



The Cognition Toolbox: Implementing Cognitive Principles and Assessing Student Learning in College Courses

Proposed Project Description

Basic and applied research, starting in the early 20th century and continuing to the present, has documented that learning (ranging from acquisition of rote skills to higher order thinking) can be dramatically influenced by certain conditions in which the learning environments are structured. Until recently, however, there has been little systematic, widespread application of the principles that come from this research to post secondary institution courses and curricula. We know a great deal about how adults learn and about how we can modify instructional environments to maximize their learning, retention, and transfer of knowledge. In this project, we will put these principles to work.

Project Description

Over the past year and a half, the Center for Excellence in Teaching and Learning (CETL) has been developing and pilot testing a new approach to meet its primary goal: assisting faculty in improving student learning and retention of course material and facilitating the utilization of teaching and learning strategies that promote the transfer of what is learned to new situations. This new approach, *The Cognition Toolbox*, is characterized by a set of strategies by which faculty implement one or more “cognitive tools” in courses they are currently (or will be) teaching.

This new approach to improving student learning differs dramatically from the standard approach found in many other teaching and learning centers. Most teaching and learning centers rely on workshops, seminars, talks, and/or “bag lunch” sessions in which faculty are provided information and examples about pedagogical methods and techniques (e.g., “how to” sessions on using *PowerPoint*, incorporating writing into courses, techniques for facilitating active learning, etc.) We plan to meet with individual instructors; assess exactly what “cognitive tools” are likely to work in a specific course; devise a plan for the implementation of the recommended cognitive tools; provide assistance in the integration of the recommended cognitive tools into courses; develop outcome measures to assess the unique impact of incorporated cognitive tools on student learning.

Purpose

The purpose of our project is to design, implement, evaluate, and disseminate a Cognition Toolbox in a broad range of undergraduate courses, initially at UNH and then at four dissemination sites. (We already have had preliminary discussions with faculty/administrators from several regional colleges/universities.). Through the systematic application of powerful cognitive principles, we will give college teachers—most of whom are not experts in areas related to cognition and learning—the tools to improve students’ learning, retention, and transfer of important course-based knowledge. During the course of the grant, we will not only build and apply our Cognition Toolbox, 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 apply principles of cognition in their own courses. UNH will institutionalize the Cognition Toolbox through CETL at the end of this project

and will support its continued implementation and assessment through our regular budgetary and staffing mechanisms.

Leadership

Victor A. Benassi, Ph.D., Project Director. Dr. Benassi is the Faculty Director of the UNH Center for Excellence in Teaching and Learning and a Professor of Psychology at UNH. He has been the coordinator of Psychology's program on preparing future faculty for their teaching roles since 1982. He has developed and/or taught seminars/practica on *The Teaching of Psychology* and on *Classroom Assessment and Research*. He has published research articles in the area of college teaching, including recent studies on the application of the "testing effect" in college courses. In 2003, he received the Charles Brewer Distinguished Teaching of Psychology award, a gold medal achievement award from the American Psychological Foundation. He has developed an online course on designing college-level courses based on applications of psychological knowledge to teaching and learning that has been taken by students from around the United States as well as eight other countries.

Edward J. O'Brien, Ph.D., Project Consultant. Dr. O'Brien is a professor of psychology in the UNH Department of Psychology. He is a cognitive psychologist with a specialty in discourse processing/reading. He is known nationally and internationally for his theory and research in the area of text processing and memory. He has served as a PI on several grants. He has written grant applications on applications of principles of cognition to teaching and learning at the college level. He developed and has taught a graduate-level course titled "Cognition, Teaching, and Learning." Dr. O'Brien serves on the Grant Review Panel, Institute of Education Sciences (a US Department of Education program which provides funding to researchers in the cognitive sciences to develop and implement applications of cognitive principles in educational settings).

Michael J. Lee, Ph.D., Project Manager. Dr. 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. Before coming to the Center in 2001, he was a lecturer in the UNH English department, where he taught a variety of courses in American Literature and in college writing. From 2001-04, his primary responsibilities involved the implementation and coordination of a \$500,000 U. S. Department of Education grant to disseminate the UNH model for academic programs in College Teaching. He has also worked closely with the leadership of the UNH Discovery Program to implement a Davis Educational Foundation grant for assessment of the program's first-year inquiry courses. 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.

Methods

Our approach will be based on a pilot feasibility project that we have conducted over the past year and a half. We will:

1. Advertise the project to all UNH teaching faculty and also identify certain types of courses for inclusion in the project (e.g., general education courses, linked courses in majors). During our pilot project, large numbers of faculty showed interest and we were able to work with only a few of them.
2. Once we have identified a particular course, we will meet with the instructor and determine what learning issue(s) the teacher wishes to focus on. Project staff will then review all of the course-related materials (syllabus, assignments, learning assessments, etc.). Finally, the project team will propose an intervention based on an appropriate cognitive principle. We will also design a strong learning outcomes assessment protocol in order to collect evidence about the impact of the intervention.

3. With the start of a course, project staff will work with the instructor to ensure the proper implementation of the cognitive principle. Based on our prior experience, contact with the instructor will range from minimal to moderate, depending on particular circumstances. One of our overriding objectives is to minimize additional work on the part of the teachers who participate in the project. If there are to be clear benefits to student learning, we need to develop interventions that teachers will use reliably in their courses.

4. About half way through a course offering, project staff will conduct a mid-course assessment (MAP) to determine the extent to which students perceive the benefits from the cognitive tool(s) used in their course. For information about the UNH MAP process refer to: <http://www.unh.edu/teaching-excellence/MidAssessmentProcess/index.html>

5. Project staff will be responsible for designing and implementing the assessment of the impact of the Cognition Toolbox intervention in each course. We have experience now with several courses in which we were able to use strong evaluation designs to assess the “testing effect” and the impact of “writing guided summaries of textual material.” (We have reports of these evaluations, including results, if you would like to receive them.)

Below is a *partial* list of principles that we will develop as tools for our Cognition Toolbox and that we will apply in the courses of teachers who participate in the project.

- Effects of testing on learning and memory

<http://news-info.wustl.edu/tips/page/normal/6715.html>

Giving students quizzes shortly after they are exposed to academic material (print, video, lecture) promotes long-term retention of that material (e.g., as measured on a final exam). This result has been found with retention of factual material and higher-order concepts.

- Effects of distributed practice vs massed practice on long-term memory

http://www.aft.org/pubs-reports/american_educator/summer2002/askcognitivescientist.html

Distributing study over several study sessions promotes better long-term memory than the same amount of study massed together. Massed practice (cramming) does lead to better short-term memory, but poor long-term memory.

- Writing guided summaries of textual material

<http://lsa.colorado.edu/>

Writing a summary (with guiding questions) of textual material helps students perform better on subsequent assignments that evaluate their factual and higher-order understanding of that material than shown by students who read and study the material on their own.

- Maintaining students’ attention in the classroom

<http://www.upenn.edu/almanac/v50/n15/teaching.html>

Attention waxes and wanes over the course of any class. Learning is best when attention is high. Varying class structure in ways that capture attention during periods when it is likely to wane has been shown to improve learning.

- Elaborative Rehearsal Enhances Students’ Comprehension

http://faculty.clintoncc.suny.edu/faculty/June.Foley/studying_for_better_retention_an.htm

http://waukesha.uwc.edu/sc/skills/st_learning.html

Elaborative rehearsal improves both comprehension and memory. When students engage in elaborative processing, they form interconnections between what they already know and the new material they are acquiring; these interconnections enhance the depth of comprehension. They do so by providing additional retrieval routes (i.e. multiple pathways to retrieve information.)

- The Role of Prior Knowledge and Beliefs in Affecting New Learning

<http://psyc.memphis.edu/learning/ndtl/index.shtml>

<http://www.yorku.ca/lbianchi/nats1800/lecture16a.html>

Students' intuitive beliefs and theories about a variety of natural phenomena (e.g., those studied in science courses) often interfere with learning scientifically-based material. Cognitive psychologists have developed methods by which these intuitive theories can be modified so that accurate scientific knowledge is learned.

Some additional cognitive principles:

- Improving Transfer of Learning to New Contexts
http://www.bianys.org/learnnet/tutorials/transfer_of_training_or_generalization.html
- Improving Comprehension Through Discourse Processing
<http://psyc.memphis.edu/learning/ndtl/index.shtml>
- Transfer-appropriate processing
<http://frank.mtsu.edu/~wlangsto/CogPsyNotes7.html>

Timetable for Implementation

Summer 2009

- Prepare for implementation of Cognition Toolbox in first set of courses, including building a project management system using Blackboard®.
- Work with instructors to prepare courses that include one or more cognitive principles.

Fall 2009 – Spring 2010

- *Fall*. Implement Cognition Toolbox in 10 UNH courses—three large-enrollment general education courses (e.g., introduction to biology), three lower-division entry-level courses in majors (e.g., physics), two lower-division foreign language courses, and two upper-division courses in undergraduate majors (e.g., psychology, health management and).
- *Spring*. Implement Cognition Toolbox in 15 additional UNH courses—five first-year undergraduate seminars (i.e., “inquiry courses” which are part of general education), four lower-division courses in majors which are conceptually closely related (e.g., statistics and research methods courses), four upper-division courses which focus of development and transfer of higher-order cognitive skills (critical thinking), and two upper-division courses in undergraduate majors (e.g., economics).
- *Spring*. Begin preparing and posting materials for web-based Cognition Toolbox.

Summer 2010

- Work with UNH instructors to prepare courses that include cognitive principles.
- Formalize linkages with four regional colleges, with the goal of designing, implementing, and evaluating Cognition Toolbox in four courses at each college during 2010-2011.
- Complete analysis of evaluation results from all courses included in project during the year. Prepare final report on each course.

Fall 2010 – Spring 2011

- *Fall and Spring*: Implement Cognition Toolbox in 15 UNH courses, with focus on including an increasingly diverse mix of types of undergraduate courses (different majors, academic levels, pedagogies, learning outcomes, etc.).
- *Fall and Spring*: Hold UNH on-campus workshops describing concept and results of Cognition Toolbox project to date.
- Give at least two presentations at regional (e.g., NEAS&C annual meeting) and national (e.g., AAC&U) meetings on results of project to date.
- Bring in nationally recognized outside consultant to UNH to help us assess and improve the impact of the Cognition Toolbox. Invite UNH people and faculty/administrators from area colleges/universities to meet with the consultant.
- *Fall*: Make site visits to regional colleges; work with faculty to design introduction of cognitive principles into at least four courses at each college; establish and implement mechanisms for collection of learning outcome measures.

- *Spring*: Implement cognitive principles in courses at the regional colleges. Maintain coordination and consultation with previously identified lead person at each college.
- *Spring*. Continue development of Cognition Toolbox website.

Summer 2011

- Strengthen linkages with the four previously identified regional colleges, with the goal of designing, implementing, and evaluating the Cognition Toolbox in additional courses at each college during 2010-2011 academic year.
- Complete analysis of evaluation results from all courses included in project during the year. Prepare final report on each course.

Fall 2011 – Spring 2012

- *Fall*: Make site visits to regional colleges at beginning of fall and spring semesters for the purpose of assisting faculty in implementing the Cognition Toolbox in identified courses; establish and implement mechanisms for collection of learning outcome measures.
- *Fall and Spring*: Final implementation of Cognition Toolbox in 10 UNH courses. These final trials will address any problems identified in earlier implementations as well as refinements that enhance the impact of the intervention and minimize unnecessary extra work on the part of course instructors.
- *Spring*. Continue development of Cognitive Toolbox website.
- Dissemination. Publish a monograph on the Cognition Toolbox project; hold day-long conference on *Applications of Cognitive Principles in College Courses*.

Summer 2012

- June, 2012: Wrap up all aspects of project, including Cognition Toolbox website, analyses and reports for all courses included in the project; preparation of final grant report.

Expected Project Outcomes

Importance of Project Outcomes

Learning outcomes. The outcomes that we will assess are those that are held to be of critical importance to college educators. Do students possess the factual knowledge that is necessary for success in academic fields and disciplines? Do students retain foundational knowledge over time? Are students able to transfer knowledge learned under certain conditions to novel situations? Can students use domain specific knowledge in a manner that appropriately informs judgments and decisions (i.e., critical thinking)? Do the conditions under which students learn academic material affect their ability to integrate disparate facts, theories, and understandings?

Dissemination outcomes. Our primary goal is to promote the widespread and systematic application of principles of cognition across the UNH curriculum. We will do this throughout the course of this grant. By the end of the grant, we will have a strong base upon which to build. CETL will sustain and enhance the gains made by making the Cognition Toolbox one of the centerpieces of our overall efforts.

Our second major goal is to assist faculty at several regional colleges/universities in their efforts to implement the Cognition Toolbox.

Methods for Assessing Achievement of Project Outcomes

We will use direct measures of student learning, retention, and transfer of course-related material. These methods derive from decades of cognitive research and have been established to be reliable, valid, and educationally meaningful measures. These measures will be incorporated into standard classroom testing measures of comprehension and memory (e.g., multiple choice and recall questions will assess factual knowledge; essays will assess integration of material across topics; and take-home written assignments will be used to assess the ability to transfer

knowledge to new situations.) For example, in one course in which we have implemented one of the cognitive tools, students answered quiz items shortly after learning factual material that was necessary to solve financial problems in a health management course. Later in the course, students completed a mid-term examination on which there were application problems. The outcome of interest was students' performance on these application questions.

University of New Hampshire's Mission and Unique Qualities

UNH Mission

The University of New Hampshire is the state's public research university. Its primary purpose is learning: students collaborating with faculty in teaching, research, creative expression, and service. UNH holds land-grant, sea-grant, and space-grant charters with five colleges (Liberal Arts, Life Science and Agriculture, Business and Economics, Health and Human Services, Engineering and Physical Sciences) in Durham and UNH Manchester, the university's urban campus. Detailed characteristics of our students and institution can be found at <http://www.unh.edu/ir/cds1.html>.

Center for Excellence in Teaching and Learning

At UNH, the Center for Excellence in Teaching and Learning is the central location for the gathering, testing, and dissemination of information about effective teaching practices and their impact on student learning outcomes. The Center's staff strives to promote the highest quality of student learning by providing full-time faculty, part-time faculty, and teaching graduate students with the resources and services they need to implement in their classrooms the best practices in college teaching. These services and resources include: consultation with individual teachers; workshops and courses on effective teaching practices; collaboration with other campus units interested in program development and review; assistance to individuals and academic units interested in designing and implementing student learning outcomes assessment initiatives; and the conduct of research on the teaching/learning process.

In 2002, the Center received the TIAA CREF Hesburgh Award Certificate of Excellence for its demonstrated success in "achieving its central mission: to enhance the teaching effectiveness of UNH faculty." During the past decade, the Center has completed two major grant-funded projects (Fund for the Improvement of Post Secondary Education), has assisted project directors from other UNH units regarding educationally-related grants that they secured, and worked with the leadership of the UNH Discovery Program on a Davis Education Foundation grant. Thus, we have considerable experience obtaining and successfully completing grant projects.