

# Mediated Learning

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



## Development of Students' Intellectual Skills: A Study of Successful Efforts, Part II

*Mark S. Cracolice*  
*Director, Center for Teaching Excellence*

Can the ability to think be taught? Can we design curricula that promote cognitive development? There is strong evidence that the answer to both of these questions is *yes*. With this article, we continue our three-part survey of the elements of curriculum design that produce measurable gains in general intellectual skills. Our goal in this survey is to systematically explore the six components of curriculum design that are commonly found among curricula documented in the research

literature as successfully improving students' formal reasoning skills. These components are: (a) duration and density, (b) concrete preparation, (c) cognitive conflict, (d) construction, (e) metacognition, and (f) bridging. Part I of this series appeared in the November issue and addressed items (a) and (b). Now we discuss the next two items in the series.

*(See INTELLECTUAL SKILLS, page 4)*

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## Excellent Teaching: An Opinion of an Expert Student

*Virginia Shay*  
*Sophomore, Biology*

Effective teachers are elemental to a strong college. Students decide which courses to take based mostly on the available times, but also on which professor is teaching. There are many qualities that superior teachers exhibit to make learning interesting and challenging for their students, namely a love for the subject, a willingness toward further discovery, the ability to have an open-mind, and a willingness to give time to working with individual students.

The first of these qualities is a love for the subject they are teaching. The most valuable teacher is the teacher who comes to class ready, happy and excited to teach. If a teacher shows enthusiasm for their subject matter, they can transfer some of that energy into their students. If a teacher shows a lack of excitement, the students won't become passionate about what they are learning.

*(See EXCELLENT TEACHING, page 6)*

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## Editorial



Professor Mark Cracolice

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*“Teaching has largely become centered on the transmission of an encyclopedia of facts instead of building a way of knowing.”*

I recently read a critique of the American educational system that said that our primary problem is that we put too much emphasis on getting *the* right answer. This book was written by a successful multi-millionaire business owner and investor. He claims that instead of nurturing the development of people who will be entrepreneurs or other types of innovators, we are in the business of creating good employees. Our primary systematic error is that by training students to avoid making mistakes, we also train them to avoid taking educated, well-informed risks, and thus they learn the mind set of an employee instead of that of an employer.

I find myself agreeing with his position, although I have a slightly different perspective on the issue. I believe that our problem is that we often only look at how to get the right answer and, most importantly, we exclude teaching the reasoning that led to the rejection of the wrong answers. Teaching has largely become centered on the transmission of an encyclopedia of facts instead of building a way of knowing. If we teach students to understand the reasoning process by which concepts are formed, we will develop both innovators *and* employees and give students the mental tools to make the choice that best fits their goals.

At the heart of the development of the ability to think is learning the skill of developing alternative hypotheses, making predictions about what will happen in the future if each of the hypotheses are true, and then designing an experiment to test and potentially disprove

each hypothesis. In other words, the process skill that we should help develop is the ability to reason from facts to conceptual systems. Presenting concepts in a neatly-packaged, already-processed form is good for developing content knowledge, but it inhibits the development of thinking skills.

A primary difficulty, one that flies in the face of the training that most of us have had, is that the lecture setting is generally not conducive to allowing a discussion of the pros and cons of competing alternative hypotheses. Lecture works great for transmitting the encyclopedia of facts, but it is a poor environment to use to allow for debate, argumentation, and, as advocated by the author of the critique, the chance to make mistakes and understand the fallacy of the logic that led to the error. The ability to process information is a *skill*, and learning a skill requires practice and an opportunity to make errors while guided by a coach.

A key question we should ask ourselves is: How do my course curricula facilitate the development of the thinking skills inherent in my discipline? A commitment to professional growth as instructors requires that we continually educate ourselves on how this can be accomplished. This newsletter is about that professional growth. I invite you to share with the campus community how you have learned to better facilitate the development of your students' thinking skills by contributing an article to next year's *Mediated Learning*.

### **CORRECTION**

*In the February edition, Sue Samson's title was listed incorrectly. Professor Samson is an Associate Professor and the Information Services Coordinator in the Mansfield Library. Our apologies to Sue Samson, the Mansfield Library Administration, and our readers.*

## Teaching Profile: John Photiades, Department of Economics

Brian Ehlert  
Sophomore, Chemistry

At the age of 17, John Photiades moved from his home in Greece to Ohio to pursue a degree in Business Economics at Miami University. Photiades was a member of the Phi Beta Kappa Fraternity as an undergraduate and received the Best Graduating Senior Award in Business given by the Delta Sigma Phi Chapter. After earning an undergraduate degree in 1965, Photiades moved to Columbia University in New York to complete his Masters in Economics. After completing his Masters, Photiades accepted a job as a teaching assistant and continued his graduate studies at the University of Illinois, receiving his Ph.D. in 1972. Before he completed his Ph.D., he accepted a teaching position here at The University of Montana in 1970. Throughout his 31 years of teaching at UM, Photiades has received awards such as UM's Distinguished Teaching Award, two Mortar Board Teacher of the Month Awards, and three UM Merit Awards for Excellence in Teaching and Research. In November, the Carnegie Foundation for the Advancement of Teaching and the Council for Advancement and Support of Education (CASE) announced that Photiades was honored as the 2001 Montana Professor of Year.

Photiades enters his classroom with an enthusiastic attitude. He then proceeds to instill in his students that same enthusiastic appreciation for economics. He realizes that many students never encounter economics in high school. As a result, he works hard to gain the interest of the students who take his courses—many who are there to simply fulfill a general education requirement. He accomplishes this with the enthusiasm that he brings to class every day. He teaches with an enormous amount of energy and passion that is often contagious for the students. This helps to create a comfortable, sometimes humorous, classroom environment. He also concentrates on using examples that students can relate to. Photiades maintains a steady and smooth pace during class to sustain his students' attention for the entire period.

One unique opinion that Photiades has about lecturing is that you should not use notes. He prepares for each class by reading the material and taking notes. He will also try to find a wide variety of information on the topics at hand to get a unique view that he can present to the students. He then writes a lecture and studies it to the point that he does not need notes as he presents the material in class. This helps to keep an even flow and quick pace as he lectures.

To keep his lectures interesting and current, Photiades uses his research to help him in the classroom. He believes that a certain level of research is needed to continue to grow as an instructor. Not only does it help in keeping up-to-date in the field, but it is also a great source of contrasting views. Although he does write approximately one research paper a year, he concentrates most of his energy on teaching. In fact, one of the reasons why he chose to come to Missoula was because the academic environment at UM allows him to concentrate on quality teaching.

Photiades never writes out his teaching goals. He knows what he wants to accomplish. Some things that he strives for are introducing a certain level of discipline to the students and to help them to establish skills to form their own opinions about the world they live in. Photiades teaches both sides of an argument but does not hesitate to let the students know his own opinions. He says that the field of economics is challenging to study without forming your own opinion: "It is impossible to tell a consistent story in economics and not have a perspective."

Kyle Stevens, a former student of Photiades, enjoyed the fact that Photiades was very passionate about economics. He also feels that he can learn more when it is obvious that the instructor delights in the subject being discussed. In particular, Kyle feels that it is helpful that Photiades is very organized and



Professor John Photiades

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## Photiades

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*“His words of advice to other instructors are to forget about impressing the students and try to get them to enjoy learning.”*

easy to follow. Photiades writes extensively on the board to ensure that students are receiving accurate information. Jessie Buresh, another student of Photiades, was nervous about economics when she enrolled in the course. She said that Photiades was funny and made the course very interesting to her. The fact that he could make her laugh helped her to relax and really enjoy learning the material in the course.

When Photiades first started teaching, he thought that students would see him as someone above them. When teaching, he would try to impress the students by talking about things that they could not yet possibly understand. Over time, though, he realized that his objective should not be impressing

students. He was a teacher—someone to help students learn. He now sees his role as relaying material to the students by supplying them with the knowledge that they need. His words of advice to other instructors are to forget about impressing the students and try to get them to enjoy learning.

Photiades shows a very high level of passion for his subject that helps to attract student interest in economics. He works diligently at encouraging students to enjoy learning and to develop the discipline that comes along with it. His knowledge and organization, supplemented with a little humor and great examples, all add up to enjoyable and beneficial courses.

## Intellectual Skills

(Continued from page 1)

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*“No teacher is exempt from the fact that students have preconceived notions about what they are learning, and those understandings are often extremely resistant to change.”*

### Cognitive Conflict

Do our students come into our classrooms more like a pile of new Lego blocks, ready to be assembled into an infinite number of choices of meaningful structures or more like a Lego set that has already been played with and returned to the box with a number of pieces snapped together? Research clearly shows that the latter is true. Students are not empty sponges, ready to absorb knowledge as it flows from our minds to theirs, but rather, they come into our classrooms with previously constructed knowledge about almost every subject taught in college.

A colleague of mine at Purdue University asked incoming chemistry graduate students to describe what is in bubbles of boiling water. Twenty-five percent of the students gave the

incorrect answer to this apparently fundamental and simple question. *Twenty-five percent* of students with a B.S. in chemistry and who had been admitted to the graduate program of one of the better programs in the U.S.! No teacher is exempt from the fact that students have preconceived notions about what they are learning, and those understandings are often extremely resistant to change.

The term *cognitive conflict* refers to a situation where someone finds new information to be discordant with their present understanding. One of our goals as teachers needs to be to present this type of new information, which helps students to see the conflict between their naïve, incomplete, or alternative conceptions and the new data that we provide. The desired outcome is to have the learner realize that their

(See *INTELLECTUAL SKILLS*, page 5)

## ***Intellectual Skills***

*(Continued from page 4)*

present understanding is inadequate in light of the new information, and then they will possess the drive to restructure their mental organization so that they have a better understanding of the concept.

The primary difficulty of incorporating cognitive conflict into the curriculum is that it must be a true conflict for any given individual, based on their present understandings. We do not know the pre-existing conceptions of each student for each concept that we try to teach. We therefore must use our experience and judgment about what makes an appropriate cognitive demand for the majority of students in a given course. A secondary difficulty is that cognitive conflict is emotionally uncomfortable for most people. No one enjoys mental (or physical) discomfort. We can reassure our students that a little short-term “pain” will produce long-term gains, but we need to be aware that invoking cognitive conflict won’t help us win popularity contests!

### **Construction**

*Construction* immediately follows cognitive conflict, and it is the process through which students gain a more powerful conceptual understanding of the subject at hand. Our role as teachers in the construction process is to mediate students’ learning by intervening as little as possible in helping them move from the given information to the target concept, but also to provide as much assistance as needed to help them construct a new, more effective understanding of our disciplines. This type of mediation can also be accomplished effectively by slightly more experienced peers who have had some training in the construction process.

A key element of meaningful learning is to allow students to construct their own knowledge. This can be accomplished by providing hints, giving bits of information, helping students to focus on the relevant variables, restructuring their questions, and asking questions designed to help them reflect on their thought processes. What we should *not* do is provide them with a model solution to imitate. Unfortunately, this is often the easiest path to take, but it must be avoided to prevent the formation of algorithms that often substitute for conceptual understanding.

Construction is also a social process. Students learn the best when they hear multiple points of view on a topic. They learn to critically analyze alternative conceptions, and through argumentation, their knowledge becomes more robust because they not only learn the “right” answer, but they also learn how to explain why the “wrong” answers are a result of faulty reasoning. Textbooks rarely present multiple viewpoints; they only give the consensus best understanding of experts in the discipline. What is missing is knowledge of how those experts arrived at their conclusions. It is the thinking process itself that is not presented in most texts, yet it is the skill of thinking that we want to facilitate. This mismatch must be reconciled in order to improve the quality of instruction. The textbook must be supplemented with an opportunity for students to discuss their understandings with others.

We will continue by addressing metacognition and bridging in the April issue of *Mediated Learning*.

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*“A key element of meaningful learning is to allow students to construct their own knowledge.”*

“... learning by doing causes us to make connections that yield meaning, and when we see meaning, we acquire and retain knowledge and skills.”

*Elaine B. Johnson*

## Excellent Teaching

*(Continued from page 1)*



The second quality that a good teacher possesses is a willingness to learn from their students. Quite often teachers enter the classroom believing that they are smarter than every other person in the room. They are generally correct when it comes to the subject they are lecturing on, but every once and a while a student will come along who knows more than the teacher on a given topic. The teacher then has two choices: they can either listen and learn from the student or they can ignore the student. A good professor chooses the former and both the professor and class benefit from the student's knowledge.

The third quality in a good teacher is a willingness to promote open discussions and open-mindedness. Many teachers feel pressured to cover a certain number of chapters every semester. While covering all the material for a course is important, it is often the case that many students would learn more effectively by talking about real issues pertaining to the specified material. For example, medical microbiology classes could discuss current antibacterial resistance issues while genetics classes could debate the controversy over stem cell cloning, and literature classes could debate about the true identity of Shakespeare. Discussion of these topics would reinforce previously learned techniques and concepts that are more valuable in the world than being able to recite a word for word definition of DNA. To understand antibacterial resistance students need to understand how genes, antibiotics, and their interactions work. The cloning of stem cells deals not only with the scientific aspects, but also with the political and ethical dilemmas that students may one-day face. In literature classes, students need to be able to read, decipher, look for patterns, and compare different works to determine their feelings on the true identity of Shakespeare. A good

teacher recognizes the value of this content in their courses and strives to include it at every turn. This quality is difficult to do effectively in large lecture classes, but a good teacher will always strive to make their material relevant, especially in upper-division courses.

The final quality of a good teacher is that they care about how and where they are steering each of their students. A major characteristic of this quality is how teachers need to be available to help, support and lead students outside of the classroom. While this may be difficult for some teachers with large lecture classes, the best thing that the teacher can do is provide office hours, a time devoted solely to helping needy students. This time should not be used by the professor to work on other projects that do not coincide with their lectures classes. A teacher that shows that they are concerned for a student's welfare will encourage the student to seek assistance when confused and therefore increase the amount of information learned.

As discussed above, there are four qualities that a good teacher follows to effectively teach their students the information that they are going to need outside of a university. These qualities include a love for the subject they are teaching, a willingness to learn, the ability to keep an open mind, and the willingness to be available for your students. These traits have been found in many teachers over the years, and as a teacher one should ask themselves: are you one of those teachers that students have found these traits in? If you are not one of these teachers are you willing to acquire these traits to benefit the people that you are here to help? The key to the development and education of the children of today into the leaders of tomorrow lie in having good teachers with these traits.

*"A teacher that shows that they are concerned for a student's welfare will encourage the student to seek assistance when confused and therefore increase the amount of information learned."*

"Teaching is more than imparting knowledge, it is inspiring change. Learning is more than absorbing facts, it is acquiring understanding."

*William Arthur Ward*

## Grant Opportunities in Teaching and Learning

*In this column, we highlight funding opportunities specifically related to teaching and learning. A brief abstract is presented, followed by the web site address from which you can obtain further information. Please contact us at [cte@selway.umt.edu](mailto:cte@selway.umt.edu) if you are aware of information that can be presented in the next issue of Mediated Learning.*

The Hewlett Foundation welcomes grant applications for its Higher Education Program. Grants are generally limited to liberal arts-oriented institutions and research universities, with emphasis on established institutions with strong records of exemplary work. Ideas that can also be applied to other such institutions are preferred.

Due: Anytime

<http://www.hewlett.org/>

The Spencer Foundation's Major Research Grants Program supports research projects requiring more than \$35,000 to investigate ways in which education can be improved. Research projects vary widely, ranging from medium-sized studies that can be completed within a year by an individual researcher to more extensive collaborative studies that last several years. Principal investigators applying for a Major Research Grant must be affiliated with a school district, a college or university, a research facility, or a cultural institution. Researchers must also have an earned doctorate in an academic discipline or professional field or appropriate experience in the teaching profession.

Due: Anytime

<http://www.spencer.org/programs/index.htm>

In order to promote the involvement of the research community in public educational activities, NSF's Directorate for Mathematical and Physical Sciences (MPS) announces the MPS Internships in Public Science Education (IPSE) program. IPSE is intended to bring current science research results from MPS disciplines to the public by promoting partnerships between the MPS research community and specialists in public science education. The IPSE activity will provide support for undergraduate and graduate students to work in conjunction with MPS research scientists, and with professionals at science centers and museums, on projects in public science education. Proposals must show evidence of partnerships between academic institutions and science centers or museums. It is anticipated that \$2 million will be available for up to 20 awards in FY 2002.

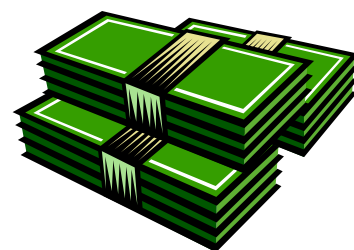
Due: 7 May 2002

<http://www.nsf.gov/cgi-bin/getpub?nsf02064>

The Pew Charitable Trust Education program welcomes proposals which coincide with its mission of raising the performance of students at all levels of education, especially the capabilities of students to learn for understanding and to acquire the literacies needed for productive employment and effective citizenship in our increasingly complex society.

Due: Anytime

<http://www.pewtrusts.com>



“If we are serious about intellectual development, we must reduce the content presented in courses to allow time for students to apply ... ideas in many contexts and to develop the strategic knowledge needed to apply information to novel problems.”

*J. D. Herron*

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