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Mediated Learning

A Newsletter by and for the Instructors of The University of Montana

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The Learning Cycle: Teaching Thinking *and* Content

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The debate continues. Should college instructors be primarily concerned with teaching thinking or teaching content? One side argues that content is a moving target that is continually changing, and it is soon forgotten after being temporarily learned, so the only meaningful part of a college education is learning to think. The other side claims that there is a body of knowledge that should be common to all educated people, so our primary obligation is to decide what students should know and then present this material in a logical, organized fashion. Is it more important to teach students to learn to think like a (insert name of discipline here) expert or should students know that (insert content knowledge common to those who are "an educated person" here)?

The problem with this debate is that it is not an *either–or* issue. We should strive toward teaching *both* content and process skills. Students should leave college as better thinkers *and* with increased content knowledge. However, since all college professors are content experts, and most college instructors have little, if any, training in designing curricula to promote the development of higher-order thinking skills in students, the Center focuses on professional development in the thinking-skills aspect of teaching. If we were taught via such methods when we were students, we were likely not explicitly aware of the strategy, and thus these methods often slip through the cracks in the training of college instructors.

Often, only a minor adjustment in course presentation is needed to produce a major effect on promoting the development of process skills. The sequence in which material is presented has a profound influence on learning, and some sequences have been shown to be better than others. The *Learning Cycle* is a theory- and research-based curriculum strategy that promotes the development of higher-order thinking skills while allowing for students to learn as much content, if not more, as with other teaching strategies. The Learning Cycle divides each unit of study into five sequential parts, labeled (1) engage, (2) explore, (3) explain, (4) elaborate, and (5) evaluate. What constitutes a "unit" of study varies by discipline, course, and instructor, but here we will discuss a one-lecture Learning Cycle as an example of how a course can be changed to improve the emphasis on the promotion of higher-order thinking skills without sacrificing content coverage.

The first phase of the cycle is to *engage* students' attention and interest. The quantity of information bombarding an individual's senses at any given moment is literally incomprehensible. Sights, sounds, physical sensations, smells, and other environmental data are continually fed to our senses. Because of limitations on our short-term memory, we must learn to attend to only those that are

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Katherine Sather
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Professors Diane and David Friend

At least two University of Montana professors work best in the dark. On autumn nights, when Mount Sentinel is only visible by moonlight, they make their way to the rooftops of campus, where groups of students wait. Once there, they awaken high-powered telescopes that reveal the intricacies of the universe to the youthful scholars. David and Diane Friend, who were married in 1975, have made up UM's astronomy department for 14 years. The two were high school sweethearts, but it was Diane who had an initial interest in astronomy. Her husband began studying it in college. "I took a class so I would know what she was talking about," Dave said.

The couple began dating during their senior year in high school in San Diego. At San Diego State University, Diane earned a degree in math and astronomy while Dave, who she married during their junior year of college, majored in physics. He pursued a PhD in astrophysics at the University of Colorado in Boulder, where Diane worked at the High Altitude Observatory, researching solar coronal physics. The couple spent four years in Boulder, where their son Scott, now 19, was born.

The couple worked in the astronomy department at the University of Wisconsin-Madison for three years. Dave then accepted his first faculty position at Williams College in Massachusetts, where Diane worked supervising the observatory program**.** In 1989 Dave joined the faculty at Weber State in Utah. Diane was hired at the Layton Ott Planetarium, where she created astronomy education programs for the local school districts. The couple moved to UM in 1990. "We decided we didn't want to move anymore," Dave said.

At UM, Diane returned to a interest in geology and completed a master's thesis on crustal structure in the northern Rocky Mountains. She's remained active in education for younger students and created the Summer Science Discovery Program at the Montana Natural History Center. While her husband's interest in astronomy didn't develop until college, Diane remembers being interested as a child. "I always liked the outdoors, and it's hard not to spend nights in the wilderness without being interested in the stars," she said. "I remember wanting to know not so much what they're called, but physically what was going on out there." Both husband and wife teach elementary astronomy classes at UM and Diane teaches the labs that accompany them, as well as an honors astronomy class and a science class for elementary education majors. Dave teaches the upper-level astronomy courses and some physics.

In the elementary astronomy courses, which are lecture classes with an enrollment up to 300, Dave and Diane try to interact with the students with demonstrations and group work. Recently, Dave has had students form small groups during class time to complete non-graded quizzes. The groups deliberate on multiple choice questions, which review what they just learned, and then hold up flash cards with their answers. "It makes it more interactive," he said. "They're not just sitting passively listening." Often, he shows video clips, both educational and humorous. Since Dave is a Star Trek fan, clips from the old TV show sometimes show up on the screen. His office in the Science Complex boasts a large collection of Star Trek memorabilia, including figurines and posters.

Diane, too, strives to make her classes more interactive. To keep students from procrastinating in the science class that she teaches for elementary education majors, she recently began assigning a small homework assignment each day that includes questions on the reading and on recently covered material. It has helped to promote discussion. "It did make a difference," she said. In her honors astronomy class, she brings in guest speakers, including graduate students in the astronomy department who have ongoing research projects that students can get involved with, some at the nearby Blue Mountain Observatory. "We try and get students out and doing things on their own," Diane said. "There are a lot more opportunities for them to have more self-direction in what they pursue. We make opportunities, or set up activities in class that require them to participate."

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Learning Cycle

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meaningful. Instructors need to focus students' attention on information of relevance. Additionally, if a new topic seems as if it will be of interest to an individual, they are more likely to pay attention to its introduction. Typically, an engage activity is a brief introduction designed to pique students' interest by stressing relevance to everyday life or a future career, or by stimulating an emotional connection.

Next comes the most important and typically the lengthiest phase of the cycle, *explore.* This is where information is presented to students *without a conclusion.* The purpose of the explore phase is to allow students to have the chance to reason from information to conclusion on their own. This is a critical component in developing thinking skills. Students must be asked to think for themselves in order to learn how to think. Students are given the same content as when we tell them the conclusions, so content coverage is not compromised. For example, if we want students to know that matter is made up of tiny discrete particles in spite of appearing to be continuous and infinitely divisible, in the explore phase, we should present the experimental evidence from which the atomic theory of matter was derived—without yet stating that the data show that matter must be made of atoms.

After allowing students to have the opportunity to draw their own conclusions, the *explain* phase presents an expert's point of view on conclusions that can be drawn from the explore-phase data. Ideally, the explain phase takes on the form of a Socratic dialogue between teacher and student, although the necessity of large-group instruction requires some creativity on the part of the instructor in designing the mechanics of this phase of the cycle. Most importantly, this phase sets up the potential for cognitive conflict, which is the mental discomfort that arises when one realizes that their way of thinking is not working well in a particular setting. If the conclusions drawn by a student don't match the expert's analysis, the student *learns* why their thought process is logically flawed, and it allows for the opportunity to revise their thought processes. Additionally, the explain phase provides an opportunity for instructors to model thinking skills, explaining how reasoning is done in their area of expertise.

After the main point has been made in the explain phase, the next thing to do is to *elaborate* on how the target concept in this particular cycle fits with all other concepts in the course. The relationship among concepts is a key component of meaningful learning, and the richer the intertwining among ideas, the more likely those ideas are to be retained and used. Much of the elaborate phase may be accomplished outside of class. Homework exercises, readings, projects, and other similar assignments can be used to have students understand the relationship among newly-learned concepts and those from previous cycles.

The final phase in a cycle is to *evaluate.* Exams, quizzes, papers, posters, presentations, and so on are among the common methods of evaluation. The primary cognitive purpose of this phase is to give students formal feedback on their progress toward the learning objectives of the cycle. This allows students another opportunity to revise alternative concepts and to be reinforced for what they've accomplished. Additionally, we obviously must evaluate students for assessment purposes.

The explore-then-explain sequence within the Learning Cycle is typically reversed in many standard curricula. We tend to tell our students about the great ideas and concepts in our disciplines and then justify that conclusion with some evidence. Simply revising the sequence of these two phases can have a profound effect on learning. The traditional quantity of content matter can be covered, and students' thinking skills can be simultaneously improved. In this way, we can give students a meaningful education in both content and process skills that will last long beyond their days on a college campus.

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