Article On the Methodology of Teaching General Subjects Using Interactive Methods

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ABSTRACT

The educational strategy has been changed and its main purpose has become bringing up of free, active, informed and responsible citizens, equipped with the skills of critical thinking and loyal to the modern democratic community in order to meet the demands of present-day democratic society.

Keywords: Interactive Teaching, traditional methods, teacher's role

The college-level general education (GE) curriculum have many goals: exposing students to the breadth of human thoughts and ideas; elevating their reading comprehension, writing abilities, evaluation of information and complex systems, critical reasoning skills; and providing an understanding of and appreciation for subjects outside of their chosen field of study. Unfortunately, the majority of this learning takes place in large enrollment courses. Therefore, as educators and researchers from many fields have documented, students often emerge from our courses without a deeper understanding of, or appreciation for, our disciplines. Further, they fail to acquire the skills and abilities we have worked so hard to help them develop.

The course differs from other introductory college science courses in that it is intended for students from *all* majors; it is not the prerequisite for any other course and there is no commonly agreed upon set of topics for the course—essentially the charge is to teach the universe in a semester! The lecture portion of the course is commonly the only time instructors meet with their students. Therefore, instructional strategies must help students resolve conceptual and reasoning difficulties without significant help from the instructor, and they must be designed for use in large lecture halls with fixed seats. Furthermore, because new strategies can require instructors to give up precious class time normally spent lecturing, teaching innovations must be relatively brief.

The Phase II of this work focused on an analysis of student responses to a fifteen-question demographic survey. A multivariate regression analysis was conducted to determine how ascribed characteristics (personal, demographic and family characteristics), achieved characteristics (academic achievement and student major), and the use of interactive learning strategies are related to student learning gains (Rudolph et al. 2010).

These studies show dramatic improvement in student learning with the increased use of interactive learning strategies even after controlling for individual and ascribed population characteristics. Classes that spent 25 percent of their class time (or more) using interactive learning strategies averaged more than twice the normalized gain scores as compared to classes that spent less than 25 percent of class time teaching interactively. Furthermore, we found no correlation between student learning gain and type of institution or class size (even in a class of almost 800 students, as we discuss in detail below). The wide range in learning gains observed for the high-interactivity classes suggests that the quality of an instructor's implementation of interactive learning strategies may well be the most important factor in determining the learning gain of a class. These research findings help to bolster the argument that faculty professional development efforts focused on how to effectively implement active learning strategies are in great need within the college teaching community. Additionally, institutional and departmental support must be provided to faculty who work to transform their courses so that their careers are not penalized for bringing proven instructional strategies into the classroom.

Perhaps most important of all our findings was that the positive effects of interactive learning strategies apply equally to men and women, across ethnicities, for students with all levels of prior mathematical preparation and physical science course experience, independent of GPA, and regardless of primary language. These results powerfully illustrate that *all* categories of students enrolled in GE science courses can benefit from the effective implementation of interactive learning strategies.

Centennial Hall (CH), where mega-classes are taught, is a venue designed for theater, dance, ballet, and orchestral performances. There are no desktops for the more than two thousand seats. The seats are fixed and don't swivel. The rows are packed very closely together, making getting to students with questions quite difficult. The lighting is much dimmer than a normal classroom. The podium, and all media and lecture controls, are located in the corner of a raised stage well above the first row of seating, far away from where you would like to stand while addressing the students. But the acoustics are fantastic! Members of CAE looked at the mega-course as a good opportunity to investigate whether findings from courses with approximately 150 students could still be achieved in this significantly larger classroom.

There were some logistical concerns we had to work through just to create a functioning classroom. Every fifth row of the class was initially blocked with caution taped to prevent students from sitting in these rows, allowing us to move easily throughout the class to assist students during collaborative group work. We had to formulate a complex flowchart, detailing where to go and what to do in order to make handing out and picking up paperwork (participation forms, homework, surveys, etc.) possible in only a few minutes.

For in-term examinations, we had to schedule Centennial Hall outside of normal class times in order to accommodate all the subtle issues of maintaining exam security and checking student IDs in a reasonable amount of time. We had to schedule a different large lecture hall (our former classroom held for 150 students) multiple times a week in order to accommodate office hours, as it is common for between 10 to 30 percent of the class to attend office hours. A zero tolerance cell phone and laptop policy was established from the start, and strictly enforced, to prevent hundreds of students from texting and using Facebook, Twitter, or YouTube during class. In addition, we chose to have multiple-choice exams, and make use of an online and auto-graded homework system, so as to reduce the number of hours needed for grading.

From a curriculum implementation standpoint, what was most challenging about this course was determining how to emulate the same vibrant and productive collaborative learning environment we had been able to foster in our 150–300 student courses. The university provided three graduate student teaching assistants (TAs). The astronomy department provided an additional graduate TA and one undergraduate astronomy major to help with grading. We knew we would need much more help to facilitate the in-class student discourse-intensive activities and to provide sufficient support in office hours. Our solution to this problem has come through what we call the Ambassador Program, a program that employs former students of the class to provide instructional help in the classroom.

From interviews with, and evaluations by, other students in the class we have learned that these Ambassador TAs are often preferred by students over the graduate students or even the instructor when they find themselves in need of help in class or office hours. The popularity of this program is evidenced by the increased number of students who state that they are attending office hours with the sole purpose of trying to get an "A" in the course so that they can become the next semester's Ambassadors. With the Ambassador Program we have found a pedagogically sound solution to an important instructional resource issue, and elevated the conceptual understanding and science literacy of a group of nonscience majors who have become skilled and eager to share their knowledge with others, and who will carry that ability and desire into their roles as members of our society.

The broader impacts of this program are now being felt in our second year as we see the role of returning Ambassadors elevated to astronomy education researcher. A cadre of these Ambassadors have engaged in a self-directed research program to investigate the relationship between the level of correctness and coherence in students' written responses to in-class and ungraded collaborative learning activities (Lecture–Tutorials) with the students' performance on corresponding questions on exams and concept inventories. The goal is for this work to lead to a published peer-reviewed science education journal article. With this work we see the progression of participants in the Ambassador Program from high-achieving nonscience majors taking a GE course, to peer-teaching assistants within the course, to astronomy education researchers evaluating the success of the course.

While the Ambassador Program and liberal arts minor will enhance the opportunities for a subset of the non-science majors, the question still remains: Does the 800-student mega-course achieve its goals for the majority of students? By a number of measures, the answer is yes. Exam averages are comparable to those of the prior seven years of Astro courses with enrollments of 150+ students. More important, class-averaged normalized gain scores on two different research-validated concept inventories, the Light and Spectroscopy Concept Inventory and the Stellar Properties Concept Inventory, are among the highest in the nation.

Evidence of successful student learning in a mega-course of 800 students is cause for excitement but also concern. Given the realities of current and future college budgets, especially at state universities, it is exciting to think that we can truly educate these students in such a setting. However, the danger comes when such a finding is misused. University leadership will undoubtedly use these positive research results to defend the teaching of mega-courses to their many stakeholders. We are concerned, however, that they will also promote the creation of these courses without providing the instructional resources, and advocating for the pedagogical practices, that are necessary if one is to create an active learning environment that leads to student success.

First and foremost our results illustrate the need for instructors to move from a professor-centered to a learner-centered teaching approach that involves effective implementation of interactive learning strategies. Without this shift in the framing of the classroom, one could ask why it wouldn't be financially sounder to simply produce high-end lecture videos of the class for students to download and watch on their own time. We fear this could well be advocated as the next step.

While our research results document that students develop improved conceptual understanding and reasoning abilities related to key astronomy topics, for those of us who have broader goals for our courses, there are still many unanswered questions. For instance, does their increased understanding of astronomy last? To what extent has their understanding of the critical role science plays in our society improved? Have we helped to create citizens capable of intellectually engaging in the issues we face as a nation? The research to answer these and other questions is being pursued in many fields, including astronomy education research, but this work is in its infancy in comparison to the research results on students' conceptual understanding of the discipline. One of our goals with this work is to motivate a national conversation among GE instructors from all topics about the importance of such goals, and of the need to conduct research about how gen. ed. Science courses can best accomplish these goals.

In conclusion, we wish to thank the thousands of students for all their hard work and contributions to helping us better understand how to teach and better meet their needs as learners.

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