

STEM Topic: Upper Level University Classrooms

Smith, M.K., Wood, W.B., Krauter, K., Knight, J.K., 2011. Combining peer discussion with instructor explanation increases student learning from in-class concept questions. *Life Science Education*. Vol. 10, 55-63.

Use of in-class concept questions with clickers can transform an instructor-centered “transmissionist” environment to a more learner-centered constructivist classroom. To compare the effectiveness of three different approaches using clickers, pairs of similar questions were used to monitor student understanding in majors’ and nonmajors’ genetics courses. After answering the first question individually, students participated in peer discussion only, listened to an instructor explanation only, or engaged in peer discussion followed by instructor explanation, before answering a second question individually. Our results show that the combination of peer discussion followed by instructor explanation improved average student performance substantially when compared with either alone. When gains in learning were analyzed for three ability groups of students (weak, medium, and strong, based on overall clicker performance), all groups benefited most from the combination approach, suggesting that peer discussion and instructor explanation are synergistic in helping students. However, this analysis also revealed that, for the nonmajors, the gains of weak performers using the combination approach were only slightly better than their gains using instructor explanation alone. In contrast, the strong performers in both courses were not helped by the instructor-only approach, emphasizing the importance of peer discussion, even among top-performing students.

Milner-Bolotin, M., Antimirova, T., Petrov, A. 2010. Clickers beyond the first-year science classroom. *Journal of College Science Teaching*. Vol. 40, 14-19.

This case study’s primary objective is to describe the implementation of the electronic response system (clickers) in a small (N = 25) second-year physics course at a large public university and to draw attention of the science faculty who teach upper-level science courses to the potential benefits of this pedagogy. This pilot study discusses the impact of the clicker-enhanced pedagogy on students’ cognitive and affective outcomes and their attitudes toward using clickers. We also outline challenges faced by the students and the instructors on the way of successful clicker implementation beyond the first year and suggest a few possible ways of addressing them.

Ortiz-Robinson, N.L., Ellington, A.J. 2009. Learner-centered strategies and advanced mathematics: A study of students’ perspectives. *Primus*. Vol. 19, 463-472.

A number of learner-centered strategies were implemented during a two semester course in real analysis that is traditionally taught in lecture format. We seek to understand the role that these strategies can have in this proof-intensive theoretical mathematics classroom and the perceived benefits by the students. Although learner-centered strategies are a welcome addition in many applied mathematics courses and are known to be successful, the literature indicates that these remain largely absent from more advanced courses [9]. In an effort to correlate student resistance and acceptance of these strategies in different classroom settings we included an applied differential equations course in the study. Student feedback was

obtained for two semesters of the real analysis course and compared to the feedback obtained during one semester of the differential equations course.

Preszler, R.W., Dawe, A., Shuster, C.B., Shuster, M. 2007. Assessment of the effects of student response systems on student learning and attitudes over a broad range of biology courses. *Life Science Education*. Vol. 6, 29-41.

With the advent of wireless technology, new tools are available that are intended to enhance students' learning and attitudes. To assess the effectiveness of wireless student response systems in the biology curriculum at New Mexico State University, a combined study of student attitudes and performance was undertaken. A survey of students in six biology courses showed that strong majorities of students had favorable overall impressions of the use of student response systems and also thought that the technology improved their interest in the course, attendance, and understanding of course content. Students in lower-division courses had more strongly positive overall impressions than did students in upper-division courses. To assess the effects of the response systems on student learning, the number of in-class questions was varied within each course throughout the semester. Students' performance was compared on exam questions derived from lectures with low, medium, or high numbers of in-class questions. Increased use of the response systems in lecture had a positive influence on students' performance on exam questions across all six biology courses. Students not only have favorable opinions about the use of student response systems, increased use of these systems increases student learning.

Carlson, P.A., Berry, F.C., Voltmer, D. 2005. Incorporating student peer-review into an introduction to engineering design course. 35th ASEE/IEEE Frontiers in Education Conference, October, Indianapolis, IN.

We report on a project to improve the teaching of engineering design at the junior level. Peer review of student work is an integral part of collaborative learning and reform-driven engineering education. Yet successfully implementing this pedagogical technique requires significant amounts of instructor and class time. Furthermore, if adequate formative assessment does not emerge from peer review, the experience may devolve into "busy work" in the eyes of the student. Here, we give early results from an NSF-funded study using Calibrated Peer Review (a web-delivered, collaborative learning environment) to enhance learning in engineering design.

Lodish, H.F., Rodriguez, R.K. 2004. Points of view: Lectures: Can't learn with them, can't learn without them. *Cell Biology Education*. Vol. 3, 202-211.

How to decide on the format for an undergraduate course in cell biology—a "standard" combination of lectures and recitations sections, or something else? The answer depends on many factors, including the numbers, abilities, and course backgrounds of the students and, perhaps most importantly, the purpose of the course. Thus, to explain why we feel that our junior-senior level cell biology course, taught with a combination of lectures, teaching assistant (TA)-led recitation sections, and extensive problem sets, works extraordinarily well for the vast majority of Massachusetts Institute of Technology (MIT) students and accomplishes its intended purposes, we need to describe several aspects of the MIT undergraduate curriculum and also what we expect the students to learn in the course.

