

Research Study Profile Sheet

Title: Increasing Learning in Introductory Geoscience Courses Using Lecture Tutorials

Authors: Kortz, K., Smay, J., & Murray, D.

Journal: Journal of Geoscience Education

Date: 2008

Summary/Abstract:

Students often leave introductory geoscience courses without learning the scientific perspective, and we developed Lecture Tutorials to help alleviate this problem. Lecture Tutorials are 10-20 minute interactive worksheets that students complete in small groups in class after a short introductory lecture. They are specifically designed to combat alternative conceptions and increase learning on difficult topics. Our study shows that Lecture Tutorials increase student learning in the classroom more than just lecture alone. On related multiple choice questions asked before and after the Lecture Tutorial (but after a short lecture on the topic), student scores increased 19%. When a subset of these questions was given before and after an extended lecture instead of a Lecture Tutorial, student scores did not increase by a statistically significant amount. On the multiple choice assessment questions given on exams relating to the information covered in the Lecture Tutorials, students who completed the Lecture Tutorials scored significantly higher than students who heard just lecture. In addition, students feel that they are an important and useful part of their learning experience. Lecture Tutorials are being disseminated and are available for instructor use.

Research Questions:

1. What is the effectiveness of Lecture Tutorials on student learning?
2. What is the effectiveness of Lecture Tutorials on student learning compared to lecture?
3. What are student attitudes towards the use of Lecture Tutorials in their introductory geoscience class?

Research Design/Methods:

After creating the Lecture Tutorials, we tested them in nine classes taught by three instructors at four colleges. One college is a large community college in the Northeast (Classes 1, 3, 4, and 7 in Table 1), one is a mid-sized community college in the Midwest (Class 2), one is a mid-sized community college in the West (Classes 5 and 8), and one is a large state university in the Northeast (Classes 6 and 9). The students tested for the Lecture Tutorials represent a diverse spectrum of students in terms of race, ethnicity, age, and educational background. No data were collected as an outside measure of student abilities (e.g. SAT scores). The length of the classes ranged from 50 minutes to 3 hours. Class size ranged from 16 students to 53 students, and students took these courses primarily to satisfy their general education science requirement. All the courses were Introduction to Physical Geology except Classes 1 and 7

which were Natural Hazards. The number of Lecture Tutorials given in each of the classes varied and ranged from 2 to 13 (Table 1).

To evaluate the success of Lecture Tutorials, we used several different methods focusing on each of our overall questions. We collected and examined many of the completed Lecture Tutorials to verify the students were correctly answering the questions, indicating they were learning. We gave multiple choice questions before and after the Lecture Tutorial. We also gave the same multiple choice questions before and after an extended lecture covering the same topics as the Lecture Tutorial in a few classes to determine if the Lecture Tutorial caused a larger change than lecture alone. We tested some of these multiple choice questions on midterm exams. Geoscience Concept Inventory (GCI) (Libarkin and Anderson, 2005; Libarkin and Anderson, 2006) scores were collected at the beginning and end of the semester. In addition, we surveyed several classes to learn about their opinions relating to the Lecture Tutorials.

Analytical Methods:

- T-tests and normalized gain calculation of mean student performance of pre-post Lecture Tutorial multiple-choice questions

Results:

Pre-post questions:

- Students who participated in Lecture Tutorials showed a statistically-significant increase in pre/post multiple-choice question performance (via t-test analysis)

		Pre	Post	Absolute Gain	Normalized Gain	# of Students	# of Questions	p
1	Igneous rock mineral sizes	0.59	0.73	0.13	0.33	83	480	<.003
2	Sediments and sedimentary rocks	0.48	0.65	0.18	0.34	137	6873	<.001
3	Metamorphic rocks	0.54	0.78	0.24	0.53	116	696	<.001
4	Rock cycle	0.62	0.77	0.15	0.40	94	555	<.001
5	Flood frequency curves	0.50	0.66	0.17	0.33	43	215	<.01
6	Climate change and CO ₂	0.47	0.79	0.32	0.61	159	890	<.001
7	Seafloor ages	0.65	0.77	0.12	0.35	67	267	<.01
8	The outer core	0.57	0.71	0.15	0.34	121	363	<.003
9	Locations of earthquake	0.72	0.85	0.13	0.47	78	312	<.003
10	Earthquake intensity and magnitude	0.79	0.87	0.08	0.40	52	155	<.10
11	Tsunami	0.53	0.74	0.21	0.44	69	414	<.001
12	Magma source depth	0.67	0.87	0.21	0.62	42	162	<.001
13	Volcanoes on other planets	0.65	0.79	0.14	0.41	81	567	<.001
	Average	0.58	0.77	0.19	0.43	443	1973	<.001
	GCI	0.58	0.74	0.16	0.35	353	400	<.001

Table 2. Pre-Post results of multiple choice questions for each Lecture Tutorial. The scores are given as a proportion of students who answered the questions correctly. p is the probability that the gain in scores is a result of chance. Normalized gain is (Post - Pre) / (1 - Pre). The GCI row refers to the seven embedded questions gathered from the GCI.

Lecture Tutorial vs. extended lecture:

- Figure 4 compares the results for the pre- and post-questions used for Lecture Tutorials and extended lectures. We compared the results of students listening to the extended lectures to the results of all students who completed Lecture Tutorials. In addition we compared the results of the extended lectures to a subset of similar classes who completed the Lecture Tutorials. These matched classes were similar to the classes used for the extended lecture in that they were taught by the same instructor at the same school covering the same material. The matched Lecture Tutorial results are similar to the results when using all the students who completed the Lecture Tutorial.

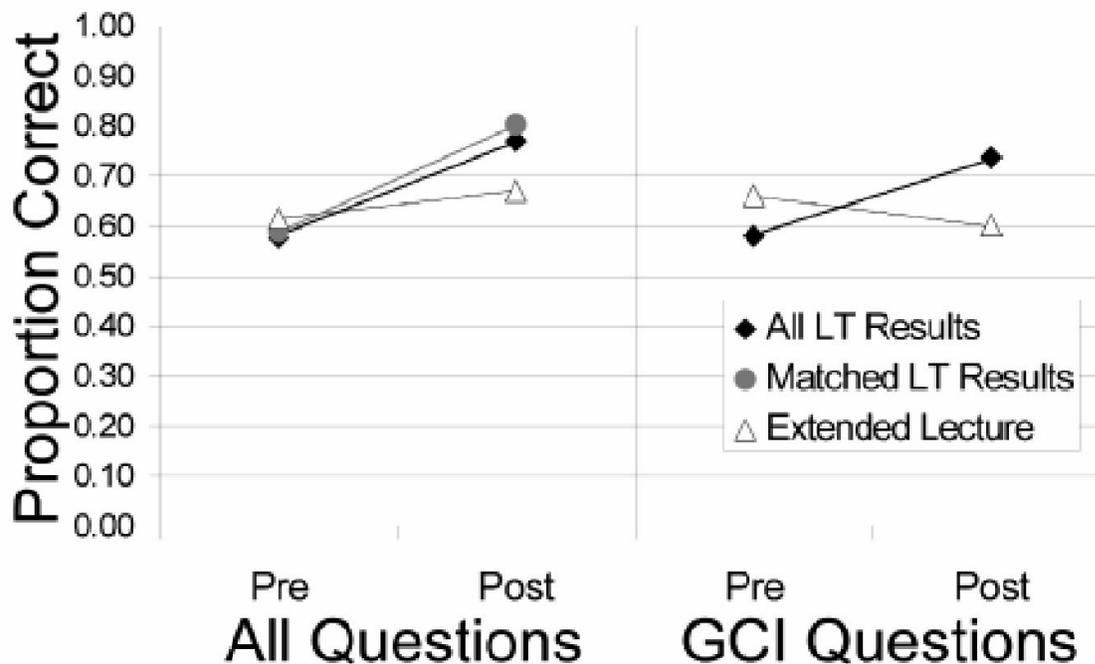


Figure 4. Pre-Post results for Lecture Tutorials compared to extended lectures. The matched Lecture Tutorial results are for classes that were similar to the classes used for the extended lectures (same instructor at the same school). Two of the five GCI questions were not used in the matched Lecture Tutorial results, so the matched Lecture Tutorial results for the embedded GCI questions are not shown.

Student Attitudes:

- Students responded to the question "The in-class exercises helped with my understanding of the subject" on a Likert scale, with 6 = strongly agree, 5 = agree, through 1 = strongly disagree. Ninety-nine percent of students (n = 209) agreed with the statement.
- There were no negative comments that pertained to the Lecture Tutorials on this survey. Because the student written response agreed with the student response on the Likert-scale question in all cases except one, we view these results as valid and reliable.