

Teaching Experiments: A Classroom Primer

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Using experiments in the classroom can enhance student learning. While numerous publications detail specific experiments, little documentation exists on how to actually incorporate an experiment into the curriculum.

This article is intended as a primer for teachers interested in using experiments as an educational aid.

Incorporating experiments into a class requires careful preparation of materials such as instruction and record sheets, planning as to where an experiment best fits into the curriculum, and, most importantly, some type of follow-up discussion based on the results.

Although fixed costs may appear to be high, numerous journal articles and textbook supplements contain examples of instruction and record sheets, as well as discussion questions which will usually require few, if any, changes to fit into a course. These publications also often include hints on how to actually run the experiment. Once an experiment has been prepared, the preparation time for future iterations can be minimal.

The payoff to both students and faculty can be extremely high. Students

appear to be much more engaged in the subject matter when motivated by the use of an experiment, and they appear to retain this information far longer than when it is presented in a standard lecture format.

Getting Started

Preparing an experiment for the first time may appear to be a daunting task. The following list contains suggestions on how to minimize the cost of using experiments while ensuring high benefits for both students and faculty.

Start slowly. Starting off with one or two experiments in the first semester is recommended. An experiment that consistently works well, and is suitable for many different courses, concerns supply and demand. In the double-oral auction version of this experiment, students, acting as buyers or sellers, bargain over the price of a hypothetical commodity. The bargaining process is repeated for several rounds in which each transaction price is publicly recorded. Invariably, the price established through bargaining converges on the equilibrium price.

Examples of this experiment are abundant, ranging from the seminal article written by Vernon Smith in 1962, to treatments outlined in textbook supplements, such as Delemeester and Neral (1995), Ortmann and Colander (1995), and Bergstrom and Miller (1997).

The experiment is easy to run, takes little time to prepare, illustrates the

basic principles of supply and demand, and can be analyzed in varying degrees of sophistication to suit a wide number of needs and tastes. Variations of this experiment can be run to illustrate the effect of taxes, subsidies, price floors and ceilings, changes in income, input cost changes, and collusion on the equilibrium price.

Virtually any size class is appropriate. The time required to run this experiment, including reading the instructions to the class, can range from 20 minutes for the basic supply and demand version, to a full class period if variations are introduced.

Another easy-to-use experiment is the dollar auction demonstration (Hauptert, 1994). This experiment quickly and convincingly illustrates the concept of sunk cost and can show the difficulty of maintaining collusive behavior.

Be well organized. It is important to prepare and organize all materials prior to the start of each experiment and to be familiar with the content, structure, and projected outcome. This will allow the teacher to anticipate potential student problems and to determine how they should be handled.

Students must comprehend the basic concepts so that they can participate fully in the experiment and follow-up discussion. Organization is also important since the teacher should inform students, at least one class period in advance, that an experiment is going to be conducted. Providing students with the instructions in advance gives

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them more time to familiarize themselves with the experiment design.

In organizing a course, it is important to consider the appropriate placement of an experiment. For example, should a supply and demand experiment be placed before or after the discussion of related theories? Which position an instructor chooses is ultimately a function of individual teaching style.

If placed before the theories are introduced, the experiment can serve as a lead-in for class discussion, and a type of learning-by-doing activity. This is accomplished by explaining the rules and objectives, gathering the data generated by the experiment, then letting the students derive the theories for themselves. On the other hand, running the experiment after the theory has been discussed serves as a reinforcement of the material covered in lectures.

Prepare a well organized follow-up discussion. This is arguably the most important part of running a classroom experiment. A good set of discussion questions, which can be handled in small groups, on homework assignments, or with the entire class, will lead students to think of the experiment in terms of economic behavior.

Why did students react the way they did? What effect did changes in experiment parameters have on individual and group behavior? How can these results be extended beyond the classroom? In what ways do "real" markets differ/mirror the experimental market? The directions one can go with the follow-up discussion are endless.

Be flexible. It is important to be flexible about the time needed for the experiment and follow-up discussion. Some very effective yet simple experiments require only 10 or 15 minutes to run. For example, the sunk cost experiment can be run in 10 minutes (Hauptert, 1994). Others can be run as simple demonstrations involving only a few students at a time, while the rest of the class works on related materials.

If the class period is long enough, an experiment may be finished in time to allow for follow-up discussion in the same period. If this is not possible, the

discussion can be held at the beginning of the next period. For the latter case, it may be helpful to distribute a list of discussion questions for the students to consider prior to attending the next class.

Have an assistant in the classroom. It is often useful to have an assistant for an experiment. The assistant can be a colleague, graduate student, or even a student recruited from within the class. Assistants can help students interpret instructions, record information on the board, organize materials that need to be changed as the experiment proceeds, or monitor participant behavior.

Select an appropriate classroom. Some experiments, for example the supply and demand experiment, use an oral auction component which can be quite loud. It is important to prepare for this, either by moving to an unoccupied area of the building, scheduling the experiment at a dead time, or shutting doors and warning colleagues to do likewise. Some experiments require students to move around and converse or bargain with each other.

Refer back to the results of experiments throughout the semester. Experiments make a lasting impression on students. Periodically referring back to experimental results, or the conclusions drawn from the follow-up discussion, helps solidify important concepts by reminding students of what is often a very memorable experience.

The benefits from using experiments in one course (typically the introductory course) can also extend to other courses. Upper division students, for example, can be asked to recount their experience with a particular experiment and to relate that experience to the material covered in advanced courses.

Commonly Asked Questions

The following are answers to the most commonly asked questions and concerns about classroom experiments:

Will students participate? An important concern is whether students will be actively engaged in the experiment and participate to the best of their abilities. For example, in the supply and

demand experiment, it is important that students attempt to maximize their gains from exchange in order for the equilibrium price to be established. In research experiments, participants are motivated by payments based on their performance; this is obviously impractical for many instructors and institutions.

In most cases, however, little or no external incentives are necessary. Students eagerly try to perform their best because they want to win the game, recognize the inherent benefits from participating, or are intrigued by the novelty of participating in an economics demonstration. However, for those who doubt this will work in the classroom, or feel more comfortable with a tangible incentive structure, there are a variety of low cost alternatives — bonus points based on performance, food, or merely honoring top winners.

If an incentive mechanism based on student performance is used, it is important to recognize that the experiment set-up often influences an individual's outcome. For example, in the supply and demand experiment, a seller who draws a high cost card will be unable to earn high profits no matter how shrewd a trader he or she is or how well he or she comprehends the exercise. In such cases, the teacher can reassign cost data in subsequent rounds so that a student initially receiving a high cost card receives a low cost card and/or award bonus points that affect grades in a manner that will not influence the curve.

In classes where bonus points are awarded, points can be added to student scores after the curve is drawn. By using bonus points in this manner, a student's performance on experiments can only affect his or her final grade, and not artificially inflate the curve, thus affecting someone else's grade.

An alternative to bonus points involves students competing for "money" which can be accumulated throughout the semester and then used to purchase bonus points or food items at an auction at the end of the semester. The auction, which can be run in a variety of formats, can itself be a lesson in allocation mechanisms.

A third alternative is to include questions in a follow-up assignment or test which requires participants to examine and explain their behavior.

How can experiments be inserted in a course? Integrating experiments into a classroom does not mean that the teacher must delete other course material. Some experiments are simple demonstrations that can be run in 10 to 15 minutes (Sulock, 1990; Hauptert, (1994). Other experiments are designed to take place outside of class, and involve only a few minutes of in-class time (Bell, 1993).

Another possibility is to replace course content with experiments. For example, experiments could be used instead of additional examples that are normally worked out in class. The discussions following experiments offer additional support for theories and often result in examples based on student discussion.

Experiments can be further integrated by incorporating formal lab periods into a course. At Reed College in Portland, Oregon, for example, a lab period of 50 minutes per week was instituted in 1991 to supplement the three 50 minute lecture/discussion sessions. During a typical semester, students participate in nine experiments.

What if an experiment fails?

Despite being well prepared, disasters can and do occur. It is important to anticipate how and when these will occur, and to have a backup plan. The time it takes to complete an experiment is also uncertain, and the teacher may need additional material to round out the discussion.

Unanticipated results or actions by students often made great fodder for the follow-up discussion. For example, while conducting a barter exchange experiment at Reed College based on Levy and Bergen's (1993) article, one of the food items used for bartering, a pizza, was not delivered on time. Instead of a disaster, this resulted in a learning experience when the students developed a futures market—a topic not covered in the introductory course. After the pizza was delivered, students

were able to discuss the role of futures markets and what factors influenced the price of pizza.

Is a computer network necessary? The majority of classroom experiments are hand-run experiments, using a pencil and paper and, for some experiments, a calculator. Occasionally, a computer may be helpful to the instructor to facilitate data correlation. A sophisticated, integrated computer network is not necessary to run a classroom experiment.

Students can benefit greatly from the personal interaction that occurs as a part of the bargaining process which results in more "real life" behavior. For example, in one of the Reed College experiments that illustrate supply and demand, one student refused to buy pizza. He subsequently explained that he disliked pizza and would not buy it at any price. This led to a discussion on the role of tastes in the demand function, and the opportunity cost to the student of buying the good.

The discussion enhanced students' understanding of the shape of the demand curve by illustrating that some people value certain goods more (or less) for those products.

What is an appropriate size class? Experiments have successfully been run in classes ranging from eight to 100 students. Some experiments, by their nature, can be run with as few as one or two students in a class (Ortmann and Colander, 1995). Experiments have been run in classes with 400 students, though in such large classes, a computer assisted experiment may be a necessity. An alternative method for using experiments in a large class is to select a subset of students to participate while others observe.

In what courses can experiments be run? Variations can easily be introduced into most experiments which will allow them to be customized to any class. This is achieved by altering rules to vary the level of difficulty and/or by targeting the follow-up discussion to highlight certain features or results of the experiment. In advanced classes,

results from the classroom experiment can be compared to results from the research literature.

Conclusion

Incorporating experiments into the classroom enhances student involvement with the material, develops interpersonal communication skills, sharpens critical thinking, and breaks up the monotony of a standard lecture. Making use of this pedagogical technique is not as difficult as it may seem. Additionally, most experiments, including the double-oral auction and public goods experiments, are extremely flexible and can be tailored to reflect different course levels and instructor needs and preferences.

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