

WHAT WORKS - REPORTS FROM THE COMMUNITY

CALIBRATED PEER LEARNING

Calibrated Peer Review fosters the development of student assessment skills— that is, the skills needed to be able to improve the performance of others and themselves. The effectiveness of a student assessment skill is itself improved by the calibration process in which students receive feedback about their assessments of the work of other students by working through a set of preliminary tutorials. Once students have shown proficiency in assessment they engage in actual assessment outside of classroom through a web-based system that provides anonymity for the students. This type of activity meets several learning goals:

- ◆ Assessment skills (assessing, criticizing, analyzing and reviewing)
- ◆ Writing skills (abstracting, persuading through writing proposals, developing logical arguments, describing)
- ◆ Critical thinking skills
- ◆ Content mastery (in assessing multiple examples of content-specific assignments)
- ◆ Career skills (related to working effectively with peers).

The student's view

Peer review and assessment is uncommon in traditional introductory science courses, but as collaborative learning activities become more widely accepted, most students will have some experience in attempting to assess the work of their fellow students. To be systematically trained to assess the work of others is even more uncommon, and for students to be assessed by the instructor in developing their assessment skills sounds like the height of educational double-talk.

However, the development of skills and strategies for peer assessment— that is, simply providing thoughtful feedback to improve the learner's performance— is effectively achieved through the "calibration" process. Moreover, these skills can be translated into methods for self-assessment. Any student can tell you that once you've figured out what the professor wants it is much easier to succeed in a course. CPR promotes that very process because what the professor wants must be clarified and explicitly presented to students for their activities in peer review. ■

THE INSTRUCTOR'S VIEW

Successful implementation of CPR can shift much of the important on-going work of assessment of student performance from the instructor to student peers. That successful implementation depends, however, upon student assessment that is of a reliable quality, hence the need for the "calibration" process.

It also depends upon careful planning by the instructor to define learning goals and success criteria at a level of clarity far beyond the norm. Instructors know that teaching a subject requires learning it at a much deeper level than as a student. It is also true that teaching skills for assessment requires learning to use assessment more effectively.



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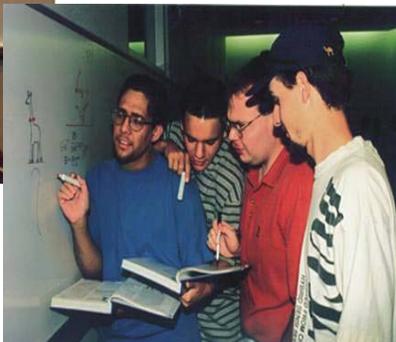
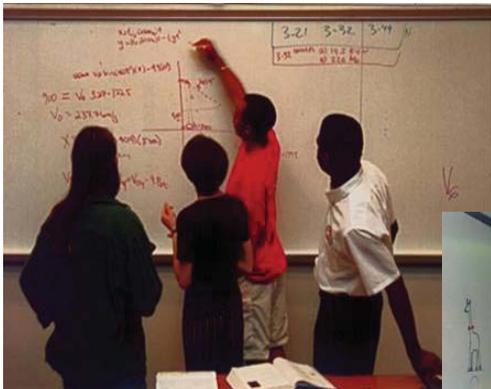
JUST-IN-TIME TEACHING (JiTT)

Just-in-Time Teaching focuses on the assessment of student performance by the instructor by use of web-based assignments that are delivered before a class meeting. The instructor has the ability to quickly gather information about student performance and understanding immediately prior to the class meeting so that the day's instruction can be tailored to actual student needs. This type of activity meets several student learning goals:

- ◆ Improving faculty-student interaction (individually and in groups)
- ◆ Content mastery (by rapid clarification of misconceptions)
- ◆ Group interaction skills (through on-line group activity).

The student's view

It is easy to feel disconnected from a science course as a student. Each day can seem as a new set of notes to take from the instructor's monologue, another chapter to read and another problem set to work on, but each unrelated to the previous day, that is, until the exam. The situation changes if the assignments are designed to pose questions that require some real effort and interaction with other students ahead of class, but providing the assurance that the toughest points will be cleared up in the class makes that work worthwhile. Just-in-Time Teaching can offer that kind of day-to-day motivation and interaction that drives the course forward. ■



THE INSTRUCTOR'S VIEW

Teaching and learning is most effective as an interactive dialogue between a student and an instructor who are at liberty to talk "about" the subject — that is to probe it from different angles and at different depths to satisfy the learners immediate needs.

Carrying on a "dialogue" with a classroom of students by creating learning needs, assessing those needs and responding to them when they exist is a challenge many instructors simply avoid. If not well-organized, it can be time-consuming and problematic in large classes due to uneven willingness of students to participate.

Using web-technology to coordinate the dialogue is a feature of Just-in-Time-Teaching that makes responsive instruction for an entire class possible.

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PEER-LED TEAM LEARNING (PLTL)

Peer-Led Team Learning (PLTL) creates small learning communities that are facilitated by experienced and trained peer leaders. Focused content study in the socially-supportive groups improves communication skills and teamwork for group members, and leadership roles and assessment skills for group leaders. The dynamics of interactions of students with peers is often more effective than with instructors. This type of activity meets several learning goals:

- ◆ Content knowledge (through assignments that reflect course content)
- ◆ Team participation skills
- ◆ Leadership, facilitation and assessment skills for leaders. (Usually a deeper understanding of content also follows for leaders due to the underlying challenge of fulfilling their roles.)

The student's view

Being a student in an introductory science course, especially in a large section, can be an impersonal, intimidating, and frustrating experience. The instructor may be willing to help, but office hours are limited and a struggling student may skip those opportunities for assistance due to the risk of revealing how little they understand. What struggling student wants to be on the spot and at the mercy of an impatient professor? Discussion sections may not be much better than class with a handful of students watching problems being solved by a TA, but not really understanding the solutions or even knowing which questions to ask. Peer-led team learning provides students with an efficient and supportive study group where they are coached in problem-solving by a knowledgeable student leader who is trained to facilitate learning. Working on specifically—designed assignments outside of class-time without the stress of being under the instructor's critical eye can provide an acceptable form of vulnerability that may be necessary for a student to find and address their real difficulties with the subject and even to enjoy it! ■

THE INSTRUCTOR'S VIEW

Engaging and successfully working with those students who really need some help to do well in an introductory course, but who refuse to admit it or to seek help can be a real challenge in teaching, even when classes are relatively small. Add to the problem by making introductory lecture sections large and teaching students who commute, who have families of their own, who work or who are otherwise not involved in the campus community.

Peer-led team learning can provide instructors in these situations with a means of indirectly reaching the students who need it most through creation of supportive communities of learners. And those students who need that support the least benefit as much by taking on leadership roles and learning the content more thoroughly through their efforts in facilitating the learning of others.



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PROBLEM-BASED LEARNING (PBL)

Problem-based Learning (PBL) simulates work-place projects that require mastery of a range of content knowledge and the development and application of process skills in an integrative and interesting format. Teams of students work together in the classroom to solve these problems, adding to the real-world challenges of communication and cooperation. This type of activity meets several learning goals:

- ◆ Defining problems (often from ill-defined situations)
- ◆ Self-direction in selection of resources and strategies
- ◆ Recognition of the instructor more in the role of a coach (rather than authoritative source of information and solutions)
- ◆ Team-work and responsibility
- ◆ Performance-based assessment and evaluation (fostering self-assessment skills).

The student's view

“Why do we need to know this?” is a legitimate and often-voiced question in science classes, but one that is often answered in abstract and unsatisfying terms. It is not only tiresome to concentrate on material and concepts that must be learned to earn the needed credit, but it is ineffective, too. Students learn best when there is perceived a need to know the missing information. Classes that effectively create these needs by introducing students to relevant problems and providing the theory and techniques for students to answer them addresses those concerns from the outset. Problem-based learning makes the course seem as important as it truly is by adding the necessary connections to reality. ■

THE INSTRUCTOR'S VIEW

Instructors are geeks. They actually find pleasure in learning the theory of the discipline. They try to solve or even invent impossible problems for fun. Most students are not geeks, thank goodness.

For most students, problems are OK if they're interesting and not too hard. Theory is good if it makes sense, can help solve a problem and if it is applicable to other problems. It is important to maintain student motivation through frequent assessment of student learning and providing appropriate resources and responses to address difficulties as they arise. Just-in-Time Teaching is one mechanism for doing PBL, even with large classes. And it makes instructors seem less like geeks.



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PROCESS ORIENTED GUIDED INQUIRY LEARNING (POGIL)

Process Oriented Guided Inquiry Learning, POGIL, emphasizes creation of active-learning situations that require self-managed teamwork, effective problem-solving, critical thinking, information processing and assessment in the classroom and laboratory. This type of activity meets several learning goals:

- ◆ Information processing and critical thinking (both by methodical examination of accepted scientific models and in creating conceptual models based on observation)
- ◆ Problem solving (both in written activities and laboratory work, by applying and extending models)
- ◆ Assessment (of the work of other group members or of other groups)
- ◆ Group management (by way of structured collaborative learning teams with assigned roles).

The student's view

When George Bailey, the character played by James Stewart in the film "It's a Wonderful Life" spoke about his ambitions to go to college, he said that he would "...go to see what they know..." before going on to "...build bridges a mile long and skyscrapers a mile high." He was naive, perhaps, but independent and confident in his ability to meet the challenges of an engineering career regardless of what he learned in college. George had learned how to learn on his own by necessity. Students who can acquire that kind of confidence and true ability to learn on their own, just might build skyscrapers a mile high. Process-oriented, guided inquiry learning fosters acquiring those abilities. ■

THE INSTRUCTOR'S VIEW

Just as the good parents who make themselves un-necessary for their grown children, good teachers make themselves un-necessary for their students. To gain this independence, students must be challenged to master the processes of learning on their own and in groups, to use resources effectively and to objectively assess their progress and success.

Ideally, students learn not only how to acquire existing knowledge, but also to create it for themselves by asking the right questions and finding the right answers and using these to develop a model or concept. POGIL focuses on developing self-directed, independent learners.



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STUDENT-CENTERED ACTIVITIES FOR LARGE ENROLLMENT UNDERGRADUATE PROGRAMS (SCALE-UP)

Student-Centered Activities for Large Enrollment Undergraduate Programs (SCALE-UP) creates highly collaborative, hands-on, computer-rich, interactive classroom learning environments for courses with large enrollments. This type of activity meets several learning goals:

- ◆ A functional understanding of content
- ◆ Growth of “expert” problem-solving skills
- ◆ Development of laboratory skills
- ◆ Increase in technology skills
- ◆ Communication and teamwork.

The student’s view

Actually understanding physics requires actually studying physics. Barriers to studying physics in a traditional large lecture class include isolation of individual students in the crowd of strangers, a competitive atmosphere and little one-on-one contact with the instructor. SCALE-UP uses techniques of cooperative learning on a large scale for class sections with enrollments of about 100. Bringing the lecture and laboratory together in this technology-rich setting promotes active group learning within consistent groups for six hours each week. The grading system requires team work so that each person in the group— even the really bright ones— benefit from working together so that everyone learns. ■

THE INSTRUCTOR’S VIEW

Lecturing to large introductory classes in vast tiered lecture halls can be an exhilarating experience at first, but loses much of the luster as students disengage, drop the class, fail the exams and complain that they can’t understand the material as the professor presents it.

Regardless of how logically and clearly challenging concepts and techniques are presented in a lecture, there will be a large fraction of students who need more active engagement with the professor and their peers in the classroom than traditional lecture can provide to succeed.

SCALE-UP can provide the desired active learning environment even in large classes and improve success rates, student achievement and satisfaction.

