

# ***Crossing the Border between Rote Learning and Strategic Thinking: Metacognition is the Key!***

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## **Abstract**

Today's students come to college with widely varying academic skills, interests, and motivation levels. Faculty often lament that students are focused on achieving high grades, but do not want to spend time learning. Most students think that rote learning by memorizing information before an examination is equivalent to mastering the material, and spend considerably less time studying than is commensurate with their grade expectations. Cognitive science findings can serve as the basis for learning activities that motivate students to become fully engaged in the learning process and to become strategic thinkers who take responsibility for their own learning. This paper will present cognitive science concepts, such as metacognition and judgment of learning that can be used to improve faculty teaching and student learning.

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**Introduction:** Students generally enter college having spent very little time studying outside of class in high school. They are entirely unaware of the difference between memorizing information and learning concepts, and they expect that the behaviors that earned them A's in high school will have the same result at the university level. And students think they have good evidence that they don't need to study to earn high grades. The Higher Education Research Institute's study of entering freshmen at one large western public university found that over 46% of the students reported earning an "A" average in high school. However, only 34% of these students reported studying or doing homework six or more hours per week in their senior year of high school. Furthermore, 70% of these students felt that their academic ability is above average, or in the upper 10% of people their age. (Sax, Lindholm, Astin, Korn, and Mahoney, 2003). The combination of students' lack of understanding of the difference between memorization and learning, their overconfidence in their academic ability, and their minimal effort at studying during their senior year of high school, put them on a collision course with academic failure. However, this collision course can be avoided if students are taught why and how to change their academic behaviors, and are motivated to make a commitment to using their newly acquired strategies.

## **A. Teaching Students the Difference between Rote Learning and Strategic Thinking**

When a group of LSU students was asked to explain the difference between studying and learning, the most common responses indicated that studying was short-term memorization of material to pass a test, but that learning involved a deep understanding of information that would enable the learner to apply the concepts learned. They all agreed that learning was fun, but studying was tedious. They further indicated that learning could and often does happen in the absence of studying, and studying does not necessarily result in learning. It was evident during the discussion that these students had not previously reflected on the difference between studying and learning, but that after the discussion they clearly understood the difference. This understanding was the first step in helping them to turn unwelcome and tedious study sessions into engaging and interesting learning sessions. And they began to understand why a greater investment of time devoted to their academics was necessary.

It is interesting to note that when the same question was posed to a group of high school students, the responses were different. The high school students responded that studying was going over information they had previously learned. When asked when they learned the material, the students responded that they had learned it while sitting in class! It is therefore not surprising that students think they can study the night before an exam and make an A on the test. They believe that they have already learned the material, and are just refreshing their memory for the examination. It is therefore imperative to help high school students recognize that they are not meaningfully learning the material while sitting in class, but that they have to actively use the material for deep learning to occur.

A particularly insightful answer to the question of the difference between studying and learning was given by a first year student at the Louisiana State University Health Sciences Center School of Dentistry. This young man said that for him, studying is focusing on the “whats”, but learning is focusing on the “whys, hows, and what if”s. He said that if he focused on just the “whats”, and forgot the whats, he could not recreate them. But if he focused on the whys, hows, and what ifs, he could recreate the whats if he happened to forget them. This explanation is particularly useful in helping students understand the difference between rote learning and strategic thinking behaviors.

Teaching students about metacognition and metacognitive strategies has proven to be very effective at helping students understand the difference between rote learning and strategic thinking, and why their behavior should be changed if they want to succeed academically. Metacognition involves thinking about thinking. It involves the ability to be consciously aware of ones self as a problem solver, to monitor and control one’s mental processing, to recognize when one is simply memorizing facts and formulas and not understanding the application of the information, and to know that knowledge and understanding are not handed out by an instructor, but must be constructed by the learner. (See

<http://www.gse.buffalo.edu/fas/shuell/cep564/Metacog.htm> for a brief overview of metacognition.)

Introducing students to constructivist learning theory has also proven quite useful in helping them to develop metacognitive strategies. See [http://carbon.cudenver.edu/~mryder/itc\\_data/constructivism.html](http://carbon.cudenver.edu/~mryder/itc_data/constructivism.html) for information on constructivist learning theory.) The examples of four LSU students provide the evidence that when students are taught *how* to learn, their performance usually takes an immediate and dramatic turn for the better. The performance of the four students, contrasting their performance before and after being taught metacognitive strategies, is shown below. (The after performances are underlined.)

- Travis, junior psychology student  
Test scores: 47, 52, 82, 86
- Robert, freshman chemistry student  
Test scores: 42, 100, 100, 100
- Michael, senior organic chemistry student  
Test scores: 30, 28, 80, 91
- Terrence, junior Bio Engineering student  
Cumulative GPA (after four

semesters) 1.67, 3.54 (fall 2003),

3.80 (spring 2004)

And the impact is just as dramatic when graduate students learn metacognitive skills. When a chemistry Ph.D. student failed seven of eight cumulative examinations during his first year in graduate school, his advisor referred him to the learning center. (Students are required to pass six examinations during their first two years in the Ph.D. program or be dropped from the program.) A miserable performance his first year meant that he had to pass five of eight exams the second year. However, after he was taught metacognitive skills, provided accommodations for his learning disability, and allowed to type rather than write out his responses to exam questions, he passed five of seven exams the following year. And he made the highest exam score in the group for one of the examinations!

When interviewed, each of these students indicated that understanding the difference between the way they had been studying *before* being taught metacognitive skills, and the way they studied *after* they were taught metacognitive skills, was the reason for their immediate and drastic improvement in their performance. Each had been trying to memorize information without understanding the conceptual structure of the material, but began to see the big picture

## B. How Can Students Be Taught that Rote Learning and Strategic Thinking are Different?

Cognitive psychologists make a distinction between rote learning and meaningful learning (Ausubel, Novak, and Hanesian, 1978). Rote learning is verbatim memorization and is not necessarily accompanied by any understanding of the terms. Students are unable to explain information that is learned by rote, and they are not able to paraphrase the information in their own words. Meaningful learning, on the other hand, is learning that is tied to previous knowledge, and it is understood well enough to be manipulated, paraphrased, and applied to novel situations. Most learning is neither completely rote nor entirely meaningful, and can be placed on a rote-meaningful learning continuum (Ausubel, 1968).

Although most students enter college not knowing the difference between rote learning and meaningful learning, when they are taught this distinction they are able to implement strategies that promote meaningful learning. When they fully understand the difference between memorizing facts and formulas for a test and working to understand the course concepts and how the concepts relate to each other, students' greater conceptual understanding and their success on problem solving tasks and examinations increases substantially.

One particularly effective way to present the different types of learning is through a discussion of Bloom's taxonomy, a hierarchy of learning levels, shown below. (Bloom, 1956).

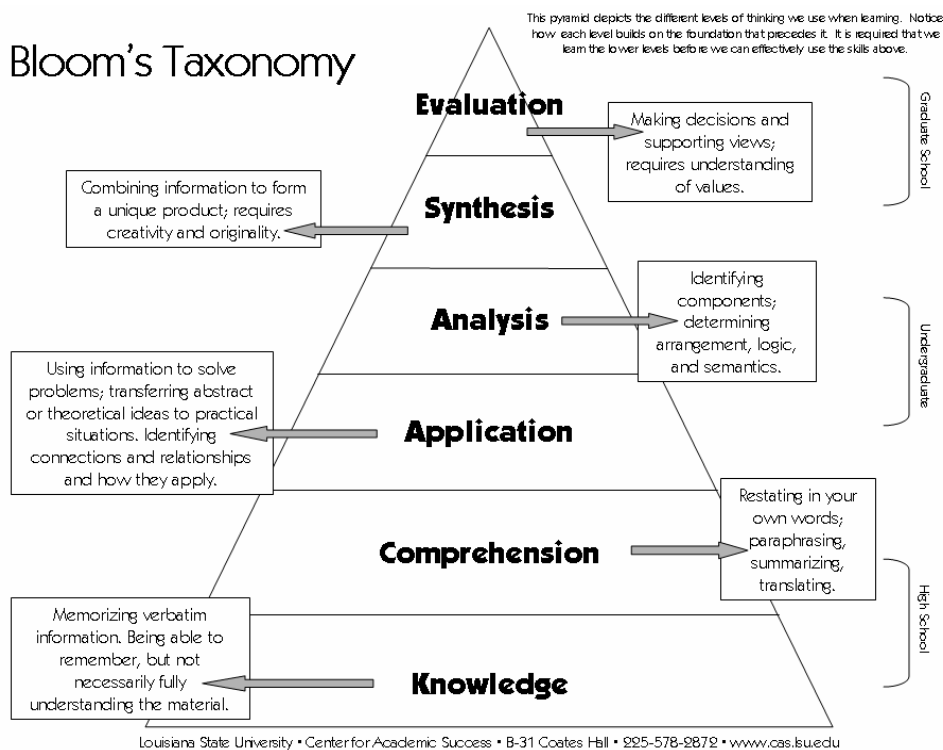


Figure 1

Although faculty generally assume that students know that memorizing information is not the same as learning, this assumption is unwarranted. Formally introducing them to differences in the levels of learning is crucial to developing the understanding of this distinction in today's students.

### **C. What Learning Strategies Can Students Be Taught?**

The Center for Academic Success at Louisiana State University has had great success teaching students to use The Study Cycle with Intense Study Sessions. This strategy is described below.

#### **The Study Cycle**

**Step 1: Preview or pre-read the information that will be covered in class before class.** Spending 10 – 15 minutes reviewing chapter material (concentrating on the bold-face print, italicized writing, figures, graphs, diagrams, etc.) prepares the mind to receive and comprehend the material that will be discussed in lecture. The previewing provides background knowledge for what will be covered in the lecture. Cognitive scientists have empirically demonstrated the importance of background knowledge to understanding and acquiring new information (Bransford, Brown, and Cocking, 2000).

**Step 2: Go to class, and actively participate in lecture.**

This step needs to be explicitly stated because the absenteeism in large introductory science classes is often extremely high (approaching 50% after mid-semester).

**Step 3: Review and process class notes as soon after class as possible.**

Spending 10 – 15 minutes reviewing and reworking lecture notes shortly after the lecture provides the mechanism for the information to be transferred from short-term to long-term memory, significantly improving retention.

**Step 4: Use Intense Study Sessions**

Intense Study Sessions are concentrated study sessions of approximately 60 minutes duration. During this short, but focused, study time, a considerable amount of learning can be accomplished. The Intense Study Session consists of four segments, each of which is important for the session to have the maximum effect on learning.

- a. 2 – 5 minutes: Set goals for the next 40 minutes
- b. 35 – 38 minutes: Work to accomplish the goals that were set.
- c. 10 minutes Review what was studied
- d. 10 minutes Take a break

Most students find that The Intense Study Sessions are real “procrastination busters” – providing a means for targeted study sessions that are efficient and “doable”. Short, focused sessions are more effective than three to four hour study marathons during which there is little meaningful learning accomplished.

### **D. Student Motivation**

Whereas knowledge of metacognitive strategies is a necessary condition for academic success, it alone is not sufficient. Students must be motivated to expend the time and effort to implement the strategies. Many instructors think that students must come to a course with their own motivation to succeed, and that the instructor plays a minimal role in student motivation. However, Eric Hobson (2001) has shown that faculty

members have a very large impact on both positive and negative student motivation. He has found that the instructor's attitude and the course structure account for 49% of positive motivation, and for 58% of negative motivation. In discussions at LSU, students have indicated several course characteristics that either increase or decrease their motivation for the course. These are presented below as motivation boosters and motivation busters.

#### Motivation Boosters

- Partial credit for partially correct answers
- Letting students use their own problem solving method
- Somewhat flexible grading scale based on student performance
- Demonstrated personal interest in having EVERY student succeed!

#### Motivation Busters

- Multiple choice tests with no opportunity for partial credit
- Requiring students to use one problem solving method
- Absolute grading scale with no flexibility
- Attitude that most students are not prepared to do well, and probably won't!

When students find that they can increase their learning by using metacognitive strategies, and that instructors have structured the course in a way that motivates the students to excel, most students can shift their paradigm from simply *memorizing* information to perform well on a test or quiz, to *learning* the material for conceptual understanding. This results in an increase in critical thinking, problem solving skills, test performance, and grades!

### **E. The 2004 LSU Dental School First Year Class: Metacognition Made a Difference!**

In 2004, the entering class of the LSU Dental School participated in a discussion about metacognition, and applying metacognitive strategies to their coursework. The students were facing their first histology examination ten days after the discussion. The presenter learned that the previous class averages on this first exam had ranged between 74 and 78, so she challenged the students to achieve a minimum class average of 84. Although the faculty and students were skeptical that such a large increase could be realized with this group (that had similar credentials and experiences of previous classes), the students indicated that they would try. When the results were in, the class had scored an average of 85! And it was reported that this group continued to demonstrate better critical thinking skills than their colleagues who had not had the benefit of learning about metacognition.

### **F. What Additional Resources are Available to Students Who Want to Improve Their Academic Performance?**

The campus learning support center, found on many campuses, is a very important, but underutilized resource to help students develop metacognitive skills. Instructors can partner with the learning center to have learning strategies information presented in classes and to assist individual students. Often students will utilize the learning center if their instructor recommends it, but most are not likely to visit it on their own.

At LSU our center is the Center for Academic Success which can be accessed online at <http://www.cas.lsu.edu/>. We have on-line workshops that will introduce instructors and students to effective learning and study strategies. Our students *can* cross the border between rote learning and strategic thinking. However, we must help them do this by teaching them strategies and holding them accountable for meaningful learning.

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Website for the Center for Academic Success at Louisiana State University. <http://www.cas.lsu.edu/>