

THE ECONOMICS OF CUPCAKES: A CLASS ACTIVITY ON THE LAW OF DIMINISHING MARGINAL PRODUCT

Christine L. Storrie¹

Abstract

Economics courses are typically lecture-based. This paper provides an alternative to the traditional chalk and talk method of classroom instruction by outlining a class activity that illustrates the concept of diminishing marginal productivity. The activity incorporates an experiment-based learning approach with minimal direction from the instructor and offers an alternative or complement to traditional lecture-based instruction methods. Although the main lesson is the law of diminishing marginal productivity, other economic concepts can also be incorporated and learned from this experiment. Variations of the experiment and possible outcomes are also discussed.

Keywords: economic education, law of diminishing marginal product, undergraduate economics, classroom activities

JEL Classification: A20, A22

Introduction

Educators often struggle to find effective ways to deliver information that will enable students to not only understand, but also to retain the material being taught. Even if students are engaged, paying attention in class, and understanding the concepts, conventional methods of instruction only allow for information to be coded in the short-term memory. Therefore, these methods typically only lead to short-term retention. In order for something to be encoded into long-term memory, a deeper encoding process is necessary. According to the levels of processing model, only deeper processing will lead to an improvement in memory (Craik & Lockhart, 1972). Craik and Lockhart (1972) contend that elaborative rehearsal is needed to encode information for long-term storage. By merely repeating information or even trying to memorize concepts as they study, students are typically only encoding the information for short-term retrieval. Elaborative rehearsal requires the brain to process the information in a more in-depth way. Elaborative rehearsal allows for the use of prior knowledge to encode the information already in long-term storage by using what is already known and incorporating it with what is being learned.

This paper provides an alternative to the traditional chalk and talk method of classroom instruction by outlining a class activity that illustrates the concept of diminishing marginal productivity. The activity incorporates an experiment-based learning approach with minimal direction from the instructor. This experiment is effective because it allows students to make a connection to the new information by linking it to information that they already know. Even if students do not know how to bake, they will at least understand the process involved in the experiment and be able to apply this prior knowledge to the new information. The experiment also

¹ Assistant Professor of Economics, Department of Economics, Finance and Accounting, SUNY Oneonta, 108 Ravine Parkway, Oneonta NY 13820

allows them to create a visual in their mind which helps them develop a way to retrieve the information long term.

Much of the literature in classroom experiments discuss the benefits of applying theory into hands-on learning to help improve comprehension of the material. Inverting the classroom changes the focus in the classroom for delivery of concepts through lectures to learning concepts through experiments, hands on exercises, and group work. This experiment presents an innovative class experiment to be used as a classroom exercise by creating a means for a visual memory as well as a way to connect the new information to previously known information facilitating long-term retention of the concept.

The seven different learning styles, according to the Perceptual Learning Styles Theory, are: print, aural, interactive, visual, haptic, kinesthetic, and olfactory (Davis, 2007). Delivering traditional classroom lectures, writing notes on the board, and assigning readings address the print, and aural style of learners. Unfortunately, that leaves the visual, haptic, kinesthetic, and olfactory learners to find other ways to learn the material since the traditional chalk and talk methods do not allow for their learning styles to be utilized. Visual learners benefit from seeing and hearing demonstrations. Interactive learners learn best through verbalization and benefit from small group discussions. Haptic learners learn by doing and benefit from a hands-on approach to learning. Olfactory learners learn best when they can incorporate their sense of smell and taste into the learning process and kinesthetic learners learn best when they are able to move during the learning process.

This paper describes an experiment that incorporates at least five of the seven different learning styles to engage the classroom and enhance the learning process. This can be used as a substitute or a complement to traditional educational delivery methods. This experiment is unique because no other experiment to my knowledge provides methods to enhance the olfactory learners' preferred learning style.

The purpose of this experiment is for students to learn the law of diminishing marginal productivity. The law of diminishing marginal productivity posits that as more and more units of one factor are added while holding all other factors constant, eventually output will begin to increase at a decreasing rate. The experiment is to create a "cupcake factory" in the classroom. The input that will be increased is units of labor. The factors that will be held constant are capital and time.

The remainder of the paper outlines the details of the experiment first by providing a list of the necessary resources followed by an overview of the classroom exercise including suggestions for adjustments for larger classes. I also include a post-experiment discussion, followed by some concluding remarks.

Resources

- Cupcakes (enough for the entire class)²³
- Icing
- Sprinkles or similar to decorate the cupcakes
- Knife(s) for icing the cupcakes or alternatively, a cake decorating tool and piping bags can be used.
- Napkins (or plates)

² To be sensitive to allergy restrictions of some of the students an ingredient list should be available upon request.

³ For larger sections, mini cupcakes can be used.

- A timer
- Other items: disposable or latex gloves and disposable table cloth to cover surface area for the production process, disposable wipes or other cleaning products for clean up

This experiment requires some pre-class preparations. I have conducted the experiment using home-made cupcakes, which is the preferred method, but I have also used store-made cupcakes. The difference would be that the store-made cupcakes would most likely have already been iced (and even decorated) so the students would then need to add a decorative element instead of just icing the cupcake. One possibility would be adding icing gel on top of the icing and adding sprinkles on top. Another alternative would be applying whipped cream which could be added to the cupcake and students could add the sprinkles to the whipped cream. Some local bakeries or grocery stores may also be willing to sell cupcakes that are not iced. This experiment allows for flexibility and creativity based on the preferences of the instructor and the constraints of the class.

It is helpful to have the area(s) where the experiments will be conducted cleaned and prepped before class begins. Thoroughly clean surface area prior to setup or cover with tablecloth. Arrange napkins, icing, icing tool, sprinkles or other decorating items, disposable gloves, and cupcakes on the table. Do not place them in any particular order, as it is important for the students to determine the best production method.

The Experiment

The instructor serves as the “manager” who hires the new workers. Initially, three student volunteers are “hired.” One student will be the time-keeper. Most students bring cell phones to class nowadays and can time the experiment directly on their phone. Alternatively, a timer can be provided. One student is selected as the scorekeeper to track the output for the rounds of the experiment. The scorekeeper can either record the data on a chalkboard or whiteboard. Otherwise, a template can be created and the student can input data into a spreadsheet that is projected on a screen for larger classrooms where reading from a board may be difficult.

Using a board is preferable to the spreadsheet for several reasons. First, it increases student engagement because not only does the student have to input data, but the student would also need to create and manage the table. Fellow students can and often do help with this. Second, it is easier to draw inferences, add columns (such as total, variable and fixed costs for example) after the experiment ends or highlight specific rounds for discussion, although this is still possible to do so on a spreadsheet.

The scorekeeper should create three columns on the board to track the output. The table should include columns for number of workers, total output, and marginal output. Sample tables are provided in the Appendix. Hiring two student workers to handle these “jobs” maximizes student involvement in the experiment. The third student will work as a cupcake decorator.

The task is for the student cupcake decorator to ice the cupcake, decorate the cupcake with sprinkles (or similar) and place it on a paper plate or napkin. The number of plated and decorated cupcakes is recorded for each round. The time allotted for each round can be altered depending on the class time but should be consistent for all rounds of the experiment. Generally, forty-five seconds is an adequate amount of time for each round. Only finished products should be recorded in the total output column (i.e. no partially finished cupcakes). It is important to have some sort of quality control aspect in the experiment. This will ensure that the finished cupcakes all have a similar amount of icing and sprinkles on the finished product. The “manager” can serve as the quality control inspector and reject any unsatisfactory cupcakes if necessary.

Additional students are hired in subsequent rounds and the output, as well as the marginal product of adding the additional worker are recorded. Rounds continue and one additional worker is “hired” each round until either all cupcakes are decorated or until marginal output (product) starts to decline. Since the workers are not homogenous, the possibility of better skilled workers being hired resulting in marginal product increasing during that round exists. Continue for several more rounds in case diminishing marginal product at this point is an aberration due to special effort by workers or rounding to whole cakes completed. Due to the restraints in capital and time, however, any increases in marginal product should be minimal and as more workers are hired with fixed amounts of time and capital, diminishing marginal product will eventually set in.

Post-Experiment Classroom Discussion

Minimal motivation is given before the experiment is performed. The key for the experiment is for students to observe the outcome of what will occur when more and more of one factor of production (labor) is added, while holding all other factors of production (capital and time) constant. Without telling the class what will happen, students are able to discover that after a certain number of workers is added with a fixed amount of capital, diminishing marginal returns will set in. They will not use this terminology when they observe the results, however. They will observe that when capital (knife, sprinkles, table etc.) is fixed, the number of finished cupcakes increases as more workers (students) are hired. But at some point, the number of finished cupcakes in the round will begin to increase at a decreasing rate and could eventually decrease in subsequent rounds.

This experiment increases student engagement in several ways. First, instead of experiments that use playing cards or dice or other props that do not necessarily promote student engagement on their own, this experiment involves the use of food. Students will get to eat the “output” of the experiment. Think back to a time when you had to sit through a long staff meeting. If someone happened to bring in donuts for the group, moods improved, and attention increased. This works in the classroom too. Second, this experiment is effective because any number of things can go wrong during the experiment, but these mishaps can oftentimes be humorous. Using humor in the classroom increases student engagement. Studies have shown that humor also correlates to significantly higher scores on examinations (Hackathorn, Garczynski, Blankmeyer, Tennial, & Solomon, 2011; Ziv, 1988).

Another outcome of the experiment is that students often begin to specialize. Typically, as more and more “workers” are added, they all tend to take on a particular task. Students can take on the job of placing the napkins or plates, decorating the cupcakes or icing them. Depending upon the size of the class, either one or two icing knives can be used. After the experiment ends, I ask the students to reflect on the experiment and give suggestions about what could be done to increase output. After they see that marginal returns sets in after a certain number of workers is added. Marginal product of labor is based on a fixed amount of capital so discussing how adding more capital (the knife, the table, the container that holds the sprinkles) could increase output but only to a certain point until marginal product sets in again. This is another benefit to the experiment as other experiments for diminishing marginal product do not have a capital component imbedded in the experiment.

Having two workers that perform duties other than producing output is a great way to incorporate a discussion on fixed vs. variable costs. During the experiment, they will be able to see that the output for workers one and two is zero. It is not until the third worker is added, that there is any output. This can be helpful to refer back to when discussing shutdown decisions.

The experiment can have many possible outcomes, but this is one of the reasons why the experiment is so effective. One semester, I had students icing the cupcakes using an icing bag with an attached decorating tip. This worked well until the bag had to be refilled with frosting. Refilling the icing bag took a significant amount of time and all production was “shut down” while the capital was being serviced or repaired. This opened up discussion on production process and the consequences of a breakdown in production.

Lastly, students appreciate a less formal approach in instructional delivery and feel more connected to the course and instructor. Pollio and Humphreys (1996) find connection between the instructor and the student is paramount to effective teaching.

Conclusion

The purpose of this paper is to offer an alternative approach to traditional methods of teaching the law of diminishing returns. I provide a self-contained exercise that can be adjusted for larger or smaller sized classrooms. In my experience, students retain the concept of diminishing marginal productivity long after the semester. They are able to recall both the experiment in detail and although they do not retain what the concept is called, they recall the main idea and outcome of the experiment even years after taking the course. The implication is that by incorporating a number of learning styles into the classroom and providing a means to allow for elaborative rehearsal and therefore long-term retention of the concept.

Although the main lesson is the law of diminishing marginal returns, other concepts that can also be incorporated and learned from this experiment are: marginal product of labor, fixed and variable resources, short-run production, the production function, costs and specialization. These topics can be incorporated at the discretion of the instructor.

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Appendix**Table A1. Sample table and initial results**

Round	Number of Workers	Total Number of Cupcakes Iced	Difference from Previous Round
1	3	2	-
2	4	4	2
3	5	8	4
4	6	11	3
5	7	11	0

Table A2. Sample table and final results

Round	Quantity of Labor	Total Output	Marginal Output	Output per Worker
1	3	2	-	0.68
2	4	4	2	1
3	5	8	4	1.6
4	6	11	3	1.83
5	7	11	0	1.57