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MAKING LECTURES MORE MEANINGFUL: INTEGRATING ACTIVE LEARNING TECHNIQUES

RESOURCE PACKET

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PRESENTER

Jim Eison is a psychologist who made teaching and learning in higher education the focus of his professional career. He is currently a fulltime faculty member in the University of South Florida's (USF) Doctoral Program in Higher Education where he teaches such courses as "Seminar in College Teaching," "Cognitive Issues in Instruction" and "Powerful Pedagogies in College Teaching" as well as mentoring students' doctoral dissertations. His well-known text, Active Learning: Creating Excitement in the Classroom was coauthored with Charles Bonwell (1991, ASHE-ERIC).

A founding Director of the Center for Teaching Enhancement at University of South Florida, Jim is a Fellow in the American Psychological Association, and in 1980 received the first national "Teaching Award for Community/Junior College Teachers of Psychology" given by Division Two of the APA. In addition, from 1998-2001, Jim served as President-Elect, President, and Past-President of the Professional and Organizational Development Network in Higher Education (POD), the national professional association of faculty developers with over 1,100 members. From 1985 - 1990 Jim served as the founding director of Southeast Missouri State University's Center for Teaching and Learning, and also served as Editor of the Journal of Staff, Program, and Organization Development.

Jim's most recently published article, "Teaching Strategies for the Twenty-first Century", appears in Robert Diamond's (2002) A Field Guide to Academic Leadership published by Jossey-Bass. Previously, Jim also coauthored with Ohmer Milton and Howard Pollio a text entitled Making Sense of College Grades (1986, Jossey-Bass). Jim has published over 40 articles, made invited presentations to faculty groups on over 100 different campuses including institutions in Canada, Kuwait and New Zealand,, and delivered an even greater number of presentations at regional or national conferences.

Jim Eison, Ph.D.
Professor of Higher Education
Department of Adult, Career & Higher Education
University of South Florida
4202 East Fowler, EDU 162
Tampa, FL 33620-5650
Phone: (813) 974-4697
Fax: (813) 974-3366
jeison@tempest.coedu.usf.edu

PANELIST ROSTER:

Johnny El-Rady
Instructor,
Division of Cell Biology, Microbiology, and Molecular Biology
Department of Biology
University of South Florida
4202 E. Fowler Ave., SCA 110
Tampa, FL 33620
jelrady@cas.usf.edu
Phone: 813.974.1590
Fax: 813.974.1614

Nancy Mills
Assistant Professor of Reading
Hillsborough Community College
nmills@hccfl.edu

April Muchmore-Vokoun
EAP Instructor
Hillsborough Community College
Amuchmore-vokoun@hccfl.edu

FEATURED VIDEO SEGMENTS WITH:

K. Patricia Cross, Professor Emerita of Higher Ed., Univ. of California-Berkeley

Thomas A. Angelo, Professor of Higher Ed. and Director of the University Teaching Development Centre, Victoria University of Wellington, New Zealand

Elizabeth F. Barkley, Professor of Music, Dean of Fine Arts and Communications, De Anza Foothill College

Zelda Gamson, Founder of the New England Resource Center for Higher Education and Co-Author of *7 Principles for Good Practice in Undergraduate Education*.

PROGRAM OUTLINE AND NOTES

TO BEST USE THIS PACKET AND GET THE MOST FROM THE WORKSHOP:

Follow along in this packet as you listen to the seminar, pausing the DVD when advised to complete activities. Take notes as you move through the workshop, and afterwards, if you care to review or test your knowledge, Dr. Eison has included a "final exam" that will enhance your knowledge and repertoire of skills. You will then be ready to put them into practice in your own class!

Now, have fun, and enjoy the program!

MODERATOR:

"Advance Organizer" Instructional Strategy:

Providing information and/or instructions prior to learning that can be used by students to better anticipate, organize and interpret important course content that will be explored in class

JIM EISON, Ph.D.:

Please complete the following sentence:

"Based upon my current understanding of the concept, active learning instructional strategies involve . . . ."

(Please Pause Program Briefly to Respond)

NOTES:

What Other Instructors Have Listed:

Having students discuss things instead of simply listening to lectures

Giving students problems to solve either at their desk or on the whiteboard

Using group brainstorming to generate ideas

Forming students into groups to work on projects

Giving either graded or ungraded short quizzes

Having students give short presentations to the class

(a) "What items or elements on the list I provided are similar or identical to items on your own list?

(b) What items or elements on your own list were uniquely different from those on the list I just shared?"

(Please Pause Program Briefly to Respond)

Quote from "Active Learning: Creating Excitement in the Classroom":

Active learning instructional activities "involve students in doing things and thinking about the things that they are doing."

Active learning instructional activities may involve students

Critical thinking, involving problem solving, analyzing, evaluating, etc.

Creative thinking, involving fluency, flexibility, originality, curiosity, etc.

Speaking with a partner, in a small group, or with the entire class

Expressing ideas through writing

Exploring one's attitudes and values

Giving and receiving feedback

Reflecting upon the learning process

Also important to note are two additional considerations: active learning instructional strategies

Can be completed by students either in-class or out-of-class

Can be done by students working either as individuals or in groups

"Background Knowledge Probe" Instructional Strategy:
Angelo, T. A., & Cross, K. P. (1993). Classroom assessment techniques (Second Ed.). San Francisco: Jossey-Bass.

"Before introducing an important new concept or topic it is helpful to assess what students may already know. Anticipating that students prior knowledge is often simplistic, incomplete and/or even incorrect, an open-ended Background Knowledge Probe question can readily identify the ideas students commonly enter class with, and point the instructor to strategies for introducing important new information that students are less familiar with."

"Comparing & Contrasting" Instructional Strategy:

- Have students make a list
- Compare with instructor's list
- Add missing/additional elements

Elizabeth Barkley Video Segment—
"Group Grid" Instructional Strategy:

See *Collaborative Learning Techniques: A Handbook for College Faculty by* Elizabeth Barkley, K. Patricia Cross, Claire Howell Major.

Essential Characteristics

Group Size	2-4
Time on Task	15-45 MINUTES
Duration of Groups	SINGLE SESSION
Online Transferability	LOW

Description and Purpose

This CoLT is probably most useful in introductory-level courses where students are building basic schema, learning a large number of new terms, and trying to understand the categorization rules of the discipline. Organizing and classifying information helps students to clarify conceptual categories and to develop categorization skills. By making students' conceptual organization explicit and graphic, Group Grid also helps students remember the information. In this activity, students sort pieces of information by placing them in the blank cells of a grid. The grid's columns and rows consist of superordinate concepts, and student groups receive scrambled lists of subordinate terms, names, equations, images, or other items that belong in the categories. Teams sort the subordinate items into the correct grid categories.

PREPARATION

Select two or more related categories that organize course information. The simplest grid sorts information into two or three columns. More complex grids have more columns, or they may contain a second level of sorting where the top horizontal row identifies one level of organization and the far left vertical column identifies another level of organization. The item placed at the point of intersection must meet both column and row classification criteria. Write out a list of items that belong in each category.

Make a grid by drawing a large rectangle and dividing it into as many smaller rectangles as you have categories and items of information. Write the name of the s categories in the top row and/or left column, leaving the remaining cells blank. Either write out the items that teams are to sort in a scrambled list on the side of the grid, or write the list on a separate piece of paper, an overhead transparency, or the chalkboard. Check to make sure you can fill out the grid yourself. You may use your grid to evaluate students' grids or to have students check the accuracy of their grids.

PROCEDURE

1. Form groups and distribute the blank grid as a handout, or have students copy it from one that you project in an overhead transparency or draw on the chalkboard.
2. Give students the list of scrambled items of information.
3. Have students fill in the blank cells of the grid. Groups can discuss and come to consensus about how the items should be sorted, and fill out the grid as a group project. Or individual students can take turns in a 'round robin' order filling in one cell per turn. Each person within the group, or each pair within a quad, can have their own writing style (cursive vs. printing) or colored markers to distinguish their contributions.
4. Students submit completed grids for assessment and evaluation, or you post a correctly completed grid for them to check for accuracy.

Think-Pair-Share

Useful for stimulating engagement in discussions, checking students' understanding of concepts, and encouraging students to rehearse, express, and compare their understandings with those of others

Estimated Time and Effort Required for

Faculty to prepare this CoLT	***VERY LOW***
Students to use this CoLT	***VERY LOW***
Faculty to assess/follow up	***VERY LOW***
Complexity	***VERY LOW***
Risk of Failure	***VERY LOW***
Duration & Location	***5-15 minutes/In class***

Group Size & Structure Pairs or triads/Informal/No pre-organizing needed

Description and Purpose:

The name of this CoLT, "Think-Pair-Share," captures the essential steps. In response to a question posed by the instructor, students think and perhaps write on their own for a few minutes, quickly pair up with classmates, and then share, discuss, and compare their responses in pairs before responding to the instructor or sharing with the entire class. This technique provides students with the opportunity to formulate responses and practice communicating them with their peers. Since *Think-Pair-Share* can dramatically improve students' willingness and readiness to participate, it's often used as a "warm up" or "step up" to a whole class discussion.

Procedure

1. Pose an engaging question to the class, giving students ample time to think about the question individually and to devise individual responses.
2. Ask students to pair with another student nearby to share responses and, if useful, to create a joint response by building on each other's ideas.
3. Ask the pairs to share their responses with the whole class. If time is limited and/or the class is large, randomly call on student pairs.
4. If appropriate, provide class with the correct or expert response, allowing them to check and, if needed, correct their individual and pair responses.

Participant Excercise--Dr. Jim Eison

"Seven Principles of Good Practice in Undergraduate Education"

Chickering, A. W. & Gamson, Z. F. (1987). AAHE Bulletin, 39(7), 3-7.

"Learning is not a spectator sport. Students do not learn much just by sitting in class listening to teachers, memorizing prepackaged assignments, and spitting out answers. They must talk about what they are learning, write about it, relate it to past experiences, apply it to their daily lives. They must make what they learn part of themselves.

Exercise:

1. Examine notes you've taken on

"Why Active Learning Strategies are Important"

2. Discuss w/partner to add elements

(**Please Pause Program Briefly to Respond)**

"Pause Procedure" Instructional Strategy:

- Lecture 12-18 minutes
- Pause approx. 2 minutes while students work w/partner
- Discuss lecture notes, ask for clarification, etc.

This procedure has been shown to significantly improve students' short term and long term retention; in one study the mean score comparison between the pause procedure treatment group and a control group was large enough to equal two letter grades (Ruhl, Hughes, & Schloss, 1987).

In short, the findings of several studies reveal that if you want to maximize students' learning during 50 minute class sessions, do not talk for more than 40 minutes! Instead, provide three pauses, each lasting three minutes, for students to work with a partner seated nearby.

K. Patricia Cross Video Segment—
"Focused Reflective Writing" Instructional Strategy:

K. Patricia Cross notes that among the different types of important connections that students might be encouraged to make are:

(1) "ah ha" connections between two previously isolated events and

(2) connections between something we learn in the classroom and something that we have experienced in real life

Please take a minute now to think back to a class session that you recently facilitated. Within this class session, can you identify one or more explicit things you asked each of your students to do that challenged them to either:

(1) Create a mental connection between two previously isolated events or pieces of important information, or
(2) Create a connection between and idea or information explored in the class session and something the student has previously experienced in real life.

(Please Pause Program Briefly to Respond)

NOTES:

Moving from how you recently taught this class to how you might next teach this subject in the future, can you think now of an alternative way to teach this same subject matter to your students in the future. Do any new or different instructional possibilities come to mind for creating explicit opportunities for your students to either:

(1) create a mental connection between two previously isolated events or pieces of important information, or
(2) create a connection between and idea or information explored in the class session and something the student has previously experienced in real life?

(Please Pause Program Briefly to Respond)

NOTES:

JIM EISON—
"The Minute Paper" Instructional Strategy:

The Minute Paper, also sometimes called the Half-Sheet Response, provides a quick and effective way to stimulate and engage student reflection in the waning minutes of a class period. It also offers faculty a simple way to collect written feedback on student learning. This strategy commonly involves faculty asking their students to submit in-class written responses to two questions:

(1) "What was the most useful or meaningful thing you learned during this session?"

(2) "What question(s) remain unanswered?"

I might add that since instructional variety is an important tool for maintaining a high level of student engagement, I often find alternative questions to pose as Minute Papers. For example, I might ask

(1) "What topic area among those that we examined today, would you most like to learn more about and why?"

(2) "If you were asked to write a short research paper on a follow-up question related to today's subject matter, what question would you most like to research?"

Thomas A. Angelo Video Segment—

JIM EISON:
In my classroom experience I have found that when my students know that I will periodically ask them to complete Minute Papers during the final five minutes of class, many educational benefits follow for both my students and me.

Students for example tend to take more thoughtful notes during class sessions, anticipating that I might ask them to (a) look back over their notes, (b) critically evaluate their relative significance, and (c) identify the most personally important or compelling thing each student has learned during this class?" In addition, when I have used Minute Papers, students appear more like to pose questions throughout the class sessions in addition to writing questions as responses to my second minute paper question.

As an instructor, I benefit by identifying at the end of one class session the unanswered questions my students have as they are leaving the classroom. Then, I have the opportunity to look for brief and engaging instructional activities to address my students' most common and important questions at the start of the next session.

Let me add one additional observation here. Despite the name of this extremely powerful Classroom Assessment Technique, I have always found that I need to allocate 3-5 minutes of class time for students' to prepare thoughtful responses to my questions.

"Low-Risk High impact" Instructional Strategies:

Figure 1 (Bonwell & Eison, 1991, p. 66) below contrasts several general characteristics of low- and high-risk active learning instructional strategies.

Figure 1
A Comparison of Low- and High-Risk Active Learning Strategies

Dimension	Low Risk Strategies	High Risk Strategies
Class Time Required [1]	relatively short	relatively long
Degree of Structure [2]	more structured	less structured
Degree of Planning [3]	meticulously planned	spontaneous
Subject Matter [4]	relatively concrete	relatively abstract
Students' Prior knowledge of the Subject Matter [4]	better informed	less informed
Students' Prior Knowledge of the Teaching Technique [5]	familiar	unfamiliar
Instructor's Prior Experience with the Teaching Technique [5]	considerable	limited
Pattern of Interaction [6]	between faculty & students	among students

[1] Short active learning strategies (e.g., the pause procedure) involve less risk that valuable class time will be "wasted" (i.e., not used productively or effectively) than longer activities.

[2] More highly-structured active learning strategies (e.g., short writing activities, debates, case studies) involve less risk that course content will not be adequately covered and that the instructor will not feel in control of the class than instructional activities that are less carefully structured or scripted (e.g., role playing, informal group discussion).

[3] The greater the degree of instructor planning, and the more thorough and thoughtful the instructions that are provided to students, the less the risk that an activity will take an unexpected and/or unproductive turn.

[4] When the subject of a lesson is relatively concrete (e.g., an in-class or out-of-class reading assignment with an accompanying writing activity) and students are relatively well prepared, there is less risk that an activity (e.g., a large-class discussion) will go astray than if the subject of the lesson is relatively abstract and/or students are not adequately prepared or informed (e.g., material supposedly covered either in high school or an assigned pre-class reading).

[5] The more familiar and experienced students and faculty members become with a particular active learning strategy, the less the instructional risk. This is especially true when faculty and students are using unfamiliar technology tools. Risk level increase dramatically when a technology tool (e.g., WebCT, videoconferencing) is new to both instructor and students.

[6] Encouraging the flow of communication between the faculty member and his/her students involves less risk that a discussion will stray off topic or that shy students will not participate than a discussion that encourages student-to-student communication without a moderator.

"The ConcepText" Instructional Strategy:

- 15 minute instruction unit
- Show single multiple choice question
- Students respond as individuals
- Work 2 mins. w/partner & convince them you are correct
- 3 times within a 50 minute lecture

Erik Mazur has demonstrated the effectiveness of a formative assessment of student understanding known as the ConcepTest to encourage active learning through in-class peer collaboration in physics courses.

In this approach designed to focus students' attention on developing conceptual understanding rather than memorization, at intervals of approximately every 15 minutes, Mazur stops his presentation and presents a ConcepTest.

The ConcepTest consists of a challenging conceptual question or problem posed in multiple-choice format. Students first answer individually, they then turn to a partner seated nearby and work together to reach a common answer (these responses then get recorded electronically).

Research data collect by Mazur and many others reveal that when concepts are used in this fashion in large lecture classes, (a) attendance and student interest goes up, student confidence in their understanding of essential course content increases, and most of all (c) class performance on classroom examinations increases dramatically.

"Microtheme" Instructional Strategy:

Nearly 25 years ago, John Bean (1982) described a highly effective and low-risk type of in-class or out-of-class writing assignment known as a "microtheme."

A microtheme is a brief essay (150-200 words) typed onto one side of a 5" x 8" index card or a half sheet of paper addressing an instructor-posed question that can then be easily and quickly read.

Variations:

- formulate a thesis statement
- analyze graphic data
- provide supportive evidence for an argument
- create solutions to complex problems

"Cooperative Learning Strategies":

Cooperative Learning Strategies involve the use of small groups so that students work together to maximize their own and each other's learning (Johnson, Johnson, & Smith (1991).

An essential element of this type of student group work involves the use of "cooperative learning structures" which are the "content-free building blocks or tools of cooperative learning used by instructors to help students learn specific course content.

Barbara Millis and Phil Cottell (1998) have provided faculty an outstanding cooperative learning resource with their text Cooperative learning for higher education faculty

Eight basic cooperative learning strategies and eight advanced cooperative learning strategies have been briefly described by Barbara Millis; these materials are found online at http://www.utexas.edu/academic/diia/research/projects/hewlett/cooperative.php

"**Team-based Learning":**

Team-based learning offers faculty some clearly described and structured approaches

> "The primary features of team learning include:
>
> (1) permanent and purposeful heterogeneous work groups;
>
> (2) grading based on a combination of individual performance, group performance, and peer evaluation;
>
> (3) the majority of class time devoted to small group activities (necessitating a shift in the role of the instructor from dispenser of information to manager of a learning process):
>
> (4) a six-step instructional activity sequence, repeated several times per term that makes it possible to focus the vast majority of class time on helping students develop the ability to use concepts as opposed to simply learn about them" (Michaelsen, 1992, p. 109).

Must reading for faculty interested in team-based learning approaches includes Michaelsen, Knight, & Fink (Eds.). (2004) as well as visiting The Team-Based Learning Website, created by the Instructional Development Program at the University of Oklahoma, that offers an extraordinary collection of on line resources and reprints at http://atlas.services.ou.edu/idp/teamlearning/index.htm

Nancy Mills Video Segment—
"Think-Pair-Share" Instructional Strategy:

A three step active learning strategy

Think

1. Professor poses a question
   - Based on prior course content
   - Related to learning goals and objectives
2. Students write down their thoughts
   - Stimulates:
     - Critical thinking
     - Creative thinking
     - Values exploration

Pair

3. Students pair with one partner to share what they have written
   - Can have pair share with another pair
   - Have brief discussions of responses

Share

- Pairs then share ideas with the class
- Ideas are noted on the board
- Students add to their notes

Overall strengths

- Think-Pair-Share is a collaborative learning strategy which
- Is useful even in very large classes
- Encourages student reflection on course content
- Allows students to privately formulate their thoughts before sharing
- Fosters higher-order thinking skills

Think

1. Having students do short informal writing before they speak
   - Encourages students to attend to reading and lectures
   - Leads to active engagement with material
   - Stimulates thinking, rethinking, and revising one's initial thoughts.
   - Enables introverts to respond using their preferred learning style

Pair

2. Allowing students to share in pairs allows students to:
   - Hear the views of a fellow student (affirmations, feedback)
   - Avoid the fear of "looking foolish" in front of their peers and the professor
   - Hear diverse perspectives in a small group

Share

3. Sharing some of the best ideas with the entire class provides:
   - More exposure to diversity
   - The expression of more ideas
   - Encouragement of student-to-student note taking.
   - The opportunity for the instructor to add information after everyone else has contributed

JIM EISON:
"Posing Engaging Questions":

Questions can be used to engage student learners

- Encouraging active and thoughtful completion of assigned readings
- Initiating a lively class discussion
- Focusing and sharpening students' thinking skills
- Arousing student interest and curiosity
- As well as assessing students' knowledge, skills, or attitudes

In addition, another obvious and powerful way to actively engage student learners is by encouraging your students to pose frequent and provocative questions. Student questions can

- Stimulate student-instructor interaction
- Focus students' concentration during at home reading or in-class sessions
- Identify areas of confusion or misunderstanding
- Create personal connections between learners and your course content

When asked in this faculty workshop to contrast how student learning might differ as a consequence of their instructor making better use of classroom questions, another faculty participant quickly volunteered an apt illustrative example from a commonly taught elementary school history lesson: She said, "Simply consider how student responses would differ to these two questions: (1) "Who sailed the ocean blue in the year 1492?" (Show Picture) and (2) "In 1492, why did Christopher Columbus leave home?"

Let's begin by first asking each of you use the next two minutes to think about the following question and to jot down your initial thoughts in list fashion:

> What would you include on a top three list of the primary purposes and priorities of teaching?

Now that you have had two minutes to think about this question for yourself, let me now ask if 3 or 4 of you are willing to read the items you noted on your top three list.

Next I would like to share someone else's thoughts on this very same question and to then describe and illustrate how an instructor's questions might be used to stimulate his or her students (1) critical thinking, (2) creative thinking, and (3) curiosity arousal about this issue.

In a journal article published in 1984, J. Michael Bishop asserted:

What are the purposes and priorities of teaching? . . .
First, to inspire.
Second, to challenge.
Third, and only third, to impart information.

SOURCE: Bishop, J. M. (1984). Infuriating tensions: Science and the medical student. Journal of Medical Education, 59(2), 91-102.

Let me begin by offering five different illustrative examples of instructor posed-questions designed to stimulate students' critical thinking about this observation:

> What is the main point you think J Michael Bishop is making in this statement? – This illustrates a question that asks students for clarification?
>
> Are there any notable similarities and/or differences between the items on your list and those provided by J Michael Bishop? – This question challenges students to compare and contrast ideas provided by two sources (i.e., contrasting their own with those provided by an authority)
>
> What are some possible underlying assumptions behind J Michael Bishop's statement? – This question challenges students to demonstrate the important critical thinking skill of identifying assumptions made by an author.
>
> What alternative assumptions might an educator make? - This question further probes students' understanding of assumptions by asking students to identify some alternative assumptions that might be made.
>
> Do you personally agree with J Michael Bishop's assertion and what types of evidence can you offer to support your position? – These two critical thinking questions ask students to both take a personal position and to provide relevant information or evidence to support their decision.

Let me now offer three illustrative instructor posed-questions to stimulate explicitly students' creative thinking about this observation:

> How many different instructional implications can you list that might follow from accepting the purposes and priorities of education stated in J. Michael Bishop's assertion?

This question challenging students to come up with as many possible different ideas as they can and elicits the type of creative thinking process that has been described in the literature as fluency

If J. Michael Bishop wanted to identify five essential purposes and priorities of teaching instead of only three, what two additional possibilities would you suggest he add to his list? This question, requiring students to embellish or expand upon ideas, elicits a type of creative thinking process that has been described in the literature as elaboration

What novel, unique, or unusual types of course activities and assignments do you think are most likely to inspire today's college and university students? This type of question illustrates one approach to stimulate the creative thinking skill of originality.

And finally, two illustrative examples of instructor posed-questions to stimulate students' curiosity about this observation include:

Who is J. Michael Bishop and why might people be interested in his perspective on this topic?

What was J. Michael Bishop like as a student?

While I would normally seek one or two volunteers to research and bring back to our next class the answers to questions intended to arouse student curiosity, yet another instructional strategy for actively engaging student learners, for today let me briefly share the following information that you might possibly finding interesting despite the fact that I promise you it will not be covered on the next exam.

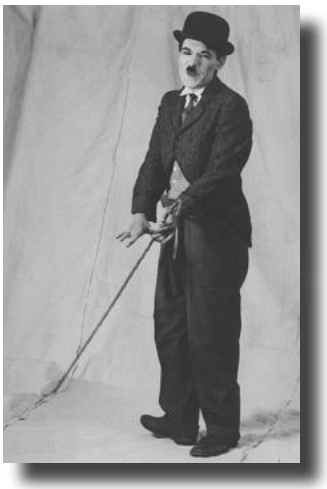
J. Michael Bishop was a co-recipient of the 1989 Nobel Prize in Physiology or Medicine for his important discovery that normal cells contain genes capable of becoming cancer genes. Regarding the question why might people be interested in his perspective on teaching, let me also mention that since 1998, J. Michael Bishop has served as the Chancellor of the University of California at San Francisco. And, quoting from a 2007 article in the American Society for Cell Biology, "While Bishop is most famous for his research, teaching is equally rewarding to him. He typically teaches three quarters a year including cell biology, advanced virology and medical microbiology."

You might find it interesting to learn that J. Michael Bishop was educated in a two-room school house in rural Pennsylvania; while his initial curiosity about medicine and science was stimulated by his family physician, when he entered Gettysburg College he imagined himself a historian, a philosopher, or a novelist. But never, he insists a scientist."

When using questioning strategies to stimulate student, one succinct yet instructionally powerful recommendation from Joe Lowman's wonderful text entitled Mastering the Techniques of Teaching is that discussion questions "should be easily understandable by students, put forth decisively and followed by silence."

Johnny ElRady Video Segment—
"Using Clickers to Make Lectures More Active":

Example Clicker Exercise
PCB 3063 General Genetics--FALL 2007



Class Participation Activity #3: Whose Yo' Daddy?

Blood types can also be used to establish the possibility of parent-offspring relationships
A famous paternity case in the 1940s involved the comedian Charlie Chaplin!
He was sued for child support by the actress J oan Barry, who claimed that Chaplin was the father of her baby Carol Ann (born in 1943).
Chaplin admitted he had had "illicit relations" with Barry, but denied he was the father of Carol Ann.
Tests for the MN and ABO blood types were performed.
The results were as follows:

	MN Blood Type	ABO Blood Type
Charlie Chaplin	MN	O
Joan Barry	N	A
Carol Ann	N	B

The jury at the trial (held in 1945) voted 9 to 3 that Chaplin was the father of Carol Ann and thus liable for child support. The court ordered him to pay $5,000 in fees to Barry and $ 75 a week in child support until Carol Ann turned 21 years old.

1. Based on the blood typing evidence, the decision of the jury was
   - A. Correct, because the MN blood test proved Chaplin was the father
   - B. Correct, because the ABO blood test proved Chaplin was the father
   - C. Incorrect, because the MN blood test excluded Chaplin as being the father
   - D. Incorrect, because the ABO blood test excluded Chaplin as being the father
   - E. Incorrect, because both the MN and ABO blood tests excluded Chaplin as being the father

2. Based on the ABO blood tests of Joan and Carol Ann, what is Joan Barry's genotype?
   - A. IAIA
   - B. IAIO
   - C. IAIB
   - D. IOIO
   - E. Either A) or B)

3. Let's assume that Charlie Chaplin and Joan Barry did have a child. What is the probabil ity that the child would have had the same MN and ABO blood types as her daddy?
   A. 0
   B. 1/4
   C. 1/2
   D. 3/4
   E. None of the above

Response Report
Session: Engaging Multiple Items
Class: General Genetics

Class Points Avg: 1431.82 out of 2000.00 (71.59%)
(Includes only students who took assessment)

4 Based on the blood typing evidence, the decision of the jury was
   A 3% Correct, because the MN blood test proved Chaplin was the father
   B 1% Correct, because the ABO blood test proved Chaplin was the father
   C 1% Incorrect, because the MN blood test excluded Chaplin as being the father
☞ D 88% Incorrect, because the ABO blood test excluded Chaplin as being the father
   E 8% Incorrect, because both the MN and ABO blood tests excluded Chaplin as being the father

5 Based on the ABO blood tests of Joan and Carol Ann, what is Joan Barry's genotype?
   A 1% IAIA
☞ B 73% IAIO
   C 10% IAIB
   D 0% IOIO
   E 16% Either A) or B)

6 Let's assume that Charlie Chaplin and Joan Barry did have a child. What is the probability that the child would have had the same MN and ABO blood types as Charlie Chaplin?
   A 0% 0
☞ B 91% 1/4
   C 5% 1/2
   D 1% 3/4
   E 4% none of the above

Article by Johnny El-Raddy, originally published in *Innovate* (citation at end of article)

"To Click Or Not To Click: That's The Question"
by Johnny El-Rady

It is not unusual in higher education these days to have classes with large enrollment. Indeed at the University of South Florida (USF) (enrollment 41,000), large classes are the norm. In the eight years during which I have been an instructor in the Biology Department at USF, my mid-level and lower-level classes have had enrollments ranging from 100-300 students. This large

class size generates a few problems, especially in terms of engaging students in active learning. While a well-designed traditional lecture can be very effective, students can engage more directly with the material when they actively take part in their learning instead of simply passively receiving information. Another problem in large enrollment courses is low attendance, especially by students taking a non-major course.

Since the fall of 2000, I have taught BSC 2035, a general education course for non-majors entitled Sex and Today's World. It is a three-credit course with no laboratory component, and its title is quite misleading. From the very first lecture, I emphasize that BSC 2035 is a biology course dealing with human reproduction, telling students, "We will discuss what good is sex, not what is good sex." Since this approach is plainly not what many students hope for, attendance rates plummet after the first lecture; attendance rates generally average at about 50% over the course of a semester. While attendance is not required and while this attendance rate may not be unusual in large enrollment classes for non-majors, it is still rather disappointing. Yet another problem the course presents stems from the student composition of the class. In a typical semester, the 125-150 students represent five to six colleges and 30-35 majors. About 75% of the students are underclassmen taking their first college-level science course. The diversity of majors and levels makes it even more difficult to engage students in an active learning environment. The students are generally reluctant to ask or respond to questions. In-class assessment is onerous, especially in the absence of a teaching assistant, so it is hard to gauge students' learning in the midst of a lecture. Consequently, the course grade has been based on performance on three midterms (the highest two count as 50%), a mandatory final exam (40%), and a student portfolio/project (10%) due at the end of the semester.

Electronic classroom voting systems present one method for overcoming the aforementioned problems. These systems are known by various names, including Audience Response System (ARS), Group Response System (GRS), Student Response System (SRS), and Personal Response System (PRS). All of these systems use wireless keypad technology that allows for real-time interactive student-instructor communication. Students use pocket-sized transmitters ("clickers") that work on infrared signals to respond to questions that the instructor poses. Students' responses are submitted to a central server, and the results are tallied instantaneously and displayed in different graphical formats for the entire class. This type of technology has been used to enhance the educational experience in many disciplines, including physics (Burnstein and Lederman 2001), biology (Woods and Chiu 2003), earth sciences (Greer and Heaney 2004), pharmacy (Slain et al. 2004), and family medicine (Schackow et al. 2004). To promote a more interactive teaching/learning experience in my class, I investigated the use of this technology in Fall 2004 and Spring 2005.

Integration of eInstruction's Classroom Performance System.

There are a number of vendors for electronic voting systems, including Classtalk Classroom Communication System (CCS), eInstruction's Classroom Performance System (CPS), Hyper-Interactive Teaching Technology (H-ITT), and Turning Point System. I used eInstruction's CPS because the course requires a McGraw-Hill textbook and eInstruction is a partner of McGraw-Hill Higher Education (MHHE).

To prepare to integrate CPS into BSC 2035, I participated in all four hour-long online information sessions that MHHE offers on the CPS technology. These sessions, delivered via WebEx, cover issues such as installing the hardware, navigating the software, creating class content, using the grade book, and generating reports. The use of the technology also required some front-end labor (Exhibit 1). Because I was concerned about the added cost to students and because I needed more experience handling the system, I was hesitant to include CPS as a course requirement in the first semester, so I decided to use it for extra credit (Exhibit 2).

The class had an initial enrollment of 126 students, 111 of whom remained in the course for the entire semester. In order to set up the system, become familiar with it, allow interested students enough time to register on CPSOnline (105 eventually did), and perform a few trial runs, I waited until Week 6 of the semester (after Exam I) to officially launch the CPS technology. While students may have been interested in the extra-credit, the CPS gradebook indicated that many of those students never actually used CPS in class. It is possible that because CPS was not required, these students did not take the clickers seriously. However, some students did use the clickers in class on a regular basis; a total of 60 students (about half the class) participated in at least 75% of class activities. 43 students missed only three or fewer lectures. At the end of the semester, 28 students (about 25%) earned the full 2.5% extra credit.

Encouraged by these results and by the students' end-of-term evaluations, I decided to make CPS a requirement for the Spring 2005 course (Exhibit 3). A total of 125 students out of the 128 enrolled in the course registered on CPSOnline in Spring 2005. We started using CPS in Week 3 of the semester. In order to get maximum credit, students had to keep up with the material, be there for the entire class, and participate in class activities using the clickers.

At the start of every lecture, I administered a quiz based on the material from the previous lecture; the quizzes were short, typically consisting of two or three multiple choice questions. While paper quizzes take time to collect and require a lot of time to grade, especially in large-enrollment classes, CPS technology allows for instantaneous grading and real-time feedback. The CPS receivers collect students' answers and relay them to a computer to display on a screen; on the screen, each student has a number that changes color once the answer has been received, and at the end of a preset time (2-4 minutes), the answers are summarized and displayed using different statistical formats.

Such instantaneous grading offered several advantages to the students as well as to myself as the instructor. On the one hand, students no longer had to wait for a few days to get their quiz results. On the other hand, they could no longer afford to wait for the last day(s) to study for the exam; CPS quizzes encouraged students to keep up with the material on a very regular basis. Moreover, because the CPS software allowed student response scores to be automatically recorded into the gradebook (Exhibit 4) while also generating comprehensive grade reports for particular activities (Exhibit 5), class assessment for these activities became a much less burdensome process.

I also used CPS during lecture by posing class participation questions to test students' comprehension of the key concepts/principles I had just presented to them. I encouraged students to form groups of two or three to go over each question, gave them enough time for consul-

tation, and then asked them to submit their responses individually. I then went over the results with them. On occasion, I used Peer Instruction (PI), a technique developed by Eric Mazur (1997), by requiring students to answer the question first without discussion and then again after a short period of group discussion with their peers. This activity engages students directly in teaching and learning. The class participation questions provided me with a way to gauge instantaneously whether the students understood the topic at hand; in turn, the distribution of student responses to some questions prompted further exploration of potential misconceptions and allowed for discussion of one or more follow-up questions. This approach promoted interactivity and discussion in class as well as active engagement in peer learning and teaching. Because I posed these questions at 20-30 minute intervals throughout the 75 minute class period, this approach also provided timely breaks from the routine of lecture.

At the very end of the lecture, I took attendance in order to reward those students who stayed until the end. Before CPS, attendance in the class averaged about 50% throughout the semester. In the Spring 2005 semester, the lowest attendance rate was 65% (in the lecture following Exam III) and the mean attendance was about 85%. Of course, mere attendance does not necessarily equal learning. However, the high attendance rate coupled with the quizzes and class participation activities did provide the means for enhanced learning.

Quantitative Data

The average on Exam I in Fall 2004 was approximately 61%. Students are not allowed to keep the exam, and I have many fail-safe mechanisms to ensure that they do not. In Spring 2005, I administered the exact same Exam I to a class of about the same size with roughly the same distribution of student major/level. The average was approximately 71%.

In order to determine if any significant difference existed between the two Exam I grades, I performed statistical analysis on the data using SigmaStat software version 3.1. The significant level for all tests was set at $p=0.05$. The normality test failed, so I used a Mann-Whitney Rank Sum Test to analyze the untransformed data; in addition, I reran a T-test with square-root transformed data. Both tests revealed that the difference in exam scores between the two semesters was significant ($p=<0.001$) (Exhibit 6).

Encouraged by these results, I decided to administer all of the exact same exams from my Fall 2004 class to my Spring 2005 students. The average improvement was about 5 percentage points from Fall 2004 to Spring 2005 (Exhibit 7). These results suggest that electronic classroom voting systems improve student retention of course material.

Evaluation of CPS

In order to get feedback about CPS, I administered a survey in which I asked students to complete the following two sentence stems:

- The best thing about CPS is…
- The worst thing about CPS is…

I gave this survey at the end of the fall semester, and right after Exam I in the spring semester. Students submitted a total of 139 responses, the vast majority of which were anonymous (Exhibits 8, 9, 10, and 11).

While students generally praised the CPS system, I would first like to address their most significant complaint. A tally of the results revealed that about 55% of the students complained about some aspect of signal reception. The keypads we used in BSC 2035 operated by infrared (IF) technology, which required unobstructed line-of-sight communication between transmitter and receiver (just like a television remote). Moreover, the technology was limited to a maximum ratio of transmitters to receivers, which, according to eInstruction, ranges from 90:1 to 100:1. These limitations caused the most significant problem in my use of CPS technology—a bottleneck effect in which too many students tried to send a signal at the same time. Initially, the classroom contained only two receivers. After the survey was conducted in the spring, another receiver was installed in the room, dramatically improving reception.

A newer version of the CPS keypads will further solve this bottleneck problem. These keypads utilize radio frequency (RF) technology, which relies on radio transmissions and thus eliminates the need for line-of-sight communication. In addition, the RF technology can support classrooms with as many as 1,000 students with just a single receiver unit. However, the RF technology costs more than the IF technology ($15 versus $4), and students indicated that the IF keypads and activation fees were expensive. Hopefully, eInstruction will be able to provide a solution that balances cost and signal reliability.

In addition to these challenges, classroom voting systems in general pose several potential disadvantages for traditional instruction. Like any technology, classroom voting systems are subject to both hardware and software problems. The CPS software is rather straightforward and eInstruction's customer support is generally prompt and very good; however, even in the absence of system malfunctions, it takes some time for an instructor to learn how to use the system. Likewise, it takes time to develop questions that are conceptual, challenging, and discussion-stimulating, and it takes additional time to load those questions into the system (Exhibit 12). Moreover, voting activities take time from traditional lectures. On average, a good conceptual multiple-choice question will consume anywhere from three to eight minutes. Thus, questions should be used sparingly to highlight certain points.

Despite these potential problems, I believe that the advantages of using electronic classroom voting systems far outweigh the disadvantages. For teachers, the technology provides a very fast way to take attendance and an efficient way to learn about course content and style. More importantly, classroom voting systems provide a real-time assessment of material that students are failing to grasp, thereby allowing teachers to concentrate on these "problem areas."

Conclusion

For students, the electronic classroom voting technology enhances the learning experience. In addition to encouraging attendance, classroom voting systems motivate students to stay focused; in any given lecture, students may be expected to discuss important concepts or principles with their peers and to answer questions accordingly. Moreover, voting systems increase students' interest in course activities. Using the clickers is fun and addictive, allowing students to push buttons and compare themselves to the rest of the class. Through the use of such systems, a class becomes less formal and the atmosphere much more student-centered. Most importantly, voting systems promote interaction and active learning. Instead of information merely passing from the instructor to students, students teach and learn from each other, and teachers can use the class response to generate further discussion. Because individual responses are posted anonymously, the technology is also quite effective for sensitive topics, such as those dealing with ethics.

Indeed, qualitative survey responses from students have generally praised the system (Exhibit 13). Although a quantitative assessment of learning as a consequence of electronic classroom voting technology may be difficult, it is certainly desirable. The results of my comparison of "pre-CPS" and "post-CPS" exam grades are encouraging. However, student satisfaction alone may be reason enough to use this system in class. Further studies with control groups may be warranted, but I strongly endorse this technology as an effective tool to promote student engagement and active learning.

[This article was modified from a keynote presentation at the Symposium on 21st Century Teaching Technologies: A Continuing Series of Explorations in Tampa, FL, March 2005.]

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Comprehensive Open Book Take Home Final Exam

James Eison, Ph.D.
Professor of Higher Education
Department of Adult, Career & Higher Education
University of South Florida, 4202 East Fowler, EDU 162
Tampa, FL 33620-5650
jeison@coedu.usf.edu

DIRECTIONS: There are many different ways faculty can promote active learning in the college and university classroom. This inventory identifies briefly some 36 different possibilities.

Step 1: .Please think about the teaching strategies you have used on one or more occasions in the specific class you teach most often. Carefully read through the list of teaching strategies below (i.e., the left hand column) and indicate with a check mark (√) if you used this teaching method anytime in the term or semester when you last taught this class.

Step 2: Then indicate with a check mark (√) whether you would be willing to try this teaching method the next time you have the opportunity to teach this class.

Teaching Strategy	Last Time	Next Time
I lectured for most of the class period but saved some time for student-posed questions at the end of class.	( )	( )
I lectured but devoted at least 15 minutes of class time to using Socratic questioning to check student understanding of material (interaction was primarily between myself & the students or between the students and myself).	( )	( )
I lectured but devoted at least 15 minutes of class time to class discussion (interaction was primarily student-to-student with only occasional remarks made by me).	( )	( )
I used a brief un-graded quiz to check student understanding either prior to or after a 10-15 minute mini-lecture.	( )	( )
I had students do one or more brief think-pair-share activities interspersed between my mini-lectures.	( )	( )
I had students do a brief group brainstorming activity.	( )	( )

Teaching Strategy	Last Time	Next Time
I assigned a short in-class writing activity without having any class discussion afterward (e.g., writing minute papers, end-of-class class summaries, etc).	( )	( )
I assigned a short in-class reading and/or writing activity that was followed by 5-10 minutes of focused class discussion.	( )	( )
I had students prepare a concept map, an exam study guide, or several sample test questions to enhance comprehension.	( )	( )
I had students interpret data from an in-class demonstration.	( )	( )
I had students examine, identify and/or analyze an object or artifact that was related to my presentation.	( )	( )
I had students access and use an existing data base as part of an individual or small group research project.	( )	( )
I had students apply course concepts to their personal life experiences and share some examples with the group.	( )	( )
I had students engage in creative thinking about a hypothetical situation related to course content (e.g., “what if”).	( )	( )
I had students complete a survey or questionnaire describing their values, beliefs, and/or behaviors (i.e., self-assessment).	( )	( )
I had students create, conduct, and analyze a survey assessing the attitudes, values, and/or behaviors of others.	( )	( )
I had students design a plausible research study to test a course-relevant hypothesis.	( )	( )
I assigned a library research project requiring students to locate and analyze information in professional journals.	( )	( )
I had students locate and critique course-relevant articles found in recent newspapers or popular journals.	( )	( )
I had students write letters to the editor in which they correctly applied course material (described accurately in layman’s language) to a local issue.	( )	( )
I had students research controversies through interviews with local experts, public figures, etc.	( )	( )

Teaching Strategy	Last Time	Next Time
I had students complete an instructional simulation.	( )	( )
I took students on a field trip (e.g., to a local industry environmental site, hospital) to enhance class discussion.	( )	( )
I took students on a walking tour (e.g., around campus, to a local garden, beach, amusement park, shopping mall) to identify illustrative applications of course subject matter.	( )	( )
I had students create and/or play a game modeled after a popular TV quiz show (e.g., Jeopardy, Millionaire).	( )	( )
I had students react in written or oral formats to campus-sponsored lectures, programs, events.	( )	( )
I assigned an in-class role play activity (e.g., a human role play of a physiological process; the deliberations of an ethics review board, a meeting of a planning commission).	( )	( )
I had students make individual, group, or panel presentations.	( )	( )
I had students make presentations or prepare posters as part of an "in-class professional conference."	( )	( )
I had students plan and facilitate in class discussions (i.e., students create the questions and lead the discussion).	( )	( )
I had students formally debate course-relevant controversies and/or ethical dilemmas.	( )	( )
I had students employ one or more cooperative learning structures to explore important course content (e.g., jigsaw, round-table, value line, structured academic controversy).	( )	( )
I had students analyze and discuss real world problems using the case method approach.	( )	( )
I had students engage in problem-based learning scenarios.	( )	( )
I had students complete one or more guided design modules.	( )	( )
I had students periodically complete formative assessments of their learning using Classroom Assessment Techniques.	( )	( )

From the above-identified activities that you indicated with a check (√) you would be willing to try the next time you teach this class, identify the single activity you feel involves the greatest risk.

What appeals to you about taking this risk? (Please describe briefly in the space below)

If you took the risk and tried this instructional strategy, what do you imagine might conceivably go wrong?

If the things you feared might go wrong did occur, what could you do to correct or address the situation?

SOME HELPFUL WEBSITES ON PROMOTING ACTIVE LEARNING

James Eison, Ph.D.
Professor of Higher Education
Department of Adult, Career & Higher Education
University of South Florida, 4202 East Fowler, EDU 162
Tampa, FL 33620-5650
jeison@coedu.usf.edu

Note: Each of these links was functioning properly on September 25, 2007

Active Learning Bibliographies -- http://www.cte.usf.edu

This comprehensive bibliography prepared by Jim Eison and colleagues at the University of South Florida's Center for Teaching Enhancement identifies literally thousands of published articles describing the use of active learning strategies in higher education. These references, published largely from 1980-1995, have been organized within eight broad-based discipline areas (business and computer science, communication, general works, humanities, mathematics, nursing and health-related fields, science and social science) and then by fifteen categories of different active learning instructional approaches. To get to this bibliographic resource, click first on "Resources," then click on "Index of All Bibliographies," and finally, click on "Active Learning Bibliography." Also available on this site is "Active Learning: A Selective Annotated Bibliography of Helpful Texts" prepared by Jim Eison in May 1999 containing brief annotations describing 32 outstanding texts.

Charles C. Bonwell's Active Learning Site -- http://www.active-learning-site.com

This site supports the scholarship of teaching by providing research-based resources designed to help faculty use active learning successfully in college and university classrooms. Of special note on this site are (a) an active learning bibliography (identifying illustrative published articles updated to 2005), (b) several concise article summaries, (c) a listing of active learning resources on the internet, and (d) online resources on VARK (a simple-to-use learning styles survey, developed initially by Neil Fleming, measuring student preferences for visual, auditory, read/write, and kinesthetic learning activities).

IDEA Center -- http://www.idea.ksu.edu

This site, maintained by the Kansas State University's IDEA Center, now offers free access to the well-known series of "IDEA Papers" that were initiated by the Center's former director Dr. Bill Cashin. In addition to a exploring a wide range of topics of interest to college and university faculty, many of these well-research and highly readable papers have addressed the skillful use of active learning instructional strategies such as "Improving Discussions" (Number 15), "Improving Student Writing" (Number 25), "Answering and Asking Questions" (Number 31),

"Focusing on Active Meaningful Learning" (Number 34), "Helping Your Students Develop Critical Thinking Skills" (Number 37) and "Getting Students to Read: Fourteen Tips (Number 40). Also of special interest at this exceptional website are the two-page papers providing background, helpful hints and additional resources for using 20 teaching methods located under POD - IDEA Center Notes.

Problem-Based Learning at the University of Delaware -- http://www.udel.edu/pbl

This site, maintained by the University of Delaware Problem-Based Learning Project and funded by the National Science Foundation, offers article reprints, illustrative PBL problems (general problems as well as from disciplines such as biology, chemistry, criminal justice, and physics), sample course syllabi from over a dozen courses, and links to other PBL sites

National Center for Case Study Teaching in Science -- http://ublib.buffalo.edu/libraries/projects/cases/case.html

While use of case method teaching is well known and widespread in disciplines such as business, education, law, and medicine, this important website contains a wealth of exciting instructional resources for higher education faculty in the Sciences. Developed over 15 years by Clyde (Kipp) Herreid at the University at Buffalo, State University of New York, this website offers viewers informative articles, engaging video-presentations, an extensive collection of case study activities contributed by faculty across, many different disciplines, several PowerPoint presentations, along with helpful bibliographies and web links, and a description of Kipp's intensive hands-on annual summer workshop on case method teaching.

Ohio State University's Office of Faculty and TA Development's "Handbook for Instructors on the Use of Electronic Class Discussion" -- http://ftad.osu.edu/Publications/elecdisc/pages/

One way to engage students actively is through electronic discussions. This excellent handbook offers faculty helpful assistance in ways to maximize the impact of this increasingly popular form of technology-enhanced teaching.

Eric Mazur's Site -- http://mazur-www.harvard.edu

Dr. Eric Mazur (1997) describes how he has used peer instruction to maximize student interaction during his large enrollment undergraduate physics lectures and to focus students' attention on underlying course concepts. Chapter Two of Mazur's (1997) text Peer Instruction is available here in electronic form; first, click under "Education," then under "Areas of Research-Peer Instruction," then under "Publications on Education Research-Book Sections".

Richard Felder's Site -- http://www4.ncsu.edu/unity/lockers/users/f/felder/public/

Dr. Richard M. Felder, in my opinion, is both an extraordinarily insightful chemical engineer and engineering educator as well as one of the most prolific authors on such topics as active and cooperative learning, learning styles, and faculty development. Each of his engaging and easy-

to-read articles, which range in style and length from two page "Random Thoughts" columns from the Journal Chemical Engineering Education to his more substantive length articles such as "Navigating the Bumpy Road to Student-Centered Instruction" are all conveniently available in full text format at this website. Time spent perusing the breadth of articles found on this website is likely to give rise to the printing of multiple reprints and several hours of productive reading.

Ted Panitz's Site -- http://home.capecod.net/~tpanitz/

Dr. Ted Panitz, a community college math and engineering faculty member, offers a wealth of helpful resources on cooperative learning, writing across the curriculum, and many other issues related to promoting active student involvement.

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NOTES

EVALUATE "MAKING LECTURES MORE MEANINGFUL"

On a scale of 1-5, with 5 being the highest, rate the videoconference in terms of its value to you.

	Excellent				**Poor**
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