Teaching and Learning with Multimedia

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Brief Project Description:
Students learn more and are better able to apply what they have learned when they are instructed with words and pictures (than when they are instructed with words alone or pictures alone). Multimedia learning refers to the conceptual understanding that students develop from words and pictures. Multimedia instruction, based on the science of learning, deals with effective and efficient ways of promoting multimedia learning. Multimedia instructional materials are being used with increasing frequency in college and university instruction, in both traditional and online courses. Unfortunately, instruction using multimedia in real academic courses has not been informed by what is known about learning with multimedia. Staff at the University of New Hampshire (UNH) Center for Excellence in Teaching and Learning (CETL), in collaboration with staff of the UNH Teaching and Learning Services (Academic Technology), are undertaking a three-year project in which we will work with faculty at UNH and other New England colleges and universities to develop multimedia instructional presentations that are informed by principles of multimedia learning. These principles will be applied in both campus-based and online courses. The overarching goal is to develop templates and simple-to-follow instructions that can be used by faculty to create their own multimedia presentations that follow best principles of multimedia learning.

Proposed Project Description:
Motivated by a desire to enhance student learning, today’s faculty may be compelled to use one of the many available cutting-edge multimedia technologies in their courses. Some examples of emerging technologies include interactive multimedia, virtual reality, lecture capture, authoring programs, etc. The following link is just one example of a powerful multimedia tool in today’s market; characteristic of many of its kind, it boasts an array of bells and whistles that prospective buyers are likely to find appealing:
Technology in hand, the instructor is charged with incorporating course materials onto the technological platform, and then design specific course features for delivery to students. Richard Mayer (2009) points out that this multimedia design approach is often driven by the technology, and argues that this approach is intrinsically problematic. Historically, Mayer reports, promising technological advances such as the motion picture, radio, television, and even the computer have failed to live up to their student-learning potential. The drawback of this approach is that the focus is on the technology and the measures required in adapting course material and delivery within that system, and not on cognitive-based principles in which humans learn. The problem is not with the multimedia technology per se. Rather, the problem is with the design approach. Mayer argues for an alternative design approach that focuses on the way humans learn. Mayer advocates for a learner-centered approach grounded in an understanding of human cognition,
Basic and applied research, over the past 10-15 years, has documented that learning from multimedia instruction is dramatically influenced by the conditions in which learning environments are structured. Scholars have examined the conditions of multimedia instruction that promote better and more efficient student learning. There has been, however, little systematic, widespread application of multimedia instruction principles to postsecondary education courses and curricula. We know a great deal about how adults learn and about how we can provide instruction to maximize their learning, retention, and transfer of knowledge. In this project, we will put powerful principles of multimedia instruction to work in both campus-based and online college and university courses.

We believe that the ideal time to undertake our project on multimedia learning is now. Although teachers have long used assorted forms of multimedia in higher education, the burgeoning growth of online academic courses and programs has seen a commensurate need for, and subsequent use of, a profusion of multimedia platforms for instructional use. However, as Mayer (2009) has argued, these multimedia tools have been almost exclusively developed and used with little or no consideration of how students learn in general or how they learn with multimedia in particular. Our project will address this issue head on in the context of real academic courses, both campus-based and online.

Purpose

The purpose of our project is to design, implement, evaluate, and disseminate powerful principles of multimedia instruction in a broad range of undergraduate courses, initially at UNH and then at dissemination sites in New England. (We already have had preliminary discussions with faculty/administrators from several regional colleges/universities.). Through the systematic application of multimedia instructional principles of learning, we will give college teachers—few of whom are experts in areas related to cognition and learning—the tools to improve students’ learning, retention, and transfer of course-based knowledge.

During the course of the grant, we will not only build and apply our set of research-based multimedia best principles and practices, we will also undertake a systematic assessment of the impact of our interventions. These assessments will provide evidence that we will use to educate and persuade other teachers, with the goal that they will begin to design and use multimedia that maximizes student learning. UNH will sustain this project at the end of the grant and will support its continued implementation and assessment through our regular budgetary and staffing mechanisms.

Leadership

Victor Benassi (Principal Investigator) is the Faculty Director of the UNH Center for Excellence in Teaching and Learning and a Professor of Psychology. He is the coordinator of the Psychology Department’s program on preparing future faculty for their teaching roles. He has developed seminars/practicum on The Teaching of Psychology, on Classroom Assessment and Research, and on Cognition, Teaching, and Learning. He has published in the area of college teaching, including recent studies on the application of the “testing effect.” In 2003, he received the Charles Brewer Distinguished Teaching of Psychology award, a gold medal achievement award from the American Psychological Foundation. He is currently President-Elect of the Society for the Teaching of Psychology (American Psychological Association, Division 2). Dr. Benassi has led UNH’s Davis Educational Foundation sponsored Cognition Toolbox project for the past three years.

Catherine Overson is the Project Director of the Teaching and Learning with Multimedia project. She was previously a research associate in UNH’s Center for Excellence in Teaching and Learning, where she worked as a member of the Cognition Toolbox staff. Her dissertation focused on applications of the science of learning in college and university courses (Three Elements of Self-Regulated Learning: Metacognitive Functioning, Self-Efficacy, and Study
University of New Hampshire

Dr. Overson has taught a university course on “Applying Psychological Science to Promote Learning,” which had a focus on multimedia learning. She is an experienced teacher of university courses in psychology, statistics, and the science of learning. She is a member of Division 2 of the Society for the Teaching of Psychology (American Psychological Association).

Michael Lee is Administrative Director for UNH’s Center for Excellence in Teaching and Learning, where he directs the university’s graduate program in college teaching, conducts teaching workshops throughout the academic year, and consults with individual faculty members regarding teaching and learning issues. He was a lecturer for many years in the UNH English department. He has worked on two previous Davis Foundation grants (Discovery [general education] and the Cognition Toolbox). As an affiliate Associate Professor in the College Teaching program, he regularly teaches both online and face-to-face courses on issues in college teaching.

Elizabeth Reilly (Teaching and Learning with Multimedia Project Assessment Specialist) is the Coordinator for Student Learning Outcomes Assessment for UNH’s Center for Excellence in Teaching and Learning, where she coordinates the course, program and college-wide assessment activities, administers online quizzes, surveys and evaluations, and consults with individual faculty members regarding teaching and learning issues. Before coming to the Center in July, 2007, she was a project assistant for a Davis Educational grant at Bowdoin College in Brunswick, Maine, where for four years she coordinated assessment projects for various academic departments and student services. Elizabeth holds a M.A. in Educational Policy and a B.A. from the University of Michigan.

Methods

We have developed a systematic approach toward working with faculty on the use of multimedia in their courses:

1. We will identify certain types of courses for inclusion in the project, and then invite faculty to participate who teach those courses. We will focus on courses that are not only routinely taught at UNH but also that are standard offerings at most colleges or universities. We are following this approach so that multimedia materials that we develop at UNH will be appropriate for use at our dissemination sites. Examples of such courses include: introductory physics, introductory chemistry, molecular biology, evolutionary biology, introductory psychology, American government, introductory courses in foreign languages (e.g. Spanish, French, Russian), geography of the Western world, and statistics. These, and many other, courses typically include a lot of multimedia material.

2. Once we have identified a particular course and its willing instructor, the project director will meet with the instructor and determine what multimedia are used (or could be used) in the course. The project director will meet with other project staff to review all of the course-related materials (syllabus, assignments, learning assessments, etc.). Finally, the project team will propose the particular multimedia that will be implemented and assessed during the next offering of the course. We will design a strong learning outcomes assessment protocol in order to collect evidence about the impact of the multimedia.

3. Before the start of a course, the project director and the project associate will work on designing the multimedia presentations that will be used during the semester. For some multimedia presentations, course instructors will use the multimedia as they have done in the past (or as they designed them for the course). For other multimedia, the project director and project associate will modify the presentations to reflect multimedia principles for effective and efficient student learning.

4. The project director, in conjunction with the principal investigator and the assessment coordinator for student learning outcomes, will be responsible for designing and implementing the assessment of the impact of the multimedia intervention in each course. We now have four
years of experience in designing and implementing strong evaluation designs to assess the impact of the interventions that we use (for example, refer to our work on the Cognition Toolbox: http://www.unh.edu/teaching-excellence/events/index.html)

Below is a partial list of principles of multimedia learning that we will apply, and that we will assess the impact of, in the courses of participating teachers (Mayer, 2009, *Multi-Media Learning, 2nd* edition, Cambridge University Press).

- **Coherence Principle:** “People learn better when extraneous material is excluded rather than included” (p. 89)
- **Modality Principle:** “People learn more deeply from pictures and spoken words than from pictures and written words” (p. 200)
- **Signaling Principle:** “People learn better when cues that highlight the organization of essential material are added” (p 108)
- **Redundancy Principle:** “People learn better from graphics and narration than from graphics, narration, and printed text” (p. 118)
- **Spatial Contiguity Principle:** “People learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen” (p. 135)
- **Pre-training Principle:** “People learn more deeply from a multimedia message when they know the names and characteristics of the main concepts” (p. 189).
- **Segmenting Principle:** “People learn better when a multimedia message is presented in user-paced segments rather than as a continuous unit” (p. 175).

Our work with faculty will be informed by the applied research done for others on application of multimedia principles in disciplines such as history, mathematics, chemistry, meteorology, second language acquisition (Mayer, Ed., 2005, *Cambridge Handbook of Multimedia Learning*).

**Timetable for Implementation**

**Year One**
- Advertise the multimedia project to UNH university community.
- Fall: Select 10-15 courses previously taught by faculty, for which they have existing slide presentations (e.g., PowerPoint®, Keynote®). Randomly select half of the presentations for each of the courses, and modify them to reflect ideal multimedia principles of learning. The other presentations will be administered “as is.” Assess impact of two slide presentation modes.
- Fall and Spring: Identify 10 additional faculty who want to develop multimedia slide presentations. We will work with them to reflect ideal designs based on multimedia principles. Faculty will offer their course during spring semester, with assistance regarding implementation and assessment.
- Spring and Summer: Identify 10-15 faculty who currently use animations, videos, online lectures (lecture capture) in their courses. Design presentation modes that compare animations with static pictures of steps in animation.
- Summer: Analyze results and write reports on projects completed during the year.
- Give presentations at NEASC annual assessment forum; Benassi has already been asked to give a presentation at the forum on multimedia learning.

**Year Two**
- Fall: The 10-15 faculty noted above will offer their courses using animations/videos, as designed; assessments of student learning will be completed.
- Based on Year One findings with slide presentation projects, we will develop “best principles” templates that provide a structure for creating multimedia slide presentations.
• Fall and Spring: Identify 10-15 additional faculty who want to design their spring course using animations, videos, or online lectures. Prepare presentations based on multimedia principles. During the spring semester, assessments of student learning will be completed.

• Fall: Work with faculty leaders from six other New England colleges/universities to identify spring courses that will potentially use multimedia material developed at UNH in Year One.

• Spring: The courses identified above will be field tested. Project director and assessment coordinator will work with faculty on any course implementation issues and ensure that learning assessments are conducted.

• Spring and Summer: Identify 10 faculty who currently use computer-based problem solving learning activities in their courses. We will work with them to reflect ideal designs based on multimedia principles. Faculty will offer their course during fall semester, with assistance regarding implementation and assessment.

• Hold UNH on-campus workshops describing concept and results of project to date.

• Give at least two presentations at regional (e.g., NEASC annual assessment forum; Benassi has already been asked to give a presentation at the forum on multimedia learning) and national (e.g., AAC&U) meetings on results of project to date.

Year Three

• Offer courses in which computer-based problem solving learning activities are used; assess learning outcomes.

• Implement additional projects at dissemination colleges/universities based on Year Two projects done at UNH (on animation and video).

• Based on Year Two findings with slide presentation projects, we will develop “best principles” templates that provide a structure for creating multimedia animations, video presentations, and online lectures.

• Dissemination. Hold day-long conference on Applications of Principles of Multimedia Learning in College Courses.

• Based on fall semester findings in problem-solving courses, we will develop “best principles” templates that provide a structure for creating multimedia.

• Give at least two presentations at regional and national meetings on results of project to date.

• Summer: Wrap up all aspects of project, including Multimedia Toolbox website, analyses and reports for all courses included in the project; preparation of final Davis Educational Foundation grant report.

• Begin preparation of a monograph on the Teaching and Learning with Multimedia project: tentative title (A Guidebook on Using Multimedia in College and University Courses—the science of learning in action).

Expected Project Outcomes

Student Learning Outcomes

The outcomes that we will assess are those that are held to be of critical importance to college educators. Researchers of multi-media learning (e.g., Mayer, 2009) have examined effects of instruction with multimedia in four related areas:

Initial Factual Understanding. If students are going to retain information included in multimedia presentations, they must first acquire knowledge. In the multimedia presentations examined in this project, we will administer immediate post-presentation assessments that tap students’ factual understanding of presented material.

Initial Conceptual Understanding. If students are going to retain their initial conceptual understanding of multimedia presentations, they must first gain such understanding. In the
multimedia presentations examined in this project, we will administer immediate post-presentation assessments that tap students’ conceptual understanding.

Retention of Factual and Conceptual Understanding. The important questions about the impact of multimedia as a teaching tool concern whether students’ long-term retention of initially learned material and their conceptual understanding of that material is enhanced as a result of the multimedia used to initially present the material.

Transfer of Learning to New Contexts. The gold standard for assessment of student learning outcomes is whether students are able to transfer their initially acquired factual knowledge and conceptual understanding to new contexts—academic and “real world.” We will administer assessments during the course and at follow-up that measure the extent to which students are able to transfer what they learned to new issues, problems, and contexts.

We will develop our specific assessment measures tapping the four areas described above based on the work done by Richard Mayer and colleagues over several decades (Mayer 2009). He has designed measures that are widely accepted as valid indicators of student achievement in these four areas.

Multimedia Templates and Tools Based on Principles of Multimedia Learning

In addition to developing course specific multimedia that can be used on an ongoing basis in courses offered throughout the New England region and beyond, our final contribution will be to create multimedia templates and tools that instructors can use to present content in yet-to-be designed presentations. For example, we will create a PowerPoint© template that is structured to make it easy for instructors to upload content in a manner consistent with principles of multimedia learning. In another example, we will develop an authoring system that allows teachers to upload problems (e.g., in math, statistics, engineering, logic) to a program that includes proven multimedia for teachers who want to teach problem solving skills.

Dissemination Outcomes

Our primary goal is to promote the widespread and systematic application of effective and efficient principles of multimedia instruction across the UNH curriculum. We will do this throughout the course of this grant. By the end of the grant, we will have developed a strong base upon which to build. CETL will sustain and enhance the gains made by making the Multimedia Compendium one of the centerpieces of our overall efforts, along with the other components of the Center (http://www.unh.edu/teaching-excellence/index.html).

We have also made a very strong commitment to field test and disseminate our multimedia project at other New England colleges/universities. This commitment is reflected in the considerable amount of time and effort we will dedicate to these purposes (see Timetable).