Romance of a mathematician: Celebrating St Valentine's Day in a mathematics class

Serkan Hekimoglu
University of Georgia, USA
<shekimog@coe.uga.edu>

'Ask her to wait a moment — I am almost done.'

Gauss (1777–1855) said these words as he was working on a mathematics problem after being informed that his wife was dying. After such words from the man considered to be the prince of mathematics or the greatest mathematician until now, how can romance exist in mathematics?

As opposed to Gauss, there are mathematicians who are quite romantic. Omar Khayyam, the famous Persian mathematician, philosopher and astronomer (1048–1122) wrote many rubaiyats dealing with love. Evariste Galois, one of the creators of group theory, may be the most famous romantic mathematician. In Eric T. Bell's *Men of Mathematics*, a chapter called 'Genius and Stupidity' describes the life and death of Galois, who was killed in a duel over a woman at the age of twenty (Bell, 1937).

The 14th of February is not just an ordinary school day, it is St Valentine's Day. Upon entering the school, one can observe happy, smiling students. Red paper hearts adorn the school walls while students joke and laugh with one another. In the spirit of Valentine revelry, mathematics will be the source of many jokes or remarks, such as, 'smart man + smart woman = romance'. Now, imagine a mathematics class where the teacher writes:

$$B4 \;\; I \;\; CU \;\; \frac{RU}{18} \;\; Qt\pi$$

How would students react? Would they see mathematics with a real-world connection?

Before presenting a list of activities useful in celebrating St Valentine's Day in a mathematics classroom, the need for connecting St Valentine's Day with mathematical activities will be discussed. As opposed to what one might think, students have experienced romance and mathematics in the last decade. The passionate side of mathematicians, along with a romanticised view of mathematics itself, have been the backdrop to some very successful movies (*A Beautiful Mind* and *Good Will Hunting*) and plays (*Proof* and *Arcadia*). These movies and plays have been successful both commercially and artistically. While *Proof* won the Pulitzer Prize, *Arcadia* fascinated mathematicians. As a

result of this interest, *Arcadia* has been the only play ever to be reviewed in *Scientific American*. Both the movies and the plays owe their success at least in part to demonstrating the poetic heart of a mathematician by integrating mathematical ideas into the action of the movie or the play. What about mathematics students? Do they still perceive mathematics as an enigma (seeing mathematics as a strictly rational, abstract, and soulless subject as Schoenfeld (1989) reported) that consists of algorithms and formulas taught in a sterile classroom? How can students' perception of the nature of mathematics and mathematics teaching and learning be changed? Since the subject of mathematics is dynamic and evolving, with many fascinating applications being used to solve real-world problems, a solid grasp of the fundamental methods of mathematics is essential in order to understand the modern world.

A need exists for educators to adopt a philosophy for creating a mathematics curriculum where students will begin to value mathematics by using real world situations as a stimulus for authentic problem solving activities. The term 'ethnomathematics' has emerged from this awareness. This term relates to helping students and teachers discover the relationship between mathematics and daily life through creating a learning environment that senses applicability and practicality in concrete situations. In order to help students appreciate mathematical concepts, ideas, and language, there is a need to make connections between what happens in mathematics class and what is happening in the world by using technology as a vital tool in helping students to develop their own solutions. The following activities (except for Activity 1) require the use of a dynamic graphing computer program such as *Graphing Calculator 3.2* (Avitzur, 2002) that can graph both functions and equations.

Ideally, these activities will help students use mathematics skills and knowledge for purposes and situations they will encounter throughout their lives by seeing beauty in mathematics via mathematical demonstrations. They will have an opportunity to examine and construct their own meanings by recognising and demonstrating the same idea from different viewpoints with the help of technological tools. Such activities will help students to see that mathematics deals more importantly with ideas rather than formulas or algorithms, and that mathematical constructs are invented or created by human beings.

Activity 1: Exchanging valentines

This activity introduces basic ideas in combinatorics by posing the question: If every student in our class gives a valentine to each of the other students, how many valentines are exchanged?

Activity 2: Making flowers for your valentine

This activity explores the polar equation of rose curves. Among all of the polar graphs, rose curves are perhaps the most fascinating ones. The general form for rose curves is either $r = k\cos(b\theta)$ or $r = k\sin(b\theta)$, where b is any positive integer and k is a real number greater than 0. The length of the 'petal' is determined by k, and b determines the number of petals. The teacher will ask students to discover how the number of petals changes with respect to b, considering whether b is an odd or an even number. Students will observe when b is odd, the number of petals is equal to b, and when b is even, there are $2b$ petals (see Figure 1). The teacher may discuss the rotational symmetry in flowers and other similar objects in the world by taking advantage of this activity. During this activity, the teacher may mention the game 'he loves me/he loves me not' where a girl pulls off a petal for each statement. Next the teacher can show the class how polar equations can be used to determine whether 'he loves her or not'.

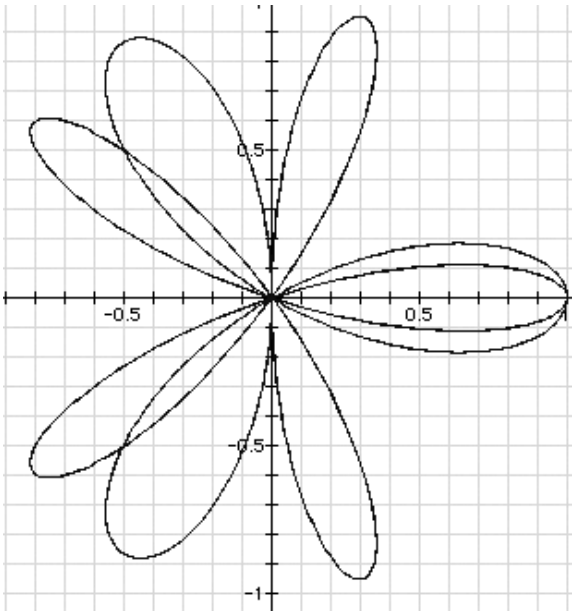

Figure 1. Rose curves with 3 and 5 petals.

Further exploration

The teacher may allow students to explore how the graph of the polar equation above changes if b is an irrational number and why that is the case.

Activity 3: Creating a St Valentine's Day card

Introduce the following two functions as examples and then let students create their own St Valentine's Day cards.

Our first equation is

$$f(x) = \sqrt[7]{x^4} \pm \sqrt{10 - x^2}$$

At first, let students graph this function. As in Figure 2, students will observe disconnection in their graph. The classroom discussion can be centred around the meaning of domain and range of a function. It may be good to ask them to graph

$$f(x) = \sqrt[7]{x^5} \pm \sqrt{10 - x^2}$$

before classroom discussion. They will observe that changing the first exponent of x from 4 to 5 has made a significant change in the graph (see Figure 3).

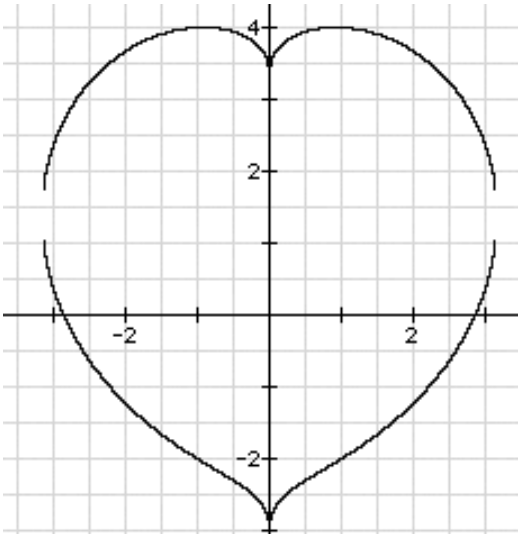

Figure 2. Graph of $f(x) = \sqrt[7]{x^4} \pm \sqrt{10 - x^2}$

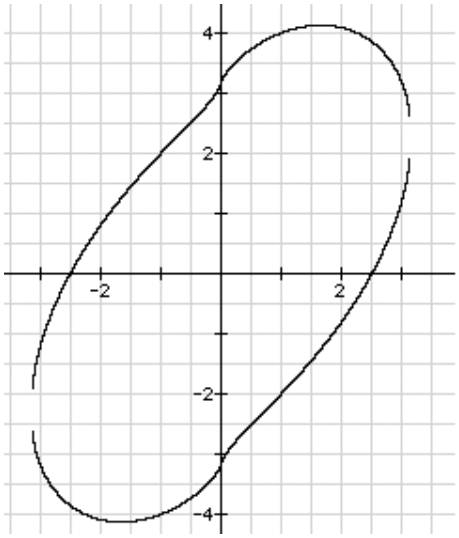

Figure 3. Graph of $f(x) = \sqrt[7]{x^5} \pm \sqrt{10 - x^2}$

Now, ask students to graph $x^2 - x|y| + y^2 = 1$ Students will come up with the following graph (see Figure 4). Now, ask the students to create the same graph horizontally on the x-axis. A discussion about symmetry and range-domain relationships may ensue.

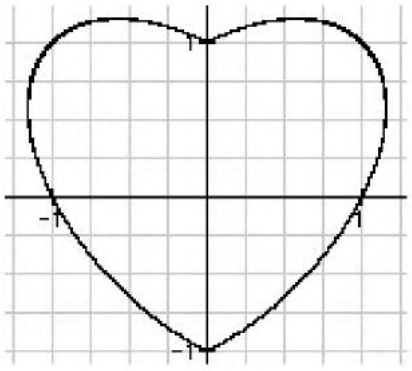

Figure 4. Graph of $x^2 - x|y| + y2$.

Further discussion can be stimulated among students by asking why the graphs in Figure 2 and Figure 4 are similar.

Activity 4: Mathematician's marriage proposal

Create a wedding ring by using mathematical equations. Ask students how they might create a wedding ring by using different mathematical functions. This activity will help students to think about graphing different piecewise functions simultaneously to get a graph of a wedding ring.

Summary

Students will start to view mathematics as a science that possesses not only absolute truth but also austere beauty. Students will see the poetic hearts of mathematicians as Weierstrass expressed, 'No mathematician can be a complete mathematician unless he is also something of a poet' (Huntley, 1970, p.1). Mathematics should not be studied simply because it is useful; mathematics should be also studied because it nurtures both the mind and soul with its beauty. By completing these activities, students will appreciate mathematical ideas both rationally and emotionally. Since students' appreciation of mathematical ideas requires learning by self-discovery, they will be encouraged to see mathematical and real-world connections via mathematical demonstrations.

References

Avitzur, R., Gooding, A., Robbins, G., Wales, C. & Zadrozny, J. (2002). *Graphing Calculator 3.2* (computer application). Berkeley, CA: Pacific Technology.

Bell, E. T. (1937). *Men of Mathematics*. New York: Simon and Schuster.

Huntley, H. E. (1970). *The Divine Proportion: A Study in Mathematical Beauty*. New York: Dover.

Schoenfeld, A. H. (1989). Explorations of students' mathematical beliefs and behaviors. *Journal for Research in Mathematics Education, 20,* 338–355.