



Fossils, Facies and Geologic Time; Active Learning Yields More Expert-Like Thinking in a Large Class for Senior Science Students

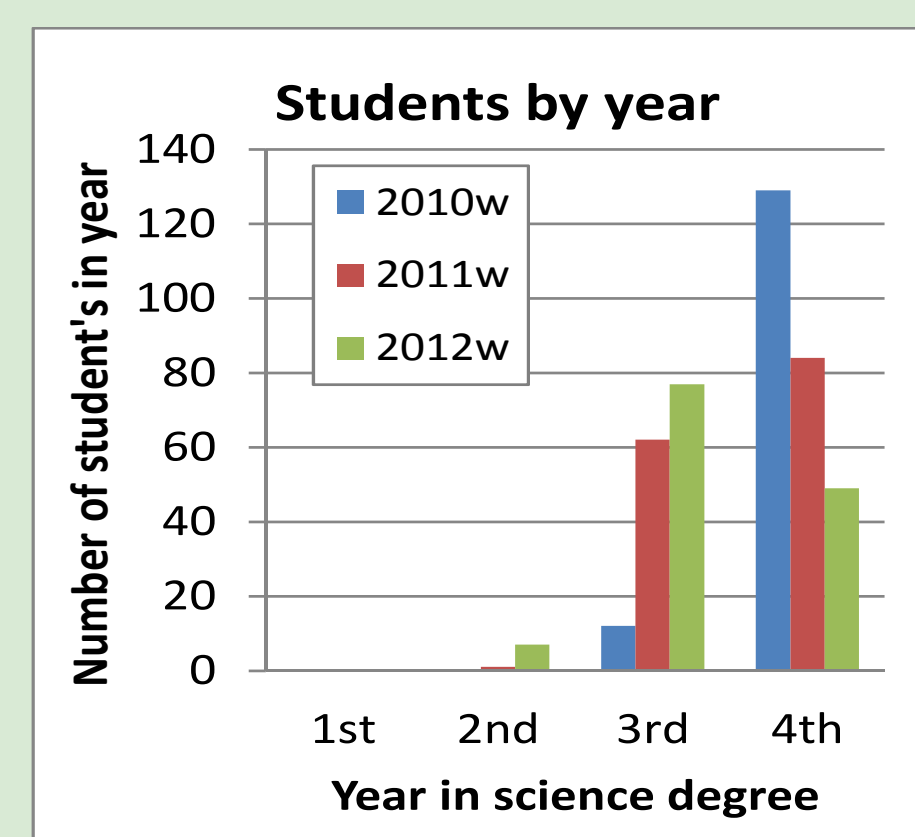
AGU, December 2012

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Context: Why transform this course?

Course

- o eos326, "Earth and Life Through Time".
- o Elective for 150 non-geoscience B.Sc. Students
- o 82-84% students in (2010 – 2012) are in Combined Major in Science ..or.. Life Science
- o Mostly 3rd and 4th year students
- o Younger students in 2011 and 2012.



Course Level Learning Goals

- o Express how the concept of geological time is an important factor in our understanding of the evolution of the Earth System.
- o Apply basic geological principles and geoscience knowledge in the interpretation of Earth's geological and biological history.
- o Describe how the biosphere has adapted to exploit various environments in the Earth's oceans over time.

Before 2010, then after

- o Primarily 3 x 50 min. lectures for 13 weeks.
- o 2 labs introduced 2007 – refined in 2010, 2011, 2012.
- o Active Fridays introduced 2011 – refined in 2012.

| Class & grading comparison ... | 2010 | 2011 & 2012 |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Labs / midterms / final | 1 / 1 / 1 | 2 / 2 / 1 |
| Hours: lecture / active | 35 / 2 | 22 / 13 |
| Final exam: MC / Short Ans. weights | 50 / 50 | 40 / 60 |
| Grading Scheme: | <ul style="list-style-type: none"> - Final exam: 45% - 1 midterm: 25% - 1 lab exercise: 25% - clickers in class: 4% - homework: 1% | <ul style="list-style-type: none"> - Final exam: 40% - 2 mid terms: 15 / 15% - 2 labs: 10 / 10% - clickers in class: 3% - homework: 4% - diagnostic test: 1% - activities in class: 2% |

Course improvement objectives:

Incorporate known "best practices" into a senior science elective for 150 students.

- o Have senior, non-geoscience, BSc. students study the tightly coupled geologic and biologic history of Earth using the tools and modes of thinking of experts.
- o Enable non-specialists to engage in the unique aspects of geoscientific thinking.
- o Incorporate more active learning within class time.
- o Enhance the variety of ways in which students engage with new concepts and skills.
- o Increase individual interactions with, and feedback from, experts (instructor & TAs).
- o Minimize low level content delivery in lectures.
- o Balance the competing needs of large enrollment against the importance of the hands on experiences.

Some pointers:
Teaching activities at <http://serc.carleton.edu/NAGTWorkshops/time/activities.html>
Eosc326 described at <http://serc.carleton.edu/NAGTWorkshops/time/courses/60688.html>
Activity: Biozones, stratigraphic log correlation, and corresponding interpretation of paleoenvironments described at <http://serc.carleton.edu/NAGTWorkshops/time/activities/61334.html>.
Also includes: - The three page worksheet for students + Instructor's PowerPoint for running the activity + Solutions; - Generic guidelines for running group-based worksheet activities, & Worksheet timing chart.

Initiatives: What changes were made ?

Pedagogic choices

- o Pre-course diagnostic + remedial content.
- o Text; weekly readings + online quizzes.
- o 2 Lectures/week with clickers. Eg. →
- o 2 hands-on laboratory experiences.
- o 8 "active Fridays" (no lecturing)

"Active Fridays"

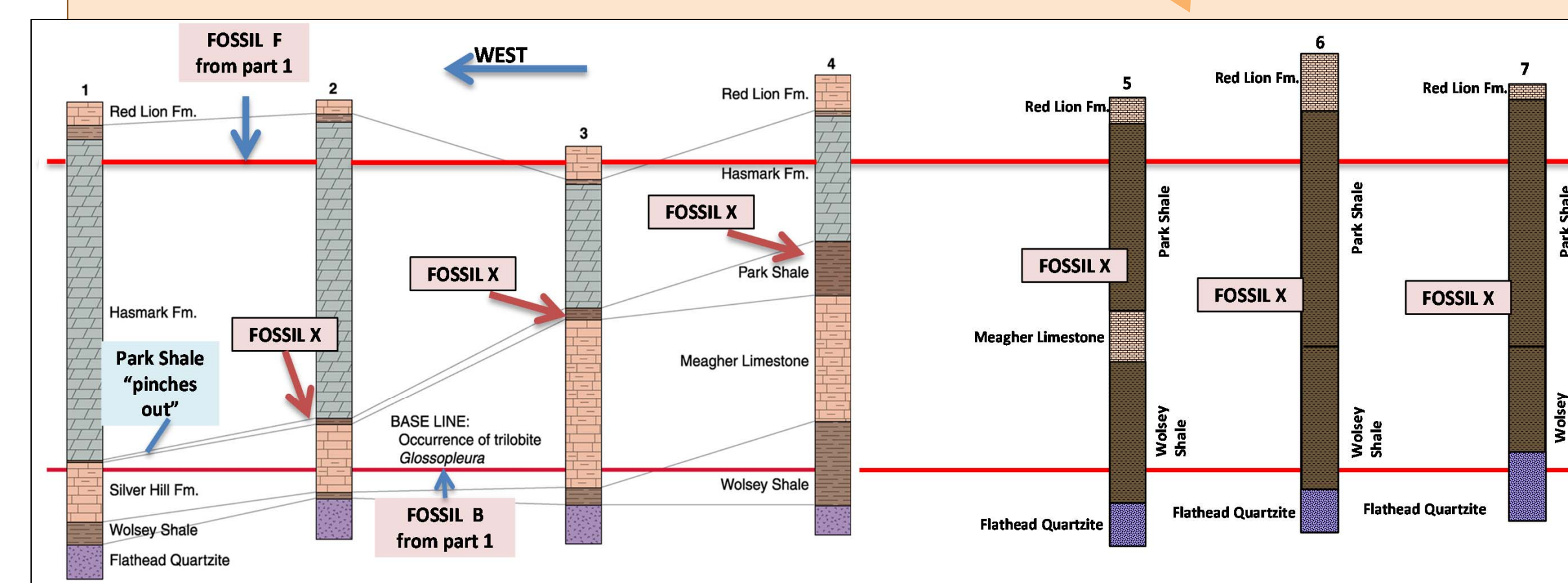
- o Group work (4-6), worksheets, 50 minutes
- o Apply knowledge, practice skills, Lab follow-up
- o Enables expert ↔ novice interaction
- o Well liked (data to the right)

Lab experiences

- o 150 students in 3 groups
- o Enables expert-novice interaction for a large class
- o I.D. fossil & rock samples
- o Analyze for genus, age, structures and environment
- o Construct litho- & bio-stratigraphies
- o Mix of in-lab, at-home and in-class group work.

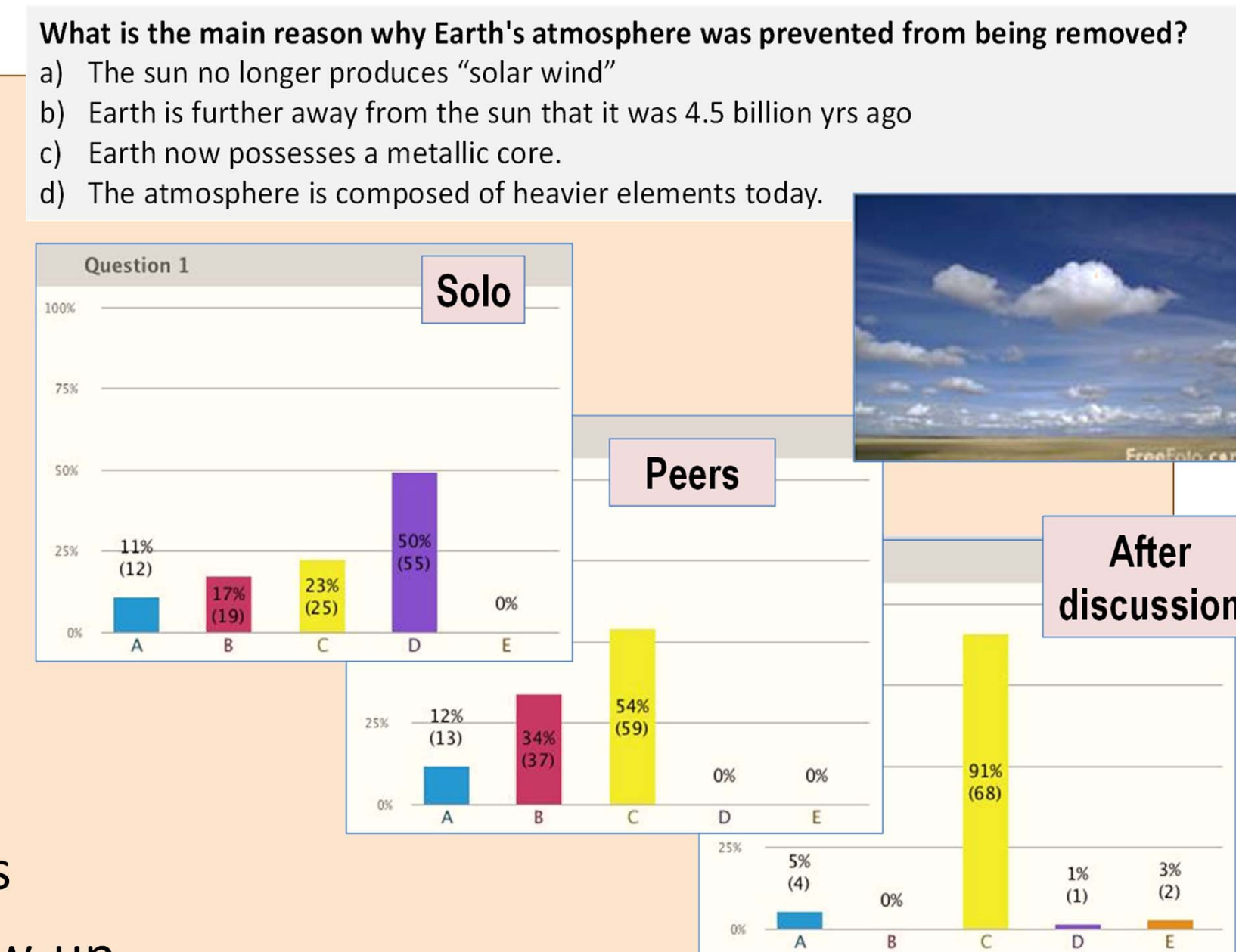
Complexity of thinking

- o **Before** (also for labs): simpler, 3-section settings.
- o **Now**: more sophisticated settings; used in class with expert guidance as clicker questions, group activities and in exam questions.



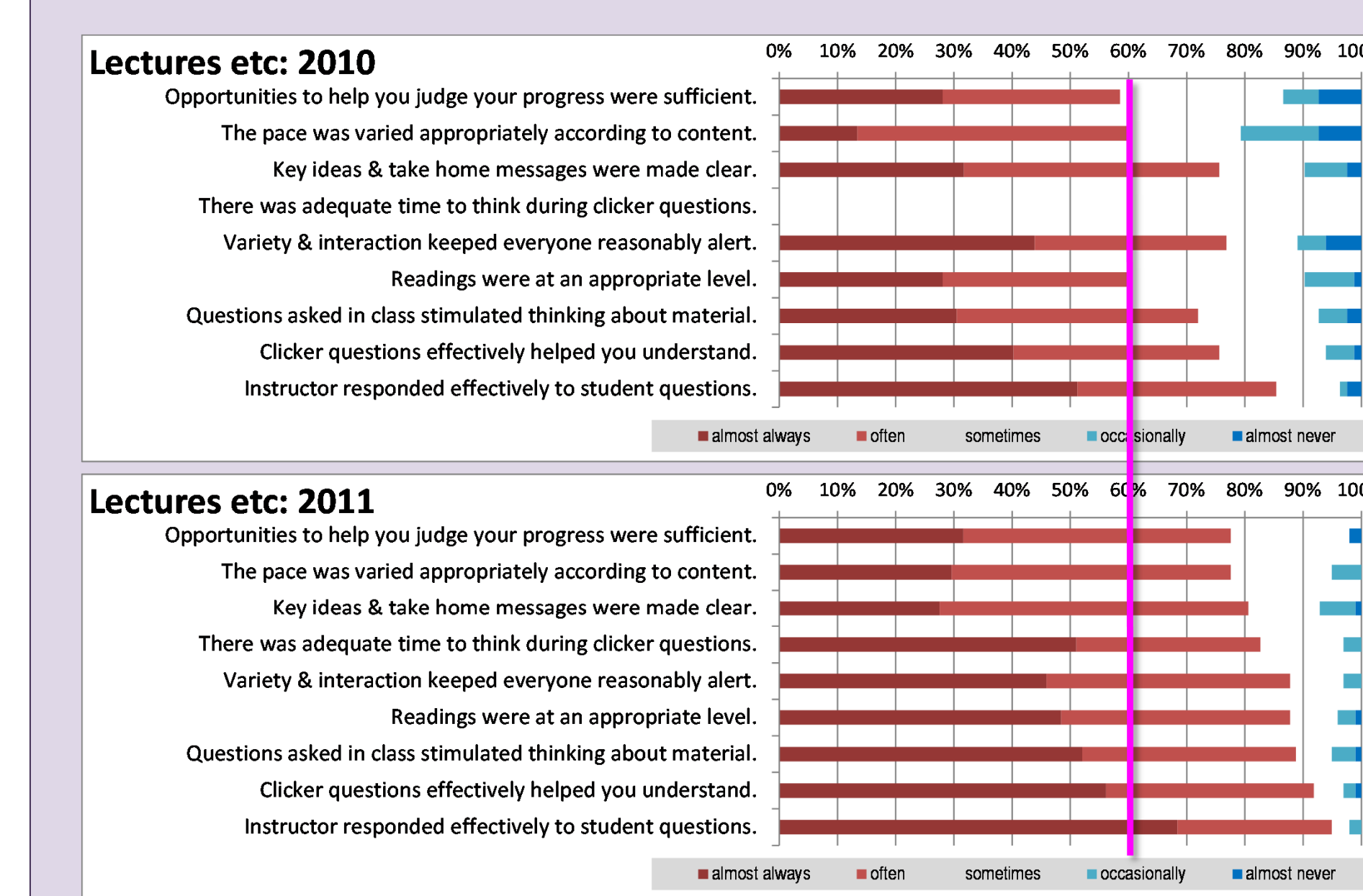
Compare two 50 minute classes:

- o What are students doing during two types of classes?
- o Class observations protocol is active research in Faculty of Science, UBC (2012).



Results: What evidence of improvements ?

Student perceptions of value



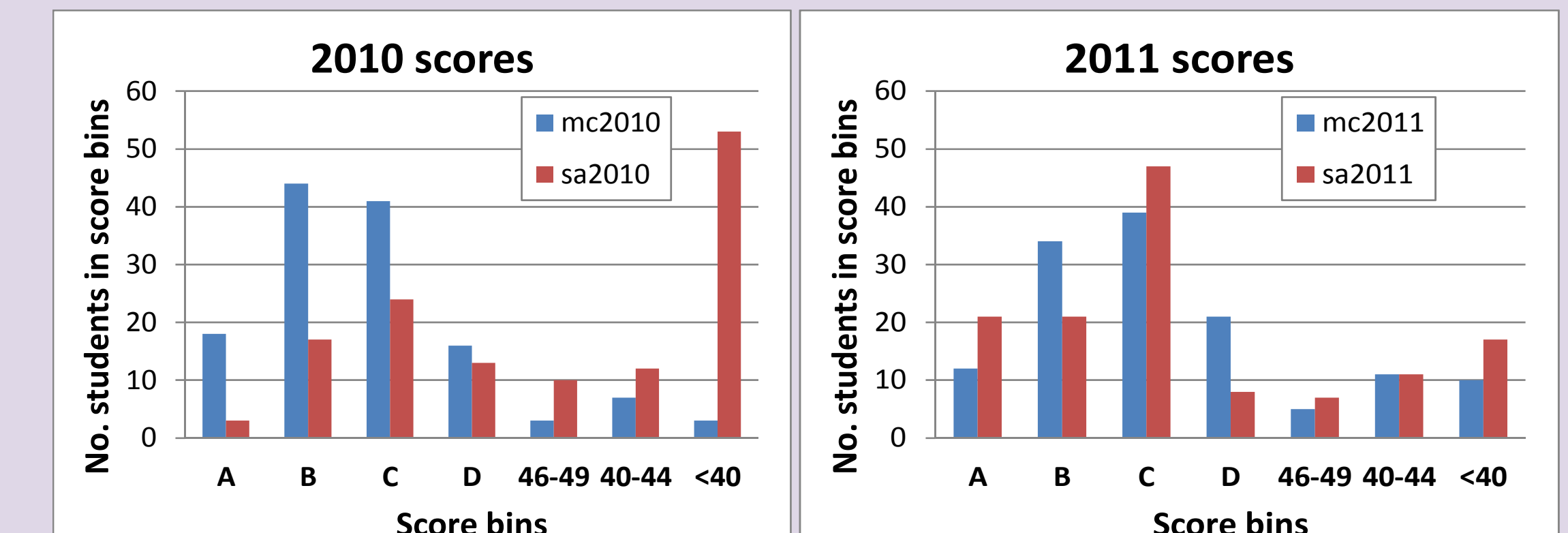
Student engagement:

- o Avg lecture: 2010 → ~80% 2012 → ~90% Grp-work class, 2012: @30mins: ~90% @45mins: ~75%

Different exams ...

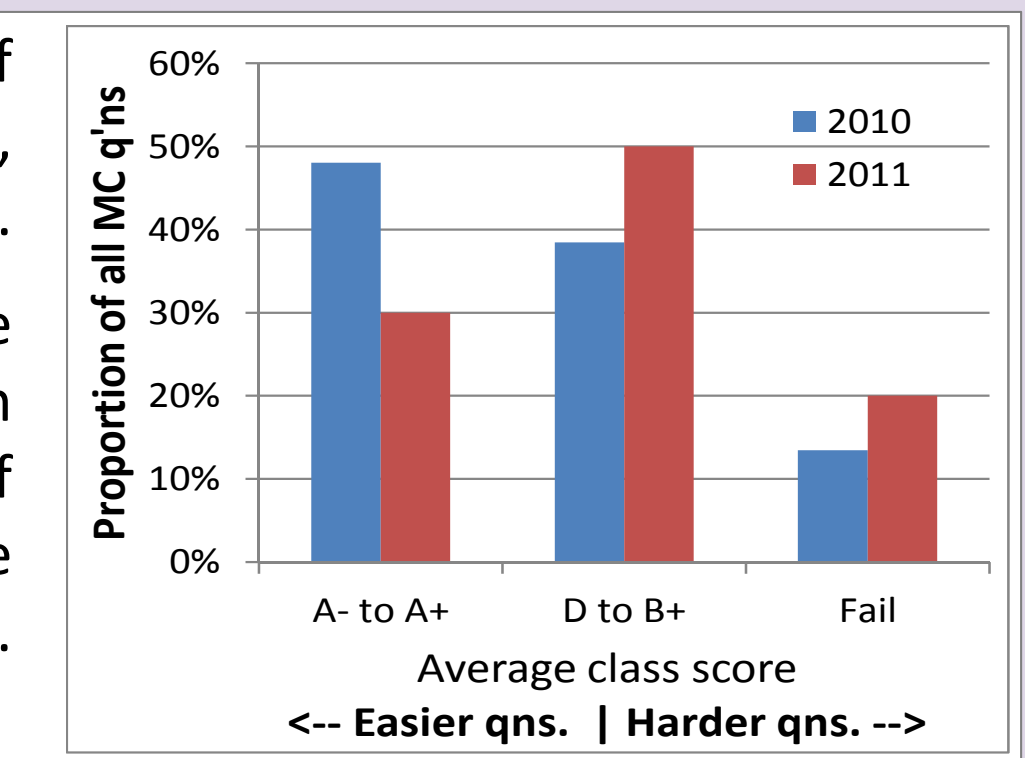
Different results

- o 2010: Fewer short answer and much more poorly done
- o 2011: More figures, more short answer questions, AND more sophisticated student answers.
- o Also, Multiple choice questions were harder and more discriminating.



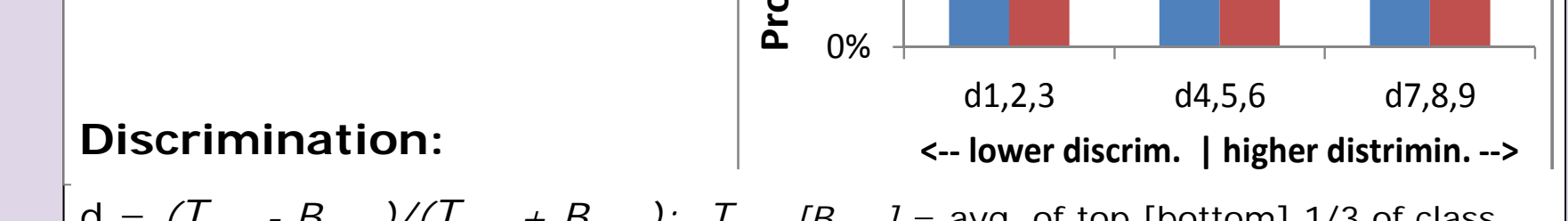
Number of questions as % of total number of MC q's, binned by avg. class score.

Eg. In 2010, 12% of the questions yielded an average class score of 0 - 60%. These were 'harder' questions.



Number of q's as % of total number of MC q's, binned by discrimination.

Eg. In 2010, 11% of q's were 'highly' discriminating.

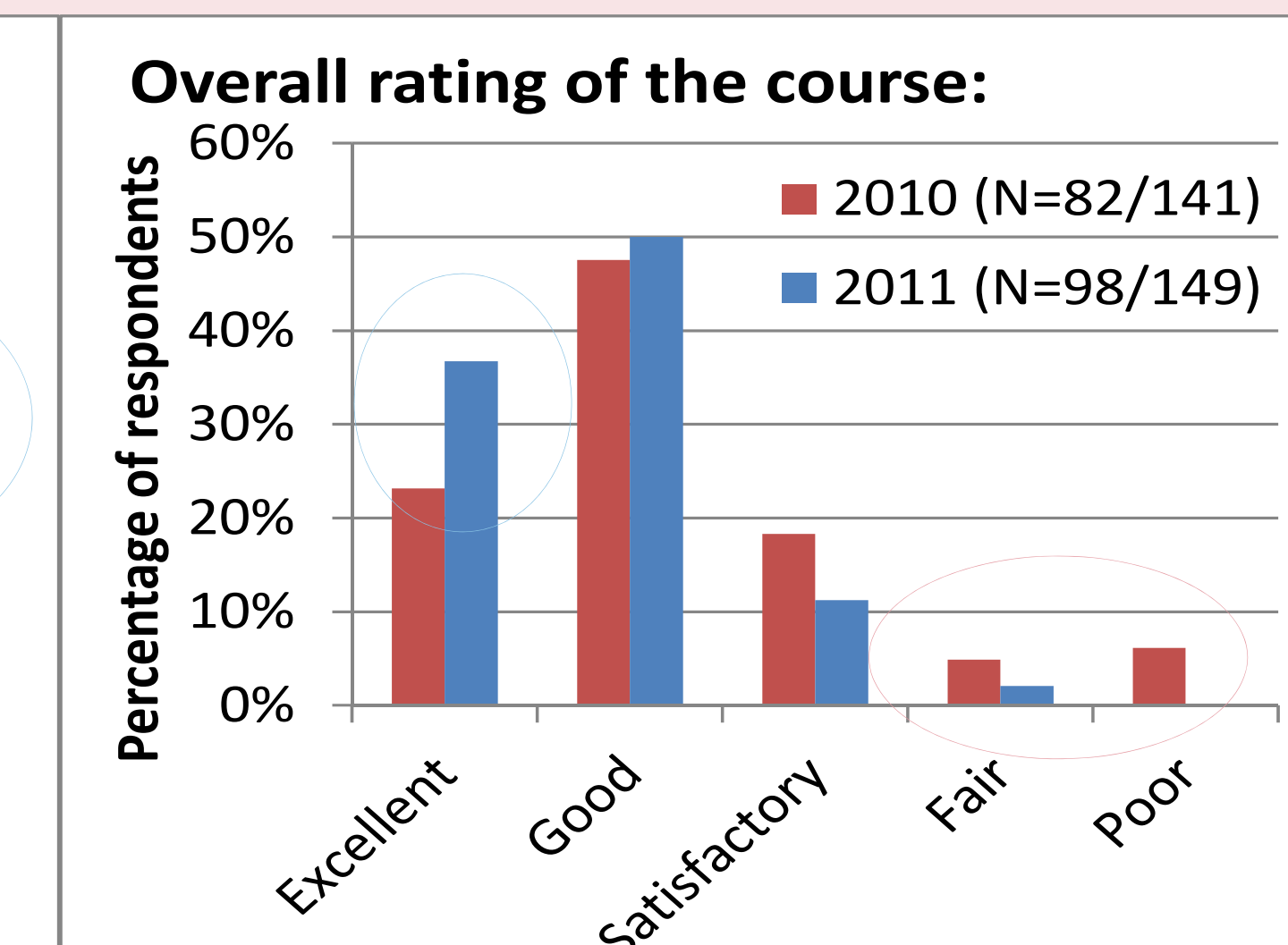
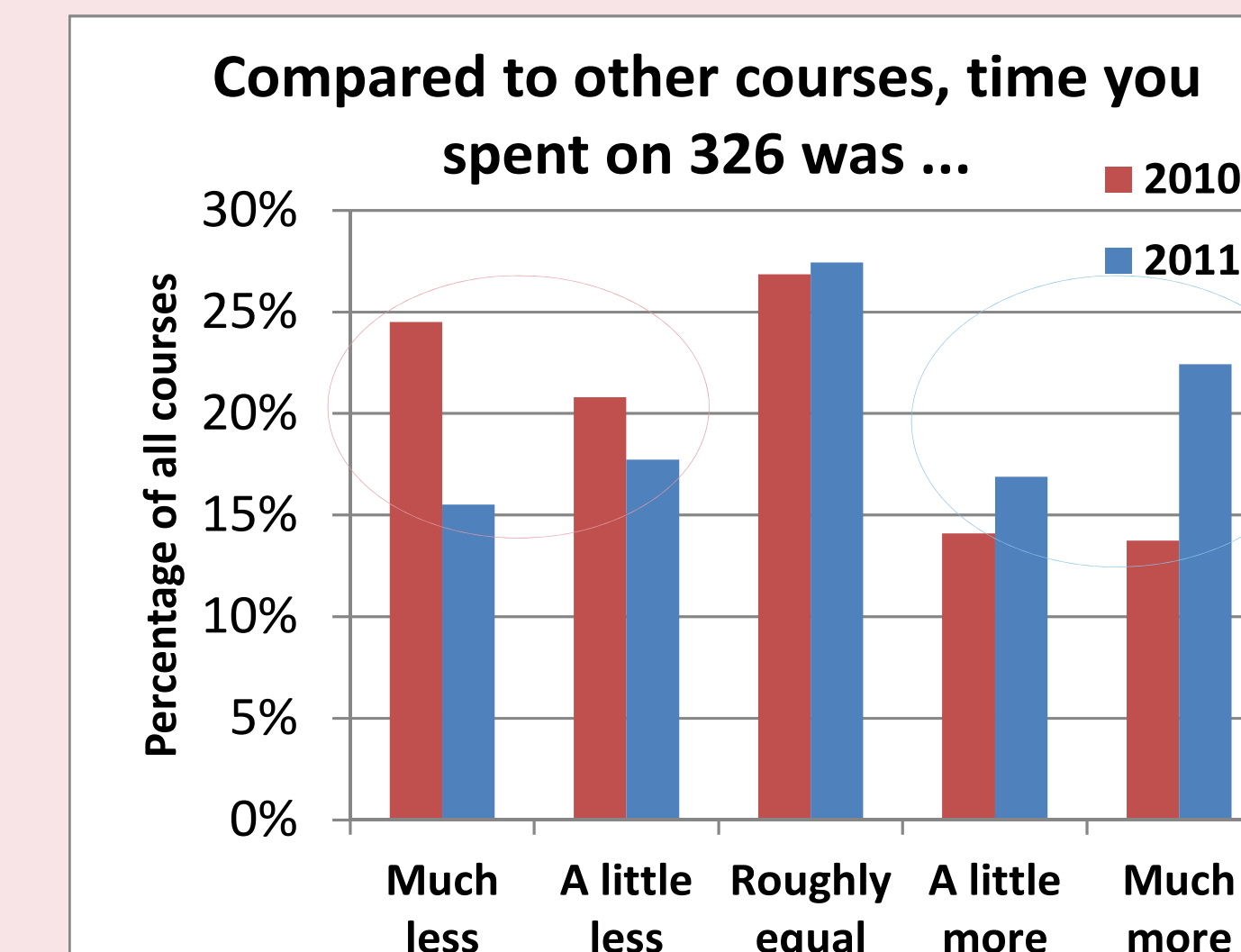


Workloads & Overall Rating

- o Compared to other 3rd / 4th year science courses, more balanced work loads in 2011 than 2010.

AND

- o higher overall rating of this course in 2011 than 2010.



Compare 2010 / 2012 lab work

Compare 2010 / 2011 short answer questions in exams

Pin lab comparisons here

Pin lab comparisons here

Pin exam comparisons here
 File "SAquestions.docx" pg1.

Pin exam comparisons here
 File "SAquestions.docx" pgs 2,3