Using Cognitive Learning Principies to Inform Teacher Decisions about Curriculum and Instruction

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This article presents a summary of five cognitive learning principles underlying student learning, an argument that these principles form the basis for a view of learning as knowledge development –a process using five different types of thinking–, and a description of Dimension of Learning (Marzano et al., 1992), a planning and instructional framework based on these five cognitive learning principles. In addition, Arredondo argues that teacher's use of this framework will improve curriculum and instructional decisions and thereby restructures the very nature of the elementary and secondary school experience.

Este artículo presenta una síntesis de cinco principios de aprendizaje cognitivos que subyacen al aprendizaje de los estudiantes, una argumentación que estos principios forman la base para una perspectiva del aprendizaje como desarrollo del conocimiento –un proceso que usa cinco tipos diferentes de pensamiento–, y una descripción de las dimensiones del aprendizaje (Marzano y otros, 1992), un marco conceptual instruccional y de planificación basado en estos cinco principios de aprendizaje cognitivos. Además, Arredondo argumenta que el uso del profesor de este marco puede mejorar el currIculum y las decisiones instruccionales y en consecuencia, reestructurar la naturaleza misma de la experiencia escolar tanto elemental como secundaria.

Introduction

The juniors and seniors in this inner city high school calculus class are taking a final exam. But the room isn't quiet, as you might predict. A young woman in a business suit is explaining her solution for a cohort survival population problem to her classmates and the handful of adults in the back of the room. Responding to the students' probing questions, she summarizes her explanation with graphs and symbols on the board and peppers her conversation with reflective comments: "The reason I chose this line of thinking in my solution is..." and "As I planned this explanation, I pictured myself someday trying to convince my company's strategic planning team." Presentation completed , she waits while all members of the audience evaluate her performance using a list of criteria generated by the class, a list including not just correctness and appropriateness of solution, but also her appearance, presentation skills, clarity and responsiveness to the audience. This unusual exam was designed – not by the teacher– but by the students in preparation for real-life use of their calculus knowledge.

Across town a first grade parent-teacher conference is in progress. No, that isn't the teacher's voice reviewing the student's latest reading scores. What you hear is a six-year-old analysing is own use of a selected learning strategy. "The one I'm working on is not giving up when the work gets hard. I used it last night with my library book. It had so many big words– and I also wanted to quit, but I said to myself, You can do this. Look at the pictures and try to figure out what the story is about. So I looked at the pictures, and thought about all I knew about the ocean and about sharks, and I kept trying, and I did it." Dad nods his assent and then relates two more examples of his son's increasing ability to engage intensely in tasks, even when answers are not readily apparent. The three then decide together that it's time to add another learning strategy to the first grader's repertoire.

Meanwhile, a few blocks down the street from the high school, a seventh grade social studies class has just been dismissed for the day. The students do not stampede toward the door, however. In small groups they linger to discuss the decision each group must make: Who

was the most influential person during the 1980s? One group debates whether their comparison criteria are really the best ones: "All our criteria fit government leaders. Don't you think someone else might be influential? What about Michael Jackson? or someone like Mother Teresa? Maybe we should include something about the different kinds of influence people have." Another group discusses the alternatives they've identified . "We just don't know enough about Gorbachov to decide how may points to give him on any of the categories. Someone's going to have to do some research."

High school calculus, first-grade parent-teacher conference, and middle school social studies, each reflects a powerful, dynamic learning situation. Idealistic? Perhaps. Impossible? Not at all. They are examples of what learning is like in a school where teachers base decisions about curriculum and instruction on cognitive learning principles, principles that reflect the way children learn.

Why an emphasis on the way students learn?

It is possible for today's educators to transform schools into powerful and engaging learning opportunities like those described above. We can develop school communities where staff, students, and parents believe that learning is both moment-to-moment and a lifelong process. We can create school cultures where it is accepted that students immerse themselves in learning, where adults model ongoing learning by developing high levels of knowledge and expertise, where teachers are engaged as inquires in both curriculum and instruction, and where they use these same inquiring strategies in their classrooms. Such vibrant learning communities focus considerable energy and dialogue on the learning process.

As school staffs have engaged in restructuring and reform efforts, the have found the abundant research about teaching and learning sometimes overwhelming a conflicting array of instructional models, practices, and innovations, all intended to improve student learning. Today's teachers and administrators may select instructional models aimed at increasing student cooperation, achieving mastery, developing thinking skills, raising expectations, teaching to different

cognitive styles and so forth. Because each innovation is research based and has been shown to enhance student learning, each has proponents who argue the effectiveness of their particular favourites as they compete for scarce staff development resources. On occasion this competition results in the models being pitted against one another as staff developers provide training in first one model then another.

Instructional innovations bring both hope and excitement to education today; but they also contribute to our tendency to focus attention on specific teaching strategies rather than on student thinking and learning. The presence or absence of certain teacher behaviours is important only to the extent that the behaviours impact specific parts of the learning process. Rather than continue to emphasize competing strategies, what is needed is a shift in thinking about teaching and learning, a shift that places the learner at center stage. By focusing on the thinking used by the learner as s/he engages in the actual process of developing knowledge, we begin to see the learner as one engaged in the meaningful use of knowledge. Such a focus improves our understanding of student thinking, helps us see connections and overlaps between the many instructional models, strategies, and innovations, and causes us to become truly knowledgeable about the learning process.

The Learning Process as Knowledge Development

The learning process can be viewed as a progression of developing knowledge, a progression that begins with the initial contact, when the learner first thinks about the new information, and progresses until s/he is able to use the information in critical, creative, and self-regulated ways. As knowledge develops, the learner moves, in iterative and "messy" ways, through several stages or phases: 1) attention to new information; 2) constructing meaning, organizing, and storing information; 3) extending and refining the information; 4) meaningful use of the information; and 5) thinking creatively, critically, or in self-regulated ways about the information. Each of these stages of knowledge development require the learner to use specific types of

thinking skills, processes, and dispositions. And it reflects a overall view of learning as being composed of different types of thinking.

Because knowledge development is never a linear process, we might think of these phases or types of thinking as being relatively fluid and interactive. For example, we might visualize them as represented by the concentric circles in the diagram below. A learner might begin the learning task of creating an essay comparing the influence exerted by the former British Prime Minister, Margaret Thatcher, and that of the former Soviet Premier Mikhail Gorbachov by researching background information (thinking used to acquire and integrate information –Circle 2) and then move to deciding which criteria would be important for comparing the two world leaders, an extending and refining type of thinking (Circle 3). After a tentative decision about comparison criteria, the learner may move back into acquiring and integrating new information, then to abstracting generalizations from his/her research (an extending and refining type of thinking), and on to investigative inquiry, a type of thinking involved in the meaningful use of the knowledge (Circle 4). The learner's thinking activities shift between the different types of thinking many times during the learning process as illustrated by the movement of the dotted line (below) as his/her knowledge is developed.

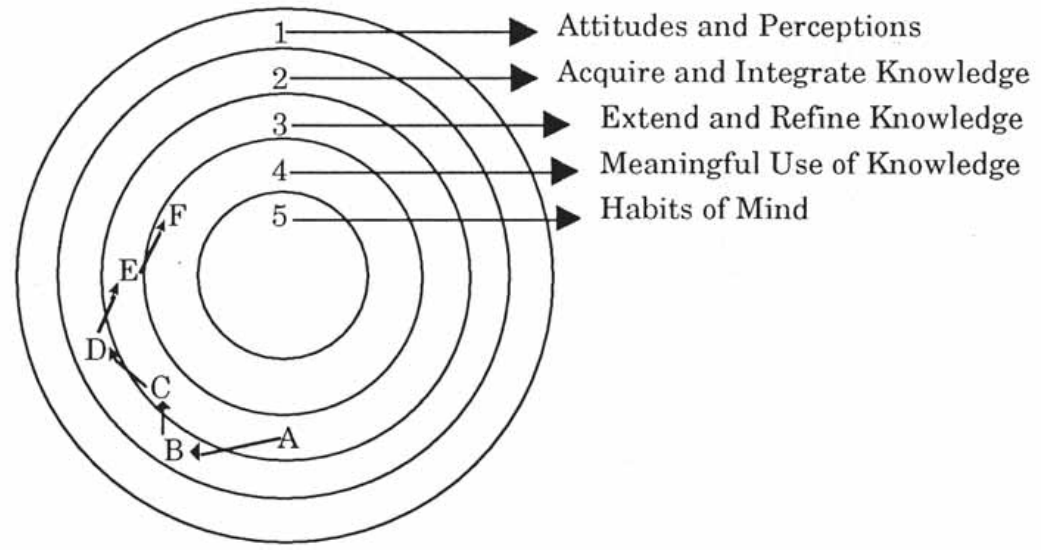

Figure 1: The Different Types of Thinking in the Learning Process

This view of learning as developing knowledge through use of different types of thinking allows us to see how various instructional models relate to one another and where the overlaps occur. Instructional models need no longer be viewed as isolated or in competition with one another. It becomes easier to see that each model reinforces some phase of the overall learning process. For example, mastery learning offers strategies that improve learning during the first and second phases of knowledge development (attitudes and perceptions Circle 1), acquisition and integration of knowledge (Circle 2) and during the self-regulated use component of the fifth phase, productive habits of mind. Cooperative learning presents strategies that develop appropriate attitudes about relationships with peers, which is a component of the first phase of learning (Circle 1).

The *Dimensions of Learning* model (Marzano, Pickering, Arredondo, Blackburn, Brandt & Moffet, 1992) is a comprehensive instructional framework for making curriculum and instructional decisions based on a view of the learning process as composed of five different types of thinking. In developing the model, the author team reviewed the research and identified five broad generalizations which correspond with the phases of knowledge development. We called these broad generalizations "learning principles" because they serve as useful guides for categorizing the types of thinking used by students during learning, or what happens inside the head of the learners as knowledge is developed. (Marzano et al., 1988). The five learning principles are as follows:

Learning Principle # 1: Attitudes and perceptions affect learning. Current research in the area of student motivation shows that attitudes and perceptions impact learning. Prior to and during any learning task, students continuously monitor feeling of acceptance, ability, safety, comfort, task clarity, and importance. During this monitoring process, they gather information relative to such questions as: "Do I feel accepted?" "Can I do this?" "Am I safe?" "Am I relatively comfortable?" "Is this task important?" Negative responses to these questions may cause the learning process to slow down or stop completely. Because of the impact these attitudes and perceptions have

on learning, teachers must continuously monitor and regulate the contextual factors in the learning environment.

Researchers studying the context of learning have identified a number of strategies that teachers may use to directly address attitudes and perceptions about learning. Many of these strategies are embedded in instructional models and available in popular staff development programs. For example, providing opportunities for students to engage in cooperative learning tasks tends to increase peer acceptance (Johnson et al., 1984); assisting students to develop positive affirmations about themselves and others tends to increase student confidence in their own abilities; teaching students to monitor their attention, to bracket put environmental interference, and to generate interest and value for tasks tends to increase student engagement and commitment to learning activities (Marzano and Arredondo, 1986); and establishing, communicating and teaching classroom rules and procedures tends to enhance the student's sense of comfort and order in the learning environment (Emmer, Evertson, and Anderson, 1980).

This first principle, **that attitudes and perceptions affect learning,** serves as a useful generalization for organizing and examining the large number of instructional strategies aimed at improving the context of the learning situation that determines whether the learner attends to the new information in the beginning phase of the knowledge development process.

Learning Principle #2: Learning involves the acquisition of both procedural and declarative information. Information to be learned is either declarative or procedural. **Declarative information** is descriptive –the *who, what, where* and *when* of our world. In subject areas, the facts, time sequences, principles, and concepts make up the declarative information. For example, in biology, the names of animals and plants, their descriptions, where they are found, and their life cycles are all declarative information. **Procedural information** describes the how, the way something is done. The process used to isolate single colonies of bacteria, the steps for making a chromosome slide, or for graphing population statistics, are examples of procedural knowledge in biology. All subject areas contain both procedural and declarative information. Secondary

music students may learn the major distinctions between fugues, rounds and canons (declarative information) or how to play a fugue (procedural information).

This distinction in the structure of knowledge is important because the way declarative information is stored in memory is quite different from the way procedural information is stored. **Declarative information** is believed to be stored in both linguistic and non linguistic components (in a dual code). The linguistic component of stored declarative information consists of both words and highly abstract semantic units, representing verbal information. Students engaged in verbal rehearsal, note taking, and outlining are using linguistic strategies to store information. The nonlinguistic component of declarative information contains visual image, auditory, kinesthetic, tactile, olfactory, and emotional components. Visual, symbolic, and mental representations of declarative information are powerful techniques for storage during the learning process. In effective learning situations, the learner either overtly or indirectly uses both linguistic and nonlinguistic storage strategies.

Procedural information is first stored in a manner similar to declarative information, with both linguistic and nonlinguistic components. For example, the procedure for isolating single colonies of bacteria is first learned as descriptive information. The student may rehearse the steps verbally and also form a mental image of herself performing the procedure. At this level, however, the student only understands the process. She cannot perform it. In order for the procedure to be usable, the student must practice it until the information can be accessed and used automatically. As procedural information is practised , it is thought to be encoded in highly abstract and efficient "production forms" or "chunks of procedures." If the information is not practiced enough for such storage to occur, it cannot be retrieved and used efficiently later.

Information about the structure of knowledge is also useful in guiding teacher decisions about the initial acquisition of both declarative and procedural knowledge. From recent research in this area (Jones et al., 1987), we know that an important cognitive operation during knowledge acquisition is constructing meaning for

the new information. For example, as a learner reads about artificial intelligence he/she activates stored information about human intelligence and compares it with the descriptions of artificial intelligence being read. Another key cognitive operation in knowledge acquisition is organizing information in such a way as to connect it with prior learning. This enhances learner understanding, increases efficiency of storage, and makes later recall of the information much easier.

This second principle, that **learning involves the acquisition of both procedural and declarative information,** provides another useful generalization for comparing instructional strategies or models. For example, the memorization models described by Joyce and Weil (1986), Hunter's mastery teaching model (1983), and the thinking skills model described by Marzano and Arredondo (1986); all emphasize specific strategies useful for storing declarative and/or procedural knowledge.

Learning Principle #3: Once acquired, knowledge undergoes change. As noted above, even during initial acquisition, knowledge undergoes constant change. Obviously, then, once information is stored it does not lie static, but rather continues to change. For example, the learner may read a news article about the effects daily use of alcohol had on a teenager during his 9th grade year in school, and form a generalization that alcohol has detrimental effects on young adults; or s/he may notice that arguments provided in a political candidate's advertisement contain inaccuracies in details about the city's proposed land use when compared with media reports on the plan. As the learner fine tunes knowledge, s/he uses thinking skills such as comparing, classifying, inductive and deductive reasoning, supporting, abstracting and analyzing errors and other's perspectives.

This third principle, that **once acquired, knowledge undergoes constant change,** provides a useful generalization for focusing attention on the instructional strategies that enable the learner to extend and refine content knowledge. Several thinking skills programs, such a *Project Impact* (Winocur, 1985) *and Patterns for Thinking, Patterns for Transfer* (Fogerty and Bellanca, 1987) directly ad dress this phase of knowledge development. The *Dimensions of*

Learning model describes and defines the cognitive operations that learners use to change knowledge as it is developed, and provides strategies that can be used to foster these types of thinking.

Learning Principle #4: The most effective learning involves meaningful use of knowledge. Current cognitive research supports the idea that effective learning situations engage students in long term, cognitively complex/multidimensional tasks, over which they have some choice and control. Real learning does not exist where students are spoon fed facts or provided a steady diet of practice with decontextualized skills. Instead students must construct their own knowledge, practice solving real problems, make decisions, and engage in experimental inquiry. The practice of postponing meaningful activities until low-level skills has been mastered is actually harmful to students, particularly to low achieving ones who are continuously relegated to dull and repetitive instruction that prevents their understanding of underlying concepts and generalizations.

For knowledge to develop students must interact with content in meaningful ways over an extended period of time. That is, students must engage in classroom tasks that may require a week, a semester or even longer. Instruction cannot be thought of as a brief teacher presentation followed by student responses. In addition, meaningful learning tasks are cognitively complex or multidimensional. In other words, they must involve different types of thinking. One way to organize complex instructional tasks is to create projects that require students to engage in **inquiry, problem solving, decision making, invention, or investigation.** Since these cognitive processes are inherently complex and multifaceted, they almost always require multidimensional student thinking. This is particularly the case when they are embedded in multidisciplinary themes. A final and important characteristic of meaningful learning tasks is that they provide some opportunity for student choice and control. This choice and control can be provided through opportunities to select which cognitive processes to use and/or through content selection within the assignment.

This fourth learning principle, **that the most effective learning involves meaningful use of knowledge,** is also useful

as an organizing category for comparing instructional strategies and models. Thinking skills programs such as *Future Problem Solving* (Crabbe, 1982) and *Strategic Reasoning* (Upton, 1989) provides strategies that foster this phase of knowledge development.

Learning Principle # 5: Effective learners exhibit productive habits of mind or dispositions of "good thinkers" –those associated with critical, creative, and self-regulated thinking. In effective learning situations, the learner displays an attitude or disposition that leads his to question, to seek new or more accurate information, to engage intensely in tasks, to push himself beyond the usual limits, and to monitor the effects on his actions. These dispositions toward learning situations have been described as characteristic of "good thinkers" and with practice become habitual behaviours in effective learners. Considerable agreement exists among educators that these dispositions or habits of mind are important educational outcomes. In fact, some educators argue that the essence of a well-educated person is the ability to use critical, creative and self-regulated dispositions in thinking about the issues encountered in daily life.

The extent to which instructional models offer strategies teachers can use to foster these dispositions in their classroom is a key criteria for judging their usefulness. For example, models such as *Philosophy for Children* (Lipman et al., 1980) focus attention on strategies that strengthen these dispositions. It seems reasonable to use this fifth learning principle, that **effective learners exhibit dispositions associated with "good thinking,"** to compare instructional models.

The *Dimensions of Learning* model has several major advantages. First, as mentioned, it provides an organizer for the compilation, description, and development of research based teaching strategies focused on engaging students in the cognitive operations used in each phase of knowledge development. **Second,** it provides a framework for better understanding of many instructional models by showing how they impact the overall learning process, how the relate to one another, and where overlaps between models occur. **Third**, *Dimensions* provides a powerful framework for planning

curriculum units and making instructional decisions based on what is known about effective teaching and learning. In addition, such a framework has the potential to eliminate the "program bashing" that currently occurs between proponents of different instructional models.

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