Improving Performance in a Learner-Centered Astronomy 101 Class

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Innovations in learner-centered education, such as Think-Pair-Share (Peer Instruction), Lecture Tutorials, and Ranking Tasks, are now commonly used in many ASTRO-101 classes. In this study, we report anonymous feedback from over 3000 ASTRO-101 students over twelve semesters from instructors using learner-centered techniques, and give a status report on several ongoing educational projects. We hope to encourage others to gather similar data, and to use this feedback to further improve their ASTRO 101 courses.

Introduction

Abundant research has shown that active learning techniques are extremely effective at increasing student understanding of course material in introductory astronomy (ASTRO-101) courses. (Slater et al. 2003; Prather et al. 2004). These methods include Peer Instruction (aka Think-Pair-Share; Mazur 1997), the *Lecture Tutorials for Introductory Astronomy* (LTs; Prather et al. 2008), and Ranking Tasks (Hudgins et al. 2006).

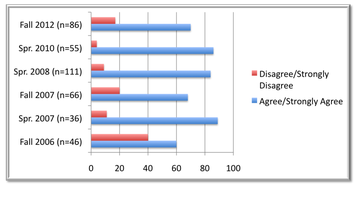
All three of these methods have been used by two instructors in the large ASTRO-101 classes at Youngstown State since 2006, and survey opinions (both mid-term, and end-of-term) have been obtained from over 3000 students. Such information is extremely useful - not only in obtaining student impressions of these learner-centered techniques, but also in assessing the implementation of these methods over time.

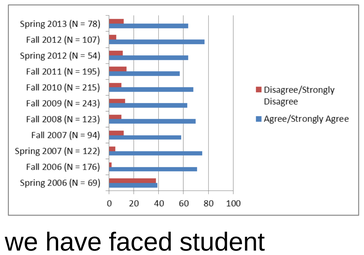
Here, we present student *perceptions* of the effectiveness of the learner-centered methods incorporated in our ASTRO-101 classes over a 7 year period. We also present some small innovations that other ASTRO 101 instructors may find helpful.

Data Collected

Our data comes from a series of Likert scale and open response survey questions anonymously posed in student evaluations at mid-term (one instructor) and at the end-of-semester (both instructors). To keep uniformity, the questions have remained unchanged over the 7-year window, though the courses have evolved over time.

Student Opinions about Active Learning Techniques Over Time

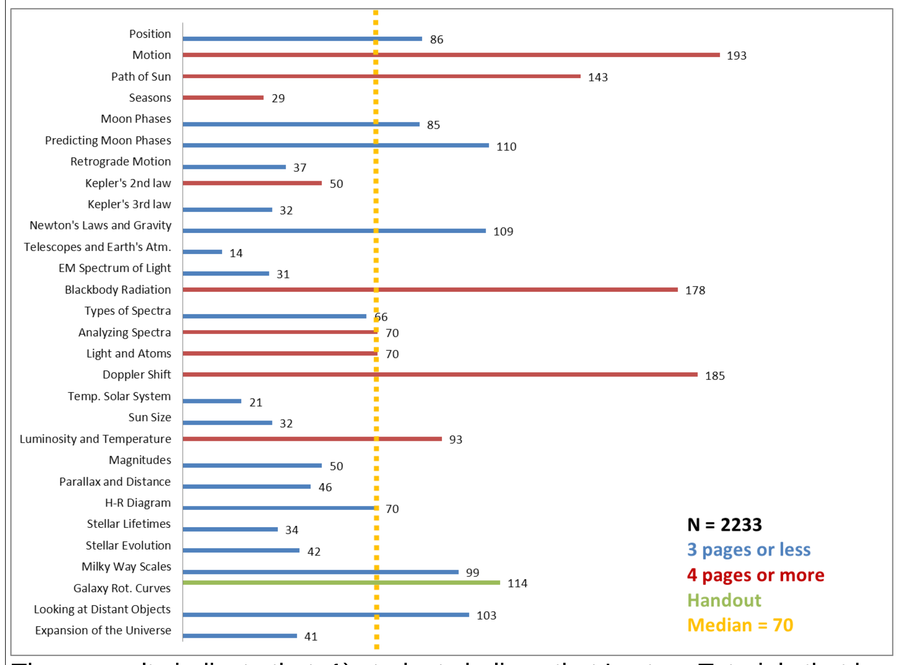




Like many ASTRO 101 instructors, we have faced student resistance to active learning techniques. In our own case, we have found that 1) as we have become more experienced in applying the techniques and 2) as we have devised responses to common student issues, **much of the resistance to active learning is reduced** (although about 10-20% of students never to seem to "buy in" to active learning). Above are the student opinion results from instructor 1 and 2 on the usefulness of the *Lecture Tutorials* to the student's learning. Notice the large drop in resistance after the first semester in each instructor's case.

Which Lecture Tutorials (LTs) are considered the `most difficult' by students?

In one instructor's ASTRO-101 classes, the students were polled at the end of the semester as to which LTs were considered to be the most difficult. The results from 20 classes and over 2000 students are given below:



These results indicate that: 1) students believe that Lecture Tutorials that have to do with spatial reasoning or more complex physics (such as blackbody emisison) are more difficult, 2) there is a small tendency for students to think longer LTs are more difficult, but this is not universal, and 3) one should expect new LTs to be perceived as difficult – note the instructor's own handout versus the LTs in the second edition.

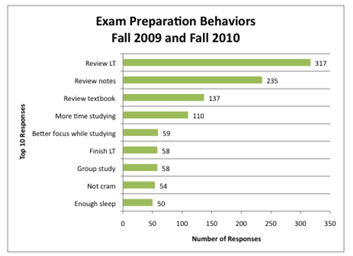
Teaching the Scientific Method through Ob-Scertainers in a Large Lecture Class

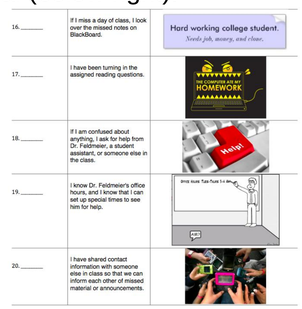
Teaching the basics of the scientific method can be rather dry. From a suggestion from David Wittman (UC Davis), we have obtained a demonstration tool called Ob-Scertainers. The Ob-Scertainers are plastic black disks that contain a ball bearing and a pattern of plastic ridges (see below). As one of our first active learning activities, we have developed a class exercise that can be used in large classes using the Ob-Scertainers. **Try it below!**

Note: We have no financial ties to Ob-Scertainers – we think they are a useful tool to demonstrate the scientific method.

How can we encourage our students to prepare better for their first exam ?

Students in Astro 101 often have "first exam shock" where they underprepare for the first exam, do poorly on the exam, and then become discouraged in the class overall. We have designed a ***student behavior survey*** to encourage better exam preparation (the full survey is attached below this poster). Using previous classes' survey data, (below left), we identified 20 student behaviors that were correlated with success on the first exam. In order to be less hectoring, we made the survey anonymous, and deliberately informal (below right).





At first, we were discouraged, since most students checked almost all of the survey questions (below left), when we know from observation that most students do not do these behaviors. However, the survey still had a noticeable impact on student behavior, because: ***It's not what the student writes down on the survey, it's what the student does afterwards that counts***. We noticed students exchanging contact information immediately after the survey (one of the successful behaviors), and when we compared the first exam performance from the previous semester, we saw a small (4%), but noticeable gain (below right). Using a bootstrap resampling statistical technique, we found this was unlikely to occur by chance (less than 20%). Given that other education researchers have found positive educational gains from written values-affirmation exercises (Miyake et al. 2010), we believe that this technique deserves further study.