UNDERSTANDING COST AND PRODUCTION USING A COOPERATIVE LEARNING TECHNIQUE IN A MICROECONOMICS CLASS

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Abstract

This article examines the cooperative learning technique of Structured Problem-Solving that induces students to work together to understand cost-calculations in microeconomics. Cooperative learning methods can help students better extract and interpret knowledge about economic issues and then display their command of that knowledge, thereby accomplishing some of Hansen's proficiencies. The article investigates the effectiveness of this technique by comparing exam results between students who engaged in cooperative learning and those who did not. I find that cooperative learning enhances academic outcomes and helps students retain their knowledge of the material.

Key Words: Cooperative learning, Microeconomics

JEL Classifications: A22

Introduction

This article investigates the efficacy of the cooperative learning technique called Structured Problem-Solving to actively involve students in their own learning in a Microeconomics course. This cooperative learning technique allows students to understand class materials better and encourages them to participate more fully in the course as a whole. It also leads students to exhibit the four key elements of effective learning: positive interdependence, individual accountability, equal participation, and simultaneous interaction. Success is measured through exam results for students who participated in the exercise and those who failed to do so.

Students in a Principles of Microeconomics class at a small state college in middle Georgia participated in this study. Most of the students are business majors representing a mix of traditional and non-traditional students. The majority are traditional younger students coming to college right after high school. The class size is 25-30 students.

The rest of this article proceeds as follows: Section 2 discusses the various elements of cooperative learning. Section 3 describes the specific elements of the structured problem solving method for the Microeconomics course. Section 4 reveals the results on student learning. Section 5 offers conclusions and implications.

The Cooperative Learning Technique

The structure of cooperative learning is the source of its effectiveness. Unlike "group work" in general, cooperative learning is planned and constructed ahead of time. It is more complex than just placing students together in a group to discuss some issue or solve a problem

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(Johnson, Johnson, and Smith 1991). Very specific rules are prepared in advance by the professor so that the students know what is expected of them, how they must accomplish their goals, and how they will be graded (Millis and Cottell 1998). In essence, the professor crafts an exercise that requires true cooperation among the students, thus allowing them to fully combine their efforts to produce an overall group result.

Such cooperation requires students to support one another as each member of the group tries to ensure that everyone else understands the assignment and contributes to the results (Moore 1999; Roger and Johnson 1994). Students are linked through their efforts on the assignment; each member shares in the work and the rewards of the group. Students attain "positive interdependence," the first key dimension of learning (Kagan 1992, 4). Students must continually communicate with each other to achieve the desired outcome (Millis 2002). They no longer compete with each other but work together to attain a "common fate" in terms of grades (Johnson, Johnson, and Smith 1991). The students engage in "cooperative" learning by helping one another; one student learns if others also learn (Deutsch 1962).

Many instructors label group activities in class as cooperative learning even though the activities are not fully structured. In such cases, students seldom work cooperatively in that they do not truly interact with each other (Roger and Johnson 1994). These interactions are collaborative work rather than true cooperative learning (Barkley, Cross, and Major 2005). The students may share their efforts, but rarely recognize their responsibility to ensure that they all understand the class material. Often, only one or two members of the group do all of the work.

Cooperative learning, however, seeks to instill shared responsibility so that every student benefits from the work of the group. In accepting responsibility, the students attain "equal participation," the second key dimension of learning (Kagan 1994). No member is excluded from the group work for any reason; all students have the same opportunity to participate (Smith 1996). No member is allowed to remain silent either, preventing free riders (Roger and Johnson 1994).

Cooperative learning activities embrace active learning in which students become full participants rather than a passive audience (Kvam 2000). This leads to "simultaneous interactions," the third key dimension of learning (Kagan 1994). This occurs when the students engage in active give-and-take, sharing ideas with each other to attain a coherent result for the group (Johnson, Johnson, and Smith 1991, 6). The students must connect the information received from the instructor or textbook to the actual work required. They see the class lessons in action rather than simply theoretical or abstract. Since the students themselves put forth most of the effort to understand and apply the information, cooperative learning is "learner-centered" (Fink 2003).

For effective cooperative learning, researchers in the area suggest that students work in small groups (Cooper and Muerk 1990, 1; Johnson, Johnson, and Smith 1991). In large groups, some students are easily overwhelmed by the number contributing to the assignment. Small groups require all members to participate to some degree (Occhipinti 2003); no one student can refuse to work, since such a refusal hampers the group's ability to accomplish its work. The ideal group size is three to five. This allows the group to do the work if one member is absent but still puts considerable pressure on everyone to participate (Millis 2002). Small groups also allow for greater interaction that helps the group bond more fully.

In a cooperative learning exercise, instructors supervise the students by walking around the classroom to ensure that the groups actually work on the assignment (Johnson, Johnson, and Smith 1991). They also can help groups that are having difficulties by explaining particular

concepts or providing hints. The instructors do not provide answers or lecture the students; they allow the students to do their own work while encouraging them with "positive reinforcement" (Kagan 1992; Kagan and Kagan 1994).

As they monitor the groups, instructors observe individual student participation. Instructors use this information to evaluate the students' group and individual work. Cooperative learning allows for both "individual and group accountability," the fourth key dimension of learning (Johnson, Johnson, and Smith 1991, 6). The expectation is that the group will attain the desired result and that instructors will judge individuals by their contributions (Kagan 1992). The group's success depends on whether or not the group produces the desired result in the way required by the assignment. Instructors judge individuals according to how well they understand the group's result. Individual accountability also may be tested by an exam, quiz, or further assignment in which students are held accountable for the work of their group.

The benefits of cooperative learning are, first and foremost, that students learn the material in a more meaningful and longer-lasting fashion than they would through conventional methods such as lectures (Johnson, Johnson, and Smith 1991; McKeachie 2002). Secondly, students attain better grades. Students tend to remember the material longer than usual (Lord 2001) and understand other more intricate concepts introduced later in the course (Johnson, Johnson, and Smith 1991). Third, students learn to think by responding to situations in which they must contribute to their group's work (Millis 2002). The students develop a "higher level of reasoning" (Roger and Johnson 1994) and often gain a stronger ability to apply their knowledge to other issues and assignments. Ideally, cooperative learning helps students become better learners with more improved study skills, more devotion to school, and a greater willingness to help others (Slavin 1995).

This article evaluates the effectiveness of cooperative learning in a Microeconomics class according to how it enables students to attain Hansen's Proficiencies. First, students should be able to "gain access to knowledge" (Carlson, Cohn, and Ramsey 2002, 182). Second, they must show "command of that existing knowledge" through summaries or analyses of issues (Hansen 2001, 232). Third, students ought to "display the ability to draw out the existing knowledge" by interpreting other sources of information dealing with the same issue (Hansen 1986, 151). Fourth, students then demonstrate that they can "use the knowledge to explore issues" (Carlson, Cohn, and Ramsey 2002, 182), by applying that knowledge to other topics or issues. Fifth, the students "create new knowledge" by presenting an original research paper or project (Hansen 2001, 232).

The Cooperative Learning Exercise

The exercise seeks to develop students' skills at constructing cost structures, explaining key cost concepts, and interpreting data as they evaluate a firm's decision-making process under specific cost conditions. Students are expected to demonstrate three of Hansen's Proficiencies: extract existing knowledge from a lecture and the textbook; show command of that knowledge while working on the exercise; and interpret and apply that knowledge by using cost calculations to explain and evaluate that firm's decisions. The exercise is designed to help students become more effective problem solvers by becoming active learners.

While many different techniques of cooperative learning are available, this exercise used the technique of Structured Problem-Solving. Students begin by working on the cost structure problem individually, then form pairs to check each other's work, and then the pairs combine

into groups of four to finish the problem. The groups must ensure that every member has the correct answers and understands those answers.

In particular, each individual student solved problem 1a (see the Appendix) individually. Given information on TFC and TC, the students had to calculate the cost structures TVC, AFC, AVC, AC, and MC for each quantity level. After 20-25 minutes, each student then paired with the closest available student to compare answers and discuss their results. Both students needed to have the same answer for 1a and subsequently solve 1b and 1c together. After another 5 minutes, this pair then combined with another pair in the classroom to form the group of four, which interpreted, evaluated, and derived the cost calculations for a firm's decision making process as it solved problems 1d - i, ii. Group members also compared and discussed their answers. Finally after 25 minutes, students in the group had to list all of their answers and give explanations for how they achieved their results. They then reported their solutions to the rest of the class.

Before the exercise began, students obtained clear instructions about the cost worksheet from the instructor. Each student also received a calculator to assist them with the problem-solving on numbers 1a, 1b, and 1c. Each group of four chose one of their members to act as the recorder and another to act as the summarizer. The classes did not have any rules on how students could choose their partners for the pairs or combine into the groups.

As the instructor, I continually monitored the students at each step. I walked around the room to ensure that all students participated in the exercise and checked to make sure that they used the correct formulas for their calculations. If some of the students started to do the problems incorrectly or used unneeded formulas, I guided them back to the proper path by giving them encouragement or offering them hints. I did not tell them the answers even when directly asked to do so. If a group finished early, I asked them to graphically depict the cost curves, showing the relationships among the cost curves AC, AVC, and MC, and to indicate the firm's efficient point based on their results.

Once I turned on the lights of the Elmo in the classroom, all groups were to finish their work quickly and remain quiet. I then called on groups to describe various parts of the problem and chose students at random to answer the specific questions from the problem. At the very end of class, I collected all of the worksheets so that I could grade them and hand them back at the next class period. A subsequent exam had the same problem as the cooperative learning exercise.

The exercise had a strict structure that allowed the students to use their own effort to not only learn the material but also apply it. In doing so, it incorporated the four key dimensions of learning: positive interdependence, simultaneous interaction, individual accountability and group accountability.

Results

Although most of the students had little experience with such a cooperative learning exercise, they participated well in the activity. Many groups attained the correct answers right away and could explain them fully to the class. I expected students who took part in the exercise to better retain and successfully apply what they had learned to later exams. To further evaluate these students, I looked at how well they solved the problem both in the cooperative learning exercise and on the next exam. See Table 1.

TABLE 1: SUMMARY OF RESULTS OF STUDENTS PRESENT FOR THE CO-OPERATIVE LEARNING EXERCISE.

Variables	S06	F06	S07	F07	S08
CL exercise grade	80%	100%	100%	100%	99.2%
Exam CL grade	76.47%	80.10%	75.42%	80.36%	77.60%
No. of students	51	47	60	56	48

Note 1: Fall 2006 and Spring 2008 had two sections of the Principles of Microeconomics. The rest of them had 3 sections of the Principles of Microeconomics.
Note 2: CL stands for cooperative learning

Table 1 indicates the average grade percentages of the students who came to class and participated in the cooperative learning exercise in the Principles of Microeconomics classes for the Spring 2006, Fall 2006, Spring 2007, Fall 2007, and Spring 2008 semesters. Students in every class section each semester could receive up to five points from the cooperative learning exercise as part of the regular course grading, with the exercise as a whole worth 5% of the overall course grade. To receive the entire five points, students needed to correctly answer the problem as individuals and in their groups, with the evaluations coming from observations of their work, correct reporting of results in class, and the graded worksheets they had turned in at the end of the exercise. On average, Spring 2006 sections had an 80% success rate on the exercise, while students in subsequent semesters averaged a 100% success rate for the exercise, except for 99.2% in Spring 2008.

To discover how well these students retained their knowledge from the exercise and to test the effectiveness of the exercise, the same problem appeared on the next exam a few weeks later. Table 1 reports the scores the students received on that exam question alone. The problem on the exam was worth up to 15 of the 100 points available in the Spring 2006 class and 10 points for the rest of the semesters. Students in each semester who had participated in the cooperative learning exercise scored an average of 76.47% in Spring 2006, 80.10% in Fall 2006, 75.42% in Spring 2007, 80.36% in Fall 2007, and 77.60% in Spring 2008. I implemented the cooperative learning exercise for a few consecutive semesters to ensure consistent results.

TABLE 2: SUMMARY OF RESULTS OF STUDENTS ABSENT FOR THE CO-OPERATIVE LEARNING EXERCISE.

Variables	S06	F06	S07	F07	S08
CL exercise grade	0	0	0	0	0
Exam CL grade	62.22%	44%	0	53.33%	50%
No. of students	6	5	0	3	1

As a contrast, Table 2 summarizes the exam results for those students who did not attend class on the day of the cooperative learning exercise, but attempted to answer the exercise problem on the exam. The results show that missing the exercise proved detrimental to their grades. These results suggest that participating in the cooperative learning exercise helped students to successfully learn the material and subsequently remember the content later in the semester.

Those students who did not come to class and therefore did not participate in the cooperative learning exercise act as a control group[2] for this study. This may create a selection problem, however. In particular, the students who missed the cooperative learning exercise might represent students who missed class regularly and consequently performed poorly on class exams and other assignments. Lower scores by these students on the exam's cooperative learning problem may not truly demonstrate the efficacy of the cooperative learning exercise. Nevertheless, there are many reasons why students might miss a class and missing one class does not automatically mean that a student will perform poorly overall.

To further examine the viability of the control group and the extent of any potential selection problem, Table 3 shows the percent of students passing the overall course who were absent for the cooperative learning exercise compared to those who participated in the exercise.

TABLE 3: SUMMARY OF RESULTS OF STUDENTS PARTICIPATING IN THE COOPERATIVE LEARNING EXERCISE WHO PASSED THE OVERALL COURSE AND THOSE ABSENT FOR THE EXERCISE WHO PASSED THE OVERALL COURSE.

Variables	S06	F06	S07	F07	S08
% of students passing the overall course	88.88%	93.87%	89.23 %	92.98%	97.82 %
% of students absent for CL passing the overall course	80%	80%	0	33.33%	100%

For Spring 2006, Fall 2006, and Spring 2008, the differences in the percent of students passing the course between those absent and those present is not significant. Fall 2007, however, had only three students who missed the cooperative learning exercise, only one of which passed the course successfully for a 33.33% rate. The small sample size contributes to this skewed result.

TABLE 4: T-TEST RESULTS OF MEAN EXAM SCORES OF STUDENTS PARTICIPATING AND NOT PARTICIPATING IN THE COOPERATIVE LEARNING EXERCISE.

Variables	***CL***	***NCL***
Mean.	8.54	6.6
Standard Deviations.	2.89	4.18
No. of Observations	262	15
T statistics	2.45	
P-value	0.014**	

Note 1: Significance at 5% shown by **. *Note 2: NCL* stands for not participating in cooperative learning

[2] The *control group* was used only for one semester (Spring 2007). The control group consisted of one class of 16 students who did not participate in cooperative learning but still did the exercise. The control group results showed an in-class exercise grade of 97.50% but an exam score of 43.12 %.

Table 4 shows the results of the t-test conducted for the differences in mean exam scores of students who participated in the cooperative learning exercise and those who did not. The results indicate statistically significant differences between the two groups at the 0.05 level.

A second concern involves the students' prior exposure to the class material, which could account for the different scores on the cooperative learning problem on the exam. The suggestion is that those students present for the exercise might have done better on the exam by virtue of having seen the problem previously in the exercise. Yet such prior exposure does not fully explain the results, particularly considering the substantial time lag between the exercise and the exam. Furthermore, students who had not participated in the cooperative learning exercise and had not seen the problem in the class activity still could have been exposed to the formulas and examples in the textbook prior to the exam. Certainly, the absent students did not have the same opportunity to develop their skills to solve the problem well and fully incorporate the information.

This cooperative learning exercise required students to meet three of Hansen's Proficiencies. First, the students needed knowledge about the problem gained beforehand through the lecture or the textbook. Second, they demonstrated command over that knowledge simply by using the formulas correctly to produce the right answers. Third, students showed that they could draw out the knowledge by applying it to a new problem that they had not encountered in the lecture or textbook. They were able to interpret the problem using their previous knowledge and to gain an additional understanding of cost structures based on this new example.

Conclusion

Cooperative learning is one of a vast repertoire of techniques teachers can use to enhance learning. It is also one of the most effective ways to ensure that students retain knowledge long after they have learned it. It can create what Hansen called "true learning," where students incorporate the information they receive into the knowledge they possess so that they can readily access it whenever they need to do so. It also encourages students to view themselves as part of a larger whole, the entire campus, rather than just as individual components because they have stronger and more meaningful interactions with other students. They can see how their learning is enhanced by the other students and how they themselves can aid those in need. In essence, cooperative learning can create a bond among the students through which they will work with one another to attain more academic and personal success.

This study explored cooperative learning as it applied very specifically to an economics class, showing that a cooperative learning exercise led students to accomplish more in-depth and meaningful learning. This article suggests that educational institutions, both secondary and post-secondary, encourage their teachers to adopt more cooperative learning exercises in their own courses as a way to help students refine their ability to understand the course materials and develop better thinking skills that will benefit them long after they graduate.

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Appendix

Cost Exercise[3] : 50 minutes.

1. Suppose the Total Fixed Cost (TFC) of an ABC lawn mowing company is $2000.00 and the following schedule for Total cost is given.
    - **a.** Write the cost formulas and calculate Total Variable Cost (TVC), Average Fixed Cost (AFC), Average Variable Cost (AVC), Average Total Cost (ATC) and Marginal Cost (MC) for each quantity.
    - **b.** What kind of cost does not depend on the quantity of output?
    - **c.** What is the cost of producing an extra unit of output called? Why is it important to know this cost?
    - **d.** What is the efficient scale of the lawn mowing company?
        i. What condition must be satisfied for the lawn mowing company to be at its most efficient scale?
        ii. Choose an output level that is either above or below the efficient scale you have identified in d. Explain why this is not efficient.

Lawns Mowed (Q)	TC	TFC	TVC	ATC	AFC	AVC	MC
1	2500						
2	2800						
3	3000						
4	3160						
5	3340						
6	3540						
7	3780						
8	4080						
9	4410						
10	4770						
11	5190						
12	5760						
13	6630						
14	7800						
15	9800						

[3] A standard cost problem from a Principles of microeconomics textbook.