

A Comparison of Grades for Students Taking a Traditional Lecture Course With and Without the Laboratory

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Reprinted From: Stanholtzer, S. 2003. A comparison of grades for students taking a traditional lecture course with and without the laboratory. Pages 317-320, in *Tested studies for laboratory teaching*, Volume 24 (M. A. O'Donnell, Editor). Proceedings of the 24th Workshop/Conference of the Association for Biology Laboratory Education (ABLE), 334 pages.

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Introduction

Most science educators could give many reasons that a laboratory experience is a valuable learning tool. It embodies many of the teaching techniques shown to enhance learning. The list would include the following justifications:

- It provides hands-on experience
- It emphasizes active learning
- It fosters collaborative learning
- It provides activities for investigation
- It demonstrates the mechanism of science
- It provides a more informal learning environment than lecture
- It encourages student-teacher interaction

In addition, most instructors can point to many case studies that provide evidence for this contention. However, studies with data comparing the performance of students taking lab with those taking only the lecture are hard to find.

At Georgia Perimeter College, a 2-year transfer institution of the University System of Georgia, a change in the State Regent's curriculum provided an opportunity to obtain data to help measure the value of labs. The old core curriculum required an eight-hour lab-science sequence for a non-science major. Beginning in 1998, this was changed so that only seven hours of science were required which did not need to be sequential. In addition only one lab was required.

The various science disciplines responded to the new policy in a number of ways. Both the astronomy and geology sequences were converted into two non-sequential courses with lab optional. Survey chemistry maintained the sequence, but made lab optional.

Biology was so convinced that labs should be maintained that rather than make labs optional, some courses were shortened to 3 hours including lab.

In an effort to support the biologists' decision to keep the labs, I realized that we could look at data from our other science offerings in which the lab was optional. In those classes we have students side-by-side in lecture, some of whom are taking lab and others who are not. Data on their lecture performance were compiled in order to compare the two groups.

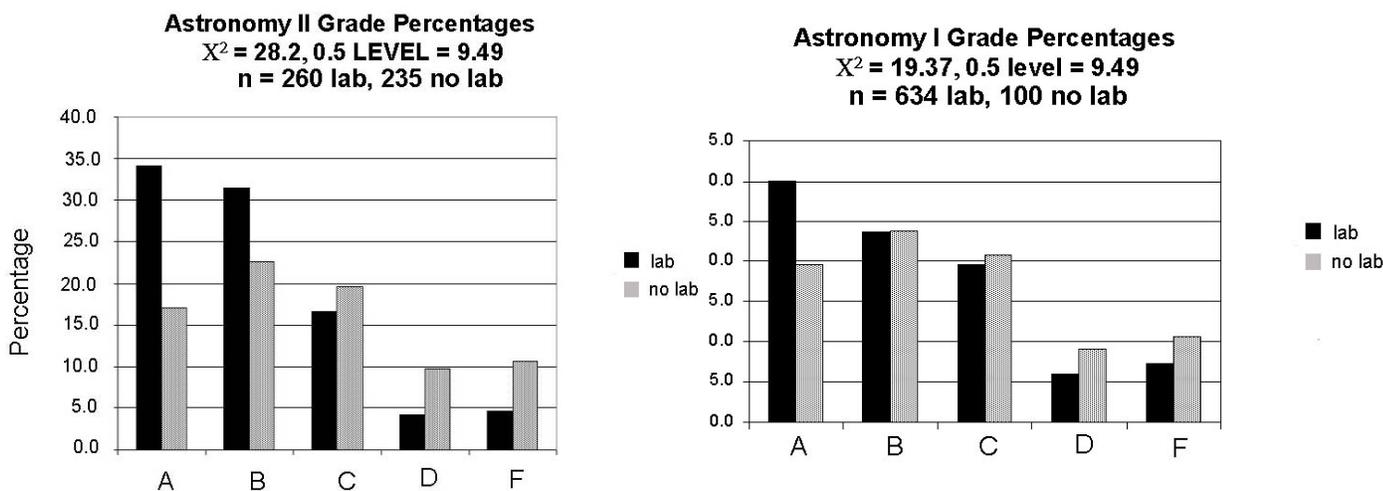
Procedures

The data compiled were from 188 classes of geology (55), astronomy (48) and survey chemistry (85). These were taught from fall 1998 to summer 2000 on five campuses, including both day and evening classes. In addition, they included classes taught by full- and part-time instructors and face-to-face as well as a few online classes. The grades of 4,603 students (3363 enrolled in lab and 1240 in lecture only) were analyzed.

The grade distributions for lecture of the students taking the lab and those who had elected not to take the lab were compared for each of the six courses using the chi-square test. In addition, withdrawal rates between the two groups were compared.

Results

The distribution of grade percentages between those with and without lab was significantly different in four of the six courses (Figure 1) and the same trend, though not significant, was seen in



the other two. In all cases the average grade was higher for those taking the lab, and in all courses except Chemistry II, a higher percentage of students taking lab made A's and B's. Figure 1 shows histograms which compare the lecture grades of those taking the lab with those who were not. The percent making each grade is shown for Astronomy I and II, Survey Chemistry I and II, and Physical and Historical Geology.

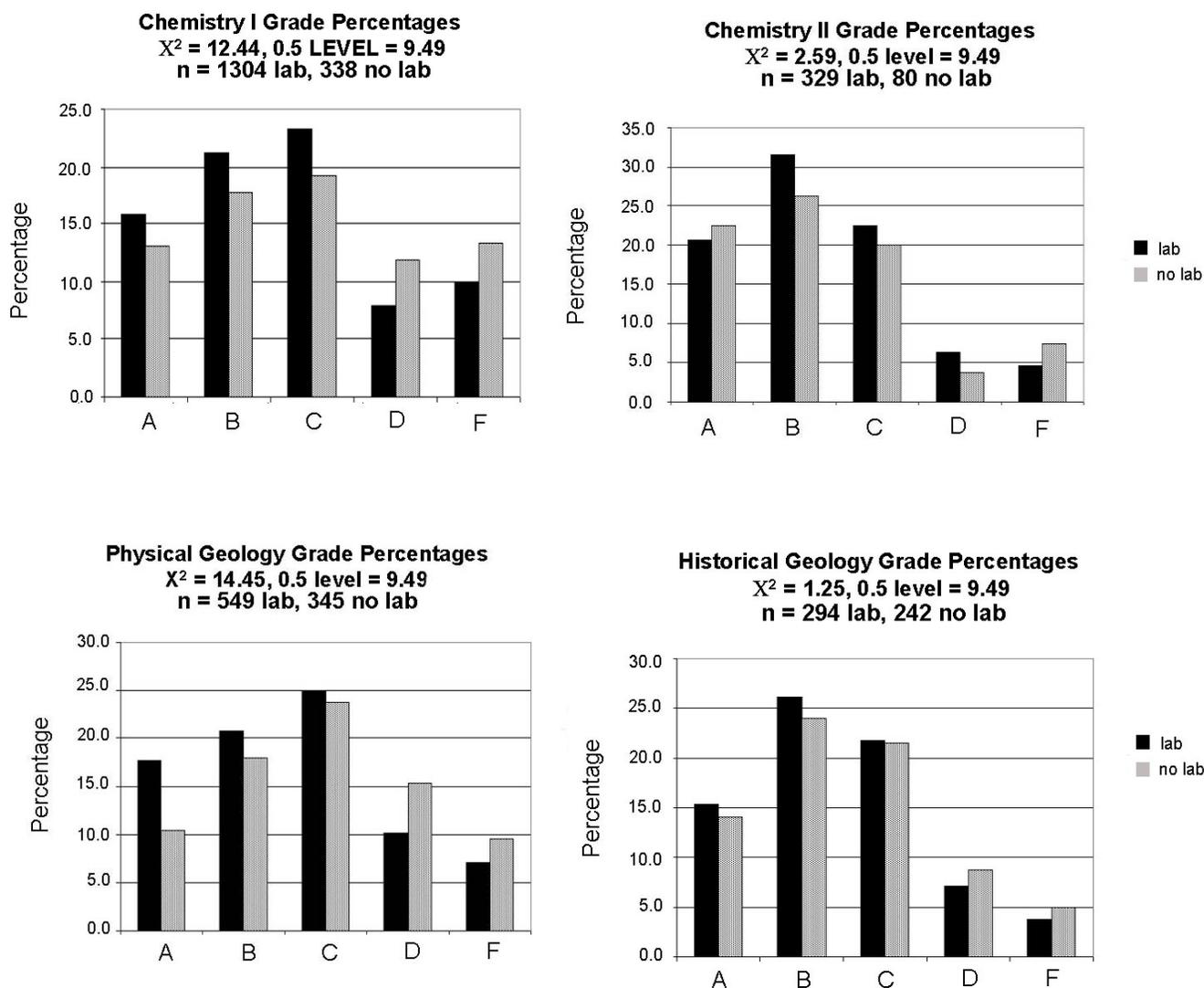


Figure 1. Comparisons of lecture grades between students enrolled in lab and those not enrolled in lab of six science courses.

The number of withdrawals by students who were enrolled in the lab was also compared with the number withdrawing who had elected not to take the lab for each of the six courses. A significantly higher percentage of students who were not taking lab withdrew (Figure 2).

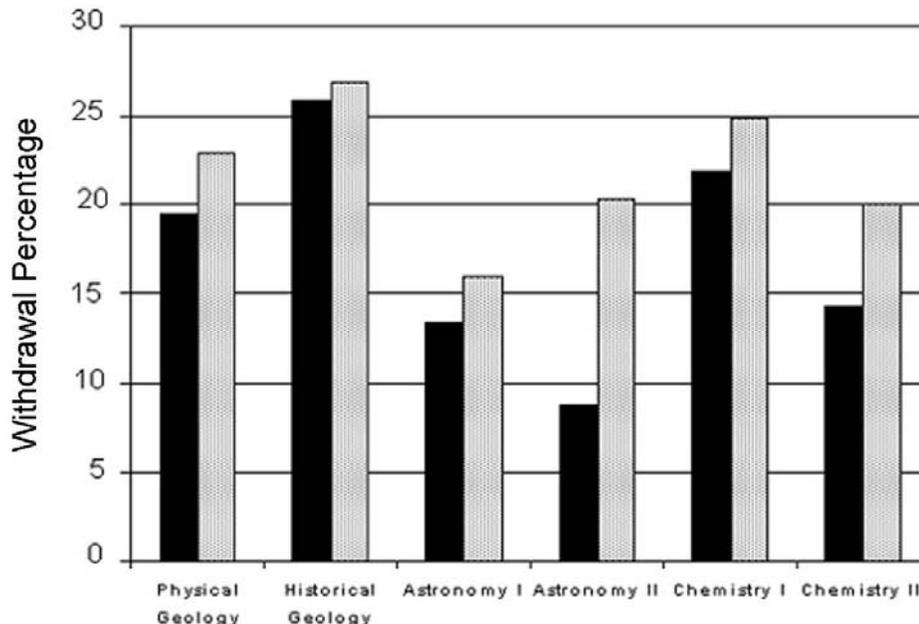


Figure 2. Withdrawal percentages of students enrolled in lab compared to those not enrolled in lab for the six courses.

Discussion

The data do seem to substantiate the observations of instructors that laboratories are of value as an aid to learning. This seems reasonable since there are different educational experiences provided by the lab that cannot be achieved as well in a classroom, on paper or on a computer. The greater contact time between instructor and student in lab also likely aids learning, and the laboratory provides reinforcement for the lecture material.

It is recognized that other variables could have played a role in the grade distributions observed. The most likely are that poorly motivated students chose not to take lab, or that students who do not allot enough time to a course elect not to take lab. These students however may be the very ones who could benefit most from the additional support that the lab experience could offer.

This study is important because it provides a large data set covering a number of courses taught in a number of ways by a variety of teachers. Laboratories are often considered an unnecessary expense for non-science majors. They require a more expensive physical setting and class size is more limited. While the value of laboratory education is known anecdotally by those in the field, there is a need for studies that provide data documenting its effectiveness.