform those tasks, but not to insure that learning takes place, because that is out of the teacher's power. Thus, a teacher holding a receptive–accrual conception would teach the social studies lesson by announcing the assignment and monitoring student behavior, perhaps responding to questions but doing little to deliberately stimulate the cognitive processes necessary for students actively to mediate and construct their own learning.

The "common sense" or receptive–accrual conception of learning will not support efficacious beliefs by the teacher. Preservice teacher education, then, must actively counter such beliefs and help beginning teachers construct a view of learning that supports efficacy through emphasizing teachers' ability and responsibility to influence students' cognitive processes. Such a change in one's perspective on learning and beliefs about teachers' roles represents genuine conceptual change, and is supported by the knowledge base described in this chapter.

Equity. Teaching from a cognitive–mediational perspective can promote equity by allowing all students opportunities for acquiring knowledge and self-regulation. Here, equity is defined as reduction of the influence of students' entering characteristics as predic-

tors of eventual school achievement. To accomplish this a teacher first must understand how a student's entering cognitive characteristics might affect cognitive processing, and then consider how instruction can compensate for or enhance the role of those entering characteristics.

When students' cognitive characteristics do not lead to spontaneous active processing of the content in order to gain meaning, those students will learn less than other students. Without teacher intervention, students' entering characteristics will determine their degree of cognitive processing, which in turn will determine who succeeds in school. Equity will not be achieved.

In the example of the sixth grade social studies lesson, each of the teacher's decisions was likely to influence students' cognitive processing of the content imbedded in the reading task, making content understanding by all students more likely and promoting equity within that lesson. Over time, such instruction contributes to significant changes in learners because knowledge and capacity for self-regulation increase. Thus, a student who originally was at a disadvantage because of entering characteristics may become more capable of spontaneous activation of the cognitive processes that lead to learning.

Knowledge and Capacity for Self-regulation

The rest of this chapter covers much of the available knowledge base on cognitive characteristics of learners and the nature of learning. It is organized around two types of cognitive characteristics: knowledge and capacity for self-regulation. Within each section, a small number of organizing ideas are presented and discussed. Taken together these ideas support a cognitive–mediational conception of instruction. It is not intended that the beginning teacher should learn each of the supporting details and examples given for each idea, nor is it suggested that teacher educators should perceive this information as either an inclusive or exclusive list of recommended content. Instead, the details that accompany each organizing idea are offered as examples of the studies, articles, and arguments that teacher educators could use to help preservice teachers understand each idea.

The use of these particular organizing ideas is intended to be functional, not prescriptive. They serve to organize a large body of theory and research for the reader and can serve that purpose for prospective teachers. Alternative arrangements of these organizing ideas are certainly possible, as long as the underlying cognitive–mediational theme is maintained.

KNOWLEDGE

An important cognitive characteristic of any learner is what that learner knows. Indeed, *knowledge* has become one of the most frequently used descriptors of individual learners in recent psychological literature (Anderson, Spiro, & Montague, 1977; Glaser, 1984; Schallert, 1982; Siegler & Richards, 1982).

Organizing Idea 1: Knowledge is organized, and individuals differ in the way in which their knowledge about particular topics is organized.

What we know is more than an accumulated list of facts or skills. It is an interrelated web of concepts and propositions which have been described using many different metaphors: cognitive structure (Ausubel, 1980), schemata (Anderson, 1977; Rumelhart, 1980; Rumelhart & Ortony, 1977); scripts (Schank & Abelson, 1977), and frames (Minsky, 1975). Earlier in this chapter, the term *conception* was used to describe organized knowledge. The vocabulary is less important than the common idea underlying each of these concepts: that knowledge is organized into sets of related ideas. During the rest of this chapter, as the psychological literature is discussed, the term *knowledge structure* will be used to represent ways that individuals organize their uniquely held knowledge. Although it is impossible to determine with certainty what persons know and how they organize it (Phillips, 1983), the metaphor of cognitive structure as a general representation of how humans hold knowledge is the foundation of contemporary theories about cognition.

Description of individuals' knowledge structures in various domains is one of the three bases for a science of instruction defined by Glaser (1982). There is likely to be a great deal of research forthcoming in the next two decades that beginning teachers should be prepared to assimilate. Therefore, even if cognitive structure is eventually replaced as a theoretically central construct, understanding it is essential for comprehending research on learning and teaching over at least the next 20 years.

Knowledge structures of experts and novices. The task of describing individual differences in knowledge structures has been attempted by a number of researchers who investigate how "novices" and "experts" approach problems in semantically rich domains such as physics and math. A review of recent expert–novice research may be found in Chi, Glaser, and Rees (1982). The most important differences between novices and experts have been in the complexity and size of the knowledge structures applied to a problem. Glaser (1984) summarizes these differences in this way:

> . . . the knowledge of novices is organized around the literal objects explicitly given in a problem statement. Experts' knowledge, on the other hand, is organized around principles and abstractions that subsume these objects. These principles are not apparent in the problem statement but derive from knowledge of the subject matter. (p. 99)

That is, persons who are more expert in a particular area

are more likely to draw inferences from the given data and reasoning about the underlying abstract principles.

Another good summary of this work is found in Flavell (1985), who points out that experts have more domain-specific concepts than novices, and that these concepts are imbedded in a richer, interrelated network. This means that for experts the odds are greater that any one concept will evoke many other concepts. Differences also exist between experts and novices in the strategies applied when planning and carrying out solutions to problems. The organization of experts' knowledge is efficient and frees information-processing capacity, allowing mental space for thinking about strategies.

Why should beginning teachers know about the expert–novice research? It is certainly no surprise that experts in a given area know more than novices. The value of this body of research is that it requires that knowledge be thought of as more complex than a straightforward accumulation of facts, which is characteristic of the receptive–accrual view of learning. Thus, understanding of the expert–novice research requires conceptual change by preservice teachers who hold a receptive-accrual view of knowledge and learning.

Schema theory. Another widely held theory in the study of knowledge structure is schema theory. A *schema* is an organizational structure that summarizes knowledge about a variety of cases linked to one another on the basis of their similarity and difference. Schemata lead us to ask certain questions and expect certain events, and are called into play whenever we attempt to make sense out of concrete situations. For example, entering a restaurant evokes a "restaurant schema" for most adults, which in turn allows customers to interpret the waiter's advances, the items on a menu, the presentation of a bill, and so forth.

Research on schema theory is especially significant for understanding how learners gain knowledge from either spoken or written text, the source of most information encountered in school settings (e.g., see Anderson & Pearson, 1984; Scardamalia & Bereiter, 1986). This research is reviewed in Anderson, Spiro, and Montague (1977) and in Schallert (1982). There are several research articles that present examples of adults in experimental settings whose interpretations of text or situations were influenced by their schemata (Anderson & Pichert, 1978; Anderson, Reynolds, Schallert, & Goetz, 1977; Anderson, Spiro, & Montague, 1977; Bransford & Johnson, 1972; Bransford & McCarrell, 1974).

Organizing Idea 2: Individuals' knowledge structures influence what and how they perceive, understand, and remember information.

Most of the studies cited in the above section also support this organizing idea. Experts perceive and represent problems differently from novices because their knowledge structures lead them to see more abstract relationships. The schemata that are activated for a given situation lead us to interpret events in a particular way, causing us to ignore details that are irrelevant to the schemata that have been activated. For example, in one of the studies cited (Anderson, Reynolds, Schallert, & Goetz, 1977), subjects were asked to read a passage that had been given two different titles (one about wrestling, the other about a prison escape). Subjects recalled details and interpreted the story according to the particular title, leading to two very different interpretations of the same passage. Obviously different schemata had been activated prior to reading. Bransford (1979) and Bransford and Stein (1984) present several other examples of the ways that knowledge structures affect individuals' perception, comprehension, and memory.

Although many of these studies are not school-based, they are nonetheless valuable for prospective and beginning teachers in learning to identify how their personal knowledge structures affect their daily thoughts and decisions. This awareness prepares the teacher to consider the existing knowledge about schemata related to the learning of school subjects. Following are some examples of literature related to schemata and school learning. It is important that beginning teachers can be convinced, through examples like these, that the prior knowledge a learner brings to a school task will be critical in shaping the student's response.

Examples of schemata and learning of school subjects. One type of schema that influences learning from reading, listening, writing, and speaking is *text structure* (also called story grammar or discourse form). Kintsch (1977), Meyer and Rice (1984), and Stein and Trabasso (1982) review research in this area. Readers who have a sense of different text types are more likely to comprehend and remember the content of the text. For example, a schema for story grammar prepares the reader to notice characters, problem definition, settings, and resolution. Children apparently develop this schema before school entry if they have heard enough stories. Children who have have less experience with stories (and thus a less well-developed story schema) will not find listening to stories for recall purposes as easy a task as some teachers might predict.

In math, several schemata about numbers and their relationships help students make sense out of math tasks. It is well documented that children bring extensive mathematical knowledge to the classroom (Cobb, in press; Resnick & Ford, 1981). Schemata for understanding word problems (akin to story structure) will affect performance on those problems because they determine what information is deemed relevant and how it should be considered (Kintsch & Greeno, 1985).

In science, research on the effects of knowledge structure has focused on the analysis of misconceptions, prior knowledge based on everyday experiences that prevent students from comprehending scientific explanations of phenomena (Anderson & Smith, 1987; Carey, 1986).

For example, students often have a difficult time understanding the role of reflected light in vision because of a preconception that light simply brightens things, allowing our eyes to see objects directly. Until students recognize that their original conception for understanding light is inadequate for scientific purposes, they will not achieve the desired understanding that will undergird further study of light and color (Anderson & Smith, 1987). The value of understanding the construct of schema or knowledge structure is that beginning teachers see the misconceptions in terms of a structure whose concepts and relations can be affected. In contrast, someone who holds a receptive–accrual view might conclude that some students' failure to learn science is due to either innate limitations or insufficient exposure to the correct facts.

Organizing Idea 3: Knowledge structures change as a result of information received through instruction and experience that leads the learner to construct new knowledge; prior knowledge structures are always the basis for the construction of new knowledge structures.

Beginning teachers need to know how knowledge structures change if they are to feel a sense of efficacy as agents of change. In particular, they need to understand those changes that are likely to result from children's maturation and out-of-school experiences, and those that can result from classroom instruction.

In preservice teacher education the topic of changing knowledge structures typically has been addressed through coursework on child development, which generally includes a large element of Piagetian theory. Although Piaget's descriptions of changes in children's knowledge continue to be compelling, his theories are no longer accepted uncritically (Flavell, 1985; Gelman & Baillargeon, 1983; Novak, 1977). Developmentalists now are questioning the general nature of change postulated by Piaget, and point to accumulating evidence that knowledge growth is domain-specific. Children change from being novices in many areas to being more like experts in many domains (Flavell, 1985). As a result, their reasoning in some domains comes to resemble those of the experts in the expert–novice studies cited earlier.

The recent emphasis on the study of domain-specific development does not mean that some general Piagetian principles and examples are no longer valuable. Piaget's proposed mechanism for cognitive development—mutual processes of assimilation and accommodation—are still viewed as the basis of changes in knowledge structures, although terminology may differ (Vosniadou & Brewer, 1987). Flavell (1985) suggests abandoning the notion of stage characteristics because recent research suggests that stages are not as general across knowledge domains as was once thought. However, he suggests that there are many developmental trends in the nature of children's knowledge that were first identified by Piaget and are still valuable to know, such as centration versus decentration, reversibility versus irreversibility, and capacity for hypothetico-deductive thought.

Another important aspect of development that has been studied in recent years is the way children process information during problem solving and how approaches to problems change as knowledge structures change to allow more efficient problem solving (Case, 1985; Flavell, 1985; Siegler, 1983). Beginning teachers might learn from this literature the importance of observing students' problem-solving efforts and the value of determing what is systematic about a child's efforts before interrupting him or her with corrections. An application of this view to school learning is found in Brown and Burton (1978).

Ways that instruction affects changes in knowledge structure (i.e., conceptual change) are discussed in more detail in the following chapter, so are mentioned only briefly here. Recent instructional research has identified common features of teaching that promote conceptual change. Although traditionally there has been a division between the kinds of instruction that promote "higher order" and "lower order" learning, recent work suggests that this is a false dichotomy. The instruction described below promotes both the learning of facts and skills as well as the development of conceptions within which those facts and skills are organized (Bereiter & Scardamalia, 1987; Resnick, 1987).

Research shows that teachers who were successful in promoting students' conceptual change used information about students' knowledge and cognitive processing in order to plan and conduct instruction. They gained this information by soliciting responses from students about their understanding of the content being studied.

Instruction that promotes conceptual change also causes students to feel some disequilibrium or dissatisfaction with their current ideas (Posner, Strike, Hewson, & Gertzog, 1982). This may result from the teacher's probing in a Socratic manner (Collins, 1977; Collins & Stevens, 1982, 1983; Roth, Anderson, & Smith, 1987; Vosniadou & Brewer, 1987) or it may result from peer interactions during group problem solving (Brown & Palincsar, in press).

Another feature of this type of instruction is that students are given opportunities to think actively about problems rather than performing arbitrary tasks that are not connected to the application of the content to be learned. For example, a "real-life" application of science may be to explain and predict physical phenomena that surround students (e.g., what causes plants to grow), rather than ask them to copy answers from a textbook (Roth et al., 1987).

These instructional features are discussed in more detail in the following chapter, along with the argument for including them in teacher education programs, which ideally should be promoting conceptual change about the nature of learning and instruction.

Capacity for Self-regulation

The preceding section has demonstrated the importance of a learner's knowledge; however, what a person knows is important only to the extent that it is used. Ideally in our educational system learners develop the capacity for self-regulation of the acquisition and use of their knowledge both in and out of school settings. The past 15 years have yielded much information about the role of self-regulated cognition and how instruction can facilitate its development. In particular, two constructs have become useful for thinking about self-regulation: metacognition and motivation.

Organizing Ideas about Metacognition

Metacognition is knowledge about and regulation of one's cognitive processes.

Organizing Idea 4: During learning and problem solving, learners regulate their cognitive processes.

Almost all adults have experienced the phenomenon of a "voice in the back of the mind" cuing them that what they are reading does not make sense. Most of us have paused before starting to write and mentally planned what to say, or stopped part of the way through a complex task and mentally assessed what we have done to that point. When we successfully perform a cognitive task we remain aware of what we know, how incoming information matches what we already know, and check our progress toward a goal, such as understanding a passage or completing a task. This form of cognitive regulation has been described as the executive function of information processing. The term *metacognition* is used to describe the knowledge and experiences related to this process.

Beginning teachers need to understand the basic characteristics of metacognitive knowledge and experiences. Learning is a constructive process in which knowledge structures are continually changing to assimilate and accommodate new information. The learner is more than a passive vessel for knowledge structures; rather, the learner is like a traffic cop who sometimes lets the traffic of information flow automatically and sometimes steps in actively to direct the process of sense making. No matter how talented teachers are in instructional presentations, they cannot replace the traffic cop in each student's mind. Nor should teachers try to do so, if learners are to become independent of teacher direction in their thinking (Bereiter & Scardamalia, 1987). In order to facilitate the development of each student's executive control, teachers must first learn what metacognition is and how it affects processes of learning and problem solving.

There are several good sources for the study of metacognition: Baker (1982); Baker & Brown (1984); Brown, Armbruster, & Baker (1985); Brown, Bransford, Ferrara, & Campione (1983); Corno (1986); Flavell (1979, 1981, 1985); Flavell & Wellman (1977); Paris, Lipson, & Wixson (1983); and Yussen (1985). The following summary of recent work is drawn primarily from Flavell (1985).

Definitions of metacognition abound. Flavell defines it as "any knowledge or cognitive activity that takes as its object, or regulates, any aspect of any cognitive enterprise. It is called *meta*cognition because its core meaning is 'cognition about cognition' " (p. 104). He lists the following areas of knowledge or performance that are influenced by metacognition: oral communication and comprehension, reading comprehension, writing, language acquisition, perception, attention, memory, problem solving, social cognition, and various forms of self-instruction and self-control. Needless to say, these areas are all highly relevant to students' performance in school.

Two categories usually are used to describe metacognition: knowledge and experience. Metacognitive knowledge includes what is known about human cognition in general and what is known about individual cognitive characteristics in particular. Some of this knowledge may be declarative ("knowing that") or propositional (e.g., knowledge that humans, especially young humans, cannot coordinate too much information at one time). Some of the knowledge may be procedural (e.g., knowing how to take notes on a lecture to overcome the limitations of human memory). Another category of metacognitive knowledge is described by Paris et al., (1983) as conditional knowledge: knowing when to use declarative and procedural knowledge (e.g., recognizing a situation as one that requires a particular memory strategy).

Metacognitive experiences are "cognitive or affective experiences that pertain to a cognitive enterprise" (Flavell, 1985, p. 107). These experiences can be consciously experienced and easily described, or they can be fleeting moments of vague awareness of incongruity. Metacognitive experiences are important because they often trigger a change of cognitive activity, such as rereading a passage, clarifying a task, or searching one's store of metacognitive knowledge for a strategy that will aid solution.

Organizing Idea 5: Metacognitive knowledge and experiences are associated with successful performance in school.

Several studies comparing more successful and less successful students, especially in the area of reading, have shown that poorer students have less metacognitive knowledge and fewer metacognitive experiences. More specifically, Baker (1982) reported that younger and/or poorer readers showed metacognitive deficits in at least nine areas, such as understanding the purposes of reading, modifying reading strategies for different purposes, recognizing the logical structure of a passage, and dealing with failures to understand. Other studies comparing the metacognitive characteristics of good and poor readers have been done by Garner and Kraus (1981–1982) and Myers and Paris (1978). Studies of more and less

fluent writers reflect similar differences. Younger or less fluent writers are less likely to demonstrate the metacognitive activity that leads fluent writers to plan, monitor, and revise according to a purpose and audience (Hayes & Flower, 1980; Scardamalia & Bereiter, 1986). In math, Schoenfeld (1983, 1987) describes the type of metacognition that is necessary for successful problem solving.

A knowledge of this literature will help beginning teachers make curricular decisions about how to teach basic skills. Unfortunately, students who have a history of low achievement and who are most in need of instruction that promotes metacognitive development often are taught with a focus on isolated facts and skills, which impedes this development (Allington, 1983). Such instructional decisions are usually grounded in the theory that students must acquire "lower-order" learning before they can acquire "higher-order" understanding, a premise that assumes that all academic learning is hierarchical and sequential in nature and underlies the receptive–accrual view. However, a limited focus on "lower-order" learning will not promote the development of the essential metacognitive knowledge that underlies self-regulation (Resnick, 1987). Beginning teachers must understand this fact in order to make informed judgments about the consequences of certain curricular decisions.

Organizing Idea 6: The capacity for self-regulation develops over time, and is influenced by the social environment, especially interactions with more knowledgeable adults or peers during problem-solving efforts.

Many developmental studies of self-regulation of cognition have found, not surprisingly, that older children are better at regulating their thinking than younger children. These differences have been attributed to the lack of metacognition in younger children. Why and how, then, does the situation change as children grow, and why do some children develop different levels of metacognitive knowledge?

One critical aspect of this development is acquisition of knowledge about particular strategies. Flavell (1985) describes a typical developmental progression for acquisition of strategy knowledge: First, the learner has no awareness of the strategy. Any attempts to elicit strategy use are ineffective. Next, the learner "knows" the strategy, but demonstrates a "production deficiency"; she or he cannot use the strategy in problem solving without external assistance. Finally, the learner progresses to mature strategy use involving adequate knowledge of the strategy with spontaneous use in appropriate situations.

This developmental progression probably occurs both for strategies taught in school (e.g., strategies for reading comprehension) and for those learned outside of school (e.g., how to plan a trip). Knowing what is typical development can help beginning teachers assess their efforts to teach about strategies.

What influences this development? Current theory suggests that self-regulation develops in a social, problem-solving context. In the classroom, self-regulation of academic learning can be fostered by teachers through modeling of thinking strategies (by both teacher and peers), explaining strategies, coaching students in the use of strategies, and providing guided practice of strategy use with feedback and gradual withdrawal of guidance until students are truly self-regulating. (See the following for descriptions of instructional programs that are characterized by these features: Collins, Brown, & Newman, in press; Englert et al. 1988; Palincsar & Brown, 1984; Paris, Cross, & Lipson, 1984; Duffy et al., 1986; Schoenfeld, 1987). In this volume, the following chapter and the Wang and Palincsar chapter discuss instruction for self-regulation in more detail.

Organizing Ideas about Motivation

Self-regulation requires more than metacognitive knowledge. It also requires the motivation to use that knowledge at appropriate times. This section addresses the motivational component of self-regulation as it might be understood by beginning teachers.

Motivation to perform a task often has been described as the joint and interactive function of individuals' expectations for success at a task and the value they attach to the task and its outcomes. Expectations for success are usually considered to result from individuals' beliefs about themselves, especially their competence and efficacy. Values associated with a task are a function of many things, including the personal goals held by the individual (e.g., to learn, to avoid failure). Both expectations and values can be thought about as knowledge held by an individual and utilized as that individual considers a particular task. Like all other forms of knowledge, expectations and values can change through the processes described in the previous section on knowledge, although in some individuals expectations, values, and goals may be deeply entrenched and difficult to change.

There are two reasons why beginning teachers should understand the content described in this section. First, if teachers understand these basic motivational concepts it will be easier to look and listen for cues about their students' beliefs. Once a "motivation problem" is defined in terms of modifiable knowledge structures (i.e., beliefs about the self and tasks) rather than as immutable personality traits, teachers are more likely to make instructional decisions that will affect learners' beliefs and, thus, their motivation for particular tasks.

Second, when teachers think about motivation in the ways described here they may be more likely to examine both tasks and the social structure of the classroom for their effects on students' perceptions. For example, task difficulty, relationship of tasks to student goals, ways that tasks are considered in the accountability system, access to resources that influence performance, and the publicness of performance are all features of classroom life that have been associated with students' perceptions

of themselves and their work (Marshall & Weinstein, 1984). The ideas in this section can help beginning teachers see how the socialization function of teaching intersects with and occurs simultaneously with content instruction, and how both can be understood using constructs of knowledge structure and knowledge change.

Organizing Idea 7: Expectations for success on an academic task—a critical determinant of a student's motivation to perform that task—are determined by (a) an individual's self-perceptions, particularly beliefs about competence in the academic domain and beliefs about control over outcomes in that domain; and (b) beliefs about cause-effect linkages—what behaviors lead to successes and failures.

When students approach academic tasks, they bring with them several types of background knowledge. Content-specific knowledge and metacognitive knowledge were discussed in previous sections. A third type of knowledge, self-knowledge, refers to beliefs that predict how one is likely to perform on a task and how much control one has over the outcomes of the task.

Like all other knowledge, self-knowledge is organized into interconnected structures that grow and change as a result of experience and instruction (Harter, 1983; McCombs, 1986). Some theorists postulate that the knowledge structures about the self act as filters for all other information. One of our most basic human needs is to maintain a personal sense of worth and efficacy (Covington, 1984), thus any incoming information that could affect our sense of self is usually processed in a manner that preserves self-esteem and perceptions of control (McCombs, 1986).

Knowledge about the self, therefore, stands at the beginning of a chain of cognitive responses to a task that ultimately determine whether and how a learner gains from task performance. Various theorists have proposed models for this process (Corno & Mandinach, 1983; Harter & Connell, 1984; McCombs, 1986). This is an active research area that will probably yield additional insight about classroom influences on self-knowledge in the next few decades. Beginning teachers who develop some basic ideas about the self-knowledge system and its role in information processing will be in a position to learn from the emerging research.

Young children have generally positive and undifferentiated perceptions of their own abilities. By the end of elementary school, however, students' individual differences are apparent in their general perceptions of their capacity for academic work. As students move through school, their self-perceptions become more domain-specific and subject-specific (e.g., one may think one is good at sports but not in social settings; or a good math student but poor in English [Blumenfeld, Pintrich, Meece, & Wessels, 1982; Eccles, 1983; Harter, 1983; Nicholls, 1983; Stipek, 1981]). Harter (1983) identified six domains of competence as perceived by school-age children: scholastic, athletic, social competence, social acceptance, physical appearance, and behavior and conduct.

Self-perceptions of competence are typically associated with higher achievement, as well as higher persistence on tasks and more realistic goals (Eccles, 1983; Findley & Cooper, 1983; Harter, 1983). However, the link between perceptions of competence and achievement are apparently not direct. A related self-perception—a sense of personal control—plays an important role in mediating the effects of self-perceptions on effort expended on a task (Connell, 1985; Harter & Connell, 1984; Skinner & Chapman, 1984; Skinner & Connell, 1986).

Building on the work of Rotter (1966) and the construct of locus of control, several studies have related perceptions of personal control to performance and effort expenditure. Students who hold beliefs that they have some personal control over outcomes typically function better on school tasks (Bandura, 1977; Brookover, Beady, Flood, Schweitzer, & Weisenbaker, 1977; Stipek & Weisz, 1981).

Some researchers have reconceptualized the construct of locus of control as sets of beliefs rather than a single dimension. Various theories about perceptions of control commonly hold that control is a complex phenomenon, that it contains elements of world knowledge about what causes outcomes, and that a sense of competence is inextricably linked to one's beliefs about one's capacity to make things happen (Connell, 1985; Harter & Connell, 1984; Skinner & Chapman, 1984; Weisz, 1983; Weisz & Stipek, 1982).

Part of the world knowledge that figures in control perceptions are causal attributions: explanations about why success or failure occurred in the past (Weiner, 1984). A learner's willingness to expend effort on future tasks depends on the explanation offered for past performance. Of particular interest are perceptions of ability and effort as causes of performance. Usually, effort is considered to be a desirable explanation for success (as lack of effort is seen as an explanation for failure) because such attributions supposedly lead to continued or increased effort on future similar tasks. However, perceptions that ability or lack of ability account for past performance lead learners to believe that future effort is irrelevant (i.e., if you are smart, you don't have to try; if you are not smart, it doesn't matter how hard you try).

Recent studies have been done on the need to consider other attributions, especially strategy use, to explain success and failure (Borkowski, Weyhing, & Turner, 1986). For some students, effort attributions are not reasonable, since they do not have adequate knowledge to perform the task. Attributing performance to knowledge and strategy use (or lack thereof) as well as to effort is a more realistic and efficacious explanation in many cases. In fact, limiting attributions to effort and ability may be detrimental to students' self-perceptions. Past the age of about 10, students are aware of the trade-off between attributions of ability and

effort. That is, if one expends great effort and still fails, one must be low in ability. Thus, students who are urged to "try hard" and still fail because of inadequate knowledge or strategic choices may eventually view themselves as having low ability, which is usually seen as an immutable trait. On the other hand, if children learn to attribute success (or failure) to presence (or absence) of knowledge and strategy use instead of ability, they are more likely to develop flexible perceptions of their competence.

Teachers need to know about attributional processes in order to consider how their feedback may influence a student's interpretations of his or her own performance. If teachers only emphasize effort in their feedback, they may inadvertently convince students who have failed that they are incompetent.

Organizing Idea 8: Students hold general orientations toward academic tasks that are associated with different student goals. These task-related goals are associated with different cognitive activities and thus determine whether students choose to utilize available metacognitive strategies while performing school tasks.

Different learners can be characterized by their general approach to and beliefs about academic tasks. Although situational variables may influence an individual's motivation for a particular task, the learner's general orientation is a very strong influence on the level of motivation (Meece & Blumenfeld, in press). In order for teachers to understand ways they can influence students' motivation, they need to understand how general motivational orientations develop, and why changing them is likely to require from them a great deal of effort and knowledge.

A number of studies have been done on general motivational orientations. Most conceptualizations present a continuum from intrinsic to extrinsic motivation—from learners who are typically interested in tasks and mastery for their own sake to learners who perform only because external consequences are attached. Beginning teachers should understand the ramifications of these different motivational orientations on student performance.

Dweck (1986) and Diener and Dweck (1978) describe students who are either "mastery oriented" or victims of "learned helplessness." The latter type tend to believe that they cannot cause successful outcomes and are basically helpless. Mastery-oriented students not only have more self-confidence, but they also tend to focus their thinking on the task, not on themselves. When mastery-oriented students encounter obstacles, they tend to focus on problem-solving strategies. In contrast, when learned-helpless students encounter obstacles, they tend to focus on their perceptions of inability and helplessness (which results in less attention to the task and its solution). Thus, the motivational patterns are related to students' cognitive responses to school learning tasks.

Nicholls (1983) described two forms of involvement that are similar to mastery orientation and learned helplessness: task involvement and ego involvement. These terms refer to a student's reasons for task engagement. Task involvement is similar to mastery orientation in that the learner is performing a task because it is intrinsically interesting or valuable. Ego involvement, while not synonymous with learned helplessness, is similar in that reasons for accomplishing tasks relate to the self and the need for self-enhancement through satisfactory performance.

Yet another way of dichotomizing motivational orientation is offered by Brophy (1983, 1987) who distinguishes between motivation to perform a task (because of the rewards and consequences attached) and motivation to learn from a task (because it is intrinsically valuable and/or interesting).

Although these are slightly different approaches to thinking about motivation, they have in common the distinction between students doing tasks for extrinsic reasons (such as the approval of others) versus reasons more directly related to learning. Research on motivational orientations has consistently suggested that students who typically approach tasks with extrinsic orientations (i.e., as learned helpless, ego-involved, and motivated to perform) have lower levels of performance (Dweck & Elliot, 1983; Meece & Blumenfeld, in press).

Not surprisingly, students' general perceptions of their competence are also associated with general motivational orientation, thus more intrinsically-oriented students tend to have higher perceptions of their own competence (Harter & Connell, 1984). However, motivational patterns are not usually associated with measures of academic ability so even able students may be extrinsic in their orientation, believing that they are not capable enough to succeed.

These general orientations are associated with the goals that students have for academic tasks. Meece and Blumenfeld (in press) describe three types of motivational goals identified in the literature: motivation to learn from the task, motivation to perform the task, and motivation to avoid work on the task. In a study of sixth graders they found that students' level of cognitive engagement was most strongly related to the goals they held for particular tasks. Those goals were indirectly influenced by the students' general motivational orientation but were subject also to some situational influences. The particular goal adopted for a task depends on the student's personal need (e.g., for either external support or intellectual stimulation) and the demand of the situation (e.g., is the task a test that contributes to a grade or is it a self-selected task for enrichment?) (Eccles, 1983; Mischel, 1977).

Classroom studies of students' goals for performing tasks do not suggest high motivation to learn. Rather, students appear to be largely motivated either to perform (or sometimes just to complete) or to avoid work, a condition especially apparent when social-comparison cues are present and failure would be evident to others whose opinions matter. Students who have low self-con-

cepts and extrinsic orientations in particular are motivated to avoid work (Anderson, Brubaker, Alleman-Brooks, & Duffy, 1985; Blumenfeld et al., 1982; Corno & Rohrkemper, 1985; Rohrkemper & Bershon, 1984). Beginning teachers can use such data to think about alternative motivational patterns and modify their goals for student performance from a focus on task completion and on-task behavior (Anderson et al., 1985; Brophy, Rohrkemper, Rashid, & Goldberger, 1983), emphasizing student understanding and recognition of the purposes inherent in school tasks (Brophy, 1983; 1987).

Although the motivational patterns described above have obvious affective consequences for learners, they also have cognitive consequences. A learner's goals for a particular task will determine what strategies are called into play; thus, different motivational goals are associated with different levels of metacognition (Corno, 1986; Meece & Blumenfeld, in press). Students whose goals are to learn and master tasks for their own sakes have a higher level of cognitive engagement than do students with other goals (Corno, 1986; Corno & Mandinach, 1983; Dweck & Elliott, 1983; Meece & Blumenfeld, in press). Thoughts tend to be focused on the task at hand and on strategies for solving problems and removing blocks to understanding. Thoughts about one's self-competence are minimized.

In contrast, when learners' goals are to perform for extrinsic reasons, they focus on the quality of the performance and, in the case of extrinsically oriented students who also have low perceptions of competence, on lack of ability. This type of thinking prevents the consideration of strategies for solving problems (Butkowsky & Willows, 1980; Diener & Dweck, 1978; Dweck, 1986).

Thus, self-regulation on academic tasks depends not only on the learner's knowledge about metacognition but also on his or her perception that metacognitive strategies will be useful in accomplishing goals. The two features of self-regulated learning—metacognition and motivation—are inextricably related. Students will not benefit from instruction in metacognition unless they perceive that it will help them accomplish their own goals. On the other hand, students are not likely to maintain intrinsic motivation to learn unless they have a sufficient repertoire of cognitive strategies that enable them to learn. When beginning teachers understand this relationship, they will realize that teaching students to be self-regulating involves not only instruction in metacognitive strategies but also socialization of beliefs about self and tasks. This has implications for both instructional planning and decisions about management, discipline, feedback and evaluation, and types of tasks and task settings (Anderson, Stevens, Prawat, & Nickerson, 1988).

Organizing Idea 9: Students' motivation is affected by the classroom social and task structure.

The preceding two organizing ideas described motivational differences in students and suggested that these differences can predict students' goals and cognitive responses to tasks. However, students' responses to tasks are not completely determined by their characteristic motivational orientations. Teachers also can affect the ways that students perceive their own competence, their level of control, and their goals when working on tasks. Although this chapter does not focus on teaching practice, the point is made here because a beginning teacher should understand that motivation in children is not a static characteristic. The selection, presentation, and organizational context of tasks may influence how the teacher may approach tasks so that even children with more extrinsic orientations can be encouraged to adopt intrinsic goals. Specific knowledge about social and task systems in classrooms is reviewed in the following chapter.

Conclusion

The purpose of this chapter has been to establish the knowledge base for a cognitive–mediational conception of learning and learners, and to suggest that beginning teachers should understand thoroughly the core ideas that compose this conception. Teachers and their students benefit from such a perspective because it advances meaningful learning by students, a sense of efficacy by the teacher, and greater equity of outcomes for students who enter with different characteristics. The knowledge base has been organized into a few core ideas that can be used to help preservice teachers construct their own personal conceptions about classroom instruction.

The next chapter emphasizes the part of the knowledge base that directly relates to the activity of classroom instruction. This chapter is an elaboration of some of the organizing ideas of this first chapter: Idea 3 (*Knowledge structures change as a result of instruction*); Idea 6 (*Capacity for self-regulation develops over time in a social context*); and Idea 9 (*The social and task systems in a classroom will influence motivation*).

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Annotated Bibliography

Chipman, S. F., Segal, J. W., & Glaser, R. (Eds.). (1985). *Thinking and learning skills: Vol. 2. Research and open questions*. Hillsdale, NJ: Erlbaum. This volume brings together a collection of research-based papers focusing on higher order thinking skills. Themes include various aspects of thinking such as intelligence, reasoning, and problem solving, and the factors that may influence them: processes through which cognitive skills develop in children; and approaches to teaching cognitive skills.

Flavell, J. H. (1985). *Cognitive development* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall. The first half of Flavell's book chronicles the general mental growth and development of social cognition from birth to adulthood, emphasizing and evaluating Piaget's work. Included in the discussion of developmental trends during middle childhood and adolescence are sections on metacognition and domain-specific knowledge. In the latter half of the book, Flavell describes development in the areas of perception, memory and metamemory, and language. He ends with a discussion of contemporary questions and problems in the field of cognitive development.

Glaser, R. (1984). Education and thinking: The role of knowledge. *American Psychologist*, **39**, 93–104. Glaser begins this article with an historical overview of theories of human thinking and problem solving and the influence these theories have had on the content and method of classroom instruction. Next, he describes four different categories of recent programs designed to teach reasoning, problem solving, and learning skills, and criticizes the programs for their lack of connection to the subject matter of schooling. Glaser then discusses the relationship between problem solving ability and an individual's knowledge base and reviews developmental studies and expert/novice problem-solving studies. Glaser concludes with an elaborated discussion of the notion of schemata and the implications of schema theory for instruction.

Glaser, R., & Takanishi, R. (Eds.). (1986). Psychological science and education [Special issue]. *American Psychologist*, **41** (10). This special issue of *American Psychologist* focuses on contributions of cognitive science to education. Each article describes theory and research about cognition and instruction in several areas, including specific school subjects (reading, writing, mathematics, and science) as well as more general topics such as testing and assessment, motivation, cross-cultural research, gifted and talented children, learning disabilities, early childhood education, individual differences, and gender differences.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education*, **66**, 211–227. The authors offer a model of the process

by which an individual moves from one set of organizing concepts to another which is incompatible with the first, referred to as accommodation or conceptual change. First the authors discuss views of conceptual change gleaned from the philosophy of science literature (e.g., Kuhn's notion of paradigm shifts) and relate these conceptions to learning theory. Next they propose four conditions that must be met in order for conceptual change to occur and describe five characteristics of an individual's current "set" of conceptions. The authors then discuss implications for teaching science, including curricular objectives, content, teaching strategies, and the role of the teacher.

Resnick, L. B. (1987). *Education and learning to think*. Washington, DC: National Academy Press. Resnick begins her piece with descriptions of the cognitive skills involved in reading and mathematics and argues that these are indeed problem-solving activities. She maintains that at all levels of schooling, successful learning of school subjects requires higher order problem-solving skills. Resnick then reviews a series of programs designed specifically to improve general intelligence or teach problem-solving skills, reading and study strategies, self-monitoring skills, and informal logic. In concluding, Resnick argues for embedding thinking skills in the academic curriculum and elaborates on suggestions for cultivating in students the habit of higher order thinking.

Siegler, R. S. (1983). Five generalizations about cognitive development. *American Psychologist*, **38**, 263–277. Siegler presents five generalizations about cognitive development that are supported by recent research about the interaction between learning and prior knowledge. The generalizations describe various aspects of children's existing knowledge and the processes by which children detect inadequacies in their knowledge and construct new knowledge. For each generalization Siegler presents a detailed example from his experimental work on children's development of the concepts of time, speed, and distance, as well as other ideas and experiments relevant to the generalization.

Stipek, D. J. (1988). *Motivation to learn: From theory to practice*. Englewood Cliffs, NJ: Prentice-Hall. Stipek's book provides a thorough survey of theory and research in the area of motivation. Topics include reinforcement theory, intrinsic and extrinsic motivation, expectancy-times-value theory, attribution theory, self-worth theory, achievement theory, and communicating teacher expectations. Each theory is clearly described with information provided from original research studies. The author also offers suggestions on how knowledge of motivational theories can inform teaching practice in classroom situations.

Vosniadou, S., & Brewer, W. F. (1987). Theories of knowledge restructuring in development. *Review of Educational Research*, **57** (1), 51–67. This article focuses on learning as a process of knowledge restructuring. First, the authors discuss the possibility that restructuring is domain-specific rather than global, as represented in Piagetian theory. Second, the authors propose that there are different types of restructuring ("weak" and "radical"), and they examine the role that prior knowledge plays in each type of restructuring. Finally, they describe teaching methods that may foster radical restructuring, such as Socratic dialogue and use of analogy.

Zimmerman, B. (Ed.). (1986). Self-regulation [Special issue]. *Contemporary Educational Psychology*, **11** (4). This special issue of *Contemporary Educational Psychology* is a collection of papers dealing with self-regulation in learning. Several articles focus on the subprocesses and influential factors involved in self-regulated learning (i.e., self-concept, self-efficacy, and self-esteem; metacognitive control components; and overt verbalization). The remaining articles discuss the design of learning environments, teaching practices, and instructional materials that promote student development of self-regulation strategies.