

Light Bulb Presentations in a Mathematics for the Liberal Arts Course

Joseph A. Fox

Abstract: Encouraging students to make independent discoveries is an effective way to get them excited about mathematics, and sharing their triumphant moments (their light bulb moments) helps to spread this excitement to their peers. A Mathematics for the Liberal Arts course is a perfect venue for the sharing of light bulb moments, as it helps to correct the negative impression of mathematics that many of these students have.

Keywords: Discovery learning, light bulb moments, liberal arts.

1. INTRODUCTION

In the good old days when I was very young and before Congress started investigating the use of performance enhancing drugs in sports, I was an avid baseball card collector. I would pour over the statistics listed on the back, memorizing them and wondering how things like batting averages and slugging percentages and earned run averages were computed. Figuring out earned run average (ERA) became a holy grail to me. I set myself to the task, and one day it suddenly occurred to me that a good measure of a pitcher's performance would be the average number of earned runs given up for every nine innings pitched. Excitedly, I got out my cards and calculator and divided pitchers' allowed earned runs by their innings pitched and multiplied by nine. To my utter joy—that's right, my utter joy—I was a weird kid—I found that the numbers I got matched the pitchers' ERAs exactly! I had had my first of many mathematical light bulb moments. These moments, more than anything, have sustained me in my life as a mathematics student, teacher, researcher, and enthusiast, and I believe that creating environments in which my students can have such moments is the best way to get them excited about mathematics.

Address correspondence to Joseph A. Fox, Department of Mathematics, Salem State College, 352 Lafayette St., Salem, MA 01970, USA. E-mail: joseph.fox@salemstate.edu

I decided to put this belief into practice in my Mathematics for the Liberal Arts class recently. I told my students about some of my light bulb moments and ensured them that the course would inspire many of these moments during the semester. I was bluffing a little bit here; I was *hoping* that they would have light bulb moments but was wondering what I would do if they did not. More on that later. I told them that part of their course grade was to be determined by a short “light bulb presentation” in which they get up in front of the class and summarize their light bulb moment and the series of events and thoughts that led to it. The presentations were to be short (no more than ten minutes) and informal (no slides or memorized speeches). I wanted them to feel like they were having a natural conversation with their peers about their discoveries.

I made the presentations worth 10% of their grades, which I felt was enough to encourage them to take it seriously, but not so much that they would fabricate light bulb moments just to boost their grades. Also, I did not expect them to give their presentations the moment they had them. Instead, I had them e-mail me when they were ready to give one, and I would then let them have a few minutes at the beginning of the next class.

Weeks went by and no one was brave enough to break the ice and give the first presentation, despite all of the exclamations of, “Oh, I get it!” and, “That makes sense!” that I heard during in-class group work. Finally the first courageous student explained to the class how he had come to understand how to compute perimeters and areas of irregularly shaped geometric figures by recognizing them as combinations of rectangles, triangles, and circles. He explained how he had always struggled with this concept in high school, but one day during our class he suddenly got it—his light bulb clicked on. After this first presentation, the floodgate opened and students became very eager to share their light bulb moments.

The first few presentations were similar to the one just described. Students explained how they suddenly understood a homework problem with which they had been struggling. Figure 1 depicts such a presentation which concerns billiard ball trajectories. However, to my surprise, most of the students’ light bulb moments happened outside the classroom. They saw how the mathematics they were learning in class related to something in their everyday lives. For example, one student, a piano player, described how she saw glide reflections and translations and other isometries in the sheet music for *Für Elise*. Another student, who was a role-playing game enthusiast, noticed that the many-sided dice used in such games are actually Platonic solids (except the ten-sided die, which is not a regular polyhedron). A theatre major noticed how prevalent golden rectangles are in stage design. I had not expected these kinds of light bulb moments, and seeing students enthusiastically talking about how the mathematics they were learning in class related to their lives was one of the most satisfying moments in my career as a teacher.

Not all of the light bulb presentations captured the spirit of the assignment. There were presentations that were inaccurate or irrelevant to the topics in the



Figure 1. A student explains a light bulb moment she had while studying the trajectories of billiards balls.

course. However, these were the exceptions. Only one student out of about 35 gave a presentation that was completely inaccurate, and only two or three gave presentations that did not relate to the mathematics of the course. As I mentioned above, I had a fear that some students just would not have light bulb moments, but at the end of the semester, only one student did not give a presentation. I suspected that this was more a function of shyness than of a light-bulb-less semester. Another worry I had was that students would talk about light bulb moments that were too minor. For example, one student talked about how excited he got when he noticed a type of symmetry pattern that we had discussed in a movie he saw in his history class. After hearing his presentation and seeing the enthusiasm he felt, I realized that no light bulb moment is minor to the person who has it. Figuring out how an ERA is computed is no great feat, but it was still a thrill for me at the time. Whether it's Einstein realizing that the speed of light is constant relative to any observer or my student recognizing an Islamic lattice pattern in a history documentary, a light bulb moment is a profound accomplishment for the person who has it.

Though there are the potential problems mentioned above, the benefits of light bulb presentations are numerous. Most obviously, the excitement generated by a student's light bulb moment is contagious. When students see peers talking enthusiastically about discoveries they made or bursts of understanding they had, the students feel more confident that they can do the same. Light bulb

presentations also enhance students' mathematical discourse and hone their ability to talk about a technical subject in a coherent way.

A benefit of light bulb presentations that I did not expect is that they serve as a way for the class to feel like a community—students get to know their peers and hear them speak. They develop an understanding of how their classmates think and comprehend mathematics. They encourage each other and even in some cases, defend each other. For example, after the inaccurate presentation mentioned above, I felt the need to ask the presenter some follow up questions to see whether she really understood her topic. Some of the students felt I was being picky and playfully scolded me for being too hard on her. The feeling of community in this course was one that I have never before experienced as a teacher. They were sharing ideas and encouraging each other in the true spirit of academia.

I chose to try these presentations in a Mathematics for the Liberal Arts course for the obvious reason that many of the students in such a course are intimidated by mathematics and inexperienced with independent mathematical discovery. Of course, light bulb presentations would be appropriate for any mathematics course, considering the fact that mathematics creates endless opportunities for light bulb moments. I also used them in a Discrete Structures course one semester and was very pleased with the results. My favorite was a presentation given by a student in which he noticed that one could associate elements of the power set of a finite set with binary strings. This provided the perfect setup for us to compute the cardinality of a power set. I certainly plan to use light bulb presentations more often as my teaching career progresses.

The pride of discovery is a powerful feeling. It encourages people to push harder and dig deeper, which is exactly what we as mathematics teachers need to get our students to do. Giving them the chance to feel like a bathing Archimedes is, I believe, the best way to do this. (Of course, we should probably discourage them from running naked through the hallways yelling, "Eureka!") Requiring my students to share their light bulb moments has been a way for me to partially accomplish this goal. At the end of the semester in which I had my Liberal Arts students give presentations, one student e-mailed me, saying, "I haven't been in a math class for a long time, and your class was very enjoyable. It made me want to study more math." I hope she does, and I hope that the excitement she felt from mathematical discovery rubs off on her peers!

BIOGRAPHICAL SKETCH

Joseph A. Fox received his PhD from Western Michigan University, Kalamazoo, Michigan, and is currently an assistant professor in the mathematics department at Salem State College, Salem, Massachusetts. His research interests include Lie theory and algebraic groups.