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Impact of the COPEL on Active-Learning Revisions to an Introductory Geology Course: Focus on Student Development

Michael R. Brudzinski[1]
Janelle J. Sikorski
Miami University

In the autumn of 2008 the authors applied to and were accepted into the Community of Practice on Engaged Learning (COPEL) at Miami University. We were interested in participating in this group because our initial vision for course redesign of our large-enrollment (90-200 students) introductory course "The Dynamic Earth" (GLG 111) involved incorporating more in-class, student-centered activities, which we saw as a form of engaged learning. Unsatisfactory experiences from our trial semester of this revised course also motivated us to seek additional guidance and inspiration. Over the next two years, our participation in the COPEL transformed our beliefs about ourselves as instructors, about our students, and about the process of learning.

Our pathway to the Community of Practice on Engaged Learning (COPEL) began with an internally funded course revision project at Miami University, the Top 25 Project, that seeks to convert the top 25-enrolled courses from predominantly lecture-based to more inquiry-based. The core premise of inquiry-based learning is the requirement that learning should be based around student questions. In science education, assessment of inquiry-based learning techniques has begun to show significant performance gains (Hmelo-Silver, Duncan, & Chinn, 2007; Geier, Blumenfeld, Marx, Krajcik, Fishman, & Soloway, 2004; Koh, Khoo, Wong, & Koh, 2008). The entire Geology department faculty embraced the opportunity to revise "The Dynamic Earth" (GLG 111) and began working together to develop a plan to adopt the inquiry-based format because it offers an opportunity to better integrate what we do in our geological research with what we do in our teaching about geology.

The goal of our revision was to enhance the ability of students to recognize geology as a multidisciplinary science that utilizes a wide range of tools to solve problems related to Earth's complex systems. The traditional structure of our introductory courses has focused on instructing students on "what to know" instead of "how do we know." This approach developed from the recognition that for a large majority of college students, this is their first experience with geology, and many have limited science backgrounds. As a result, previous classroom instruction has been geared toward building a vocabulary-based foundation, which is the standard at most colleges and universities (for example, McManus, 2002). However, the recent media coverage of natural disasters such as the Haiti earthquake, the Indonesian tsunami, and Hurricane Katrina, as well as the debate over available natural resources and global warming, has put geology at the forefront of the minds of our students. They want answers to geological questions as *they* experience these issues and plan for *their* futures.

The Geology department recognized its responsibility to respond to our students' developing interests by both creating and maintaining a more inquiry-based learning environment. The key issue for our faculty is that predominantly lecture-based courses are also the norm throughout geosciences introductory courses. Considering the large amount of faculty time required for each instructor to successfully revise his or her own course to a new inquiry-based format outside the norm, the innovation our department developed was a modular compilation of teaching resources that facilitates faculty members in adopting the new format. We envisioned the collection of learning activities to transform our courses by incorporating more cooperative learning with opportunities for in-depth discussion and real-world problem solving while shifting more routine tasks such as vocabulary recitation outside of class. Ultimately, this new approach sought to improve student achievement in our introductory classes, improve the critical-thinking abilities of our undergraduate students, and increase student satisfaction with their learning to promote inquiry-based learning beyond the classroom.

To guide our construction of teaching resources, the department developed a well-defined set of learning outcomes framed around the scientific method:

1. Select and/or generate possible answers (hypotheses) to key questions.

2. Collect and analyze data.
3. Place the results of data analysis in the context of other experiments.
4. Evaluate hypotheses based on results.
5. Disseminate the conclusions to peers.
6. Convey the scientific information to the general public.

Because each of these steps is a component of how a geologist works to solve a problem, we designed the revised course with a framework of assignments and activities that involve students using these six steps to answer questions. Activities are designed to help students identify key problems that they can address with geology as well as to encourage students to add important questions of their own during each course section to ensure that the topics covered best match their needs. The assignments seek to ensure that students get frequent practice using the various aspects of the scientific method such that they could implement these techniques to help answer their own questions once the class is complete. An example of a task that targets outcome 2 (collect and analyze data) is an out-of-class assignment that asks students to go to the course's website and download seismic data for an imaginary Planet X. Then, using a graphing program such as Microsoft Excel, students create a seismic wave velocity versus depth chart. A follow-up in-class activity has our students work on interpreting these data to determine the planet's internal structure and layering. Our students are then asked to compare their analysis of planet X to those published for planet Earth, an activity that also serves to target outcome 3 (place results of data analysis in the context of other experiments).

Reality Check:
Students Struggle With Great Expectations

Implementation of our Top 25 project began in the summer of 2008, and we took the lead on this project beginning with collecting and organizing materials to form revised teaching modules. We were specifically interested in collecting materials that focused on topics such as plate tectonics, earthquakes, volcanoes, Earth's interior, minerals, climate, and rock groups (for instance, sedimentary, igneous, and metamorphic). We found quickly that some existing course materials needed to be modified to fit with our student outcomes and active-learning approach and that some topic areas needed new materials to be constructed. During the 2008-09 academic year, we began testing the materials in a pilot section of GLG 111 taught by second author Janelle Sikorski while collecting assessment data across all sections. The course enrollment in our GLG 111 course varies from 90 to 200 students; the pilot section taught by Sikorski had an enrollment of 90 students. The classroom used in the pilot study was set up with one instructor computer with Internet access, one projection screen, and multiple fixed tables positioned in an amphitheater-type fashion facing the front of the room. While our redesigned course incorporated a much greater level of inquiry-based activities, students struggled with the new format.

Our efforts to interpret the cause of the student response and to help students better engage in scientific inquiry led directly to our participation in the COPEL. Thus, it is useful to describe the results of our pilot course revision. While Sikorski served as the in-class instructor for the pilot section of GLG 111, Sikorski and Brudzinski collaborated on a regular basis to prepare course materials and work through challenges that arose in implementing the redesigned version of GLG 111. Ultimately, both authors of this article invested significant time in transforming GLG 111 into a more engaged learning environment.

Student responses to the first section of the revised GLG 111 were surprisingly more negative than previous sections taught by Sikorski. Students resisted, and in some cases were openly hostile, to many well-planned activities, resulting in frustration from both the students and instructor. Students used course evaluations, online surveys, and e-mail in-boxes to express dissatisfaction with their experience. Their comments ranged from dissatisfaction in how grades were assigned and the course workload to dissatisfaction with the instructor herself. For example, one student wrote,

> This class is far to [sic] difficult for its 100-level title. Expectations were too high and assignments were often overwhelmingly difficult and poorly explained. Additionally, in-class activities, homework, take-home problems, and quizzes were given weekly—I had more work in this class than in my 300- and 400-level classes! Tests were not at all easy, and I had a very difficult time in this class.

From Sikorski's point of view, the biggest source of frustration was the students' inability or unwillingness to try to solve a problem first on their own. Students would have much preferred that she simply give them the right answers, and they grew increasingly agitated when she would respond to their questions with "Well, what do you think?" or "What would we need to know to solve this problem?" The number of open-ended questions asked in this course also seemed to intimidate some students, who always seemed to be asking, "Is this right?" While we didn't realize it at the time, these are key indications of issues related to student development, which was at the heart of what we learned through the COPEL.

In any course there will always be a few dissatisfied students, but this time 65% of the students who responded to the standard university course evaluation rated their experience with coursework as a 2 or lower (on 0-4 scale), with 25% of these students rating their experience as a 1. In the three years leading up to this pilot study, Sikorski had already achieved excellent teaching evaluations with this course (3.43 +/- 0.68), so that her personal disappointment and frustration with the results were greater than for any previous teaching experience. Part of the frustration also came from the substantial amount of time invested in redesigning GLG 111 to help increase student satisfaction with the course. So what led to a decrease in student satisfaction? To help address this question, it is particularly telling to review the first day of class in our pilot section.

It is well documented that the first day of class is where student and instructor expectations for a course are both challenged and formed (see, for instance, McGlynn, 2001). In keeping with our newly defined student learning outcomes, we felt it was important to use the first day to establish the focus of this course as being on active participation in learning and applying the scientific method to geology, as opposed to a more passive presentation of geology content. We found it striking, therefore, to find a sign posted outside a popular student bar and grill stating, "The first day doesn't count," followed by an advertisement for daily food and drink specials to welcome the students back to campus. Given this critical discrepancy in expectations for the first day, we realized that our new approach issued a monumental challenge to a well-accepted student belief system.

While we did not recognize the size of the challenge until we joined others from across campus in the COPEL to discuss how actually to foster student engagement, there was already anxiety about the new format and redefining our role as instructors. Were we ready? How would our students react? How would our peers react? Realizing significant change would not occur in one day, our goal for the first day of class was simply to make the students aware of the types of experiences and responsibilities they would have in the course.

The first difference in our redesigned course from the previous semester offering was that we posted the syllabus on the online course site prior to the first day of class and instructed students by email to review the document prior to coming to class and to post any questions about the syllabus beforehand. Our purpose was to increase student responsibility in the course by clearly outlining an important expectation of the course—to do work outside the classroom and arrive prepared for class. This approach was also designed to increase the amount of time available in class for more meaningful discussion and engagement. However, an informal poll found only about one third of the students indicated they had looked at the syllabus beforehand. In the time designed for open discussion of the teaching approach, students asked questions already answered in the syllabus that they clearly had not reviewed. Sikorski was frustrated that she had allowed 15-20 minutes of the first 50-minute class period to be used to discuss course logistics when a goal of this new approach was to transfer this type of information outside of class.

Following this rough introduction, Sikorski then moved directly into the first formal "lecture." There were several audible groans from the students, with one commenting, "But it's the first day and we only have 30 minutes left?" Dismissing the student concerns, Sikorski asked students to brainstorm what they knew about the scientific method. As a class they identified the key steps used in the scientific method, such as observation, interpretation, and hypothesis. Sikorski next projected the image of a red hand shape on a white background and asked the students to write down three different observations of the image. Students were asked to write their best observation on the chalkboard, but many turned out instead to be disappointing interpretations, like "it is a bloody human handprint." Sikorski wanted to help students realize when they move from observation to interpretation, so she and the students jointly listed the characteristics of a valid observation and formulated a class-accepted definition of this term.

At the end of this first class period, Sikorski assigned students homework due the next class to improve their preparedness for an activity during the next class period. Later that day, she also posted several online surveys and short multiple-choice quizzes on low-level content due within the next week.

Throughout the rest of the semester, students struggled to resolve the discrepancies between their personal expectations for the course and their actual course experiences. They always seemed to be asking, "I'm not a geologist; how could I know the answer?" or "Do you really expect us to do this?" For many of the students, this internal conflict led them to discredit the instructor, the course material, and the educational approach. To be successful in a course that is less about memorization and more about problem solving, students were asked—often for the first time— actively to engage in critical analysis of the natural world. Students' frustration was due, in part, to the fact that this wasn't the same course their fellow students had taken in previous semesters; this course required more effort than what students anticipated. It is common for students to take geology to fulfill their physical science requirement because they think it is easier than chemistry or physics—hence the phrase "rocks for jocks"—but our new approach directly challenged this belief. The students and Sikorski entered the course with significantly different goals and expectations that ultimately led to a breakdown in trust between them. As a result, students interpreted most activities Sikorski asked them to try as "busy work," an indication that she and the students were unable to build a meaningful learning relationship and that an adversarial relationship had been constructed instead. So by the end of our trial semester, it was painfully obvious that simply adding new course activities to GLG 111 would not be enough to create more engaging and meaningful classroom experiences. Without a better support system in place, it was clear our efforts would fail.

The Transformation: Co-Constructing Knowledge in the Community of Practice on Engaged Learning

A primary benefit of our involvement in the COPEL was the ability to share our frustrating classroom experiences from the revised GLG 111 section in a safe environment. In doing so, we gained informed and empowering feedback. Through thoughtful discussion about the challenges educators in higher education face, we were better able to put the "failures" of our redesigned course into a more meaningful context. For the first time, we began to see all of our students as active participants in the course regardless of their behavior, which provided opportunities to comprehend potential sources of student behavior. We transformed undesirable student behavior from an unfortunate part of the classroom experience to a symptom of an urgent problem that needed to be addressed. The COPEL discussions uncovered that students could be struggling and frustrated not because we asked too much of them, but rather because we may not have provided enough of a framework for them to succeed in a student-centered learning environment (Doyle, 2008). In particular, we became aware that student development theory could provide an important context for understanding how students perceive knowledge and learning in our revised courses and, ultimately, provide a pathway for creating more meaningful classroom experiences.

In the COPEL meetings, members from various disciplines considered how aspects of student development might influence the instructor-student relationship and understanding of student behavior. Specifically, we explored the Learning Partnerships Model developed by Baxter Magolda (2004). In this model, many young adults enter college with the belief in "external formulas"—that knowledge is to be located, knowledge is absolute, and knowledge must come from others (see Taylor, Baxter Magolda, and Haynes's article in this issue for more information regarding college student development). To us, this meant that these students tend to believe their own thoughts and beliefs have little value within the classroom and that there is no way they could participate in the construction of knowledge. We found in our discussions with other disciplines that the belief in external formulas is particularly prominent for students in the science classroom setting, with some students indicating that their own thoughts are important in other classes but that science is about learning the "right answers" already found by experts.

Thus, when we reconsidered our redesigned trial course, it began to make sense why many students were frustrated with the student-centered approach. Students seeking knowledge through external formulas would naturally reject the student-centered approach as a waste of time and question why the instructors (experts) would avoid telling them the correct answers. By asking an increasing number of open-ended questions that lack clear, correct answers that can be easily recited, our course revision was creating frequent moments of dissonance for students seeking knowledge via external formulas. We were giving students plenty of reason to shout, "But that isn't in the book!" and "How do you expect me to know this?" Of course, we can now see why we might have worsened the situation by responding with "What do *you* think is the answer?" Ultimately, the central issue in our redesigned course was that we were directly challenging student beliefs about knowledge and learning.

A critical realization from our participation in the COPEL was that we had made a flawed assumption: that students would just know what to do when we changed the learning outcomes. If we were expecting students to spend more time at the center of the learning process, utilizing the scientific method to derive their own answers, then we needed our classroom experiences to foster student development and ensure that the activities and assignments are appropriate for how students view knowledge and learning. We envisioned developing strategies to help increase student willingness to accept the new challenges we were creating for them in our redesigned course. In doing so, we hoped students would see why our class was different as well as how it was designed to help them develop new skills, advance their understanding of knowledge, and, ultimately, to increase student satisfaction and improve student behavior in subsequent offerings of our redesigned course.

The Current Vision: Designing Courses to Recognize and Promote Student Development

As we began to construct our new vision for our course, we realized that our new ideas still followed a traditional route for course design (Richlin, 2006). Thus, our first step was to develop new course goals, and our second step was to determine new student learning outcomes. We established these goals for further revision of our course: Advance students' ability to construct and manage knowledge, impact students' perception of themselves as learners, and challenge students to consider alternative ways of knowing. To help guide us in achieving these goals, we began working on more specific student learning outcomes. We realized, however, that although we did not want to give up on the previous learning outcomes we had established around the scientific method, we also needed additional supportive learning outcomes that were more focused on student development. We defined these new student developmental outcomes as follows:

1. Students can accurately evaluate their abilities.
2. Students have confidence to use what they learn.
3. Students take the initiative to apply science to their own questions.
4. Students value working with others to answer questions.
5. Students take responsibility for their learning as they realize they need to continue learning to be successful in life.

We envisioned that each assignment or component of our course would be designed to address at least one student learning outcome or at least one student developmental outcome, or both. We saw how some of our assignments (for instance, "What killed the dinosaurs?") could be changed slightly to address both the original student learning outcome we had targeted (evaluate hypotheses) as well as a new student development outcome (have confidence to use what they learn). But other aspects of the developmental outcomes, such as students accurately evaluating their abilities and taking responsibility for their learning, would require entirely new assignments and course components altogether.

One of the first changes we made in the course redesign process was to create a course orientation letter for our students. Reflecting on the trial semester, we realized that Sikorski had months to prepare herself mentally for this new course approach. She personally designed many of the new activities that would define the new course. She also knew she was changing the role of students in her classroom and had plenty of time to think about what the new role would require of students. What was missing from our planning process was how to alert the students that such a significant change was coming, what that change would mean for them from the start, and why this change was meaningful for their professional development. We crafted an orientation letter (see Figure 1) that has been posted on the course online site in subsequent offerings and sent through e-mail to each student enrolled about one week before classes start.

In addition to the course orientation letter, we also purposefully added justifications to course assignments to explicitly outline for students the goals of the assignment and how their work would be evaluated. Consistently providing clear expectations to our students seems to have increased their satisfaction in Sikorski's redesigned sections of GLG 111. For example, the average overall instructor rating for the two semesters following the pilot study is 3.3 +/- 0.71 (out of 4), with 77% of these students rating their experience with the course material as a 3 or 4. In subsequent semesters Sikorski invited small-group instructional diagnosis (SGIDs) to be conducted within the first six weeks of the course. Discussions with the SGID facilitators about student perceptions have shown that students recognize Sikorski wants them to be self-directed and is providing opportunities to apply course material. In one section, 100% of the students participating in the SGID found value in the course activities, commenting that in-class activities in particular "assist in making the content more clear, correspond to each other, and make the course interactive," and they "help students learn the material."

The most significant change seen in our trial redesigned GLG 111 is that the previous adversarial relationship that developed between Sikorski and her students has been replaced with a more effective partnership. Specifically, students are able to recognize that the course has been designed more deliberately to involve them in the process of learn-

Figure 1
Course Orientation Letter

Dear GLG 111 Student,

Welcome to Our Corner of the Engaged University.

Thank you for choosing to spend time with me this semester as we engage in learning about geology and science. Miami has made a strong commitment to engaged learning that involves guiding students to develop their own belief system, actively engaging students in discovering new knowledge, and creating a vibrant campus learning community. This course is part of these efforts to better engage you, as we are revising this course through the Top 25 project to utilize more hands-on learning in the 25 largest-enrollment courses at Miami. I have been working with many other faculty, staff, and students to ensure that this course gives you the best possible learning experience, and will ultimately prepare you to be an exceptional college graduate who is very successful in your career and personal life.

What are the expectations of this course?
I have high expectations for this course and expect that no class session will consist of me lecturing to you for 50 minutes. All class periods will have in-class assignments, some of which will take up nearly all of the 50 minutes. In addition, there will be frequent if not daily out-of-class assignments, with many short quizzes, surveys, readings, and lecture notes posted for you on Blackboard. In addition you will be working cooperatively within groups during each class period. This all means that you will need to arrive "with your game face on," as you will need to be prepared to contribute in class, leaving little time to catch up on e-mail and Facebook! However, I believe this approach will provide you with a less stressful workload by giving you more interaction with me and spreading the work out over the semester, instead of cramming by yourself right before exams. In reality, I find that working on course material on a regular basis is critical for you to be able to learn the ideas and concepts well enough to recall them when you really need them. The most important concepts we want you to master are those of the scientific method, because science is really a problem solving strategy. There is no doubt that you will encounter a whole variety of problems in your life, and I want to make sure you have the skills and confidence to use science to help solve them. So we will frequently practice your abilities to generate possible answers to key questions, collect and analyze data, compare the results to other experiments, evaluate possible answers based on the results, and effectively communicate the conclusions to your peers.

Figure 1
Course Orientation Letter (*continued*)

What is the goal of this course?
I see the goal of higher education not only to provide you with excellent academic resources and content knowledge, but also to invest in you as an individual. In fact, Miami's President Hodge stated the goal of our undergraduate education is to cultivate a student as a scholar. In other words, we are investing in the education of well-rounded individuals who leave Miami better prepared to identify, manage, and solve life's future challenges. The format of this course as compared to traditional, lecture-dominated courses will expose you to the types of experiences that will help you to develop your own view of knowledge, your personal identity as a learner, and your problem-solving abilities. All of these aspects have been identified by educational researchers as key predictors of your future and long-term success.
I look forward to seeing you for our first class!
Sincerely,
Your instructor

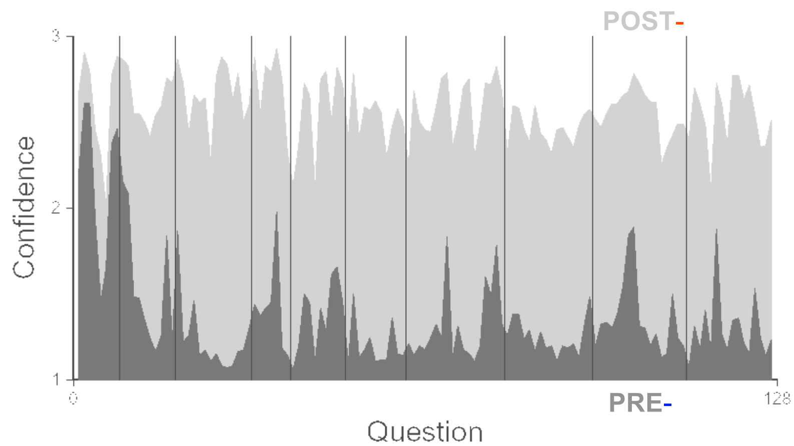
ing. Students comment that the instructor "makes the big lecture seem small by learning names," "understands we are not geology majors and tries to make it relevant to a diverse group," "focuses on the process, not just the results," and "keeps everyone involved." Part of this transformation resulted from Sikorski's being more deliberate in preparing students for the changes they would experience in the new course.

In addition to sending out the course orientation letter, we have also redesigned the first day's dialogue. Instead of simply a review or question-and-answer session about the syllabus followed by activities about geology or the scientific method, we specifically discuss how the course is constructed to enhance learning. Justifying this last part has required further class discussion on what the prevailing views are on how we learn, including brain research (Zull, 2002). As one might expect, an integrated introduction to the course approach, learning, and the scientific method (not to mention geology!) cannot all be achieved on the first day. Thus, we have decided to utilize the entire first week (three 50-minute class periods) to ensure students know that this different approach is truly important to their learning and that their role may be quite different from their expectations. Specifically, the course activities during the first week allow students to explore experiences that lead to "deep" learning, such as those outlined in Kolb's (1984) learning cycle, to explore how lifestyle habits such as multi-tasking appear to be detrimental to "deep" learning (Medina, 2008), and, finally, to explore ways in which the scientific method of problem solving is an efficient way to learn in the context of such discussions. For example, students are asked, "Do you think the process of problem solving is more or less important than the results in your course work? What about at your job?" A lively discussion often follows, which creates an open forum for the students to share their fundamental views about learning. Based on the results of these initial discussions, Sikorski finds herself better prepared to respond to the needs of the students in subsequent weeks, and when she and her students are at odds over an assignment, she often finds that reminding them about the discussions during the first week increases student acceptance of an assigned task.

A third key component to our course revisions following the COPEL experience focused on student confidence, and in particular, the assessment of it. We decided to utilize knowledge surveys (Nuhfer & Knipp, 2003) to foster self-reflection and examine student perceptions of their own learning. We established an initial list of 128 course objectives based on exam questions or assignment tasks. We then asked students to self-assess and rate on a 3-point scale their confidence in their ability to perform the learning objective based on their present knowledge. This assessment was given at the beginning of the course to establish a baseline of knowledge entering the course, and then the assessment was performed again before each test for objectives covered in that unit. Figure 2 demonstrates that there is clear improvement in student confidence following the instruction in each course unit.

Once we understood more about how student development was impacting our course, we were better prepared to identify how we needed to modify the instructor's role. Prior to our redesign plans, it was common for the instructor to make significant course decisions such as the topics covered in the course, the textbook used, and the number and format of exams. In this more traditional format, the instructor had full control or authority over the classroom experience. The belief also that content needed to be the sole priority of the course decreased the amount of opportunities purposely designed to help students connect the skills and content they were studying to their future well-being. In shifting toward a more student-centered environment in our introductory science course, it is vital for the instructor's role to shift toward that of a personal trainer or coach. We as instructors must engage in a true working partnership with our students. As part of that relationship, we must learn to respect our students' current developmental level and consistently construct meaningful experiences that push students to function at a level just above their com-

Figure 2
Results of Knowledge Survey in One Section of GLG 111 Pre- and Post- Instruction



Note. Student self-confidence in 128 different course objectives ranges from low (1) to high (3). Vertical lines mark different units of the course focusing on different geological content.

fort zone (Vygotsky, 1978). We must learn to better share authority within our classrooms and give students more opportunities to provide feedback and seek personal growth. Our final and most important role is to have the support in place to help students navigate the new challenges and roles we are imposing on them. Specifically, we now recognize that in addition to our learning outcomes focused on understanding the scientific method, there needs to be student developmental outcomes that focus on how students think about learning. In other words, assignments not only should build content knowledge, but also should advance students' ability to construct or manage that knowledge, impact their perception of themselves as learners, and challenge them to consider alternative ways of knowing.

Through an analogous situation of reflection and self-assessment designed by the COPEL coordinators, we also gained significant insights about our own "inner landscapes" (Palmer, 1998), including our motivations, strengths, and limitations that both define our identity as teachers and impact how we relate to students. For Sikorski, it was the discovery that she was allowing her own doubt and fear to shape her perception of her students, which only served to further disconnect her from them. For Brudzinski, it was the discovery that while he was busy working on the transition from simply conveying geologic concepts to practicing scientific methods, he now had to find ways to target the affective domain in his teaching as well.

These insights, however, raise new concerns about our original course revision proposal to create a digital warehouse of teaching materials and classroom activities that would be made available to our department for use in introductory classes. This implementation plan is content-centered and focused on providing active scientific experiences for students, but it neglects the role of the instructor's identity and his or her potential need for transformation. We now question the initial assumption that a faculty member accustomed to a traditional lecture-based teaching style, but open to more active learning methods, could simply download a new student-centered activity and insert it into his or her classroom successfully. Adopting a student-centered teaching approach requires a variety of other changes for instructors, including a willingness to be flexible about the amount of content covered, to share authority with their students, and to more actively engage in the development of their students. Based on our own successful experience in a university-wide community of practice, we now recognize that leading a department-scale community of practice would serve to aid our colleagues in making the transition to this new "curriculum."

Footnote

[1]Both authors contributed equally to this article.

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Mike Brudzinski *is an Associate Professor in the Geology department at Miami University, which he joined in 2005 after receiving a Ph.D. in Geophysics at the University of Illinois at Urbana-Champaign and an endowed postdoctoral fellowship at the University of Wisconsin-Madison. His overarching goal is to help people better understand the physical processes happening inside the Earth, with a focus on subduction zones where tectonic plates collide. Mike carries the theme of natural hazards through his courses and provides research opportunities for students through seismic experiments in the Pacific Northwest and Mexico investigating recently discovered forms of fault motion. He is working to further integrate his activities through a NSF CAREER project, which is expanding the inquiry-based learning approach to other classes, undergraduate research experiences, and workshops for teaching environmental science in high schools.* **Janelle Sikorski** *is a Lecturer in Geology at Miami University. She has an undergraduate Geology degree from the University of Cincinnati and an MS degree in Geology with a special focus on Glacial Geology from Northern Arizona University. She has taught 100- to 300-level geology courses, primarily to non-majors, for the past six years. Her current teaching interests focus on how best to incorporate more active learning pedagogy into her large-enrollment introductory geology courses.*