

## **Chapter Three**

### **Building Blocks Of Knowledge: Cognitive Foundations for Constructivist Counselor Education**

**Danielle S. McNamara, Jennifer Scott, and Tammy Bess,  
Old Dominion University**

Constructivist instruction is unique in its focus on both the student and the teacher. Constructivism posits that the student, rather than acquiring knowledge from the instructor, constructs knowledge in an environment created by the instructor (e.g., Pressley & McCormick, 1995). The heart of constructivism (at least from the constructive developmental perspective) grounds learning in what the student brings into the learning situation. Students' widely varying prior experiences, knowledge, learning strategies, and personalities heavily influence the learning process and constructivist teaching.

This chapter offers a cognitive psychological perspective on constructivism. Cognitive psychology is the study of the thought processes involved in performing a task, and includes the study of human attention, memory, learning, thought, language, decision making, and problem solving. Cognitive psychology studies how humans encode, store, transform, elaborate, retrieve, convey, and otherwise use information. Learning can be maximized by accounting for these mental processes. Hence, knowledge of cognitive psychological findings can contribute to instructors' understandings about how to effectively and optimally assist students in constructing knowledge and skills (e.g., Hacker, Dunlosky, & Graesser, 1998; Resnick, 1989).

In this chapter, we present a brief introduction to the research in cognitive psychology, including research on the importance of active processing for memory and learning. We also provide five cognitive learning principles, referred to as *building blocks of knowledge*

*construction*, which are supported by both laboratory and applied research in cognitive psychology. The research supporting these building blocks lends empirical support to constructivist approaches to classroom teaching.

### **Early Research in Cognitive Psychology**

One goal of cognitive psychology is to develop a better understanding of human learning and memory (e.g., Healy & McNamara, 1996). Early in the history of psychology, concepts of learning and memory were driven by behavioristic principles. These initial principles revolved around notions of conditioning and the causal relationship between a stimulus and a response, stressing only the influence of the environment on an individual. Early behaviorism ignored the internal workings of the mind, referring to the mind the "little black box," because such workings were unobservable and considered outside the realm of science (e.g., Gardner, 1985).

Despite their many valuable contributions, behavioristic principles failed to provide us with a framework for understanding the complexities of human learning and memory, not to mention principles of instruction. The notion of learning as the passive passage of information from one source to another was not helpful for understanding the type of knowledge construction human beings strive to achieve and to promote. However, the limitations found in behaviorist research spurred the birth of what today is referred to as cognitive psychology (e.g., Gardner, 1985).

### **A Key to Learning: Active Processing**

Cognitive psychology progressed from the behaviorist emphasis on passive memorization to exploring active processing -- the interaction between the learner and the new information. Numerous cognitive studies have supported the positive effects of active processing on memory and challenged behaviorism's notion of "the little black box," i.e., the unknowable, and, to

behaviorists, uninteresting, mind. Research on active processing indicates that the more semantically complex (i.e., conceptually meaningful) the thought processes involved when learning new information, the greater the likelihood that the information will be integrated into long-term memory. Four useful notions under active processing are: semantic processing, the generation effect, encoding specificity, and mnemonics. Each can be explicitly applied to counselor education. We close this section with a discussion of types of memory and their application to teaching and learning.

### **Semantic Processes**

Craik and his colleagues were among the first to experimentally investigate the utility of semantic processing during learning (Craik & Lockhart, 1972; Craik & Tulving, 1975). Their experimental results indicated that semantic processing (i.e., having a meaningful context for an idea) involved greater depth than phonemic processing (i.e., thinking about the idea in terms of how it sounds), which in turn had a greater depth than structural processing (i.e., thinking about the idea in terms of how it looks when written). They found that the degree of active processing induced during learning predicted the probability of later recalling a target word. Most importantly, these researchers demonstrated that rote rehearsal (i.e., repeating information without thought to meaning) was the most ineffective method for learning (e.g., Craik & Watkins, 1973). In sum, the more semantically complex (i.e., conceptually meaningful) the thought processes involved when learning new information, the greater the likelihood that the information will be remembered and integrated into the individual's memory.

### **The Generation Effect**

The generation effect is another finding from cognitive research that points to the importance of active processing during learning. The generation effect refers to learners

remembering self-produced information better than information that is simply copied or read (e.g., McNamara, 1995; McNamara & Healy, 1995; Slamecka, 1966; Slamecka & Graf, 1978). Slamecka and Graf established that when participants are given the task of generating a target word from a cue and a word fragment (e.g., hot – c\_ld), they better remember the target words (i.e., cold) than if they simply read the intact words. In sum, when participants generate target information, rather than merely reading it, they recall it better afterward. Since Slamecka and Graf's landmark study, the generation effect has become well established across a wide range of stimuli types and experimental manipulations and is widely cited as a source of evidence for the critical role of active processing during learning.

### **Encoding Specificity**

Encoding specificity is an important caveat to the generation effect (e.g., Jacoby, 1983; Tulving, 1983). This notion means that the match, in terms of mental processes involved, between a task, such as generating or reading information, and how memory for that task is tested, impacts the degree of advantage displayed by each learning condition. For example, a “generation advantage” is more likely when the retention test taps into the same mental processes -- retrieving or recalling the information -- that were used during the generation task. On the other hand, a “read advantage” will be evident if the retention test taps into the same mental processes – reading -- that were used during the read task. Instructors would thus do well to match testing procedures to learning procedures if they want a true reflection of the learning achievements (e.g., Healy & Bourne, 1995; Healy & Sinclair, 1996; Healy, King, Clawson, Sinclair, Rickard, Crutcher, Ericsson, & Bourne, 1995).

## **Mnemonics**

The importance of active processing is also reflected in the benefits provided by simple memory aids, called mnemonics. Cognitive research has repeatedly demonstrated the benefits of mnemonics for enhancing memory (e.g., Bower, 1970; Bower & Clark, 1969). Mnemonics are generally effective because they increase active processing of the words (or phrases) and render them more meaningful by linking them to familiar concepts in memory. In addition, mnemonics often use mental imaging (e.g., Bower, 1972). Images not only render the information more meaningful, but they provide an additional route for "finding" information in memory (e.g., Paivio, 1971). The more meaningful links exist to the information we need to remember, the greater the likelihood it can be retrieved

## **Types of Memory: Episodic, Semantic, and Procedural**

The experiments which generated the above principles require translation into teaching practice. After all, how relevant for higher education is memory for word lists? In many of the studies discussed thus far, the participant received a single presentation of a word list, under laboratory conditions manipulated by the experimenter, and then was asked to recall the list within a relatively short period of time (typically within the same experimental session). These conditions hardly mimic those found in a standard educational setting.

The research on *types* of memory bring us closer to the teaching situation. Tulving (1972, 1983) identified three types of memory: *episodic*, *semantic*, and *procedural*. The last two are especially useful for educational endeavors. Remembering an episode, such as what you ate for breakfast yesterday, your tenth birthday, or a word within a list presented an hour ago, are all examples of episodic memory. Examples of semantic memory are knowing the appropriate foods to eat for breakfast, what a typical birthday includes, or the meanings of words in a presented list.

Procedural memory concerns memory for how to do a task, such as riding a bicycle, composing a letter, or playing a musical instrument. All tasks (and knowledge) combine these three types of memory; but each task generally requires one type of memory more than another. Because episodic memories are more likely to be forgotten, the underlying goal of instruction should be to integrate course material within the student's semantic and procedural memory.

This research on active processing reminds counselor educators that they might incorporate semantic and procedural memory in assignments and classroom activities. Thus we might instigate multiple exposures to learning situations (e.g., “read, hear, see, try” in learning interviewing skills), and help students to form strategies or mental procedures to process new information (e.g., presenting an anecdote before launching into a discussion of an abstract concept), and making a sufficient number of errors during learning (e.g., having practice sessions with feedback). Research supporting the value of active processing for memory and learning implies that teaching abstract concepts without connecting those concepts to something the learners already understand is fruitless.

### **Five Building Blocks for Knowledge Construction**

This brief review of research regarding the birth of and the empirical foundations for today's cognitive psychology highlighted one general principle -- the importance of active processing. But how can we create opportunities for active processing? This section presents five general guidelines<sup>1</sup> which we have called *building blocks for knowledge construction*. Counselor educators might consider incorporating these five guidelines in their work. They are: (1) developing and using reinstatable cognitive procedures, (2) retrieving and testing information

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<sup>1</sup>Here we only presented a subset of cognitive learning principles that seem most relevant to knowledge construction. For more complete reviews, along with explanations of the supporting research, see Healy et al., 1995 and Healy & Sinclair, 1996.

numerous times, (3) learning the same information in a variety of ways and settings, (4) increasing metacognitive processing, and (5) actively using prior knowledge.

### **Cognitive Procedures**

Perhaps most important to knowledge construction is developing and using “cognitive procedures.” Cognitive procedures are actions, mental or physical, that increase the distinctive meaning of the information by helping the learner relate the incoming information to prior experience. Such procedures illustrate one way to follow Chapter One’s suggestion to personalize teaching. In essence, cognitive procedures help new information to *attach* itself to information already in memory. Without such *attachment*, the new information is only processed in short-term memory and will be quickly forgotten.

The *mnemonics* previously discussed are a familiar example of a cognitive procedure. Developing and accessing mnemonics and strategies, or other means of relating information to prior experience, contribute integrally to gaining skill in any domain and to demonstrating such skills in testing situations. Ample cognitive research demonstrates that when the learner links new information to prior knowledge, the information will be learned at a deeper, more meaningful level, and will be retained for a longer amount of time (e.g., Craik & Lockhart, 1972; Craik & Tulving, 1975; also see Kintsch, 1998 and Resnick, 1989 for discussions of this literature as it relates to instruction). However, demonstration of the effectiveness of such active processing depends on the match between the conditions of learning and the conditions required when testing the construction of knowledge (e.g., Healy & Bourne, 1995; Healy & Sinclair, 1996).

In order to link new information to prior knowledge, instructors may ask students to think of personal applications of the concepts being introduced during class. With larger classrooms

and with "shy" students, students may be asked to write their thoughts down. In general, writing assignments encourage active knowledge creation. Counseling instructors might, for instance, present students with a case and ask them to write their evaluation of the case and techniques they might use to aid the client. In-class writing assignments, followed by sharing or peer evaluation, may contribute both to active learning and to reducing the time necessary for the instructor to grade writing assignments. Alternatively, weekly worksheets can be used concurrently with reading assignments to require the learner to actively engage the information and integrate new information into a prior body of knowledge.

### **Distributed Retrieval Practice**

Retrieving and testing information numerous times is essential to learning (e.g., Healy & Bourne, 1996; Healy & Sinclair, 1996). The more times the information is tested (and thus retrieved), the better it will be remembered in the long-term, because every time the information is retrieved, its strength and stability in long-term memory is reinforced. In addition, retrieval practice should be distributed, that is, spaced out in time rather than done all at once (e.g., cramming). Further, practicing skills or retrieving information in random order – rather than in a fixed order – also increases long-term retention.

For counselor education, the need for retrieval practice can be translated into practice tests, worksheets, and quizzes. Moreover, counseling skills should be practiced (not just talked about). This practice might be achieved by acting out scenarios in class and by applying certain counseling theories to a variety of cases. Likewise, a variety of counseling approaches can be applied to a single case so that the student better understands alternative methods of counseling.

## **Heterogeneous Learning Experiences**

Learners benefit from learning the same information in a variety of ways and settings, as the authors point out in Chapter One's Guideline Two. For example, a student learning school counseling principles may read about them, discuss them, observe them in a school setting, produce a drama demonstrating them, and debate them among classmates.

Heterogeneity of learning experiences provides a number of benefits. It improves the student's understanding of the material and maximizes the similarity between presentation of material and demonstration of knowledge or skill. It respects the fact that students learn in different ways, that they walk into our classrooms from a wide range of starting points, with different backgrounds, different skills, and different knowledge. Mixing up the content and teaching style may also be valuable in keeping students' attention. Further, different types of questions on exams will tap into different levels of understanding. Finally, including different types of questions on worksheets or exams ensures that each student will have an opportunity to convey their understanding of the material.

## **Metacognition**

Increasing "metacognitive processing" is increasingly recognized as crucial to learning. Metacognition involves three basic processes. First, students need to develop an awareness of their own thought processes. Second, students need to become aware of whether or not comprehension has been successful. Finally, and most importantly, students need to use strategies to remedy comprehension difficulties.

Instructors can increase metacognitive abilities in several ways. First, instructors can create an "active learning environment" in order to focus students' attention on what is happening in the classroom. Counseling students, for example, can be encouraged to think about whether or

not they understand a counseling technique well enough to utilize it with a client. They can further evaluate their understanding through attempting role plays and writing about concepts. Second, instructors can provide an atmosphere in which asking questions during class time is accepted and encouraged. Sometimes this requires simply stopping a lecture on difficult material and asking for questions. If met with silence, instructors simply wait for as long as it takes for the questions to emerge. Such interactive, multi-faceted experiences allow students to identify areas that need more work. More clarification can take place as students ask questions in the classroom, request more "practice time" through role play, observe counseling situations outside the classroom, or ask for specific case examples of a technique being used with a client.

### **Prior Knowledge**

One of the most important building blocks of knowledge is prior knowledge itself. For example, the comprehension of both written and verbally presented information depends in large part upon the reader's or listener's prior domain knowledge (e.g., Bransford & Johnson, 1972). Knowledge is particularly important for the understanding of instructional textbook material because textbooks rarely spell out everything needed for successful comprehension. This prior knowledge allows the reader to fill in contextual gaps within the text and to develop a better global understanding of the text (e.g., McNamara & Kintsch, 1996; McNamara, Kintsch, Songer, & Kintsch, 1996). The use of this knowledge also leads to a more active processing of the text. Readers who successfully understand text material have been shown to use their prior knowledge to process such things as the relationship between two separate sentences; the relationship between two separate paragraphs; the global purpose of the text; and how to integrate their prior knowledge with the text to develop a more complete understanding of the text. (e.g., Oakhill, 1984).

However, many students do not actively process text material or use their prior knowledge to understand and learn from the text, despite the fact that college courses require students to read articles or textbooks. Various training methods may be used to improve reading comprehension by inducing the reader to more actively process the text and to use prior knowledge to understand the text (e.g., Kucan & Beck, 1997). For example, less skilled comprehenders benefit greatly from inference training, that is, using prior knowledge to fill in conceptual gaps in a text (e.g., McNamara & Scott, 1999; Yuill & Oakhill, 1988). Prompting students to explain the text aloud to themselves while reading, stopping periodically to describe in their own words what they have just read, has also been found to enhance comprehension (e.g., Chi, de Leeuw, Chiu, & LaVancher, 1996). “Self-recitation” also induces greater comprehension. This means that while reading a text, students raise questions, seek answers, compare, contrast, and organize, and seek relationships among ideas. Students who engage in these types of study habits are more successful than those students who use such techniques as memorization or repetition (Walker, 1995).

Sometimes insufficient knowledge by the reader doesn't permit active processing. Such students may need an easier, more explicit textbook (e.g., McNamara & Kintsch, 1996; McNamara, et al., 1996). Instructors may need to have more explicit materials on hand to offer to struggling, less knowledgeable students in order to provide them with some basics before tackling the more difficult textbook. More explicit books may provide the students with a knowledge base to build upon during the course of the semester.

### **Speed of Acquisition versus Long-term Retention**

Often educators and researchers are misled into considering an instructional technique effective when rapid acquisition of the knowledge or skill is observed. Also, in much cognitive

research, the testing time is immediately after the intervention. Researchers and educators often don't have the luxury of observing longer-term retention or performance, only remaining aware of students' performance on a final exam rather than students' abilities to perform in the field six months after graduation.

A consequence of employing these learning principles may be a more time-intensive initial learning process. However, the benefits reaped in long-term retention and a deeper understanding of the material should be worth it. Research has shown that when information is acquired rapidly, it is also rapidly forgotten. On the other hand, when the learning requires time and effort, the information will be better retained and more useful in a wider variety of situations (see e.g., Healy, et al., 1995; Healy & Sinclair, 1996 for excellent reviews of this literature).

### **Conclusion**

In summary, we have presented five building blocks of knowledge: (1) developing and using reinstatable cognitive procedures, (2) retrieving and testing information numerous times, (3) learning the same information in a variety of ways and settings, (4) increasing metacognitive processing and awareness, and (5) actively using prior knowledge. Such principles emphasize active processing of material, experiential and personalized learning, linking new information to information already stored in memory, engaging students in the learning process, encouraging questioning, posing questions that allow students to conceptualize information from different angles and to become comfortable with ambiguity, and creating a community of learners working together to create knowledge. These approaches to teaching and learning have been immensely successful and are currently accepted and used by an increasing number of teachers and schools (e.g., Brown & Palincsar, 1982, 1989; Palincsar & Brown, 1984).

Using these principles requires instructors to give up some control in the classroom. Instructors using a pure lecture format generally know what they will say, when they will say it, and how much information they will cover. Once students join in the teaching/learning process, instructors lose some of that control. However, our goal as instructors is, or should be, to assist students in constructing an understanding of the information, a deep, long-lasting understanding, that extends well beyond the classroom and the particular course's domain of study, even if we must give up some control.

Further, using these principles requires energy, genuine excitement about the material, and commitment to making new discoveries. These active learning approaches invite challenge in the classroom. Instructors need to be prepared to be questioned, to step down from the podium, to not always be the most knowledgeable person in the classroom. Once students start thinking, doubting, and worrying about learning, they will never again unquestioningly accept what instructors say. And that is good preparation for the fluid, dialectical experience that is professional counseling itself.

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