

The Challenges of Teaching Large Numbers of Students in General Education Laboratory Classes Involving Many Graduate Student Assistants

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Abstract: Engaging students in science is one of the most challenging tasks of teaching General Ed. Lab. classes. The previous experience of these students varies considerably. They relate to diverse areas of science with varying degrees of success especially if the topics covered do not seem to touch their daily lives. It is little wonder that the science laboratory seems to be confusing to a majority of General Education students who usually enroll because the course is a requirement. Students who have a more extensive biology background may find the material too elementary to warrant their attention. In addition, Graduate Teaching Assistants come to Indiana State University with their own varying levels of biology background, teaching experience, and English language proficiency and further impact the General Education students' interests, involvement, and accomplishments.

It is important for science teachers, strategists, and policy makers to devise ways to improve both the content of science education and its presentation to make it meaningful and understandable. To initiate dialogue in this important aspect of undergraduate education, I have focused on areas that are important to understanding and improving the teaching of General Education biology. Specifically, how can we improve our laboratory presentations and have them be interesting, yet focused.

1. How can we challenge students to think productively and arrive at their own answers to presented problems as well as design experiments to test their ideas?
2. How can we best select topics and experiments which the students are more likely to relate to their daily lives?
3. How can we help Graduate Teaching Assistants engage in effective teaching, communication, and attitude, as well as provide a degree of uniformity in all laboratory sections of the same course.

Key Words: General education labs., Graduate Teaching Assistants, Language problems, Teaching experience, Problem based learning, Class size.

Introduction

Biology as a subject is receiving a great deal of attention from educators and administrators. Because the world is simmering with biological problems and concerns ranging from the environment to an aging population, biology is important in the General Education curriculum. We need not only teachers and practitioners of science but a significant segment of society which can participate in matters of a biological nature as informed citizens, environmentalists, industrialists, and administrators in many facets of our society. How do we accomplish this and at the same time keep our students interested and excited about biology? I want to share my experience and understanding of teaching General Education Biology

Laboratories, particularly the hands-on-experience for students that promotes a practical understanding of biology.

General Education and Its Problems

What is General Education? According to Indiana State University Student's Handbook,

“General education provides an essential foundation and broad academic base for students in all curricula, both liberal arts and professional. It also encourages each student's development as a round human being, and informed citizen, and an individual capable of functioning effectively in an evolving society.”

Although these goals are admirable, it is difficult to meet them due to the challenges that accompany teaching science in Gen. Ed. Classes. What are these challenges?

Student Challenges:

1. The large majority of our Gen. Ed. Students enroll in a science class only because it is a requirement.
2. Gen. Ed. Students come with varying degrees of preparation making it difficult for them to relate to diverse areas of science.
3. Many of the students are not interested in science.
4. Students with good scientific backgrounds find the standard course too limited to warrant their attention.
5. Many of the topics covered do not touch their lives.

Instructor Challenges:

1. The large number of students enrolled requires many sections and, therefore, many instructors.
2. Many graduate teaching assistants (GTAs) are involved in the one course.
3. These GTAs do not possess uniform academic and language backgrounds.
4. There is a wide range of attitudes among GTAs toward undergraduate general education students as well as a wide range of teaching ability.
5. The relatively rapid turnover rate of GTAs makes pedagogic development difficult.
6. There is a relatively high ratio of students to GTAs.

Approaches to Student Learning

Today there are many words and phrases that are becoming buzz words in the context of undergraduate science education: hands-on, investigative, research rich, inquiry-or-discovery-based, student-active, integration of teaching and research to mention some of them. What these terms have in common is that they all talk about strategies to provide opportunities for students to learn how scientists think and work. The hope is that students will develop an appreciation of how science is actually done and come to a better understanding of how biology and chemistry connect to the world outside the classroom and lab.

There is renewed interest in designing laboratory courses and curricula that emphasize student investigation and inquiry. According to Sundberg and Moncada, implementation of an investigative laboratory course for non-science majors challenges students' misconceptions about biological science.

How can we as instructors satisfy the needs of all students at the introductory level? Does one size or plan fit all? What kind of laboratory experiences best facilitate student interest and support a solid grounding in the fundamentals?

Good teachers are able to recognize what works in a class. Recent research is helping to determine how the mind works and what type of teaching helps the learning process. Students learn best when they learn how to use the tools of science hypothesizing and testing and when they are involved in collaborate learning.

Problem Based Learning

Problem based learning (PBL) revolves around the use of "real-world" problems and initiates learning new concepts through group efforts. Students seem to learn best when they learn how to:

1. Use the tools of science to ask questions.
2. Generate a hypothesis.
3. Test their hypothesis.
4. Work in a collaborative manner.

PBL offers a number of challenges for all involved. Students are asked to admit to what they don't know and to stretch themselves beyond the simple tasks of memorization and recall. Students must use their own strategies for solving problems. Instructors must learn to teach in a manner different from the way they themselves were taught and to give up control and predictability in the classroom.

Successful implementation of the PBL is easier if one instructor teaches the entire course. What do we do if there are large multi-section courses? What do we do if the instructors include new recruits of GTAs every semester? What do we do if the GTAs themselves come with different academic backgrounds and with language problems? How do we maintain uniformity and quality without losing PBL approach for student learning?

Results of Students' Performance as Correlated with the Variables Associated with Teaching A Multi-Section Course with a Large Number of GTAs

First we determined the distribution of students in the various sized sections based upon their SAT scores. Figure 1 shows that the percent of students with SATs below 1000 is about 45% for both the small (up to 15 students) and medium (16-28 students) classes and about 35% for the large (29-36 students) classes. If SAT scores were the only deciding factor, we would expect students in large classes to perform better. Instead, the data illustrated in Figure 2 shows that the smaller the class size the better the student performance as measured by final grades.

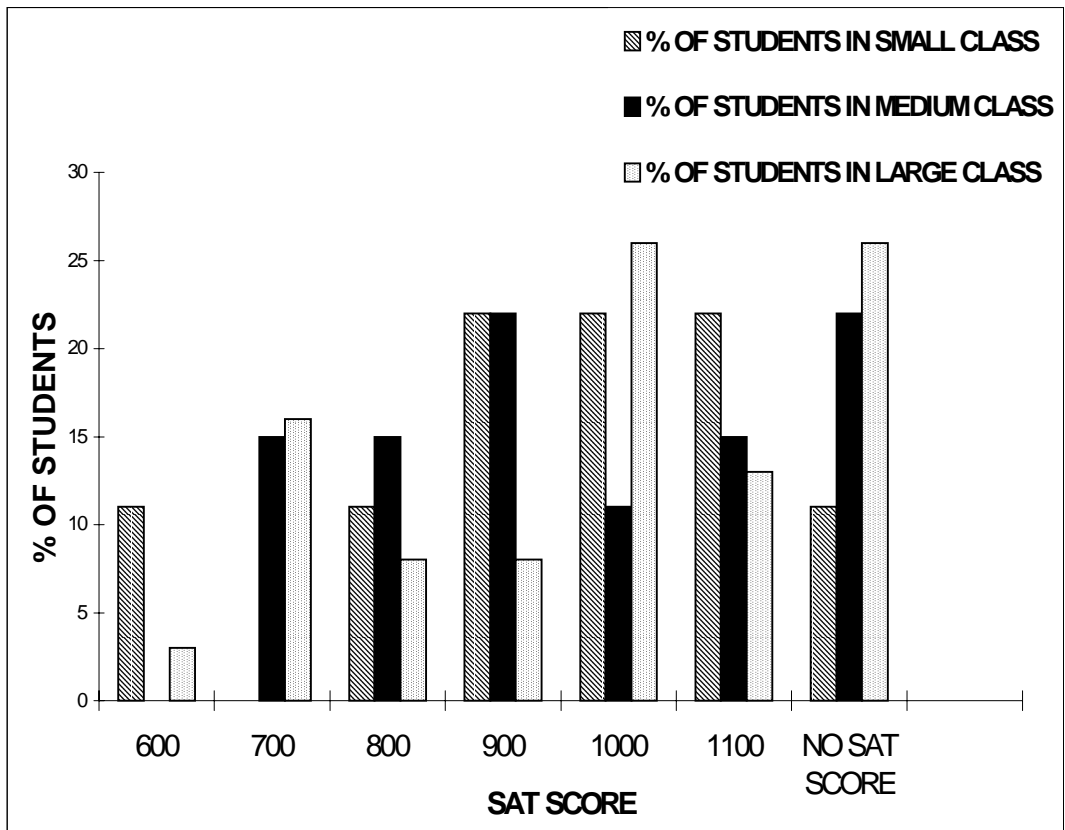


FIG.1: "SAT" DIVERSITY IN TYPICAL GEN ED LAB SCIENCE CLASSES

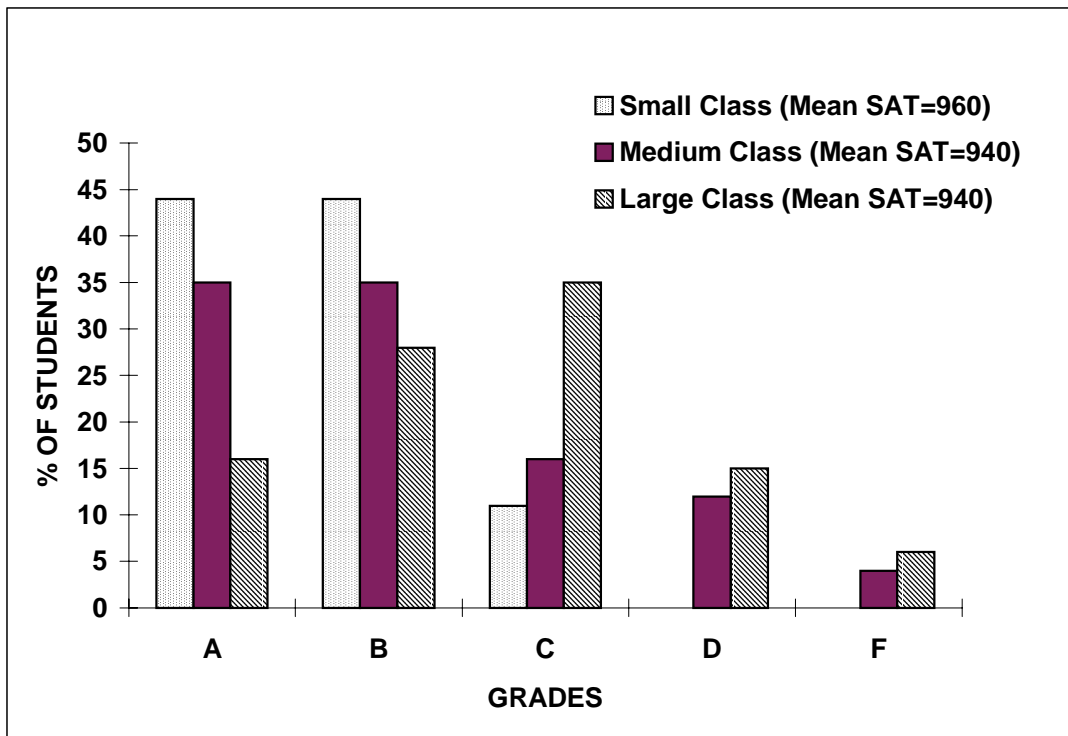


FIG. 2: SMALL CLASS SIZE VS MEDIUM AND LARGE CLASS SIZE

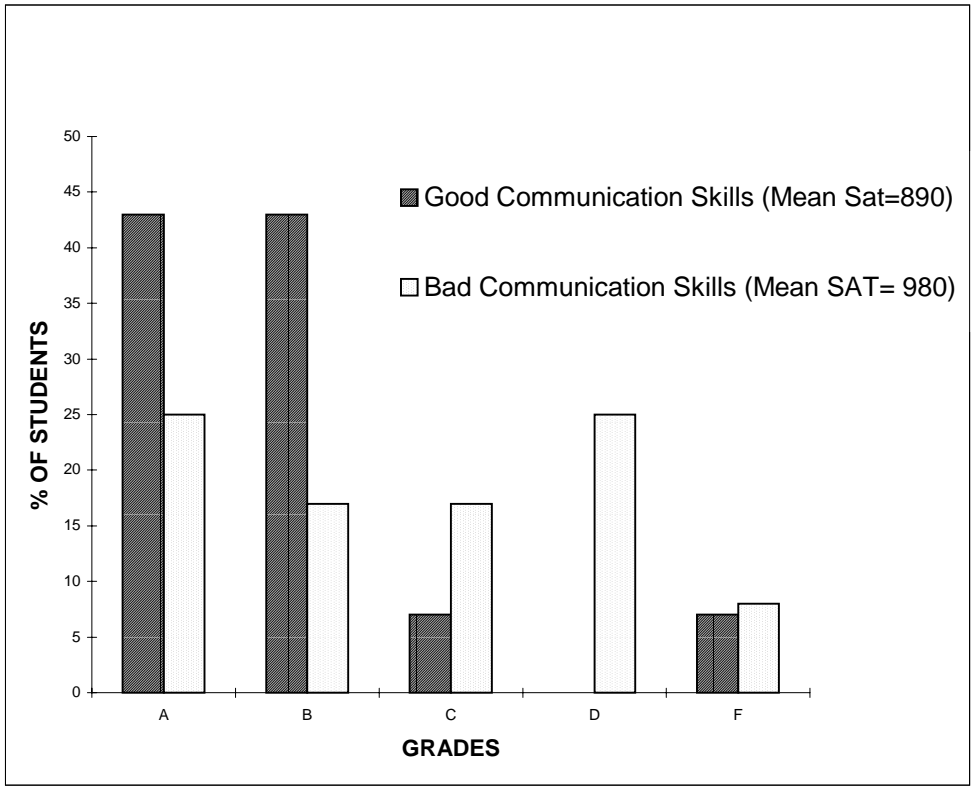


FIG. 3: GRADE DISTRIBUTION IN CLASSES TAUGHT BY GTAs WITH EFFECTIVE COMMUNICATION SKILLS AND BAD COMMUNICATION SKILLS

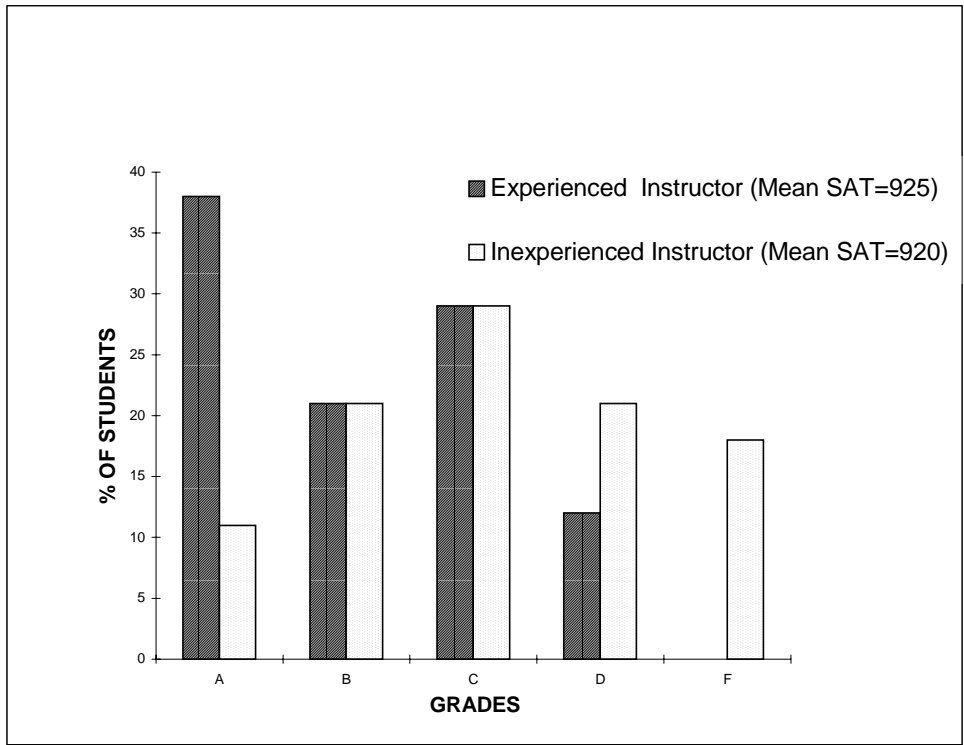


FIG. 4: GRADE DISTRIBUTION IN CLASSES TAUGHT BY EXPERIENCED GTAs AND INEXPERIENCED GTAs

We next examined data to determine the correlation between student grades and the communicative skills of the GTA. Figure 3 shows a direct correlation between the GTA's communicative skill and the grades obtained by the students.

Analyzing the performance of the students based on the relative teaching experience of the GTA (Figure 4), there is a significance at the "A" level and the "D" and "F" levels with a positive correlation with experience and "A" grades and a negative correlation with the "D" and "F" grades.



Possible Solutions

In our University, we offer a Gen. Ed. Biology lab course for non-science majors so that they can obtain hands-on experience with science. Previously, all the lab exercises were structured, but we are replacing them with PBL exercises. We introduce the problem to be considered in that week's laboratory. The goal is to recognize the problem and list some reasonable, working hypotheses. Quizzes attempt to follow the same format as do discussions of previous lab reports. Some laboratory exercises are still structured and are designed to test several hypotheses and develop basic laboratory measurement skills. Students are taught how to gather data and how to analyze them. They are also introduced to simple laboratory apparatus and equipment for measuring such things as length, mass,

volume, pH, optical density, and cellular inclusions. These skills will help them in designing their own experiment in order to test their hypothesis.

A major problem to teaching this lab course is that we have many sections (15) and an average of 8-10 GTAs supervised by one instructor. The language skills, varied backgrounds, and attitudes toward teaching of the GTAs vary. In an effort to maintain quality teaching in all sections, the supervising instructor monitors every GTA's teaching methods, communication skill, and attitude. Unannounced visits are made to every section to observe the GTA in action. Effective use of time by the GTAs is given attention. The instructor holds regularly scheduled weekly meetings with the GTAs to discuss problems, including what to cover and methods of presenting the material.

New GTAs are encouraged to attend seminars for GTA training. GTAs with language problems are encourage to take a remedial course in spoken English. An attempt is made to assign two instructors to each lab section in an effort to maintain one instructor per 15 students. Whenever possible, a new GTA is matched with an experienced one, and during the first few weeks of the semester the experienced GTA serves as the main instructor. Inexperienced GTAs are encourage to observe a class taught by an experienced, full-time faculty member.

In an attempt to maintain uniform standards, students in all sections take the same tests. In addition, the supervising instructor meets with the GTAs to insure a similar grading scale for all sections.

Conclusions

On the basis of our data and observations the following conclusions can be made:

1. Students benefit by being exposed to PBL and by being able to relate the topics covered in class to their personal experiences.
2. Sections must be maintained at a proper size in order to adequately handle PBL.
3. Obviously, small class size means many sections and thus the need for a rather large number of GTAs. The GTAs must be properly prepared and monitored so that they have the proper attitude and provide effective teaching.
4. Improving the communication skills of GTAs enhances student learning.

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