A Beacon for Great Colleges
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Great Lakes Colleges Association

Pathways to Learning Collegium

Final Report to the Teagle Foundation

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Introduction

This document constitutes the final report by the Great Lakes Colleges Association (GLCA) to the Teagle Foundation for the GLCA Pathways to Learning Collegium, a project undertaken with a grant of $150,000 from the Foundation in March 2008.

During the last several decades a great deal of research has been done on human learning; the findings of this research have important implications for pedagogy as described in the landmark publication of the National Research Council, *How People Learn*[1]. While there has been substantial innovation in K-12 education based on human learning research, little has been done in applying research-based learning principles to higher education. It was the purpose of this project to engage faculty members from our member colleges in pursuing research-based innovation to liberal arts teaching and learning. The Teagle-supported innovative pedagogy projects ("collegia") involved both research universities and consortia of liberal arts colleges; because liberal arts colleges place a central and primary emphasis on the quality of student learning, they are ideal settings not only to implement and assess the learning impact of innovative pedagogies, but also to build communities of shared interest within and across colleges that are committed to improving undergraduate pedagogy.

We called our collegium "Pathways to Learning," based on the idea that there may be a number of pedagogical "pathways" that can be taken to arrive at a particular learning destination rather than a single "best" approach. As such, our program was designed to make it possible for faculty members to explore alternative research-derived approaches or "pathways" to teaching and learning in undergraduate courses. We created a grant program to support faculty members who sought to apply theory to practice – to design and implement a pedagogical innovation derived from research on how learning occurs, and compare the learning results to those obtained from another, often more traditional method of teaching.

The GLCA Pathways to Learning Collegium has taught us how a comparatively modest amount of Foundation funding can foster a substantial community of interest in pursuing innovative approaches to pedagogy and comparing the impact of those approaches to more traditional styles of teaching. Ours was a community that ultimately engaged 28 faculty

[1] Bransford, John, et al, 2000 and previous editions. *How people learn: brain, mind, experience, and school.* Washington DC: National Research Council.

members in 13 academic disciplines. The premises of our program, derived from the Teagle Foundation's RFP, were:

- That the body of research conducted on the cognitive, social, and neurological dimensions of learning through recent decades offers promising insights on how to achieve more effective teaching at the undergraduate level;
- That it is by systematically introducing an alternative pedagogical approach derived from such research, comparing learning results to those obtained from a more traditional teaching method, and making adjustments to pedagogy based on those results that improvement in liberal arts teaching and learning can occur;
- That the dissemination of these research-based applications in practice can encourage more faculty members of our colleges to explore alternative approaches, assess results, revise teaching techniques, and thereby contribute to an improvement in student learning at liberal arts colleges.

From the time that GLCA received the grant from the Teagle Foundation in spring of 2008 through its culminating meeting of project leaders in June 2010, our Pathways to Learning Collegium has accomplished a sequence of actions, including the following:

- Convening a formative meeting in May 2008 with 15 faculty members to identify key principles from the research literature on learning and outline the design of the program;
- Creating a Request for Proposals (RFP) for innovative pedagogy projects, disseminated to our member colleges in summer 2008 (see Appendix B);
- Identifying a panel of faculty judges to evaluate proposals received;
- Requiring a comparative framework for each project proposed as an integral design component – one that compares a research-based alternative pedagogy to a more traditional teaching method and assesses learning results;
- Attracting proposals for 26 faculty-led projects, 20 of which were funded;
- Supporting proposals led by faculty members at 11 GLCA member colleges for projects in 13 academic disciplines: Biology, Chemistry, Economics, English, Environmental Studies, French, Geology, German, History, Mathematics, Physics, Political Science (2), Psychology (8).
- Commissioning two of our faculty project leaders to give presentations at a national Scholarship of Teaching and Learning (SoTL) meeting at Wabash College in March 2009;
- Commissioning two faculty participants to serve as presenters/facilitators of an international conference on liberal arts pedagogy in Eastern Europe in March 2010;
- Supporting four projects that involve two or more faculty members working collaboratively;
- Supporting three projects that include an analysis of long-term learning retention;
- Convening a culminating meeting of project leaders and other interested faculty in June 2010, allowing project leaders to present their findings and receive comments and suggestions from colleagues of several member colleges and academic disciplines;

- Helping to build a community of interest in improving/assessing liberal arts learning across GLCA member colleges.

This final report includes a summary of the initial steps that led to the design and implementation of the GLCA Pathways to Learning Collegium. It describes preliminary findings and lessons learned from the 20 individual faculty projects that our Collegium supported with funds from the Teagle Foundation. Finally, it describes ideas for continuing the momentum generated by this program from the culminating meeting of the Collegium project leaders in June 2010.

Formative Steps

GLCA turns frequently to the chief academic officers of its member colleges for insights about potential topics for program development. When the Teagle Foundation first issued its Request for Proposals calling for a series of Collegia that would explore the applicability of recent research on how learning occurs to undergraduate teaching and learning, we asked our academic deans whether a consortial program on this theme would be a valuable step in heightening the interest of faculty members in exploring alternative pedagogies across our member colleges. The deans gave strong support for GLCA to submit a proposal for one of the Teagle Foundation's Collegia.

Our first step in shaping a proposal for the Pathways to Learning Collegium was to identify a set of faculty members from across our member colleges with expertise and/or interest in research on learning and its application to pedagogical exploration in different fields of study. Again we turned to our chief academic officers, asking them to supply us with names of those who would have a potential interest in a consortial project on this subject. That request yielded the names of nearly 20 faculty members, many of them psychologists with expertise in the cognitive, neurological, or social elements of learning. Several faculty members from a variety of other fields – including biology, economics, history, and modern languages – who have a particularly strong interest in improving liberal arts pedagogy brought additional perspectives. Two members of our core design group for the Pathways to Learning Collegium are Teagle Assessment Scholars. We convened these faculty members in a series of conference calls in December 2007. From these calls we gained valuable advice on both the substantive content and structure of the program we would propose to Teagle, and we developed the proposal as submitted to the Foundation.

After learning that we had received a grant from the Foundation to establish the Pathways to Learning Collegium, GLCA convened a formative meeting in May 2008, which included most of the faculty who had been involved in the earlier planning conference calls. While we initially thought we would invite one or more outside experts to address this group, we found that our participating faculty had a high level of expertise, including national reputations, in this area. As such we concluded that, if our faculty were to fully "own" this project and progress was to be made expeditiously, we were much better served by acknowledging this expertise at the outset and having participants look to each other for expert advice rather than creating a sense of

dependency on outside experts who would be much less available as the projects developed. At this meeting individual participants gave brief presentations on such topics as increasing the transfer of knowledge, building foundations of expertise, strengthening long-term retention of knowledge, and metacognitive strategies (instilling habits of structured reflection). Individually and collectively, these presentations were rich and engaging; our exchanges on different components of learning took on the character of a graduate seminar, and more than one participant described the meeting as one of the most informative and valuable professional experiences they had ever had.

That meeting provided the substantive basis to develop the Request for Proposals for our Pathways to Learning Collegium. That document appears as Appendix B to this final report.

One of the challenges we faced in introducing the program was to attract proposals from faculty members who were not experts in the research on learning. Not surprisingly, the participants in our formative meeting included a disproportionate number of psychologists who brought a strong grounding in this literature. The RFP sought to allay the reluctance that faculty members in other disciplines might have by providing a summary of key research concepts in terms that are accessible to a lay readership, and it offered a sample bibliography of research in essential areas of learning. Beyond these steps, GLCA staff often worked extensively with faculty members who were interested in developing proposals (requiring far more staff time than originally planned); in some cases faculty experts from our colleges were involved in conference calls or e-mails to provide expertise on a particular principle of learning the proposer wished to explore.

We established a panel of judges that included faculty experts from our member colleges, each of whom brought a substantial grounding in the research on learning, the scholarship of teaching and learning, and/or evaluation methodology. The judging panel also included GLCA's co-directors of the Pathways to Learning Collegium. Each proposal we received generated insightful comments and valuable advice from our judging panel. This advice in many cases helped proposers to revise and strengthen their project designs, and ultimately to gain approval for funding from the Collegium. The correspondence between the judging panel and individual proposers in this evaluation process exemplified the rich collegial exchange among faculty members who share a common interest in improving liberal arts learning across our member colleges.

Pathways to Learning Project Clusters

In all, the GLCA Pathways to Learning Collegium supported 20 projects in 13 academic disciplines across 11 of our member colleges. We have grouped these projects into five general clusters:

- Building Foundations of Expertise;
- Introducing Digital Tools as Mediators of Knowledge to Increase Learning Effectiveness;
- Metacognitive Strategies: Instilling Habits of Structured Reflection;
- Engaging the Social and Emotional Contexts of Learning;
- Strengthening Long-term Retention of Knowledge.

The projects undertaken in the context of the Pathways Collegium are summarized below under these five cluster headings. In retrospect it is interesting to observe the degree to which the proposals submitted aligned with several of the broad categories of research on learning as summarized in our Pathways to Learning Collegium RFP. Some of the projects are still in process (those for which a comparison course is being taught in the current academic year), and their accounts provide preliminary rather than final results. The focus here is to convey a general sense of the topic, the projects undertaken, general findings within each cluster, and selective insights from individual projects. Each project is described in more detail in Appendix A.

Initial Findings by Cluster

Cluster A: Building Foundations of Expertise

Research has shown that those who attain expertise in a particular field of knowledge develop a capacity to recognize key patterns in new information and to understand new problems in the context of organizing principles or concepts within that field of knowledge. This ability to perceive rapidly the key attributes of new information distinguishes the expert from a novice, who must take several deliberate steps to discern patterns of meaning. Experts are also more adept at perceiving which organizing principles are most important. The pedagogical challenge is to draw students beyond the memorization of facts and instill a capacity for applying relevant conceptual principles that facilitate the discovery of meaning.

The goal of the projects in this cluster was to create learning contexts that draw students beyond the act of memorization and recitation of content – in effect to draw students closer to a state of expertise through activities that encourage students to construct and apply internal representations of relevant conceptual principles to discover meaning. Projects in this cluster (and a brief statement of the purpose of each project) were:

- A constructivist approach to Introductory Psychology (Thomas Ludwig, Psychology, Hope College). Introduce collaborative learning in place of lecture format in one of two otherwise identical sections of an introductory psychology class.
- Collaborative learning in a seventeenth-century French literature class (Jean Blacker, French, Kenyon College). Students teach/lead other students in class engagement with instructor oversight.
- Integrative learning through learning communities (Marcy Sacks, History; Jess Roberts, English; Dean McCurdy, Biology, Albion College). Engage student interaction in learning-community configuration to promote curricular coherence, integrative, high-quality learning, collaborative knowledge-construction. Incorporate approach in several sections of first-year seminar program.
- Concept mapping to gauge levels of critical thinking in a plant biology class (Bruce Serlin, Biology, DePauw University). Have students complete survey device to determine aggregate skills in understanding key principles; use initial concept maps to

structure suitable learning activities that advance cognitive understanding of applicable principles.

A general finding from these projects was that in establishing a classroom dynamic that makes students responsible agents of one another's learning, the instructor recasts his or her relationship to students as a learning resource, becoming less a conveyor of knowledge and more of a mentor/guide in helping students navigate their journeys toward greater understanding of course material. By creating a context in which students actively engage and apply relevant concepts to create meaning for themselves and their peers, the instructor contributes to a student's evolution from novice toward the acquisition of greater expertise.

It was also observed that students in many cases may not exhibit the same enthusiasm as faculty members for the active learning approaches that characterize each of these projects. Many students prefer to remain passive recipients of knowledge and recite factual information that the instructor identifies as being "on the test." The challenge in these and other projects is to help students understand the value of a kind of learning that prepares them for a lifetime of critical inquiry and engagement – a kind of learning often considered integral to liberal arts education.

A sampling of results from this cluster included these findings:

- A constructivist approach to teaching can achieve comparable results to traditional lecture. In the introductory psychology project, the alternative pedagogy group did not show any measurable deficits in content learning (in spite of the lack of traditional content lectures), and its members showed increased motivation and engagement in the course.
- In the collaborative learning in a French literature class, students felt that their own teaching had better helped them see parallels between political and social movements and literary texts, though they found the instructor-driven component of the course more effective in helping them refine their approaches to literature. In this latter case, students simply did not yet possess the degree of expertise in the language itself to feel confident in their initial responses to literary texts.
- "It is well worth taking the risk of letting go of control of one's course and turning over significant sections to the students, if goals are clearly articulated and guidance is available when needed."

Cluster B: Introducing Digital Tools as Mediators of Knowledge to Increase Learning Effectiveness

The common goal of projects in this cluster was to introduce digital tools into the teaching-learning process to stimulate cognitive engagement and develop meaningful understanding of content and methods. Students who are now enrolled in college have come of age with digital tools; electronic media and communication have been central to many of their formative learning experiences. While students may expect digital tools to be part of their educational experience, it is not necessarily the case that such tools in themselves enhance learning or foster the thinking skills that a liberal arts education seeks to instill. Technology can

make the learning environment more enjoyable, but that in itself may not result in improved learning. The educational challenge is to ensure that digital technology tools are actually used by students to enhance the quality of learning. The projects in this cluster included:

- Use of peer instruction with classroom response systems (clickers) in an introductory geology class (Shelley Judge, Geology, College of Wooster).
- Examining the implementation and use of mobile technology for teaching and learning in the physical sciences (Guy Cox, Center for Technology-Aided Teaching and Learning; Kyle Shanton, Education; Andrew French, Chemistry; and Aaron Miller, Physics; Albion College). Tablet PCs were randomly assigned among the students. Student interaction with course content, media, and tools were observed and recorded as well as the pedagogical activities of the instructors.
- Use of digital assignments for improving writing quality (Jennifer Hayward and Leslie Wingard, English, College of Wooster). Replace graded, discipline-specific written assignments with more open-ended and ungraded blog assignments to provide opportunities for writing practice and skill development.

A general finding from these projects was that one of the most important effects of introducing digital tools to the instructional process was to clarify the instructors' own awareness of how well students understood the material being considered at a given point. Both the clickers project and the tablet PC project provided instructors with immediate feedback about the state of understanding among students in a lecture class. This important information allows the instructor to recast the instructional focus and/or alter the pace of presentation and discussion as needed to increase student engagement. The clickers project also underscored the importance of writing multiple choice questions of a kind that call for genuine thought and indicate the extent to which students have gained a deeper understanding of material. Some particular findings from the projects:

- Students rate use of clickers as helpful, though most did not like sharing clickers. Having a clicker of one's own increases a student's sense of directly participating in the class.
- In the digital assignments for improving writing project, initial results suggest that ungraded low-stakes blogging increases students' experience/skill in writing because it frees them to be more creative; at the same time, this process appears to motivate students to polish their work because it will be read by their peers as well as the instructor.
- Using pen-enabled technologies within the organized activities of the science classrooms has clarified the instructors' awareness of students' comprehension. The instructors have systematically shifted their pacing, or the rate at which they introduce topics while teaching.

Cluster C: Metacognitive strategies: Instilling Habits of Structured Reflection

Increasing learning effectiveness requires the development of a reflective capacity – the ability to stand critically apart, reflect on particular strategies the learner has applied to understand key information and concepts, and adjust or discard individual learning strategies that

prove inadequate. Structured reflection is a requisite step in the development of more effective techniques for individual learning. The educational challenge is to encourage students to examine their own habits of learning (sometimes described as "metacognitive strategies") and to make adjustments as needed to improve both retention and understanding. Often this step entails the recognition that the frameworks or principles of meaning a student has applied to a body of knowledge are inadequate – or simply wrong. The general goal of projects in this cluster is to present the subject matter of a given course in ways that encourage students to reflect on their own premises and strategies for learning, and to change habits as needed to strengthen learning skill. The projects in this cluster included:

- Engaging and strengthening different learning processes in introductory statistics (Nathan Tintle, Todd Swanson, Jill VanderStoep, Mathematics, Hope College).
- Use of deliberate practice in advancing statistical expertise in students (Gary Gillund, Psychology, College of Wooster). Have students focus on the underlying characteristics of the data as much as on the data analysis itself.
- Effect of providing instruction about cognitive and metacognitive theories about learning (Claudia Thompson, Psychology, College of Wooster).
- Applying principles of metacognition to improve study habits and enhance learning (Claudia Thompson, Psychology, College of Wooster). Provide estimation of test performance and test debriefing after exams, with the aim of increasing students' ability to reflect on their own learning processes and to improve their study practices.

A general finding from these projects was that engaging students in the act of structured reflection about learning is not always an easy or natural undertaking, if only because students may perceive that examining their own premises and learning methods is an added, often frustrating task. A second major finding is that introducing principles of metacognition to students in itself does not guarantee improved learning; in fact there was a significant negative correlation between the introduction of metacognitive principles and learning performance in two of the studies undertaken here. There is some suggestion from these results that students in an introductory-level course may not be developmentally capable of the structured self-reflection about learning that metacognitive approaches seek to instill. The premises of metacognition often run counter to an 18-year-old's sense of identify and beliefs about the origins and nature of knowledge. Some sample results from projects in this cluster:

- From the different learning processes in introductory statistics: there were learning gains from some aspects of the new approach introduced to teaching statistics, but also some areas in which students performed more poorly with the new approach.
- From the deliberate practice in introductory statistics project: focusing on underlying characteristics of problems results in students being more capable of correctly applying statistical knowledge. The advantage may be most pronounced for the weakest students.
- From the instruction about cognitive and metacognitive theories project: there was, surprisingly, a significant negative correlation obtained between students' ratings of usefulness of the four major metacognitive theories presented in the course and their final exam performance.

- From the project to apply principles of metacognition to improve study habits: students gave mediocre ratings regarding the helpfulness of performance estimation and test debriefing to foster metacognitive awareness in their learning, preferring instead traditional study aids. This project also confirmed a reliable finding from the research literature that the highest-achieving students repeatedly underestimate their likely performance on tests, while the lowest-achieving students consistently overestimate theirs.

Cluster D: Engaging the Social/Emotional Contexts of Learning

The likelihood of successful undergraduate learning increases as students have opportunities to engage with academic content in different ways (analytical, creative, abstract, concrete, kinesthetic, auditory, etc.). A diverse human context in which students work to understand and cooperate with others in constructing meaning can become a rich learning environment, fostering key cognitive and social skills such as critical thinking and empathy, which are fundamental to a liberal arts education in our global era. The educational challenge is to discern the strengths and weaknesses students exhibit in different modes of learning, and to teach in ways that engage students' passions and interests, while helping to improve their ability to learn effectively in a range of different contexts and modes of engagement. A general goal of these projects was to introduce pedagogical variations that transform the learning context from abstract presentation to more participatory modes that involve concrete, personal/emotional, narrative contexts.

Among the projects undertaken in this cluster are:

- Biography/autobiography versions of a Sensation and Perception class (Karen Gunther, Psychology, Wabash College).
- A case learning approach, including those employing print and visual media, in an International Political Economy course (Matthew Krain, Political Science, College of Wooster).
- Using economic experiments (or case scenarios) in a Principles of Macroeconomics class (Stephanie Martin, Economics, Allegheny College).
- Using multiple media and methods of engagement to enhance learning in a German Language and Literature course (Elizabeth Hamilton, German, Oberlin College).
- Using film as a primary medium to convey content in a political science course on war and peace (Jeffrey Lantis, Political Science, College of Wooster).
- Using a place-based education approach to an environmental studies course (Jay Roberts, Environmental Studies, Earlham College). Supplementing classroom instruction with experiential learning on a local river.

A general finding from these projects was that student interest in a course subject matter is notably enhanced by learning contexts that employ different media and offer modes of engaging on levels that are more personal and emotional. Student evaluations from these projects indicated increased satisfaction measures from the real-world application of course content and principles. At the same time, an inherent question within several projects is how

best to foster and how to measure the affective skills and propensity to lifelong learning, which are considered integral to a liberal arts education. To the extent that increased engagement corresponds with improved learning, these pedagogies offer the prospect of helping to strengthen liberal arts education. Some of the projects offer a cautionary note that while increasing a student's enjoyment of the learning process may be desirable, striving for "fun" may not always produce the best learning. Discomfort and challenge can be equally important tools of the learning process.

Sample Results:

- From the case learning project: "I expect to find that case learning that engages students' senses in multiple ways – i.e., problem-based learning and case studies using films as texts – will yield greater knowledge and retention gains than case learning approaches that do not create such 'memorable' events."
- From the multiple media and methods of engagement project: Initial sense that providing a variety of learning options and engagement modes will have positive impact on long-term retention, as well as the ability to transfer knowledge and skills from one context to another.
- From the film as a primary medium for war and peace course: Movie clips and documentaries can help students to connect to history and abstract concepts in concrete ways, elicit learning at different levels of understanding, and place theories of international relations within a meaningful context. "Students in the traditional class reported that they enjoyed the readings on both topics more than students in the film class. Students in the film class reported that they enjoyed the non-reading class materials on the topic of war much more. Finally, students in the film class reported (rather honestly, I think) that they put less effort into both sections of the class than did their counterparts in the traditional class."
- "The social and personal impact of getting students out into the community included very emotional connections made by students to their own sense of place (both in Richmond and in their own home towns) as well as serious inquiry into the purpose of their own educational journey."

Cluster E: Strengthening Long-Term Retention of Knowledge

Long-term memory is enhanced when the educational process involves repeated engagement and application of content within a field of knowledge, as opposed to the intense singular engagement that often characterizes rote memorization and content recitation. Fostering long-term retention entails rehearsals of information and concepts over intervals of time; the greater the number and the longer the duration of these rehearsals, the greater success in long-term retention. The educational challenge is to structure the learning process in ways that encourage students to draw repeatedly on key areas of academic content to strengthen long-term retention.

The primary goal of the three projects in this cluster is to enhance long-term retention of knowledge through repeated engagement and application of knowledge, as opposed to stressing

simple memorization. Each of these projects involves contacting students at intervals of approximately one year after their enrollment in a course to test the impact of an alternative pedagogy on their longer-term retention of key concepts. In one case, the project leader applied for a second grant to conduct the follow-up study, while in the other two the long-term assessment was part of the original project design. The projects of this cluster are:

- Examination of the testing effect in the classroom with student-generated questions in Introductory Psychology (Aimee Knupsky, Psychology, Allegheny College). Compare the testing effect produced by instructor-generated versus student-generated questions.
- The effect of on-line quizzes in enhancing students' long-term retention of material from an Introduction to Psychology class (Lynda Hall, Psychology, Ohio Wesleyan University).
- A constructivist approach to Introductory Psychology (Thomas Ludwig, Psychology, Hope College). One-year follow up test of retention of knowledge by students from earlier study comparing two sections, one of which introduced a constructivist approach to learning in place of lecture format.

The general findings from this cluster were that the likelihood of retaining knowledge over time increases to the extent that students repeatedly draw upon and apply key subject matter and principles of understanding. The use of frequent quizzes/tests is one means of strengthening long-term retention, as is the practice of making students active agents of one another's learning. These projects suggest that distribution of practice over time imparts a benefit to learning. Some sample results:

- For the project on the effect of on-line quizzes in enhancing students' long-term retention: The decline in learning is greatest for concepts in which there was no quiz. "On-line quizzes have the potential to encourage new students to prepare for class more effectively so that they comprehend material more completely and are able to contribute thoughtfully to discussions."
- For the Examination of the testing effect in the classroom with student-generated questions in Introductory Psychology: "Thus far, the use of student-generated questions in class quizzes has had a positive impact on retention of material for section exams. It will be interesting to see if this effect holds up for the very long term memory assessment."
- For the long-term follow-up on a constructivist approach to Introductory Psychology: "It appears that the initial gains in communication skills, computer use, creativity, and intellectual curiosity shown by the alternative pedagogy group have been maintained across two semesters. In addition, those in the alternative group seem to rate the value of the course to them more favorably than those in the traditional group."

Culminating Meeting: Visions for Continued Momentum

A final step for our Collegium was to convene a culminating meeting in June 2010 that brought together the leaders of the pedagogy projects our program had supported in addition to

other faculty members with a strong interest in the research on learning and its application to liberal arts teaching. This meeting provided a forum for each project leader to present his or her work to some two dozen faculty colleagues from across GLCA's member colleges; as such, the meeting provided an opportunity for each project leader to consider his or her project in the context of others the Collegium had supported. (Several of the insights recounted as general findings from the project summaries above derived from the rich discussions that followed individual presentations in our five project clusters.)

This culminating meeting provided an occasion for our faculty participants to identify significant overall themes or questions distilled from the experience of these projects both individually and collectively. Three such themes were identified: questions of what we teach and how we measure it, the risks of pedagogical innovation, and the value of a consortial community of interest. Each of these is described in greater detail in the following pages. In addition, these discussions yielded visions, also elaborated below, for actions GLCA could take to continue the momentum generated by the Pathways to Learning Collegium.

Significant Themes

Questions of what we teach and how to measure it.

A recurrent strand in the discussions was the question of what kind of learning the projects sought to instill, and how to measure learning progress. Is the gauge of learning success expressed as the ability to identify or convey content correctly? Is it to apply principles to solve problems? What is the relation between short- and long-term learning? As one faculty member observed, "We measure what we measure, but we don't always measure what we want." A conundrum that surfaced in many projects was that the kinds of learning considered most essential to liberal arts education – the ability to think critically, apply relevant concepts to solve problems or achieve understanding, communicate effectively, develop an empathy for others – are the most difficult to measure in quantitative terms. The strongest projects in terms of research design that our Collegium supported were those that focused the analysis more directly on understanding course content as measured by test performance. Projects that sought to contribute to students' acquisition of the broader, longer-term learning goals of liberal arts education often found it difficult to gauge student progress in ways that were not at least partially subjective. One project leader articulated this dilemma with the observation that, "The teaching innovation that I tried was a great success; the project itself, though, was a miserable failure." While she intuitively understood that the approach had improved the classroom dynamic and contributed to increased learning, she had only subjective measures – the data of human experience – to corroborate her claim. These are the kinds of evidence that are regarded with increasing skepticism in a social and political climate that seeks greater accountability for learning outcomes in higher education institutions and their faculty.

There is a clear need across our colleges to instill in faculty members a broader understanding of learning assessment: what techniques and approaches are best suited to gauge particular learning goals in a course, and can assessment results be used to improve pedagogy? In developing a stronger culture of evidence for effective teaching and learning, faculty members

could benefit from a stronger knowledge of how to assess educational qualities that do not lend themselves readily to quantitative measurement and analysis.

The risks of pedagogical innovation.

Every faculty member who undertook an innovative pedagogy project incurred a risk in more than one sense. Though it might be said that faculty members are constantly experimenting with different techniques in the classroom, anyone who tries systematically to assess the impact of an alternative pedagogy is regarded by government- and/or professional organization-imposed policy as an "experiment" involving humans. As such, virtually all the innovative pedagogy projects that we supported required the approval of a college's institutional review board (IRB), with a number of attendant complications (e.g., if one thinks that an innovation is likely to result in better learning, then it is unethical to withhold the innovation from some students). Beyond that, a faculty member takes on a certain risk of being held responsible to students if a project fails. One faculty member who substituted a constructivist approach (in which students are agents of one another's learning in small groups) for a traditional lecture section of the same course had cause to worry about two troubling scenarios:

1. What if students in the alternative pedagogy class performed substantially worse on their tests than students in the traditional lecture section? Could the professor be held accountable for depriving those students of the direct faculty instruction they had paid the college to receive?

2. On the other hand, what if the new pedagogy proved far more effective than the lecture technique? What would that say about the lecturing technique he had employed in teaching students through the past 20 years?

In this case it was a relief to the instructor to find that there was no significant difference in the performance of students in the lecture and constructivist learning sections – both methods of instruction can be equally effective agents of student learning.

In a more general sense, however, the risk of introducing an alternative pedagogy derives from the faculty evaluation and reward system within institutions. A comparatively small number of faculty members who undertook projects in our Collegium were in the pre-tenure stage of their career; most were tenured professors in positions to experiment without undue fear of adverse consequences. As noted above, some projects required students to invest more effort than they might otherwise have done, or to approach the course material in ways they may not have found to be most enjoyable or intuitive. Student dissatisfaction gets expressed in course evaluations, which are read by administrators (often for salary increase decisions) as well as by promotion and tenure committees. One of the key attributes by which liberal arts colleges distinguish themselves in the market (and justify their higher tuition) is the quality of teaching students receive. Student satisfaction is not in itself a measure of successful learning, but negative student ratings of teaching can jeopardize a faculty member particularly in the pre-tenure stage.

The discussions of our meeting affirmed that our colleges need to be places that encourage the taking of well-conceived risks to improve teaching and learning. A productive failure of a pedagogical innovation can lead to subsequent reformulations that ultimately improve the course for successive cohorts of students. A failed experiment in teaching innovation should not (though it currently may) carry the risk of career failure.

The value of a consortial community of shared interest.

One of the strongest themes that emerged from the discussions in our culminating meeting was the value that faculty members gain from their exchanges with others, both within and beyond their home institutions, who share an interest in pedagogical innovation which seeks to strengthen student learning in liberal arts education. Beyond the financial support, one of the most important effects of the grants our Collegium conferred was to affirm the value and encourage the progress of a faculty member's proposed project. In submitting a proposal, a faculty member entered into a dialogue, initially with the judging panel, which provided substantive feedback, and later with colleagues from across our member colleges who were also interested in research-based pedagogical improvement and assessment.

The Pathways to Learning Collegium demonstrated that the principle of germination can be very powerful both within and across our member colleges. As noted in our interim reports to the Teagle Foundation, the number of proposals initially submitted was smaller than we had hoped to attract. By the outset of the third year, however, there was a sharp increase in the number of proposals submitted from a range of academic disciplines. It was clear that "word had gotten out" not just through our web material and campus visits by one of the Collegium co-directors, but also through the informal networks of conversation among faculty members about the opportunity the program offered to apply a research finding to design, implement, and assess the learning impact of an alternative pedagogy project.

The discussions of our culminating meeting made clear that GLCA had made an important start through this program in building a community of shared interest linking faculty members from over a dozen liberal arts colleges and as many academic disciplines. The need to build on this foundation was affirmed in a range of suggestions that faculty members made at our culminating meeting. Toward the end of our meeting, one participant offered a variation on the germination metaphor which we had used to characterize the Collegium impact: "All of us are seeds of pedagogical innovation on our own campuses," he said. "GLCA can play a vital role in cross-pollinating pedagogical ideas across our colleges."

Potential GLCA Actions to Continue Momentum

In our culminating meeting, participants also offered a range of suggestions for actions that GLCA could take to further the progress made from this initial effort to heighten awareness and foster increased faculty engagement in pedagogical exploration and improvement across our member colleges.

Measurement

- *Build a network of assessment experts and project mentors.* Identify a cluster of faculty members across GLCA member colleges with a sound knowledge of the research on how learning occurs and how to assess student learning; create a consortial process that allows these experts to communicate with other faculty members who need assistance in designing a process to assess student learning and apply these assessment results to improve their teaching. This would be different in character from the extremely important and successful *Teagle Scholars* program in that the idea is to go to the next step by fostering a sense of shared expertise within the colleges (as contrasted with the idea of an expert external consultant).

- *Facilitate assessment forums on member college campuses.* Convene faculty members from empirical and non-empirical fields at a given college to discuss approaches to measurement and assessment of learning.

- *Create an assessment database* of key findings, data, and seminal works on assessment methods, assembled in a format that provides a valuable how-to guide to encourage those who seek information and guidance on how best to evaluate the learning goals of their courses.

- *Consider seeking funds to undertake or commission a significant longitudinal study of lifelong learning*, contributing to the development of more sophisticated methods of measuring attributes of learning that liberal arts colleges seek particularly to instill.

Encouraging the Taking of Risks

- *Foster decanal discussion of the issue.* Initiate a discussion with the GLCA Deans' Council to consider the need to create institutional environments that allow an untenured faculty member to engage in well-conceived pedagogical innovation without experiencing adverse professional consequences if the approach should fail to achieve the desired learning result – or fail to garner favorable ratings on student course evaluations.

- *Write a statement attesting to value of a faculty member's pedagogy project.* Provide a letter from an officer of GLCA for a faculty member's tenure and promotion file, outlining a project he or she has conducted under the auspices of the Pathways to Learning Collegium – one the underscores the rigor of the method, value of results, and contribution to the discourse of improving pedagogy within the profession and across our consortium of colleges.

Building Community of Shared Interest

- *Foster continued pedagogical innovation.* Seek to continue the Pathways to Learning Collegium, or a successor program that provides faculty members with opportunities to design and implement new approaches to teaching and learning, derived from research on how learning occurs.

- Create *a teaching innovation caravan* – a program that allows several faculty members from one GLCA member college to tour one to three other colleges within our consortium, meeting with faculty members of those settings to describe the innovative steps they have taken and the impact on learning.

- *Publish a scholarly volume that conveys the work of the Pathways to Learning Collegium*, one that includes formal presentations of the individual project undertaken with Collegium support and describes the impact of the Collegium in attracting interested faculty to pursue improvements in liberal arts teaching and learning. Even though some project leaders intend to publish their work in professional journals, the strong likelihood is that they would be happy to produce a version of their work for inclusion in such a volume. Creating such a volume would offer the opportunity for project leaders to take their work to a higher level by considering salient questions from the research literature of learning that could help them understand their results in a broader perspective.

- *Digital mini-conferences.* Use the capacities of digital media to convene inter-campus brown bag mini-conferences (lasting one hour over lunch) on a particular aspect of learning, or to discuss an alternative pedagogy project a faculty member has undertaken at one college.

- *Create a clearinghouse for compelling approaches to improve liberal arts pedagogy.* Serve as a clearinghouse, through a wiki or other web-based medium, for innovative approaches to pedagogy that are taking place across our member colleges, drawing together relevant work from the Collegium, Scholarship of Teaching and Learning, and other projects. A web resource of this kind could also identify the initiatives being pursued by campus teaching and learning centers of our member colleges.

Points of the Compass

GLCA would like to express its gratitude to the Teagle Foundation for the grant which made it possible to establish the GLCA Pathways to Learning Collegium. This project has been a significant learning experience – for the faculty members who designed and led Collegium-funded pedagogy projects, for the formative group of faculty who first gathered in 2008 to design and give a substantive basis to the Collegium, and for the two GLCA staff members who served as co-directors of the Collegium. This program engaged us in a sustained dialogue centered on the challenges of effective teaching and learning – with faculty colleagues across our member colleges, with GLCA chief academic officers, with GLCA presidents, and with the leaders of other Teagle-funded collegia in two different meetings the Foundation convened in New York.

One of the images that GLCA has adopted to convey its sense of strategic vision and direction for the future is a navigational compass. The Pathways to Learning Collegium provides a very apt exemplar of how a program of finite duration can position a consortium of colleges to discover several opportunities for continued progress – in effect to identify multiple points on the compass that offer promising directions to strengthen liberal arts teaching and learning. In addition to the potential next steps noted above that derived from our culminating meeting of

faculty practitioners, two other possible directions have been suggested as a result of the Collegium project. First is the prospect of building a sustained dialogue on effective pedagogy with a set of higher education institutions in Eastern and Western Europe, North Africa, and the Middle East that were founded on the principles of the American liberal arts college. With grants from the Christian A. Johnson Endeavor Foundation and the Mellon Foundation, GLCA and its member colleges have formed a set of working relationships with a dozen such institutions overseas, called the Global Liberal Arts Alliance (www.LiberalArtsAlliance.org). In its earliest stages, this Alliance has made it possible for faculty and administrators of our GLCA colleges to visit Alliance institutions overseas and vice versa. In March of this year, two faculty members who have had close affiliation with the Pathways to Learning Collegium (Kiran Cunningham, Anthropology, Kalamazoo College; and Rick Warner, History, Wabash College) traveled to the Bratislava International School of the Liberal Arts to serve as facilitators and presenters at a conference focusing on liberal arts education and the development of effective pedagogies for instilling liberal arts learning. The conference constituted an important bridging event between our American faculty members and faculty of institutions whose national and cultural environments tend to conceive teaching and learning as a process in which a professor delivers information to students in lecture format and students are tested on that factual content. Our faculty colleagues were well received at this event. On the basis of this and other such international visits, we believe the Global Alliance could offer an important venue for extending the dialogue on effective liberal arts teaching and learning beyond the context of U.S. colleges and universities. We have learned that discussions across cultural and national boundaries bring important new insights, as famously demonstrated by Alexis de Tocqueville in the nineteenth century; we believe that, if support for this purpose is available, the same could be true for innovative pedagogy.

Second, we noted at the outset of this report that our chief academic officers serve as important sounding boards and advisors to GLCA; their advice provided initial encouragement for us to pursue a grant from the Teagle Foundation to establish the Pathways to Learning Collegium. We asked our academic deans this spring for their insights about what next steps GLCA should consider to continue the focus on pedagogical innovation, assessment, and improved learning results which the Pathways Collegium had fostered across our member colleges. Their discussion centered on the need to improve education in the natural science and engineering fields. Liberal arts colleges are known as institutions that educate a disproportionate number of those who then pursue and earn advanced degrees in the scientific disciplines. At the same time, the shared impression of our deans is that GLCA's colleges could do better in attracting a larger proportion of their student body to study and persist in these fields – particularly women students and members of underrepresented minorities. GLCA is now working with the academic deans and key science faculty of our member colleges to develop a concept for a program focusing on strengthening science pedagogy, based on the insights of research, in liberal arts colleges. We conceive that a well-designed program on this topic could become appealing to the National Science Foundation as well as other foundations.

In short, the Pathways to Learning Collegium has had a major impact in advancing GLCA in the domain of liberal arts teaching and learning. The journey thus far has demonstrated that there are several promising directions to be pursued in this domain; and while

it is unlikely we can develop every idea presented, this seminal program has taught us that we need not confine ourselves to a single point on the compass in moving forward.

Appendices

A. Detailed Summaries of Pathways to Learning Collegium Projects
B. GLCA Project RFP
C. Budget Report

Appendix A

Detailed Summaries of Pathways to Learning Collegium Projects

Note: This summary document was prepared as background for participants in the GLCA Pathways to Learning Collegium culminating meeting, which took place in Ann Arbor, Michigan June 10-11, 2010. Some of these summaries represent a project leader's preliminary findings (i.e., of projects in which the comparison group is a class being taught in the current academic year), while other summaries indicate final results.

Directory of Projects

A constructivist approach to introductory psychology

Learning research concept being investigated: A constructivist approach to Introductory Psychology

Constructivism: Students learn by constructing internal representations of the concepts and principles of the academic discipline. This principle, originally derived from the work of Piaget and Vygotsky, remains a dominant viewpoint within educational and cognitive psychology, in spite of recent criticism.

Learning by Teaching: Student motivation and understanding is enhanced when students teach concepts and principles to other students. This idea has increased the prevalence of oral presentations in college courses, and is supported by considerable anecdotal evidence from students who serve as teaching assistants or tutor other students.

Name, discipline, college of professor: Thomas Ludwig, Psychology, Hope College ludwig@hope.edu

Course experimented in: Introductory Psychology

Short description of the innovation applied: Introduction of a collaborative learning format for one section of the class. Teams of students interacted with each other and with the course material (as "creators" of customized instruction), as they gathered and filtered information about human behavior, analyzed its source reliability, compared it with textbook material, and considered ways of presenting it effectively to help other students comprehend the principles.

What the control/comparison group was: A second section of the same introductory course, taught in traditional format by the same professor.

What the outcome was (if known): Three measures applied: 1. content comprehension and application of concepts/principles; 2. student motivation and learning strategies; 3. Skills of learning and value gained from course.

There are two assessments: one at the end of the course. A second follow-up assessment is being conducted at an interval of 18 months.

The end of course comparison showed that the alternative pedagogy group did not show any measurable deficits in content learning (in spite of the lack of traditional content lectures), and showed increased motivation and engagement in the course, with some improvements in research skills and communication skills.

Preliminary results from the follow-up assessment (which was a subsequent project funded by the Collegium) indicate that *the initial gains in communication skills, computer use, creativity, and intellectual curiosity shown by the alternative pedagogy group have been maintained across two semesters.* In addition, those in the alternative group seem to rate the value of the course to them more favorably than those in the traditional group.

Observations, comments: It should be noted that most previous research has found that motivational gains from alternative pedagogies tend to be temporary. On the other hand, gains in skills (and confidence in using those skills) that emerged as a result of the alternative pedagogies are more likely to persist. If the preliminary pattern noted above holds true, this study could be an important link in documenting the long-term impact of the constructivist pedagogical approach.

Collaborative learning in a seventeenth-century French literature class

Learning research concept being investigated: Collaborative learning, a broad pedagogical approach predicated upon basic tenets of modern cognitive and neurological theory – holds that learners must be actively engaged in learning, that people "literally 'build' their own minds throughout life by actively constructing the mental structures that connect and organize isolated bits of information" (Barkley et al, 2005, 10-11). "Collaborative learning occurs when students and faculty work together to create knowledge…It is a pedagogy that has at its center the assumption that people make meaning together and that the process enriches and enlarges them" (Matthews, 1996, p. 101).

Name, discipline, college of professor: Jean Blacker, Modern Languages and Literatures, Kenyon College blacker@kenyon.edu

Course experimented in: Seventeenth-century French literature

Short description of the innovation applied: "Learning Communities in a Seventeenth-Century French Literature Classroom" (Spring, 2009, enrollment 4 advanced students) was a learner-centered, problem-solving, inquiry-based project involving collaborative learning which sought to determine to what extent students were more engaged and more able to learn and retain concepts and approaches when they taught each other, in comparison with a more traditional, teacher-centered mode of information delivery. The course involved student-taught modules, in which students were responsible to teach/lead other students in class engagement in subject with instructor oversight.

What the control/comparison group was: Other segments of the same course with instructor-led discussion/lecture

What the outcome was (if known): Anecdotal observation: "From my perspective, the team-taught modules were by far the best form of student presentations I have ever witnessed and participated in."

Based on written student course evaluations and self-evaluations (developed with assistance of a colleague in psychology), "students felt that their own teaching had better helped them see parallels between political and social movements and literary texts."

"It was not surprising that they considered the instructor-driven component slightly more effective in helping them refine their approaches to literature, and given the strength of their French skills, the effectiveness of the student-driven and instructor-driven were considered exactly even."

Observations, comments: "It is well worth taking the risk of letting go of control of one's course and turning over significant sections to the students, if goals are clearly articulated and guidance is available when needed."

Barkley, E.F., K. P. Cross, and C. H. Major (2005). *Collaborative Learning Techniques: A Handbook for College Faculty*. San Francisco: John Wiley.

Matthews, R. S. (1996). "Collaborative Learning: Creating Knowledge with Students." In R. J. Menges, M. Weimer, et al, eds. *Teaching on solid ground: Using Scholarship to Improve Practice* (pp. 101-24). San Francisco: Jossey-Bass.

Integrative learning through learning communities

Learning research concept being investigated: Integrative Learning through Learning Communities

Although there are various models for learning communities, they are all structurally based on the principle of integrative learning, what Mary Taylor Huber and Molly Breen define as "linking ideas and domains that are not easily or typically connected" (Huber and Breen, 2007). Studies such as *Learning Community Research and Assessment* (Taylor, Moore, MacGregor, & Lindblad, 2003), the *National Study of Living-Learning Programs* (Inkelas, et al 2004), the National Survey for Student Engagement (2007), *High Impact Education practices: What they are, Who Has Access to Them, and Why They Matter* (Kuh, 2008), and "Learning Community Participation and Educational Outcomes: Direct, Indirect, and Contingent Relationships" (Pike, Kuh, McCormick, 2008) document and explore the positive correlation between participation in learning communities and student learning and success. Pedagogies that employ the techniques of learning communities are central to the creation of "curricular coherence; integrative, high-quality learning; collaborative knowledge-construction; and skills and knowledge relevant to living in a complex, messy, diverse world," (Lardner and Malnarich, 2008).

Name, discipline, college of professor: Marcy Sacks, History; Jess Roberts, English; Dean McCurdy, Biology; Albion College msacks@albion.edu

Course experimented in: A series of courses to be linked in the college's First Year Seminar Program

Short description of the innovation applied: The aim of this work is to initiate a pilot project that will intentionally create integrative learning opportunities for students through the development of learning communities in the form of linked courses. We are designing our exploration of learning communities through Albion College's extant First Year Seminar program; we propose to create five sets of learning communities (linking one interdisciplinary first year seminar with one discipline-based course) out of the 30-odd first year seminars available.

What the control/comparison group was: Ten total faculty members will be involved, five of whom will teach a seminar and five of whom will teach a linked, disciplinary course. Because the learning communities will comprise only a portion of the total number of first year seminars, we will be able to compare our traditional form of instruction for first year students with this deliberately integrative approach. We intend to assess the Learning Community pilot program both qualitatively and quantitatively.

What the outcome was (if known): Through learning communities and integrated assignments, we hope to see greater student engagement in learning, deeper connections made between classes and disciplines, and more active and peer-initiated learning. We also hope to find an increase in student retention as a result of a stronger appreciation of learning in the liberal arts tradition.

Observations, comments: Our project remains at the design stage. We have offered a two-day workshop on integrative learning principles and methods to our colleagues as well as other opportunities for discussion and consideration of this pedagogic model. We have witnessed cross-disciplinary interest in this teaching model. However, we also are encountering structural challenges to the implementation of alternative pedagogies, and they may be significant enough to preclude the real transformation of our teaching methodologies.

Concept mapping to gauge levels of critical thinking in a Plant Biology class

Learning research concept being investigated: To gain insight into the level of cognitive development in the sciences, as defined by Perry's (1970) Theory of Cognitive Development

Name, discipline, college of professor: Bruce Serlin, Biology, DePauw University dance@depauw.edu

Course experimented in:
Introduction to Plant Biology

Short description of the innovation applied:
Have students enrolled in my spring Introduction to Plant biology; complete a constructed survey device both at the start of the semester and again at the end of the semester. The intent is to initially gain insight into the stage of critical thinking that the class, in toto, is beginning the course. This information should assist in pitching class activities appropriately so as to enhance science appreciation. Looking for changed responses from the second round of responses to the survey device should provide data on how successful the course activities were in fostering cognitive growth in the sciences.

What the control/comparison group was:
Sections of the same course in 2008 and 2009. Both classes were introduced to concept mapping during the first week of the semester. The spring 2009 class was given more practice opportunities than the 2008 class.

What the outcome was (if known):
I cannot say that this device has had a significant impact on students' cognitive development. Partly because of small class sizes, the project has not discerned significant differences between the two groups.

Observations, comments:
Despite an inability to demonstrate student cognitive growth due to exposure throughout the semester to a variety of concept mapping exercises, I feel this technique did aid deeper student thought and understanding, both factual and conceptual. Finally, it may be too much to expect students to demonstrate cognitive growth over the time period of one semester. It may take more than one course in one semester to change thought patterns developed over several years.

The one aspect of using the concept maps that I do like, regardless of the outcome on the cognitive development aspect, is that talking about various individuals' maps in class, students gain additional ways of viewing, organizing, and seeing relationships among topics being considered.

Perry, William G., Jr. (1970), *Forms of Intellectual and Ethical Development in the College Years: A Scheme* (New York: Holt, Rinehart, and Winston.).

Use of peer instruction with classroom response systems in an introductory geology class

Learning research concept being investigated: Use of peer instruction with classroom response systems in an introductory geology class.

Different pedagogical approaches that utilize social interactions of students as a means to improve learning outcomes have been outlined in the literature (Crouch and Mazur 2001, Johnson et al 1991, Johnson and Johnson 1987). Lord (2001) has shown that students who work together improve upon their scientific thinking, and Johnson and Johnson (1989) have expressed that students reason better and show improved critical thinking skills when they work in cooperative groups.

Name, discipline, college of professor: Shelley Judge, Geology, College of Wooster
sjudge@wooster.edu

Course experimented in: Introductory course in geology with 55 students

Short description of the innovation applied: I interspersed the lecture with appropriate Course Response System (CRS or "clicker") questions (similar to Conceptests); students were given set time intervals to discuss the question with their peers in the classroom and then answer the questions using CRS. My strategy throughout the semester was to re-poll the students if less than 75% of them missed a question. Re-polling consisted of a classroom discussion, followed by peer discussions, then followed by the use of CRS.

What the control/comparison group was: Course of identical content taught by same instructor at another institution. My original intention was to analyze the differences between these two courses. The fact that the students were significantly different at the earlier institution made this comparison more complex and less reliable than I had originally anticipated.

What the outcome was (if known): Course evaluations bear out research that indicates benefits of clickers, which include: (1) providing instant feedback to the students, (2) appealing to an ever-growing, technology-savvy student body, (3) permitting the students to express their choices anonymously, (4) encouraging increasing group dynamics and healthy debate, and (5) allowing instructors to receive real-time assessment on their teaching.

Observations, comments: I altered the use of clickers during the semester. Some days, each student had their own clicker in the classroom, so even if they did discuss the answer with peers, they each were able to use a clicker. Other days (when I thought that they were not discussing things as much as I would have liked to see), I only gave one clicker out to every two students. They were forced to share clickers. I received several comments from students that they did not like sharing clickers. The students told me that even if they came to the same conclusion as their partner, they would much rather be able to use their own clicker because it seems as if they are participating more in class.

References

Crouch, C.H. and Mazur, E., 2001. Peer-instruction: Ten years of experience and results. American Journal of Physics, 69:970-977.

Johnson, D.W. and Johnson, R.T., 1987. Learning together and alone: Cooperative, competitive, and individualistic. Englewood Cliffs, NJ: Prentice Hall.

Johnson, D.W. and Johnson, R.T., 1989. Leading the cooperative school. Edina, MN: Interaction.

Johnson, D. W., Johnson, R. T., and Smith, K. A. 1991. Cooperative Learning:Increasing College Faculty Instructional Productivity. ASHE-FRIC Higher Education Report No.4. Washington, D.C.: School of Education and Human Development, George Washington University.

Lord, T.R., 2001. 101 reasons for using cooperative learning in biology teaching. American Biology Teacher, 63:30-103.

Examine the implementation and use of mobile technology for teaching and learning in the physical sciences

Learning research concept being investigated: Examine the implementation and use of mobile technology for teaching and learning in physical sciences.

Part of Lev Vygotsky's (1934;1986) theory of cognition examines the role that tools play as mediators of knowledge. Within what Vygotsky identifies as the "zone of proximal development," tools are stimuli that influence the behavior of oneself and others.
The project explores how the tools of mobile technology in two science classes – in this case calculus-based physics and organic chemistry– are actually used by students and teachers in developing meaningful understandings of science curriculum and phenomena.

Name of professors: Kyle Shanton (Education) kshanton@albion.edu, Guy Cox (Center for Technology-Aided Teaching and Learning) gcox@albion.edu, Andrew French (Chemistry) afrench@albion.edu, and Aaron Miller (Physics) ajmiller@albion.edu ; Albion College

Course experimented in: Chemistry and Physics

Short description of the innovation applied: Use tablet PCs and software as mediating tools. Testing the premise that as students and teachers work with these tools and the course content they will become more involved and integrated with the "culturally organized" activities of science. Tablet PCs are randomly assigned among the students. Student interaction with course content, media, and tools are observed and recorded as well as the pedagogical activities of the instructors.

What the control/comparison group was: Students using tablet PCs in the course are compared to those who were not.

What the outcome was (if known): Both comparison groups included students who did very well. Those who were provided tablet computers and had ready access to pen-based technologies had a much narrower distribution of scores that was centered near the top of the overall class distribution.

Observations, comments: Using pen-enabled technologies within the organized activities of these science classrooms has clarified the instructors' awareness of students' comprehension and opened different pathways for students to overcome hesitations or hurdles to talking about what they do and do not understand, even in the middle of class. The instructors have systematically shifted their pacing, or the rate at which they introduce topics while teaching. They are regularly checking in with individuals and small groups of students to (dis)confirm their assessment of whether the students "got it."

Vygotsky, L. (1934; 1986) *Thought and language*. Cambridge, MA: The MIT Press.

Use of digital assignments for improving writing quality

Learning research concept being investigated: Use of digital assignments for improving writing quality.

Experts in the field of college writing have argued that frequent, short, informal and ungraded writing assignments improve critical thinking while strengthening the writing skills needed for more formal essay assignments. Peter Elbow, for example, made the case for this approach in his influential *Writing Without Teachers* (1973) as well as in more recent articles like "High Stakes and Low Stakes in Assigning and Responding to Writing" in 1997. Making a similar point, Erika Lindemann draws on cognitive psychology to emphasize the ways writing helps us to process ideas. Her widely used *A Rhetoric for Writing Teachers* (1982) encourages faculty to assign "Writing to Learn," informal assignments that increase faculty insight into students' understanding of course concepts, as well as students' own cognitive processing of lectures, readings, and other course materials.

Name, discipline, college of professor: Jennifer Hayward jhayward@wooster.edu and Leslie Wingard lwingard@wooster.edu , English, College of Wooster

Course experimented in: Introduction to Literary and Cultural Studies

Short description of the innovation applied: We replaced a number of our graded, discipline-specific written assignments with more open-ended and ungraded blog assignments. To assess learning, we used two measures: indirect (a colleague ran a focus group on the blogging experience with students in the experimental English 120 sections) and direct (we gave short pre-semester and post-semester tests to both experimental sections and the 120 sections that employed more traditional teaching methods).

What the control/comparison group was: Compare writing results to those of students from sections of this class that did not include the options for ungraded writing in blog format. To assess learning, we used two measures: indirect (a colleague ran a focus group on the blogging experience with students in the experimental English 120 sections) and direct (we gave short pre-semester and post-semester tests to both experimental sections and the 120 sections that employed more traditional teaching methods).

What the outcome was (if known): From focus groups: Students both enjoy and learn from blogging because the low-stakes writing assignment frees them to be more creative; at the same time, many students are inspired to polish their work since it will be read by a larger audience. Student engagement with writing assignments was strengthened, as measured in focus groups. At the same time, student mastery of the core course goals was greater in the experimental sections than in the control sections, indicating that the substitution of "low stakes" writing for more traditional assignments did not prevent students from mastering the basics of literary critical terminology and close reading skills--and may in fact have helped them to master those skills.

From comparison of writing assignments to non-blogging sections: We expect to find that blogging is a flexible form that can be used to develop skills of critical analysis and argumentation needed for formal papers

Observations, comments: To test the impact of this technique over the longer term, collect a number of the essays that our students submit early in the term and a number of those they submit at the end of the term; then compare the essays to gauge whether or not our inclusion of blogging and other more "informal" assignments leads to results that are better than the traditional course results.

Engaging and strengthening different learning processes in introductory statistics

Learning research concept being investigated: Two principles as summarized in our Pathways RFP: *to engage and strengthen different learning processes* (by moving from a mainly lecture format to a format driven by self-discovery, active-learning and tactile demonstrations). And *to strengthen long-term retention of knowledge* by systematically cycling back through core concepts throughout the semester.

Name, discipline, college of professor: Nathan Tintle tintle@hope.edu; Todd Swanson swansont@hope.edu; Jill VanderStoep vanderstoepj@hope.edu, Mathematics, Hope College

Course experimented in: Nine sections of introductory statistics (each with 30 students)

Short description of the innovation applied: In our new approach to the course, we will: (1) spend limited time *teaching* descriptive statistical methods, instead including time to *review* and *reinforce* the proper use of descriptive statistical methods through hands-on real data analysis experiences,
(2) eliminate explicit coverage of probability and sampling distributions, and
(3) spend the bulk of the semester visiting and re-visiting the core-logic of statistical inference as demonstrated by permutation tests.

What the control/comparison group was: Students enrolled in the fall 2007 introductory statistics courses (using the traditional curriculum).

What the outcome was (if known): We anticipate that course content knowledge, long-term retention of that knowledge, and course attitudes should all improve with our revised curriculum based on the research-based principles of learning.

Assessment results show positive learning gains in a number of areas emphasized by the new curriculum as well as increased retention in four month, post-course follow up. The assessment results also indicate a number of areas for which students performed more poorly using the new curriculum, some of which we will attempt to improve through further curricular development and revision. Overall, we are encouraged by the assessment results and the promise of an improved introductory statistics curriculum.

Observations, comments: More candidly, we've shown that the new curricular approach is indeed possible, and (anecdotally) students are doing well. The assessment data is bearing this out. We are very encouraged by the fact that we are doing as well as we are with what we consider to be a "rough draft" of the final curriculum. We have recently agreed to continue this textbook development project with two established introductory statistics textbook authors (Allan Rossman and Beth Chance, Cal Poly-San Luis Obispo) who have utilized a similar approach. Additionally, we are in discussions with Wiley publishing about the textbook, one paper covering giving an overview of the assessment data in revision at the Journal of Statistics Education and another is being drafted, and a TUES grant to continue this project is now pending at NSF.

Use of deliberate practice in advancing statistical expertise in students

Learning research concept being investigated: Applied K. Anders Ericsson's approach to the development of expertise, which combines the traditional emphasis on practice with the concept that attention and effort must be allocated to the underlying principles and structures of problems in a particular domain to achieve expertise.

I examined the role of *deliberate practice* as a means of advancing the statistical expertise of students enrolled in a psychological statistics course. Statistics students typically analyze data sets in a statistics course as a means of practicing problem solving. However, the practice problems are rarely realistic because students do not have to think about what statistical techniques to apply (i.e., "we are discussing *t*-test problems so complete a *t*-test on these data") only how to apply them. I asked students to focus on the underlying characteristics of the data and to analyze the data as best they could. This form of deliberate practice emphasized the underlying structure of a problem and increasing sophistication as the semester progressed.

Name, discipline, college of professor: Gary Gillund ggillund@wooster.edu, Psychology, College of Wooster

Course experimented in: Introduction to Statistics in Psychology

Short description of the innovation applied: Deliberate practice is practice that focuses on specific goals. In the statistics class, the goals that were emphasized were ones relating to the deep structure of a problem such as identifying the key questions to be answered, the independent and dependent variables, the scales of measurement employed, the levels of the factors, and so on and then analyzing the data to the deepest level available to them at that point in the semester.

What the control/comparison group was: To address whether the deliberate practice was effective, scores on questions designed to address whether students knew what statistical technique was most appropriate were administered to students in a deliberate practice class and these scores were compared to the scores of students in two classes taught with traditional practice.

What the outcome was (if known): Students presented with deliberate practice problems scored higher on the test questions than those who did not. The technique was most valuable for students who struggled using traditional practice. Specifically, 39% of the students using traditional practice scored below 60% on the test questions whereas only 12% of the deliberate practice students scored below 60%.

Observations, comments: This shift in attention and effort due to deliberate practice, when compared to traditional practice problems, results in students more capable of correctly applying statistical knowledge. The advantage may be most pronounced for the weakest students. Any area where complex problems or cases are analyzed would seem to be a viable candidate for the application of deliberate practice.

Ericcson, K. A. (2006). The influence of experience and deliberate practice on the development of superior expert performance. In K. A. Ericsson, N. Charness, P. Feltovich, and R. R. Hoffman, R. R. (Eds.). *Cambridge handbook of expertise and expert performance* (pp. 685-706). Cambridge, UK: CambridgeUniversityPress.

Effect from providing instruction about cognitive and metacognitive theories about learning

Learning research concept being investigated: Effect of providing instruction about cognitive and metacognitive theories on student learning

Providing instruction to students on four theories of cognition: *Bloom's Taxonomy* (or its revised versions, e.g., Anderson & Krathwohl), which presents a hierarchy of six increasingly complex levels of cognitive processing: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. 2. John Flavell's tripartite theoretical framework for metacognition describes *person variables, task variables, and strategy variables. The model encourages students to consider how each variable affects their own learning processes. 3.* Deanna Kuhn and David Dean have described four theoretical Levels of Epistemological Understanding: *Realist, Absolutist, Multiplist, and Evaluativist*. A reasoner at each level of epistemological understanding uses different cognitive processes to understand and learn. 4. Robert Sternberg's model of *internal executive processes* includes planning, monitoring, and evaluating. This approach argues that learning is enhanced when a student engages in metacognitive processes that keep track of task planning, monitor progress toward task goals, and produce adjustments to the plan as the progress is monitored and evaluated.

Name, discipline, college of professor: Claudia Thompson crt@wooster.edu, Psychology, College of Wooster

Course experimented in: Introductory Psychology

Short description of the innovation applied: The four metacognitive theories described above formed the basis of activities designed to help students in two Introductory Psychology classes develop their own metacognitive learning strategies. The activities were intended to encourage students to draw on more conscious access to their own cognitive and metacognitive processes. One major objective of the research was to compare how well students learned using these metacognitive approaches with how well they learned when more conventional approaches to the teaching of introductory psychology were employed. A second objective was to relate students' own perceptions of their use of metacognitive strategies of learning with their actual performance on exams that tested what they had learned in the course.

What the control/comparison group was: Both of the two sections of the introductory psychology class received instruction on metacognitive principles; the first group received initial instruction in week four, the second group did not receive it until week nine. Subsequently, both classes received further metacognitive instruction and activities, interspersed with more traditional methods of instruction and learning activities. The design of the study permitted both within-group and between-group comparisons of the effects of metacognitive instruction on exam performance at different times throughout the semester.

What the outcome was (if known): Five major findings emerged in the present study about the use of metacognitive teaching and learning strategies in two Introductory Psychology classes: 1.) Performance on exams throughout the semester was not influenced systematically in the two classes by the controlled introduction of metacognitive instruction.
2.) Students reported using a variety of metacognitive practices during the course (measured at three times by the *MAI*). This reported use did not increase during the semester, and was not correlated significantly with Final Exam performance.
3.) At the end of the course, students were highly aware that metacognitive practices had been emphasized and encouraged (revised *GSMOS*). The degree of students' reported awareness, however, was not correlated with their Final Exam performance.

4.) Students rated four major theories of metacognitive processes as being, on average, somewhat useful to their studying and learning. Surprisingly, students' perceptions of the usefulness of these theories were significantly *negatively* correlated with Final Exam performance.
5.) Students provided ratings of the perceived usefulness of 15 specific learning strategies used during the semester. Students rated some strategies as more useful than others, but metacognitive strategies were not perceived to be more useful than more conventional study techniques. Significant positive correlations occurred for one class between the use of Study Guides and Final Exam performance.

Observations, comments: Even more puzzling than the lack of a strong positive relationship between various metacognitive emphases and exam performance was the significant *negative* correlation obtained between students' ratings of usefulness of the four major metacognitive theories presented in the course and their Final Exam performance. Apparently, the more useful a student found the four theories to be, the worse they performed on the Final Exam.

Anderson, L.W. & Krathwohl, D.R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives.* New York: Longman.

Flavell, J.H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34,* 906-911.

Grossman, R.W. (*in press*). Structures for facilitating student reflection, *College Teaching.*

Kuhn, D. & Dean, D., Jr. (2004). Metacognition: A bridge between cognitive psychology and educational practice. *Theory into Practice, 43,* 268-273.

Schraw, G. & Dennison, R. S. (1994). Assessing metacognitive awareness. *ContemporaryEducational Psychology, 19,* 460-475.

Sternberg, R.J. (1986). Inside intelligence. *American Scientist, 74,* 137-143.

Thomas, G.P. & Au Kin Mee, D. (2005). Changing the learning environment to enhance students' metacognition in Hong Kong primary school classrooms. *Learning Environments Research, 8,* 221-243.

Weimer, M. (2002) *Learner-centered teaching.* San Francisco: Jolley-Bass.

Apply principles of metacognition to improve study habits and enhance learning

Learning research concept being investigated: Apply principles of metacognition to improve study habits and enhance learning

The findings of Kruger and Dunning (1999) have suggested that some students routinely overestimate how much they have learned; in Kruger and Dunning's words, they are "unskilled and unaware of it." According to the authors, some students perform poorly because they lack not only the knowledge in a certain domain, but also the *metacognitive ability* to recognize their own "incompetence", leading to overconfidence and then unexpectedly low performance.

Name, discipline, college of professor: Claudia Thompson, Psychology crt@wooster.edu, College of Wooster

Course experimented in: Introductory Psychology

Short description of the innovation applied: I used the alternative pedagogy of *metacognitive instruction*, including specifically *estimation of test performance* and *test debriefing* after exams, with the aim of increasing students' ability to reflect on their own learning processes and to improve their study practices.

What the control/comparison group was: I compared exam performance as well as perceptions of their own study habits for students in two different sections of an Introduction to Psychology course: One section received metacognitive instruction about the Dunning-Kruger Effect as well as extensive test debriefing after each exam, and the other section (the control group) received standard instruction (without metacognitive instruction or activities).

What the outcome was (if known): Exam performance was slightly better for the metacognitive instruction group throughout the semester, but this small advantage was evident from the very beginning of the semester, even before metacognitive instruction began. 2. The metacognitive learning strategies of *comparing one's estimated exam performance with actual exam performance*, and then using *test debriefing* to investigate what sorts of questions on the exams posed special difficulties, produced only modest and inconsistent changes in students' awareness of how effective their study practices were throughout the semester. 3. High-achieving students (TOP 1/3 in actual exam performance) in the metacognitive instruction group consistently *underestimated* their exam scores throughout the semester, whereas high-achieving students in the control group underestimated only on the first exam. In contrast, low-achieving students (BOTTOM 1/3) in both groups persisted in *overestimating* their exam scores (i.e., regardless of whether they received metacognitive instruction or not). 4. Preliminary analysis suggests students gave only mediocre ratings regarding the helpfulness of *performance estimation* and *test debriefing* in their learning, preferring instead rather traditional study aids.

Observations, comments: Based on the analyses, it is not possible to conclude that metacognitive instruction about performance estimation led to systematic improvements in all students' ability to gauge how well they had learned what the exams tested. But *high-achieving students* did appear to make use of metacognitive learning strategies they had been taught, with the result that they seemed to develop a keen awareness throughout the semester of how much there was to know and how likely it was that they didn't know all there was to know (therefore consistently *underestimating* their exam performance)(Kruger & Dunning, 1999). *Low-achieving students* did not know nearly as much (low *cognitive* awareness) and therefore also didn't have an accurate idea of how much there was to know that they didn't know yet (low *metacognitive* awareness); these students consistently *overestimated* exam performance. Further results

suggest that students found standard summaries of the information needed for study purposes to be helpful, but did not find instruction about how to reflect on their own study practices to be as helpful; this finding is not really surprising, since the exams tested their knowledge of the information and not their knowledge about metacognitive strategies of learning. Further analyses may reveal that certain students valued metacognitive instruction more than others. The results suggest that *motivation* to engage in metacognitive strategies of learning differs widely among students who receive metacognitive instruction. How to convince weaker students to take advantage of metacognitive strategies is an important question for educators.

Anderson, L.W. & Krathwohl, D.R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives.* New York: Longman.

Burson, K.A., Larrick, R.P., & Klayman, J. (2006). Skilled or unskilled, but still unaware of it: How perceptions of difficulty drive miscalibration in relative comparisons. *Journal of Personality and Social Psychology, 90,* 60-77.

Ehrlinger, J., Johnson, K., Banner, M., Dunning, D., & Kruger, J. (2008). Why the unskilled are unaware: Further explorations of (absent) self-insight among the incompetent. *Organizational Behavior and Human Decision Processes, 105,* 98-121.

Flavell, J.H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34,* 906-911.

Krajc, M. & Ortmann, A. (2008). Are the unskilled really that unaware? An alternative explanation. *Journal of Economic Psychology, 29,* 724-738.

Kuhn, D. & Dean, D., Jr. (2004). Metacognition: A bridge between cognitive psychology and educational practice. *Theory into Practice, 43,* 268-273.

Kruger, J. & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflatred self-assessments. *Journal of Personality and Social Psychology, 77,* 1121-1134.

Schraw, G. & Dennison, R. S. (1994). Assessing metacognitive awareness. *ContemporaryEducational Psychology, 19,* 460-475.

Stankov, L, Lee, J., & Paek, I. (2009). Realism of confidence judgments. *European Journal of Psychological Assessment, 25,* 123-130.

Sternberg, R.J. (1986). Inside intelligence. *American Scientist, 74,* 137-143.

Thomas, G.P. & Au Kin Mee, D. (2005). Changing the learning environment to enhance students' metacognition in Hong Kong primary school classrooms. *Learning Environments Research, 8,* 221-243.

Weimer, M. (2002) *Learner-centered teaching.* San Francisco: Jolley-Bass.

Biography/autobiography versions of a Sensation and Perception class

Learning research concept being investigated: BIOGRAPHY/AUTOBIOGRAPHY VERSION OF SENSATION & PERCEPTION CLASS

Testing the claim from other studies that show that abstract material is not retained as well as concrete facts or narrative. If abstract concepts are presented in a context, however, they are better understood and retained. Thus, given that the material in a textbook or lecture may seem irrelevant to daily life, the use of (auto)biographies can give a context for the facts presented in class lectures. Consistent with this, Sadoski et al. (1993) found that student ratings of concreteness correlated highly with their ratings of comprehensibility and interestingness.

Name, discipline, college of professor: Karen Gunther guntherk@wabash.edu, Psychology, Wabash College

Course experimented in: Sensation and Perception

Short description of the innovation applied: Phase 1, fall 2009: Teach the course using a combination of biographies/autobiographies and textbook.

Phase 2, fall 2010: Substitute biographies and autobiographies entirely for standard text in teaching sensation and perception

What the control/comparison group was: Class taught in a previous year that used only textbook. And the textbook-only units in Fall 2009.

What the outcome was (if known): The use of (auto)biographies supplemented with standard lectures and class discussions on scientific articles is very well-liked by the students. On the end of the year course evaluation, seven of the sixteen questions yielded statistically significant increases. Of the questions that showed a significant increase, the most interesting was the effectiveness of the instructor in stimulating students' interest in the course, one of the main goals of the use of non-fiction novels. The overall ratings of the course and of the professor both increased significantly as well. These bode well for the future interest in the course – Wabash is a small campus, thus word gets around about which courses and professors are good and which should be avoided. Ratings of the instructor's level of interest in the material, the instructor's preparation, the construction of the exams, and the fairness of the grading all increased as well – nothing was changed here from previous years when only the textbook was used. Although not significant, the effectiveness of this course in challenging the students intellectually did increase substantially. On an evaluation specifically for this project, 67% of the class preferred the non-fiction novels to a textbook (22% preferred the textbook, 11% liked the combination of formats). Eight of the nine students said that reading the (auto)biographies did make them want to learn more about their sensory systems.

On the objective measures (exam performance), there were no statistically significant results. During the semester, the difference in average exam performance between the two formats was usually 1-3%. I had the class come back for a 4-month re-take of the cumulative final exam (requesting that they did not study for this exam). On this one, although the results were not significant, the averages between the formats differed by about 12%, in the wrong direction (worse performance on the (auto)biography units). The lack of significance in any of these results may be the nature of the beast when analyzing exam scores. We design exams to spread out the students, with some questions designed for everyone to get and others designed to pull out the A students. However, the students say that their intrinsic motivation to further study our sensory systems was increased by the use of (auto)biographies. Given the ease

nowadays to look up facts on the internet, perhaps this motivational change is the more powerful outcome of this project.

Phase II, using only (auto)biographies is on-going this semester. We just started our first (auto)biography two days ago, so I don't yet have results from this semester.

Observations, comments: There is no reason to expect that the preference for (auto)biographies, and their aiding in student retention of material (should the results support this hypothesis) would only apply to courses in Sensation & Perception, or even only to courses in Psychology.

I plan to publish my results in either *The Journal for Undergraduate Neuroscience Research* or *Teaching of Psychology*. I will also present this project and maybe lead a discussion on it at the GLCA neuroscience conference on October 2.

Sadoski, M., Goetz, E. T., & Fritz, J. B. (1993). Impact of concreteness on comprehensibility, interest, and memoryfor text: Implications for dual coding theory and text design. *Journal of Educational Psychology*, *85*(2), 291-304.

A case learning approach, including those employing print and visual media, in an International Political Economy course

Learning research concept being investigated: Case Learning – including those that employ different media – compared to traditional lecture-oriented approach

Case learning is guided by the principles of the active teaching and learning approach. Active teaching and learning is a pedagogical approach that attempts to move classroom instruction from traditional, lecture-oriented "instructional paradigm" to a new "learning paradigm." This process of discovery places students in the position of critical thinkers and generators as well as consumers of knowledge in an active, collaborative and experiential learning environment.

Name, discipline, college of professor: Matthew Krain mkrain@wooster.edu, Political Science, College of Wooster

Course experimented in: Class on International Political Economy

Short description of the innovation applied: Using a pre- and post-test experimental design, to compare the learning results from different types of case learning, and to also compare them with other more traditional teaching approaches that I will employ in other sections of the course.

What the control/comparison group was: Other sections of the same course that do not use the case approach. Also, to compare sections employing cases in written form to those that convey a case using visual techniques such as documentary film.

What the outcome was (if known): I expect that, consistent with the cognitive psychology findings that underlie much of the active teaching and learning literature, case learning that engages students' senses in multiple ways – problem-based learning and case studies using films as texts – will enhance the exercises' effectiveness yielding greater knowledge and retention gains than case learning approaches that do not create such "memorable" events. I also expect students to see greater knowledge and retention gains using *any* of the case learning approaches as compared with the less interactive lecture/discussion approach.

Observations, comments: Active and experiential learning (and the case learning approach in particular) have already been shown to have significant educational benefits across the sciences, social sciences and humanities, and in fields as diverse as the teaching of medicine, law, business, engineering and art and design. Perhaps these results will spur on teacher-scholars in these fields to continue to employ, assess, and refine these approaches for their classrooms.

Use of economic experiments (or case scenarios) in a Principles of Microeconomics class

Learning research concept being investigated: The first is to strengthen retention of knowledge. A second principle of learning to be applied here is to build foundations of expertise. The use of economic experiments requires students to actually *do* the economic concept under study, and experiments derive from the literature of active learning to engage students on a broader range of levels in the material.

Name, discipline, college of professor: Stephanie Martin stephanie.martin@allegheny.edu, Economics, Allegheny College

Course experimented in: Principles of Microeconomics

Short description of the innovation applied: Introduction of experiments to complement traditional lecture in the teaching of microeconomics. Teaching with experiments engages students collectively with the material as they interact with each other in order to complete the experiment. For example, the market experiment requires students to engage with each other as buyers or sellers in order to make a trade, and the production experiment involves them working together in groups of various sizes to maximize production as if they were a real firm. This collaboration mimics the real world interactions of economic agents, but it is also critical to develop the desired concepts. Each student has a slightly different experience during the experiment that all must be shared in order to fully understand the outcomes and the implications for the theory to be demonstrated. Thus, the students attain positive interdependence during the experiment and during the follow-up discussion.

What the control/comparison group was: Earlier sections of the course taught by same instructor that did not use experiments

What the outcome was (if known): Preliminary results suggest that learning is improved within the units that contained experiments. The student attitude results are not yet known. However, the students appear to be more engaged during class, and better able to think through application questions that analyze real world phenomena. As an aside, I am also having more fun presenting the material using experiments.

Observations, comments: I hypothesize that using experiments increases student interest in these economic concepts. In order to more explicitly test this hypothesis, the research project is repeated in one section of Principles of Microeconomics in Fall 2010, using a concurrent Principles of Microeconomics course taught by the same instructor (without experiments) as a control group.

Using multiple media and methods of engagement to enhance learning in a German Language and Literature course

Learning research concept being investigated: The two learning goals under examination are (1) long-term retention of knowledge and skills and (2) transfer of knowledge and skills to new contexts.

The project applies the principles of Universal Design for Learning (UDL) as articulated by the Center for Applied Special Technology (CAST), a research organization affiliated with the Harvard Graduate School of Education. UDL us an approach that provides students with multiple means of representation (the "what" of learning), multiple means of action and expression (the "how" of learning), and multiple means of engagement with the course material (the "why" of learning).

Name, discipline, college of professor: Elizabeth Hamilton elizabeth.hamilton@oberlin.edu, German Language and Literature, Oberlin College

Course experimented in: A German Literature Course

Short description of the innovation applied: 1. Introduce a variety of media and methods to provide educational scaffolding within and between units. 2. State my learning goals even more explicitly than ever. 3. Have students measure their skills and comprehension at frequent intervals in the semester via written and oral pre-and posttest.

What the control/comparison group was: Students of same course in previous year who did not experience this method.

What the outcome was (if known): I am currently assessing the new pedagogy by comparing student essays from each year and by comparing students' responses to survey questions.

Observations, comments: The value of making learning goals explicit: When students are told how and for what purpose the course activities are designed, they are given the opportunity to reflect on the process of learning itself. This, when paired with a variety of options at every stage of a unit, allows students to assess their own learning style and tailor their work to their specific needs and goals. My initial sense is that this factor will have the greatest impact on long-term retention.

The other major component (varied options for presentation, engagement, and demonstration of acquired knowledge or skills) will, I suspect, aid students in transferring knowledge and skills to new contexts. That is in effect what the variety of options was designed to do: allow students to express knowledge and skills in multiple formats. The attention students paid in the process of choosing their formats was itself an exercise in moving from one context to another.

Using film as a primary medium to convey content in a political science course on War and Peace

Learning research concept being investigated: In a provocative 1995 article in *Change*, Robert Barr and John Tagg describe a transformation underway in higher education—a move from traditional, lecture-oriented "instructional paradigm" to a new "learning paradigm." The new learning paradigm sees learning as a *process of discovery* and places students in the position of generators of knowledge in an active classroom. Given the evidence from educational research on the effectiveness of multi-sensory approaches to teaching and learning, film and video seem particularly well suited to the active teaching and learning classroom. Indeed, proponents argue that films often provide a deeper understanding of world politics, a visual expression of important themes for a new generation of students, and even a common bond or "language" for discussion of issues within a visual (and often emotional) context (Weber 2006; Weldes 1999; Boggs and Pollard 2006).

Name, discipline, college of professor: Jeffrey Lantis jlantis@wooster.edu, Political Science, College of Wooster
Course experimented in: New Course: Political Science 229: War and Peace on Film

Short description of the innovation applied: I plan to test student engagement with themes of international security and learning outcomes through comparison of the results of pre- and post-test surveys. In pre- and post-tests, students are given a multiple choice quiz designed to see how well they understand the nature and scope of key issues as well as their level of interest.

What the control/comparison group was: Compare learning outcomes with those from a traditional Political Science class, Political Science 221: International Security.

What the outcome was (if known): Analysis of survey data plus anecdotal evidence suggest that films provide a deeper understanding of the complexity of some security issues and a common bond or "language" for discussion of issues within a visual (and often emotional) context. On a theoretical/pedagogical plane, the survey data demonstrate that films, movie clips and documentaries can help students to connect to history and abstract concepts in concrete ways, elicit learning at different levels of understanding, and place theories in international relations within a meaningful context.

Observations, comments: I enjoyed the opportunity to develop a new film class and think carefully about assessment of learning objectives. Students were actively engaged in both classes and eager to embrace themes in international security from alternative perspectives. Anecdotal evidence from observation of classes, conversations with students, and very positive statements on course evaluations also suggest this was a successful project. At the same time, the assessment data on the achievement of educational objectives provide mixed results. For example, there was no distinct increase in knowledge gained by students in the experimental group and there was less empathy gained than had been expected.

Barr,Robrt B., and John Tagg. (1995) "From Teaching to Learning: A New Paradigm for Undergraduate Education." *Change* 27 (6): 13-25.
Boggs, Carl, and Tom Pollard. 2006. "Hollywood and the Spectacle of Terrorism." *NewPolitical Science* 28 (3): 335-351.
Weber, Cynthia. 2006. *Imagining America at War: Morality, Politics, and Film*. New York: Routledge.
Weldes, Jutta. (1999) "Going Cultural: *Star Trek*, State Action, and Popular Culture." *Millennium: Journal of International Studies* 28 (1): 117-134.

A place-based education approach to an Environmental Studies course

Learning research concept being investigated: A place-based education approach to an Environmental Studies course

One of the persistent challenges with a "theory-laden" course such as environmental philosophy is getting the students to see the relevance and meaning in "ideas" when they tend to falsely dichotomize such endeavors from "action." This theory-practice divide has been the subject of much discussion in the environmental studies literature (Christensen & Crimmel 2008; Hutchison 2004; Orr 2002).

Emerging recently in the literature and research in the pedagogy of environmental studies is an approach that holds some promise for meeting the challenges described above. "Place-Based Education" (Gruenwald & Smith 2008; Sobel 2005), incorporating experiential methods and strategies, grounds students in direct experience that is relevant and meaningful while amplifying course content. Sobel (2005) described place-based education as "the process of using the local community and environment as a starting point to teach concepts… this approach… helps students develop stronger ties to their community, enhances student appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens."

Name, discipline, college of professor: Jay Roberts robertja@earlham.edu, Environmental Studies, Earlham College

Course experimented in: Environmental Philosophy: "Pedagogies of Place"

Short description of the innovation applied: To meet these principles, two pedagogical methods were employed: integrative, thematic learning and engaging students on personal, emotive levels with the subject matter. By utilizing the place-based learning approach, it was hoped that students would retain and understand the complex material better as well as increase their own sense of place at Earlham, potentially indicating a possible issue for retention. Assessment consisted of a pre and post attitudinal survey of their place appreciation as well as follow up interviews with the previous class participants.

What the control/comparison group was: Students enrolled in the same course taught in previous semesters.

What the outcome was (if known): Students very clearly enhanced their own sense of place about Richmond, Indiana and remarked that they saw Richmond much more appreciatively after the course. In addition, the final project enabled students to meaningfully demonstrate new learning in terms of environmental philosophy. Getting students out into the community yielded surprising educational results. The social and personal impact of such activities were much higher than expected and included very emotional connections made by students to their own sense of place (both in Richmond and in their own home towns) as well as serious inquiry into the purpose of their own educational journey and what they hope to get out of college.

Observations, comments: What are the potential long-term impacts of local, place-based educational methodology on college satisfaction and student retention? This to me is the most interesting question coming out of this preliminary research. In addition, a follow-up with this group in terms of their long-term retention of knowledge in comparison with the non-experiential group would be quite interesting.

References

Christensen, L., & Crimmel, H. (2008). *Teaching About Place: Learning from the land*. University of Nevada Press.

Gruenewald, D. A., & Smith, G. A. (2008). *Place-Based Education in the Global Age: Local diversity.* Lawrence Erlbaum Associates.

Hutchison, D. (2004). *A Natural History of Place in Education.* Teachers College Press.

Orr, D. W. (2002). *The Nature of Design: Ecology, Culture, and Human Intention.* Oxford University Press.

Roberts, J. (2008). "Beyond Learning By Doing: Brain-based learning and Experiential Education," in Warren, K., Mitten, D., & Loeffler, T. A. (Eds.), *The Theory and Practice of Experiential Education.* Boulder: Association for Experiential Education.

Sobel, D., & Society, O. (2005). *Place-based Education: Connecting Classrooms & Communities.* Orion Society.

Examination of the testing effect in the classroom with student-generated questions in Introductory-level Cognitive Psychology

Learning research concept being investigated: Examination of the testing effect in the classroom with student-generated questions.

The primary research-based principle of learning applied by the project is *strengthening long-term retention of knowledge*. A secondary principle of learning applied by the project is *metacognitive strategies: instilling habits of structured reflection.*

My project examines the effectiveness of the testing effect in the classroom. The testing effect is a well-established finding in cognitive psychology that shows greater long-term retention for material when preceded by repeated testing as compared to repeated study. While the testing effect has been shown to be quite robust, investigators have only recently begun to test the effect in the actual classroom. My study compares the testing effect produced by instructor generated versus student generated questions.

Name, discipline, college of professor: Aimee Knupsky aknupsky@allegheny.edu, Psychology, Allegheny College

Course experimented in: Introductory level cognitive psychology

Short description of the innovation applied: The alternative pedagogy employed is repeated testing with student generated questions. This alternative pedagogy combines two of my previous pedagogical practices including regular take-home quizzes and the development of student-generated review quizzes before each section exam. It seemed logical to determine whether combining these approaches would further facilitate long-term retention.

What the control/comparison group was: I am comparing performance across the instructor tested, student tested, and non-tested questions on the section exams. I will also be comparing performance across these three conditions on a very long term memory assessment that I will distribute at the beginning of the Fall 2010 semester so that I can identify any potential retention differences across time.

What the outcome was (if known): Initial results seem to indicate that, thus far, the use of student generated questions in class quizzes has had a positive impact on retention of material for section exams. It will be interesting to see if this continues and if the effect holds up over time for the very long term memory assessment.

Observations, comments: In terms of study strategies, an initial comparison of reports from the beginning of the semester and the mid-point of the semester shows that students have not significantly increased their use of self-testing. This is a good manipulation check for the variable of interest. Any changes in the use of other study strategies will also be assessed at the end of the semester. I would be very interested in collaborating with other faculty to explore the testing effect, as well as other principles derived from cognitive psychology. I support the current interest in my field in trying to apply the basic research findings derived from laboratory studies to the classroom. In fact, I am considering the development of a faculty workshop at my institution to share some of the findings regarding learning and memory from cognitive psychology. I am also hoping to continue this line of investigation and would welcome opportunities to expand the work.

The effect of on-line quizzes in enhancing students' long-term retention of material from an Introduction to Psychology class

Learning research concept being investigated: Evaluate the effectiveness of online chapter quizzes for enhancing students' long-term retention of material from Introduction to Psychology

Harry Bahrick and others have shown reliably that a spaced distribution of practice increases long-term retention of knowledge. College students tend not to comply with reading assignments, which leaves them unprepared to engage actively with material during class. Johnson and Kivineimi (2009) employed online mastery-based quizzes for an introductory psychology class and found that students who completed these performed better on exams. This project tested the effect of such online quizzes on students' long-term retention.

Name, discipline, college of professor: Lynda Hall lkhall@owu.edu, Psychology, Ohio Wesleyan University

Course experimented in: Introduction to Psychology

Short description of the innovation applied: Introduce online quizzes to eight of sixteen chapters in the course; the other eight chapters do not include online quizzes. Test the impact in cumulative final exam and again four months after the course to gauge loner-term retention.

What the control/comparison group was: Chapters in which no online quizzes were offered.

What the outcome was (if known): Four months after the course ended, students demonstrated 96.6% retention of concepts that were quizzed compared to 91.6% retention of concepts from chapters that were not quizzed, although the difference was not statistically significant. A recent review by Custers (2010) summarized 41 studies of long term retention of educational material, including 12 in which retention tests were administered 3 to 6 months after the course ended. Of these 12, retention rates ranged from 54% to 92% with a median of 81%. In the present study, it's likely that the impact of the quizzes was diluted by the unusually high level of retention for all course material.

On-line quizzes have the potential to encourage new students to prepare for class more effectively so that they comprehend material more completely and are able to contribute thoughtfully to discussions. Repeated interactions with the material in and out of class may also serve to enhance retention of course material, especially in the long term. The results of the present study showed a trend for quizzes to enhance retention after a period of four months, and follow up assessments after even longer intervals might demonstrate the benefits of the quizzes more decisively.

Observations, comments: If on-line quizzes may be used to persuade students to comply with reading assignments and to prepare more completely for class, then instructors may be able to change the focus of class time. For example, in my Introduction to Psychology class, I feel I spend too much time repeating basic definitions from the textbook so that students are able to follow other class activities. If the quizzes provide an effective means for students to learn more of these terms outside of class, I should be able to spend more class time on demonstrations and discussions.

References

Bahrick, H. P., Bahrick, L. E., Bahrick, A. S., & Bahrick, P. E., (1993). Maintenance of foreign language vocabulary and the spacing effect. *Psychological Science, 4,* 316-321.

Clump, M. A., Bauer, H., & Bradley, C. (2004). The extent to which psychology students read textbooks: A multiple class analysis of reading across the psychology curriculum. *Journal of Instructional Psychology, 31,* 227-229.

Johnson, B. C., & Kiviniemi, M. T., (2009). The effect of online chapter quizzes on exam performance in an undergraduate social psychology course. *Teaching of Psychology, 36,* 33-37.

Sappington, J., Kinsey, K., & Munsayac, K. (2002). Two studies of reading compliance among college students. *Teaching of Psychology, 29, 272*-274.

Appendix B

Original GLCA Project Request for Proposals

Great Lakes Colleges Association
Pathways to Learning Collegium
Project Description and Request for Proposals

Overview

The Great Lakes Colleges Association (GLCA) seeks proposals from faculty of its member colleges to design and undertake innovative pedagogies in the social sciences, humanities, and natural sciences based on recent research on learning. From fall 2008 though winter 2010, GLCA will support a number of such projects. Collaborations involving more than one college are possible, and the GLCA will help facilitate connections among faculty members; in addition, advisors on research findings and assessment will be provided. The GLCA Pathways to Learning Collegium is supported by a grant of $150,000 from the Teagle Foundation. The grants awarded will generally range from $2,000 to $5,000 but may be more or less depending on the size of the project and number of faculty and institutions involved.

GLCA and a core group of faculty from its member colleges stand ready to assist individual faculty who are interested in submitting a proposal for support from this program; specialized knowledge of research findings or assessment principles are not required. The GLCA Pathways to Learning team can assist in identifying principles of learning and project design, as well as in the identification of assessment techniques to gauge the learning impact of a given pedagogical approach.

GLCA's member colleges collectively offer an ideal setting to apply the findings of research to pedagogical practice. Across these campuses there are significant numbers of faculty members in all academic disciplines who actively explore new methods and approaches that help undergraduates learn more effectively. In many cases the Pathways to Learning Collegium may provide a research-based context to gauge the impact of techniques that faculty members have considered or applied informally. A consortial project of this kind offers the opportunity to build communities of interest across member colleges and to increase the scale of pedagogical experiments within disciplines by linking faculty members across different institutions. More broadly, this program holds the potential to strengthen the impact of teaching methods in achieving core goals of a liberal arts education – including the goals of producing graduates who are capable of thinking critically, developing informed judgment, and expressing themselves effectively.

A Comparative Approach

The Pathways to Learning Collegium seeks to foster purposeful exploration of alternative, research-based pedagogies in undergraduate courses – and to gauge the impact of such alternatives on student learning. Proposals seeking financial support from this program

must include a basis for comparison between the learning results from a new or alternative pedagogy and the results from another educational approach not using the alternative techniques.

There are several different contexts in which comparisons could be made:

- *A single unit or "module" within the context of a single course.* A faculty member applies a notably different approach to a particular segment of a given course, with assessments that compare students' learning results from the experimental unit to student learning in other units of the class that did not use the innovative approach.
- *Two sections of the same course ("paired alternatives") taught by the same professor*. In one section of the course the professor applies an alternative research-based approach to teaching; in the other section of the same class he or she uses other, possibly more traditional techniques in place of this experimental approach. Learning assessments from both class sections are then compared.
- *Comparisons of classes covering the same academic content across institutions.* Either of the two approaches described above can be expanded in scale by collaboration among two or more faculty members of the same discipline at different institutions. Particularly for introductory level classes using a common textbook, two faculty members may work together to develop and apply the same alternative pedagogy in either a "module" or "paired alternatives" context.

The three options described above involve successively larger investments of faculty time, at the same time they yield increased information about the impact of pedagogy on learning. Because the strength of program design increases as the basis of comparison expands, GLCA will work to assist faculty members who seek partners in the same discipline at other member colleges to devise a Pathways to Learning project. At the same time, GLCA welcomes proposals that are smaller in scope that can be undertaken by a single faculty member.

Principles of Learning Derived from Research

In May 2008, some two dozen faculty from GLCA member colleges identified the following set of research-based learning principles, each of which resonates with core goals of a liberal arts education and could be applied and assessed in undergraduate courses. While the list is not exhaustive, proposed pedagogies must be based on research-based findings on learning.

- *Increasing the Transfer of Knowledge.* A central skill to be developed, and an indicator of successful learning, is the ability to transfer insights and principles derived from one context to another. While a specific disciplinary or thematic context provides a necessary framework for the discovery of meaning, information that is too heavily contextualized can paradoxically impede the transfer of learning into domains beyond the original context. The educational challenge is to provide an appropriate context to facilitate effective learning within a domain, while encouraging

the habit of discerning core principles that can be applied beyond the original field of inquiry to other kinds of circumstances.[2]

- *Building foundations of expertise.* Research has shown that those who attain expertise in a particular field of knowledge develop a capacity to recognize key patterns in new information and to understand new problems in the context of organizing principles or concepts that serve as aids to understanding. This ability to perceive rapidly the key attributes of new information distinguishes the expert from a novice, who must make several deliberate steps to discern patterns of meaning. Experts are also more adept at perceiving which organizing principles are most important. The educational challenge is to draw students beyond the memorization of facts and instill a capacity for applying relevant conceptual principles that facilitate the discovery of meaning. Related to this is the instructor's challenge of recognizing the difference between his or her own expertise and that of undergraduate students.[3]
- *Strengthening long-term retention of knowledge.* Long-term memory is enhanced when the educational process involves repeated engagement and application of content within a field of knowledge, as opposed to the intense singular engagement that often characterizes rote memorization and content recitation. Fostering long-term retention entails rehearsals over intervals of time; the greater the number and the longer the duration of these intervals, the greater success in long-term retention. The educational challenge is to structure the learning process in ways that encourage students to draw repeatedly on key areas of academic content to strengthen long-term retention.[4]
- *Metacognitive strategies: Instilling habits of structured reflection.* Increasing learning effectiveness requires the development of a reflective capacity – the ability to stand critically apart, reflect on particular strategies the learner has applied to understand key information and concepts, and adjust individual learning strategies that prove inadequate. Structured reflection is a requisite step in the development of more effective techniques for individual learning. The educational challenge is to encourage students to examine their own habits of learning (sometimes described as "metacognitive strategies") and to make adjustments as needed to improve both retention and understanding. Often this step entails the recognition that the frameworks or principles of meaning a student has applied to a body of knowledge are inadequate – or simply wrong.[5]

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[2] For a clear and accessible account of learning transfer, Chapter 3 of the National Academy of Sciences volume, *How People Learn: Brain, Mind, Experience and School* (Bransford et al., eds, 1999), is particularly helpful. This summary of key principles from research on the subject also provides citations to studies detailing more particular aspects of the subject.

[3] See chapter 2 of Bransford, et al. (1999) for a cogent discussion of how experts differ from novices.

[4] For a seminal discussion of long-term maintenance of knowledge, see Bahrick (2000).

[5] See Flavell (1979) and Kuhn and Dean (2004) for discussions of metacognition. For a discussion of fostering student reflection on their own learning strategies, see Grossman (2008).

- *Engaging the social contexts of learning.* The likelihood of successful learning increases in proportion as students work together as members of a learning community while increasing their sensitivity to individual and cultural diversity. In becoming an agent of others' learning, a student takes responsibility for understanding elements of the subject; this kind of active engagement with academic content in a social context strengthens individual learning. The educational challenge is to move students beyond the role of passive receptor of knowledge to a mode in which knowledge must be actively engaged and applied in conjunction with others. A diverse human context in which students work to understand and cooperate with others in constructing meaning can become a rich learning environment, fostering key cognitive and social skills such as comparison and empathy, which are fundamental to education in our global era.[6]
- *Engaging and strengthening different learning processes.* The likelihood of successful undergraduate learning increases as students have opportunities to engage with academic content in different ways (analytical, creative, abstract, concrete, kinesthetic, auditory, etc.). The educational challenge is to discern the strengths and weaknesses students exhibit in different modes of learning, taking account of different learning styles as well as cultural factors that may influence the process of learning – and to teach in ways that engage students' learning strengths while helping to improve their weaknesses.[7]

The principles of learning sketched above are intended to be suggestive rather than exhaustive. A proposal to this program should not feel compelled to limit itself to this set of research insights. It is important, however, that a proposal explicitly describe a research-based principle of learning that it seeks to apply through an experimental pedagogy.

Pedagogical Method

After describing a principle of learning, a proposal should outline a process by which the proposer seeks to apply and gauge the impact of that principle. The proposal narrative should briefly describe a particular technique or approach the project will employ in the teaching and learning process. The pedagogical innovation may consist of a single adjustment to an existing

[6] For insightful discussions of the learning community concept and its applicability to classroom teaching, see Fink (2003) and Finkel (2000).

[7] Seminal work on the different kinds of activities and skills involved in learning includes Bloom's Taxonomy – a representation of successively higher-order skills identified by Benjamin Bloom in 1956. Through the past decade Bloom's Taxonomy was revised by Lorin Anderson and others. A summary representation of both the original and recast versions of Bloom's taxonomy can be found at http://www.odu.edu/educ/roverbau/Bloom/blooms_taxonomy.htm. See also Anderson and Krathwohl (2001). Equally influential is Howard Gardner's Theory of Multiple Intelligences (Gardner 1983). For a sample of insights into different cultural aspects of learning, see Pascarella and Terenzini (1995), Cheryan and Bodenhausen (2000), Steele (1997), and VanderStoep and Norris (2005).

approach, or it may entail several steps leading to a substantial course redesign, depending on the learning principle the project seeks to explore in practice.

A sampling of pedagogical methods that were considered by GLCA faculty members in the Pathways to Learning project meeting:

- *An integrative learning approach,* organized around a thematic structure, which seeks to engage students collectively in the subject matter through the creation of learning communities within a class, making the instructor more of a learning coach than a dispenser of knowledge, and allowing the student learning process to converge across several kinds of learning encounters.
- *Taking stock of students' abilities; being explicit about the learning results an instructor seeks to instill.* Measuring the development of particular knowledge and learning skills includes an assessment at the outset of a course to gauge students' command of a subject and/or relevant learning skills. The means of conveying a professor's expectations may take the form of a syllabus and/or evaluation rubrics making clear the particular skills and knowledge the course seeks to develop in students.
- *Providing educational scaffolding that encourages growth in particular kinds of learning.* Educational scaffolds are structures providing effective means to address particular aspects of learning a faculty member seeks to develop in students. The kind of learning scaffolding a faculty member constructs results from having sought to gauge students' abilities in light of the learning goals of a course.
- *Testing as a means of instilling more effective learning strategies in students.* Testing can be a form of intervention that encourages students to develop skills conducive to the learning goals of a given course, and to liberal arts education in general. The kinds of assessments constructed and the frequency of testing can vary significantly, depending on the instructor's learning goals.
- *Engaging students on a personal, emotive level in the subject matter*. A challenge to faculty members in any discipline is to compel students' emotional engagement in learning. A student with no emotional investment in the course content will not have a strong incentive to engage. On the other hand, a student who is intimidated by the course content or exhibits major test anxiety will not likely be an effective learner. Taking emotional factors into account and seeking constructive engagement can contribute to the quality of student learning. Emotional engagement also serves the important purpose of allowing students to develop empathic responses to their social environment and, thus, to become more sensitive to others' beliefs, motivations, contexts, and goals. Personal engagement and empathy are key components of education that help students become tolerant and responsible members of the community.

These pedagogical examples are not intended to be comprehensive – they are offered as points of reference that can help inform a proposal to the Pathways to Learning Collegium. Conceptually, it may be helpful to think of the learning principles as columns and pedagogical

methods as rows in a matrix. In the most basic sense an individual proposal might occupy a cell within this scheme, focusing on one research-based learning principle, engaging one or possibly two pedagogical methods that seek explicitly to develop and assess that principle.

Pathways to Learning Collegium: Matrix of Learning Principles and Pedagogical Methods

	Learning Principles/Goals	Increasing the transfer of knowledge	Building foundations of expertise	Strengthening long-term retention	Instilling habits of structured reflection	Engaging the social contexts of learning	Engaging and strengthening different learning processes
Pedagogical Strategies							
An integrative learning approach							
Taking stock of students learning abilities							
Providing appropriate educational scaffolding							
Testing to instill effective learning							
Engaging emotive responses in students							

Assessment of Learning Results

As noted above, the Pathways to Learning Collegium requires a comparative framework for gauging the impact of pedagogical innovation; the learning results from a course that applies a particular innovative approach must be compared to student learning from another course or unit within a course that does not employ that approach. In all likelihood the process would include an assessment given to students at the outset of a class, seeking to ascertain a student's grasp of certain content or the degree to which a student exhibits particular skills that a Pathways project seeks to elicit through the course. Other assessments may occur through the course, at the conclusion of the course – and possibly at a longer interval one or two semesters after students have completed the course. A proposal should discuss how the proposed assessment method will gauge the particular dimension of learning a Pathways project seeks to improve. The proposal should describe the kinds of information your project expects to obtain through assessment and the types of analysis the project will perform to compare learning results.[8]

Final Report

The lead faculty member for any project undertaken through the Pathways to Learning Collegium should plan to submit a final report to GLCA that summarizes the nature of the project and reports findings and conclusions.

A final report should be written in a form that can be widely shared among faculty of GLCA colleges and with the Teagle Foundation. From the standpoint of a faculty member's

[8] A helpful resource on assessment is the National Academies' *Knowing What Students Know* (Pelligrino et al. editors, 2001).

own professional development, it might be helpful to conceive of the final report as being synonymous with an article suitable for publication in a scholarly journal.

A report on a given alternative pedagogy project should include a description of the project – the principle(s) of learning it sought to engage, the alternative pedagogy applied, the assessment method and basis of comparison to another course or unit using more traditional pedagogy, and appropriate links to research on learning or education. A final report should also include an analysis of the assessment data collected. The findings and conclusions should derive from those learning results.

Because a core purpose of this Collegium is to foster dialogue about effective teaching and learning across GLCA's member colleges, it would be especially helpful if a final report included reflections on how the learning principles, methods, and findings of a particular project could be applied to undergraduate teaching in general, including courses in other academic disciplines.

Budget

Proposals should include a budget that reflects the costs of the project you seek to undertake. The budget may include an honorarium derived from a responsible estimate of the time it will take you to design and develop the project, including the development of assessment techniques, the collection and analysis of data, and the preparation of a final report. The budget should also include an estimate of material costs of developing and carrying out the work you propose. It is likely that the budget of individual proposals will vary significantly, depending on the number of faculty (and institutions) involved and the extent of course redesign entailed in introducing a given pedagogy.

Proposal Format

As a general rule, proposals should be 3-5 pages long. The final page of this document is a proposal form (available electronically) you may use in question/answer format. It includes the following sections:

- *Title:* A descriptive phrase that describes the purpose and nature of the proposed project.
- *Summary:* A one-paragraph overview of the proposal's focus, the pedagogical method(s) it seeks to explore, the importance of that focus, its assessment method, the names of faculty members and colleges involved.
- *Narrative:* A description of (a) the research-based principle of learning the project will apply and the pedagogy to instill that dimension of learning; (b) the class or unit(s) in which the innovative approach will be applied, indicating whether the comparison will be to other units of the same course, another course of identical content taught by other methods, or courses of the same content taught across two or

more colleges; and (c) the kinds of results a project might expect to obtain, and the potential significance of the project to other courses in the same or different fields.

- *Assessment:* A description of the assessment(s) the project will employ to gauge students' competence in the area identified, as well as the means of collecting and analyzing results.
- *Budget:* Present a responsible estimate of the project's costs, including an honorarium for the investment of your time in developing and applying the alternative pedagogy.

In addition to these considerations, each proposer should observe the customary practice of his or her home institution regarding the submission of proposals for external funding. For example, if a given college requires that a grant proposal to an external funder include the signature or written approval of the academic dean, please include such a statement in the proposal submission. In some cases a Pathways to Learning proposal may require preliminary review and approval of a college's institutional review board (IRB); proposers must comply with the policies of their home institution in this matter.

Proposals will be reviewed by a panel of five, including three faculty members from GLCA member colleges who are associated with the Pathways to Learning Collegium, in addition to the President and the Director of Program Development at GLCA.

GLCA welcomes inquiries and statements of interest in developing a proposal for support from this program. GLCA also stands ready to assist faculty members seeking assistance in developing assessment techniques or other aspects of a proposed teaching innovation. Please contact Greg Wegner of GLCA for more information or with questions: wegner@glca.org; telephone 734-661-2338.

Representative Works

The following is a select list of works providing insights into key aspects of learning for general reference.

Anderson, L.W. & Krathwohl, D.R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives.* New York: Longman.

Barr, R. & Tagg, J. (1995). From teaching to learning: A new paradigm for undergraduate education. *Change* magazine 27, 6 13-25.

Bok, D. (2006) *Our Underachieving Colleges.* Princeton, NJ: Princeton University Press.

Bransford, J. D., Brown, A. L. & Cocking, R. R., Eds. (1999). *How people learn: Brain, mind, experience, and school.* Washington, D.C. National Academy of Sciences Press. New classic.

Cohen, G., Steele, C. M., & Ross, L. D. (1999). The mentor's dilemma: Providing critical feedback across the racial divide. *Personality and Social Psychology Bulletin,* 25, 1302-1318. http://psp.sagepub.com/cgi/reprint/25/10/1302.pdf

Fink, L.D. (2003). *Creating significant learning experiences: An integrated approach to designing college courses.* San Francisco: Jossey-Bass.

Finkel, D.L. (2000). *Teaching with your mouth shut*. Portsmouth, NH: Boynton/Cook.

Flavell, J.H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34,* 906-911.

Gardner, H., (1983) *Frames of mind: The theory of multiple intelligences.* New York. Basic Books.

Grossman, R.W. 2008, Structures for facilitating student reflection. In press, *College Teaching.*

Kuhn, D. & Dean, D., Jr. (2004). Metacognition: A bridge between cognitive psychology and educational practice. *Theory into Practice, 43,* 268-273.

Pellegrino, J.D, Chudowsky, N, & Glaser, R., Eds. (2001). *Knowing what students know: The science and design of educational assessment.* Washington, D.C.: National Academy Press.

Pascarella, E T. & Terenzini, P.T. (1995). *How College Affects Students.* San Francisco: Jossey-Bass.

Steele, C. M. (1997). A threat in the air: How stereotypes shape the intellectual identities and performance of women and African-Americans. *American Psychologist*, 52, 613-629.

VanderStoep, S.W., & Norris, B. (2005). The relationship between religious beliefs and cognition, motivation, and behavior. In M.L. Maehr & S.K. Karabenick (Eds.) *Advances in Motivation and Achievement, 14* (191-222), St. Louis: Elsevier.

Zull, J. E. (2002). *The art of changing the brain*. Sterling, VA: Stylus Publishing, LLC,