

More Learning, Less Memorizing: Increasing Engagement and Understanding using Interactive Planetarium Shows

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Objectives

- ▶ To test the hypothesis that highly interactive planetarium shows in small groups are an effective tool for increasing student understanding of key astronomical concepts in large first-year astronomy classes.



Literature Review

- ▶ Planetarium shows have been shown to improve students understanding of astronomy concepts (seasons) (Plummer, 2008) and understanding and attitudes in general (Malon & Bruce, 1982).
- ▶ Understanding in undergraduate astronomy has been improved using other interactive approaches, such as cooperative quizzes (Zeilick, 2004).
- ▶ Abundant research in school science points to the potential learning gains in active, engaging learning experiences in which students are constructing their own knowledge (e.g., Hodson, 2009)



Learning Theory Foundations

- ▶ Sociocultural constructivist theory (Vygotsky, 1962)



- ▶ Cultural-historical activity theory (CHAT) (Stetsenko, 2012)



- ▶ Students become knowledge producers (Woods, 1998)

Research Questions

- ▶ Do interactive (student-led) planetarium shows improve student understanding of concepts in science?
- ▶ Are student-led planetarium shows better at increasing student's understanding of astronomical concepts than non-interactive shows?

Research Context

Astronomy 101 course characteristics	
Students	<ul style="list-style-type: none"> • 1350, ethnically and linguistically diverse non-science majors
Study participants	<ul style="list-style-type: none"> • Approx 800 consented, 50 were chosen for focus groups
Course components	<ul style="list-style-type: none"> • Bi-weekly lecture (1 hour) • Weekly tutorial (1 hour) led by a TA • Planetarium shows (20 minutes), 3 total shows per student • Mastering Astronomy online activity package • Clickers Quizzes • Online discussions • Textbook
Planetarium types	<ul style="list-style-type: none"> • Instructor-led – a course TA guided students through required content • Student-led – students explored content, using the controller, with minimal guidance by instructors

Methodology

Quantitative Methods

- i. Used a 3 item questionnaire to collect data about their learning in the:
 - o Tutorial,
 - o Instructor-led Planetarium
 - o Student-led Planetarium.
- ii. Questionnaires were administered concurrently in each learning experience at the beginning, middle and end of the course.
- iii. A pre-test and a post-test questionnaire were given at the beginning and near the end of each learning experience

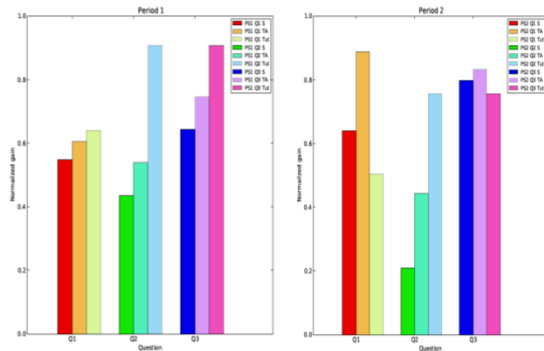
Qualitative Methods

- ▶ We conducted 5 focus groups of approximately 10 students each to collect qualitative data about their experiences in the course, focusing on the planetarium.

Quantitative Data Analysis

- ▶ There were few instances where differences in students performance gains on the pre/post tests between learning experiences was statistically significant.
- ▶ Among significant differences, students performed the poorest in student-led planetarium shows.
- ▶ Tutorials appears to be the experience in which students demonstrate the greatest performance gains.
- ▶ There were also some gendered differences noted. Males scored higher on average in all of the experiences, however pre/post test gains appear to be equal.

Quantitative Analysis



Qualitative Analysis

Name	Duration	Reference	Created On	Created By	Modified On	Modified By
Q1	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q2	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q3	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q4	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q5	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q6	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q7	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q8	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q9	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q10	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q11	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q12	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q13	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q14	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q15	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q16	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q17	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q18	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q19	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q20	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q21	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q22	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q23	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q24	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A
Q25	15	5/14/2011 11:07 AM	5/14/2011 11:07 AM	A	5/14/2011 11:07 AM	A

1. Attitudes

"I enjoyed it but I didn't find it really changed anything or that I learned anything from it, I guess I'm sort of neutral, I still liked it but it didn't change anything."

"I was really excited for it. I thought it was going to be a huge massive thing on the top of the building, but it actually is just this small little blow-up igloo, but it actually is still really cool. I actually enjoyed it."

1. Attitudes cont.

- ▶ Students were generally very positive about the lecture and lecture-based activities.
- ▶ Students were moderately positive about tutorials and the instructor-led planetarium (this depended largely on the TA)
- ▶ Students had mixed attitudes about the planetarium in general and the student-led planetarium (students had the most negative attitudes about this)

2. Engagement

"I just think it is a more engaging experience, being inside the planetarium is more engaging than studying in a book, and you're more likely to participate too, because there were questions in my planetarium as well, so I think you are more likely to participate, it's just the actual set up and planning that was the problem."

"It was engaging to actually see the topics we were talking about whereas it's, I think, a lot easier to not pay attention in the classrooms because it isn't as immersive."

2. Engagement cont.

- ▶ Students were very engaged in the experiences associated with the lecture, and the instructor-led planetarium
- ▶ Students were moderately engaged in the tutorial and the student-led planetarium

3. Learning Experiences

"I enjoyed it but I didn't find it really changed anything or that I learned anything from it, I guess I'm sort of neutral, I still liked it but it didn't change anything."

"I think it was nice to see the way that you could zoom in and out of the disc of the solar system and to see a bird's eye view of it, but the thing I didn't like the most was that I could have been in tutorial learning the concepts the TA was teaching us instead of just looking at pictures."

3. Learning Experiences cont.

- ▶ Students had very polarized views on learning
- ▶ Students felt the most effective learning experiences were those associated with the lecture.
- ▶ Students felt the least effective learning experiences were those associated with the planetarium.

3. Learning Experiences cont.

- ▶ Learning experiences containing these concerned students.
 - i. Test/exam preparation (memorization)
 - ii. Language (non-native speakers)
 - iii. Lack of structure (Planetarium)
 - iv. Lack of time (Planetarium)
 - v. Lack of Relevance (Planetarium and Tutorial)
 - vi. Too advanced (Lecture, one professor)
 - vii. Unskilled TA (Especially Planetarium, but also Tutorial)

4. Understanding

"It didn't really help except that it enforced the fact that these are the planets and this is the way they are aligned."

"I liked it, I liked being able to navigate through space and see the distance, and like seeing the relative sizes of things."

"Yeah like it was nice zooming in and zooming out and being able to go and see all the different rotations and different orbits that each planet took, and to actually visualize what we had been learning, that helped and it was interesting."

4. Understanding cont.

- ▶ Students expressed what greatly aided their understanding were the activities associated with the lecture.
- ▶ Students expressed what moderately aided their understanding was the instructor-led planetarium
- ▶ Students expressed what did not aid their understanding was the planetarium in general and the student-led planetarium.

Summary

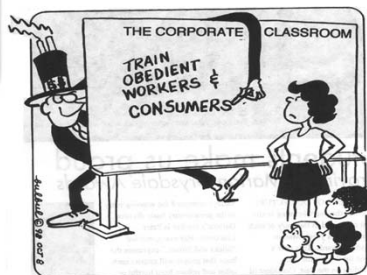
“Yeah, and one of my friends had to go to the planetarium the week before the midterm, and she was really upset that she had to go to the planetarium before the midterm because she didn’t get the review session, and she was like the planetarium was a waste of time, because the stuff you do in the planetarium doesn’t really show up on the midterm, so it just really isn’t as important.”

Conservative culture of school science



Knowledge
Producers

Knowledge
Consumers



Discussion

1. We suggest an explanation for these results may be that students have been socialised in school to be knowledge consumers, rather than knowledge producers (Wood, 1998).
2. This may be the result of neoliberal influences in mass schooling, that have resulted in the need for high-stakes, standardised assessments.
3. As a result, students are highly focused on assessment and grades, and are concerned the planetarium is ineffective in providing an experience conducive to these.
4. Students see a lack of cohesion between planetarium experience and course assessments
5. Planetarium appears to be engaging, (involving) but still is perceived to be an inferior learning experience

Some Suggestions

Given the unlikelihood that neoliberal/capitalist influences will cease, the following suggestion might make the planetarium a more viable learning experience:

- Planetarium needs to be more structured/organized/relevant (i.e. more assessable)
- Assessments need to 'match' the learning experience
- Assessments for student-led experiences need to matter.
- Knowledge constructed by students needs to be recognized and count for grades.

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Thank You!

If you would like more information on this research or presentation, please contact me at:

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