

Lecture-Tutorials: Incorporating Active Learning into Traditionally Lecture-Based Courses



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I. Introduction

Lecture-Tutorials (LTs) are a research-validated technique to incorporate active-learning into content-heavy, traditionally lecture-based courses. LT activities consist of worksheets, completed in-class in pairs or small groups, which are designed to help students learn conceptually difficult material. Founded on the constructivist learning principle that new knowledge is built on prior knowledge, these activities seek to systematically elicit students' existing ideas about a topic, confront any potentially problematic misconceptions that may exist, and offer a resolution to facilitate new conceptual development. Research done in the field of undergraduate astronomy education has found that the use of LT activities improves student learning of conceptually difficult topics beyond what is typically achievable by lecture alone [1,2].

II. Context

- Astronomy 150 is one-semester introductory special-topics course for non-majors.
- The Fall 2015 topic was cosmology (the origin and evolution of the Universe).
- 34 students were enrolled, with a mix of astronomy background and year in school.
- The course followed a traditional format utilizing a textbook and lectures for the majority of content delivery.

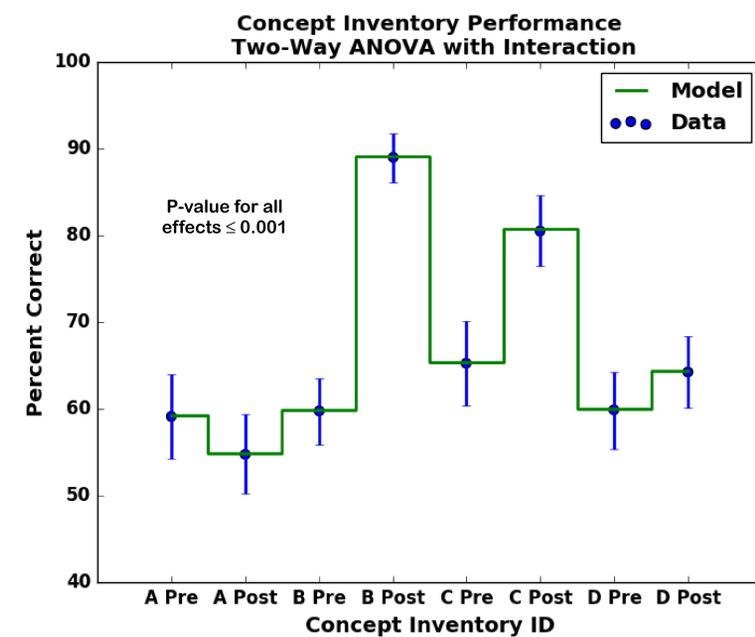
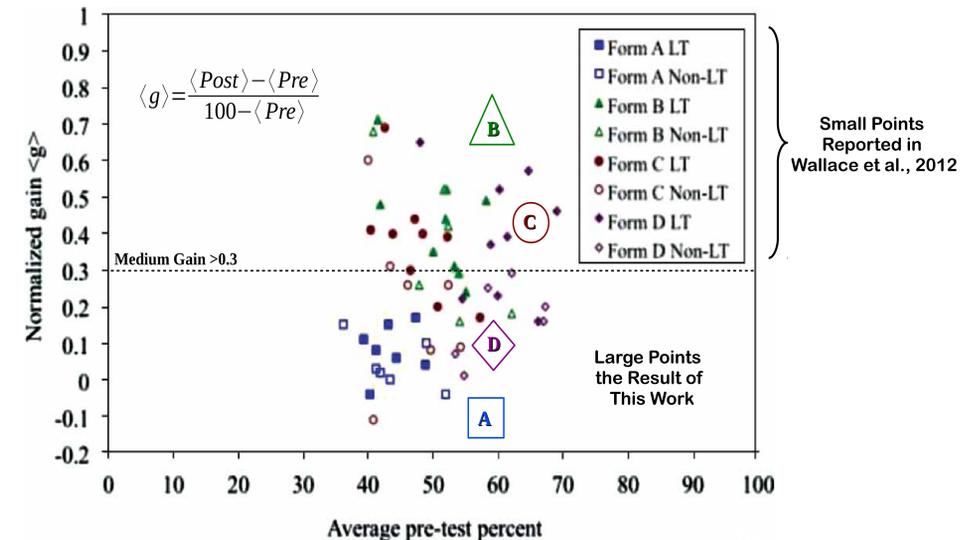
III. Methods

- In order to improve the quality of instruction, a new suite of five cosmology-specific LT activities were implemented throughout the semester.
- All LT materials, including assessment tools and rubrics, were developed by Wallace, 2011 [3] and were selected to permit comparison to previously published results.
- LT activities were used to reinforce instruction of four core cosmology topics that have been identified to be conceptually difficult to learn [4].
- Student learning gains for each topic were measured using four corresponding concept inventories administered at the beginning and end of the semester.
- An effort was made to adhere to the best practices for LT implementation, as outlined by Brogt, 2007 [5].

| Inventory ID | Topic | LT Order |
|--------------|---------------------------|----------|
| A | Hubble Plots | 2 |
| B | The Big Bang Theory | 4 |
| C | Evolution of the Universe | 3* |
| D | Dark Matter | 1 |

*Two LTs, one week apart

IV. Results



V. Conclusions

- Measured learning gains are consistent with those reported in the literature [2].
- On all four inventories, students performed at least as well as non-LT classrooms.
- Students achieved medium-level learning gains on two inventories, which is rarely achieved through lecture alone.
- Despite uniform implementation practices for all LT activities, statistically significant differences in student performance exist between different inventories.

VI. Acknowledgements

This work was conducted as part of a Delta Teaching-As-Research Internship. I would like to thank Dr. Amy Barger, my faculty partner in this project and the instructor of record for Astronomy 150, for her assistance and for sharing her teaching experiences with me. I would also like to thank Dr. Devin Wixon of the Delta Internship Program and my fellow cohort of Fall 2015 interns for their support and guidance. The Delta Program is a project of the Center for the Integration of Research, Teaching and Learning (CIRTL) on the University of Wisconsin-Madison campus. This material is based on work supported by the National Science Foundation and Great Lakes Higher Education Corporation.

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