

CWSEI – PHYS & ASTRO Newsletter

November 2010

Our department has always been committed to high standards in education. Recently, with support and leadership from the CWSEI, we have made increasing progress in successfully implementing research based educational methods in our classrooms. An increasing number of our faculty are showing keen interest in these developments. In response, we distribute this monthly newsletter to keep you up-to-date with the latest CWSEI efforts.

In this issue, Ingrid Stairs and Peter Newbury discuss Astro 311.

Prof. Ingrid Stairs, with contributions from Dr. Peter Newbury

ASTR 311: "Exploring the Universe II: Stars and Galaxies" is a large (~150 students) service course aimed specifically at students who are not in the Faculties of Science or Applied Science. Students taking this course have a wide range of backgrounds and mathematical abilities. I had taught this course once before, using the traditional lecture format (gratefully building on slides provided by Jenny McDonald) and using a few ABCD questions with voting cards but with no solid understanding of the best clicker-question choreography. The class was usually quiet and disengaged, and although the students mostly did acceptably well on the exams, it was clear that this was not their favorite course -- a shame, since astronomy is one of those topics that naturally excite lots of people.

For the last 18 months, Peter Newbury has led a significant transformation of ASTR 311 through the Carl Wieman Science Education Initiative. Ludo van Waerbeke, working with Peter, introduced learning goals, which we are following with only a few modifications. Peter also completely revamped the tutorials for the course by devising activities for those learning goals best addressed by hands-on experiences, such as, "You will be able to describe what you would see and feel if you fell into a black hole." (Don't worry, only modeling-clay people are harmed in this activity!) This year, it was time to bring learner-centred methods into the classroom; there are several components to this.

The biggest in-class change was the introduction of clicker questions implemented with a "Think-Pair-Share" or "peer instruction" choreography. A few (typically 3-5) times per class, we pose a question, ask the students

to think about the answer on their own and then ask them to vote using their clickers. The distribution of answers influences the next step: if more than about 80% of the students pick the correct answer, we move on to the next topic. If fewer than this fraction get it right, we usually ask them to Pair up with their neighbors and attempt to convince the other person of their answer. This is followed by a re-vote. If the students still haven't converged on the correct answer, we often quickly eliminate the 2 or 3 answers that are obviously incorrect, then ask the students to Share their thoughts on the remaining answers, leading to a review of the concept. Ultimately, we always confirm the correct answer.

We have required the students to buy the book Lecture-Tutorials for Introductory Astronomy by Prather et al. This book consists of several dozen worksheets on topics in basic astronomy; it would be useful for ASTR 310 as well as 311. Students work in pairs or threes on the activities, which typically consist of about 3 pages of questions that guide the students through the topic and deliberately introduce common misconceptions, asking the students to identify and correct these. We allow about 5 minutes per page, and during this time, Peter, Tessa Vernstrom (the in-class TA) and I wander through the room, providing help. Typically the lecture-tutorials are debriefed by working through one of the questions together using the document camera, or by asking a clicker question. Similar in-class activities are short (1-2-page) worksheets; often these consist of ranking tasks or other exercises that illuminate concepts not covered by the lecture-tutorials. Peter has designed most of these.

Two months into the term, we asked the students to rate, from "strongly disagree" to "strongly agree," the statement, "The [learning component] helps me learn astronomy." We combined the ratings "strongly disagree" and "disagree" as well as the ratings "agree" and "strongly agree". The results of this anonymous survey are shown on the next page. The traditional components of the course (lecture notes, homework and even the lecturing) still rate highly. The new learner-centred components (clickers, tutorials, lecture-tutorials and other worksheets) are also well-received in

general. Of course, the students' opinions do not necessarily reflect whether any of these tools actually work. The students' success on the final exam will give us some quantitative measurements of the impact of the new learning strategies.

There is one area in which the students are not completely accepting of the new methods: we have encountered some dissatisfaction with our decision not to post solutions to the lecture-tutorials or worksheets. Peter targeted this resistance by explaining that not having the solutions forces them to evaluate their confidence in their own learning; we will be looking for relevant comments in the course evaluations.

To liven up the class even more, we have the occasional demonstration and hand out Canadian Space Agency stickers for "good questions." My overwhelming impression is that the class is a lot more fun to teach than when using traditional methods alone. The students pay attention and are not shy about answering questions I pose or about sticking up their hands to ask for clarification. The clickers and progress on the lecture-tutorials and worksheets make it clear when students are struggling to understand a concept, meaning that the remaining slide-based lecturing can be made more effective more-or-less on the spot. Learning the clicker choreography was easy, and it was reassuring that the silence during Thinking quickly stopped feeling awkward. Many of these techniques will now be simple to import into other courses.

If you'd like to see how this works in practice, you're welcome to come to any of the remaining lectures (MWF at noon, in Hebb Theatre).

