

**With A Little Help From My Friends:  
How Faculty Peer Review Can Transform Mediocre Teaching Methods into  
Powerful Learning Experiences**

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*Faculty members expend a large amount of time and effort working to provide the best learning experiences for students. At times, teachers can become so focused on positive outcomes for students that they do not always tap into the valuable pedagogical insight, experience, and support available from our own colleagues. In this article, we illustrate how the peer review process in an informal, nontraditional faculty learning community greatly improved classroom practices that utilize demonstrations and activities to deliver course content. We discuss serendipitous advantages from formative feedback on classroom demonstrations and activities and show how this process led to the creation of potentially transformative learning experiences for students. Additionally, the process of peer reviewing in-class activities resulted in teaching materials that can be shared with colleagues and continually improved. Finally, we discuss how the strategic and deliberate creation of activities with accompanying assessments can engage students in deeper, more meaningful learning that promotes problem solving and critical thinking skills. The collaborative peer review process described can be applied in any discipline to improve a wide variety of teaching methods and tools.*

### **Introduction**

A number of studies have demonstrated that having students work in peer groups to complete projects and accomplish tasks improves student learning and outcomes (Crouch and Mazur, 2001). This mode of teaching is widely accepted across multiple disciplines and has become a common classroom assessment practice for educators. Despite the widespread use of peer review and collaborative learning amongst students, faculty seldom engage in these types of activities outside of the formal faculty learning community setting. As faculty, we tout the benefits of collaborative learning and peer review to our students, yet we often work as isolated and autonomous individuals when it comes to our own approach to teaching

and pedagogy. Formal faculty learning communities (FLCs) are one method to promote a community of practice and enhance collegiate interactions. The traditional definition of a FLC is a group of 6 to 15 trans-disciplinary faculty, graduate students, and professional staff engaging in an active, collaborative, yearlong program (Cox, 2004). An FLC typically has a curriculum that focuses on enhancing teaching and learning and includes seminars and activities to provide faculty development, promote the scholarship of teaching and learning (SoTL), and build community (Cox, 2004). Formal FLCs can help faculty test and improve pedagogies and enhance student learning, reduce faculty isolation and burnout, foster mentoring relationships between participants, and provide a supportive framework for future classroom research (Sipple and Lightner, 2013). Yet, a formal FLC is not necessarily required to achieve these results. Faculty who face a common problem or challenge, particularly faculty within related-disciplines, may benefit from a structured, yet less formal approach that allows for the sharing of ideas, peer-review, and development of new course materials that directly impact student learning.

For example, whether practicing their craft at the elementary, middle school, high school, college, or graduate and professional school level, teachers struggle with how to effectively engage students in the learning process and how to assess students' mastery of course content. Keeping students engaged in course content is essential to promoting deeper learning experiences (Bain, 2004), and deeper learning experiences are associated with greater student mastery, long-term retention, and transfer of knowledge (Halpern and Hakel, 2003). Effective teachers must utilize techniques and practices to challenge students, provoking full participation and impassioned responses (Ambrose, 2010; Bain, 2004). One technique to harness the benefits of student engagement is the use of demonstrations where students actively participate in the learning process rather than passively observe (Crouch et al., 2004). Using classroom activities and demonstrations not only engages students, but also allows for an alternative presentation of difficult and abstract concepts. These types of activities are often extremely valuable in classes of open-access institutions where students come to the classroom with different life experiences and skills. The small class size found at many open-access campuses provides the perfect forum to deliver course content using activities and demonstrations, yet many can also be adapted for larger lectures. The concept of "the flipped classroom" has been shown to be an effective use of instructional

time and calls for the development of activities that challenge students to solve complex problems in class, replacing the traditional lecture (Brunsell and Horejsi, 2013). In-class activities and demonstrations can be used in nearly every discipline in both traditional and innovative classroom formats, but they require a high degree of preparation by the teaching faculty.

In the sciences, communicating complex concepts is often a challenge for both new and seasoned instructors. While science laboratories are often considered the “hands-on” learning component of the course, not every topic covered in the curriculum of any science course has an accompanying lab or experiment. As such, demonstrations and activities are commonly used in science classrooms to provide a visual framework of microscopic, molecular, or atomic-level concepts that are difficult for students to grasp. Students typically prefer such participatory exercises over lectures, and faculty receive positive comments when they are integrated into the course. Yet the effectiveness of these in-class activities in increasing student learning is not always analyzed or measured.

The peer review component of an informal FLC focused on a specific topic, such as the use of activities in sciences courses, has the potential to benefit students by improving the design and implementation of these teaching tools. It also benefits faculty, as it increases their understanding of the acquisition of new information in their discipline and promotes critical analysis of pedagogies and the use of valuable classroom time.

## **Methods**

A group of four faculty from two departments, biology and chemistry, met bi-weekly to specifically address the use of in-class demonstrations and activities to explain complex processes in science. The group’s activities were designed to provide formative evaluations of faculty practices so that significant improvements could be developed, implemented, and assessed. The premise was that the group would help each member enrich a currently used activity. At the initial meetings, faculty members described activities they were currently using in the classroom and their perceptions of the activities’ strengths and weaknesses. Each faculty member would describe the background and rationale for the activity, share handouts and tools or props used during the activity, and describe current methods of assessment, if any. The group analyzed the activity’s pre-work requirements, the clarity of the handouts, and the general effectiveness of the activity to engage students and improve

learning, and then made suggestions for improvement. The faculty often participated in mock demonstrations, acting as the “students.” If possible, a member of the group also observed the activity in use in the classroom. Finally, the group helped the faculty member develop an effective post-activity assessment to collect information on student learning and student perceptions of learning.

As a result of this process, after the group met for several weeks, a list of specific criteria for creating effective in-class activities was developed. From that point, each activity was assessed using the criteria. The criteria and rationales for their inclusion are listed below:

### Top 10 Characteristics of an Effective In-class Activity

1. **Guided by specific student learning outcomes (SLOs).** Each activity should have one to three specific SLOs. The instructor must be clear about what the students are expected to learn in order to evaluate whether the demonstration or activity helps students to achieve the desired outcome.
2. **Requires pre-work.** An activity that integrates previous course concepts with recently acquired information is the most effective. The best use of laboratory or lecture time at the college level is to engage students with the most complex concepts, not just facts. Requiring students to read, solve problems, or answer questions in advance of the activity will make the activity more valuable. The activity will then correct any misconceptions and challenge students to take the information to the next level. Pre-work should require the students to acquire the facts necessary to understand the activity.
3. **Challenges students to engage!** Student engagement is a term with many definitions. The definition used here is not described solely by participation, but more accurately by “critical thinking.” When students are analyzing an activity, solving problems, or applying information, they are engaged with the course content. During the review of the activities, an interesting aspect was observed: when the instructor explains everything about the problem, it takes the challenge out of the process. Excessive explanation makes the demonstration too straightforward and less engaging. The directions for the activity should

be presented clearly, but the details of what is happening are often better left unexplained.

Plan the activity so that students have time to observe or participate and to attempt to make connections on their own. In the beginning, the students may be hesitant and try to take the path of least resistance. The instructor may be eager for them to quickly “grasp the point” of the demonstration or calculate the “right answer.” Planning adequate time for the students to do this on their own, with specific, but minimal guidance from the instructor, will make the activity a true learning experience. The instructor will determine the amount of explanation and guidance based on the student population and the specific activity.

4. **Provides specific directions.** Preparing a detailed handout with clear instructions will give the instructor more time in class to guide students on the challenging aspects of the activity. (Peer review of your handouts can significantly highlight problems with this!)
5. **Increases participation.** Ask students to work in pairs or small groups to enhance learning through collaborative discussions. If the activity includes a demonstration, have the students in the “audience” make observations, direct the action, correct mistakes, or make predictions.
6. **Encourages team problem-solving.** The ideal activity will include challenges or “puzzles to solve.” Collaborative learning at its best will require students to explain and debate their observations and answers. (Note: Each student should complete a handout to take home for review.)
7. **Leads students to the SLOs.** The documents that accompany the activity should provide detailed directions as well as the tools students need to successfully complete the task (reference information, website addresses, etc.). The ideal handout would also have the following characteristics: a) relates terms and concepts from the pre-work to the activity; b) includes graphics or requires the student to generate graphics; c) poses challenging questions/problems, including ones that require application and/or predictions.

8. **Adds an element of competition.** While not every activity must be a contest, sometimes group dynamics can be enhanced by a little competitive spirit. Successful student groups can earn bragging rights or points for credit or extra credit. Another option is to design the activity with built-in feedback or rewards.
  
9. **Requests feedback.** A post-activity assessment has two purposes. First, it helps the instructor to determine if students have achieved the SLOs. Second, it allows the instructor to measure the students' perceptions of how the activity affected their learning. Assessing the student understanding of the concepts covered during the activity will help you to pinpoint deficiencies in the demonstration or misconceptions caused by the activity. It will also guide the instructor in addressing any discrepancies between student perceptions of their understanding and their actual mastery of the content. Having immediate feedback on the effectiveness of the activity will help the instructor to make improvements. Questions should be designed to assess whether students achieved the learning outcomes through completing the pre-work or participating in the activity. Additional questions can assess whether the students can apply the content.
  
10. **Requires reflection.** Reinforce learning by assigning one or more take-home, challenge problems that require students to recall the activity prior to the next class. This assignment will help students synthesize and retain the information.

In addition to the criteria, a template for the post-activity assessment was developed. A copy of the template is available from the authors upon request. The assessment template, which is modified to fit each activity, measures if students grasped the concepts explained by the activity with questions regarding the content of the pre-work and the activity. It also challenges students to extend their knowledge with an application-based problem. Students are also asked to evaluate their understanding of the concepts both before and after the activity. The results of the assessment can guide the instructor in providing additional support, including tutorials, informative Internet-based resources, extra practice problems or supplemental reading, or a review of the topic in the next class.

The collaborative process led faculty members to significantly change their design and assessment of in-class activities. The results of the formative evaluations of two separate activities are discussed below. These examples demonstrate the usefulness of the collaborative process.

## **Outcomes**

### *The Chemistry Example*

One result of this collaborative process was the development of a complete, self-contained activity to both deliver and practice course content and then to assess student learning for the challenging chemistry topic of molecular shape and polarity. The shape and polarity of a molecule determine whether a substance is or is not soluble in water. This has always been a difficult topic to teach and is one of the most challenging topics for students to understand. It is a foundational concept that chemistry students must take with them for future applications in biology, biochemistry, and higher-level chemistry courses. Originally, this topic was taught as a series of separate concepts over the course of several lectures and two chapters of the textbook. Additionally, balloon demonstrations to model molecular shapes and commercially available high school level worksheets were used as a supplemental exercise, as time allowed. Only self-reported evidence indicated that some students benefitted from these activities.

By sharing both the worksheet and the balloon demonstrations with colleagues, the Top 10 Characteristics list was applied to redesign the activity into a coherent package. Instead of using a commercial worksheet, an original problem set was designed to lead students through the process of pre-lecture reading, in-lecture exposure to the material, and step-by-step application of the content to determining molecular shapes and polarity. Additionally, the example molecules used in the problem set were carefully chosen to start with the “easy” examples and then to increase in difficulty, ending with a series of “challenge molecules” to be used ultimately as an assessment of learning. Molecular models, made from balloons, are used at various stages of problem completion to illustrate shapes. Input from faculty acting as students helped to develop the appropriate level of direction to include in the problem set.

The result was a self-contained packet that included SLOs, explicit pre-work expected of the students, step-by-step instructions for problem completion, and an assessment of the activity. All the reference materials

that are needed, such as charts and any quantitative values, were also included in the materials distributed to students, and a completed example problem, combined with the new, specific directions, allow students to participate in the activity with minimal instructor direction.

In class, students completed the activity in groups of four, reviewing the concepts and practicing determining molecular shape and polarity. While students worked together, each student completed an individual handout that could be reviewed and used for future study. Initial feedback from students indicates that they appreciated the ability to work with peers, the visual aid of the balloon molecular models, and the ability to practice many problems of varying difficulty. The student feedback and results were then shared with the faculty group, and this led to refinement of the activity and the assessment of learning. As the activity and assessment of learning is improved, the ultimate goal is to use the activity consistently, gather data, and assess the impact on student learning. Thus, what was once a supplemental aid has now been thoroughly developed into an effective method to deliver demanding course content. Another benefit of this process is that now the activity is a complete, self-contained learning module, and can be utilized in either lecture or laboratory settings, depending on the needs of the course.

### *The Biology Example*

Another example of a classroom activity that benefited tremendously from the peer review process was an activity demonstrating an enzymatic metabolic pathway. One of the concepts taught in introductory biology courses is the structure and function of enzymes, and the various factors that influence the activity of enzymatic reactions. Students often have difficulty understanding the connection between the function of individual enzymes in a metabolic pathway and disease states associated with abnormal metabolic processes. Before inviting a member of this faculty group to class to provide a formative peer review, this activity was primarily a demonstration that consisted of 4 student volunteers acting as “enzymes” that manipulated Play-Doh® “substrates” into “products.” The other students in the class passively watched the activity and were verbally asked questions about what biological processes the demonstration was representing. As part of the demonstration, the student enzymes were periodically told to alter their activity, for example, by not using one of their hands, to illustrate the effect of a change in enzyme structure on the



process. Again, students were verbally queried to see if they could ascertain what the demonstration was representing. Anecdotal responses indicated students enjoyed the activity, and watching their peers working with Play-Doh® often added a humorous levity to the enterprise. There was, however, no formal method to determine if students understood the concept more clearly than before the activity.

The process of having a colleague participate in the activity as a student helped to reveal how students perceive the activity. Several significant improvements resulted from the ensuing feedback. For example, pre-work that includes questions about enzyme structure and function is now a required, graded assignment. By having students acquire some of the basic facts of the process on their own, more instructional time can be allotted to illustrate more complex concepts and to allow students to analyze the process on their own in order to draw conclusions. Other simple, but effective changes involved reversing the set-up of the demonstration in the classroom so that it was oriented relative to the student observers and projecting images on the screen to ensure that students in the back of the classroom could monitor the details of the demonstration. These were issues that the instructor, who was originally positioned at the head of the classroom orchestrating the demonstration, did not detect. In addition, while several students were actively answering questions, not every student was required to participate. The activity was active for those posing as enzymes, but potentially passive for students watching the demonstration. After receiving feedback from the faculty observation, the demonstration has transformed into an active learning experience. Students observing the metabolic pathway demonstration now work in small groups tasked with completing a handout that asks questions about the “enzymatic pathway” and changes in conditions that are demonstrated, but not verbally explained by the instructor.

Since all observing students are completing a handout, which will act as a review tool, everyone is participating. Completing the handout requires students to make observations, apply their prior knowledge, and solve problems that explain how a change in condition (such as change in pH or temperature) would affect the pathway’s activity. Part of completing the in-class handout also includes a competitive, problem-solving competition between the groups. For each of these questions, the first group to determine the correct answer earns a point. Each group continues working until they reach the correct conclusion for each question. The

competitive aspect of the activity really energized and engaged the student participants. Finally, to ensure that students who are participating as “enzymes” have the opportunity to apply their knowledge, they direct a question and answer session to wrap up the activity. They consult with each other to determine if the student observers correctly answer questions covered by the handout.

The culmination of the activity includes an assessment with questions polling students about their understanding of the specific student learning outcomes both before and after the activity, as well as specific content-related challenge questions. The creation of the assessment instrument was one of the greatest benefits, providing a mechanism to evaluate not only the effectiveness of the activity, but also how well students perceived the benefits of this teaching tool. Finally, the new assessment and new participatory components will allow for data to be collected to further refine the activity, and the assessment has a basic structure that can be easily adapted to other classroom activities.

### **Discussion and Conclusion**

This collaborative process has been fruitful in a number of ways, the first of which was the idea of creating a list of criteria for an effective activity that is widely applicable across disciplines, topics, and technologies. Whether an in-class activity involves solving problems (as in our chemistry example), demonstrating a complex process (as in our biology example), evaluating historical precedents, analyzing a poem, or performing discipline-based research on the Internet, the criteria can be used as a guide to help ensure that the activity is engaging and most importantly, effectively supports student learning. Including specific learning objectives, mandatory pre-work, precise instructions for the activity without too much explanation, and a post-activity assessment that gathers data on both student perceptions and mastery of content have proven to be helpful in improving our in-class activities. By consistently approaching the development of in-class activities, the activities adopt a framework or structure which can act as a vehicle for classroom-based research projects, allowing for their continued improvement. Furthermore, as we have embraced the implementation of these criteria, as well as the utilization of a template for assessments, we can see how this approach will ease the development of new activities for other complex topics.

It is interesting that the activities and demonstrations were

transformed from supplemental tools to primary modes of content delivery. Whether used in a more traditional curriculum or as part of an inverted or “flipped” classroom, hands-on activities have the potential to be a more engaging and effective use of classroom time, but only if they are carefully designed and properly assessed. While student performance on exams is one measure of teaching effectiveness, it does not discern between knowledge students acquired on their own and understanding obtained from a specific aspect of the course. Immediate assessment of in-class activities and appropriate follow-up with additional instruction or quizzes can help teachers effectively utilize classroom time.

For our particular institution, an open enrollment, regional campus of a state university, these types of activities, which often allow for self-pacing, help address the great differences in backgrounds, skills and preparation levels amongst our students. Well-designed instructions and guided practice free the instructor to interact with the small groups to provide feedback as necessary. Meanwhile stronger students can reinforce their understanding by assisting those who may be confused about a topic. All students benefit from practice, immediate feedback and peer interaction. In this way, effective activities challenge all levels of students in a variety of ways.

Finally, in addition to the improved activities, the possible research avenues, and the benefits to students, we have stumbled upon a hidden treasure: the process itself! We have discovered personally, and quite unintentionally, the real benefits of collaboration. Our careful and unhurried peer review of all parts of each activity, including pre-work, handouts, instructions, in-class props and tools, and assessments, yielded learning tools that were markedly improved from their original forms. Peer review of the instructor conducting the activity in the classroom produced insights that improved timing, promoted greater student involvement, and more effective student-teacher interactions. Through the review process, we achieved together what we had not achieved alone.

This collaborative approach could be applied to many different teaching challenges: for example, writing effective exams, creating engaging lecture materials and study tools, or developing online tutorials. An informal faculty group focused on solving one specific challenge of teaching allows members to provide thorough formative assessments and detailed suggestions for improvement. Limiting the group size and including faculty from related disciplines helped to ensure that each faculty member could contribute and benefit from the process. It was interesting to us that

as we worked to help our students experience the benefits of collaborative learning, we ourselves became the recipients of the advantages as well. The value of peer collaboration to improve pedagogy became, for us, a tangible reality, resulting in valuable tools for our classrooms, and we hope, for yours, too.

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