Focus on Mathematics Pedagogy and Content
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Using Technology in Teaching Math

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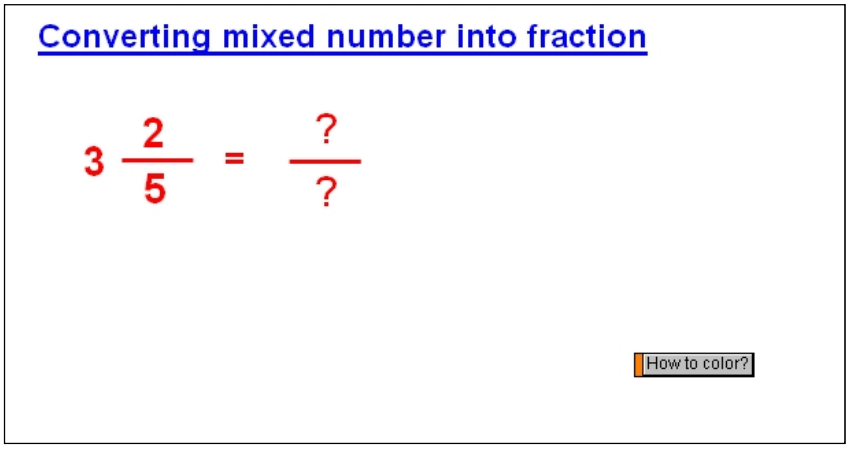
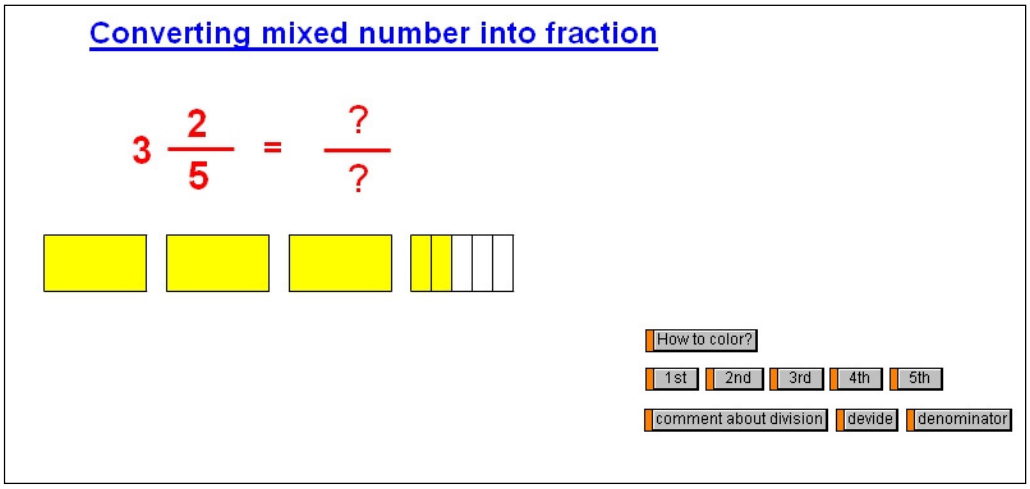
I am a math teacher in Croatia. I work in a primary school, teaching grades 5^{th} - 8^{th}, working with kids of 10 to 15 years of age. Unfortunately, in my school, there is not enough equipment for each student to have his or her own computer. Thus, I compensate for the lack of computers, by using a projector. I started using it about 7 years ago and found it to be very useful. I have used several programs, including GeoGebra, Geometer's Sketchpad, and Power Point, when making materials for my classes. In this article, I will describe ways to use some of these materials.

Investigation - Converting a mixed number into a fraction

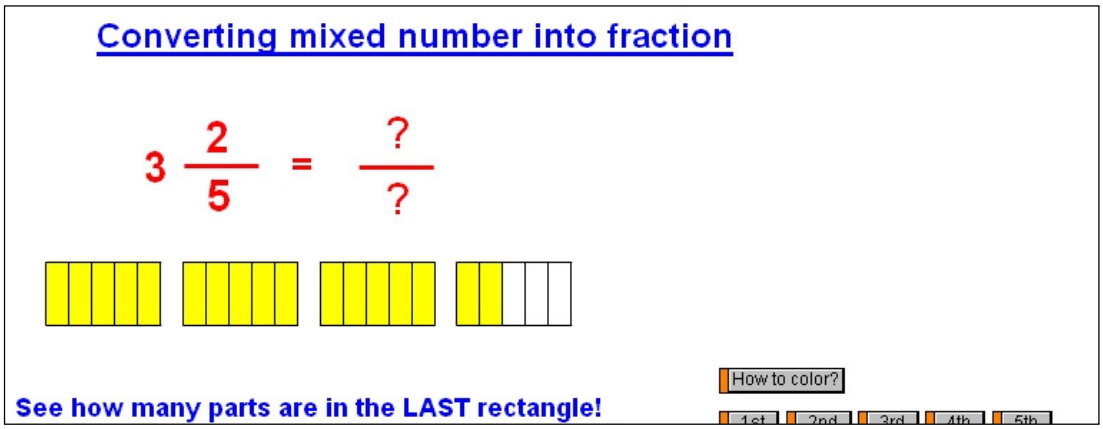
Our kids work with fractions in the 5th grade. Computers prove to be very useful in this section. For example, we use the projector to illustrate the procedure for converting a mixed number into a fraction. For this purpose, we use The Geometer's Sketchpad file: http://www.antonija-horvatek.from.hr/materials-English/Fractions/Converting-mixed-number-into-fraction.gsp .



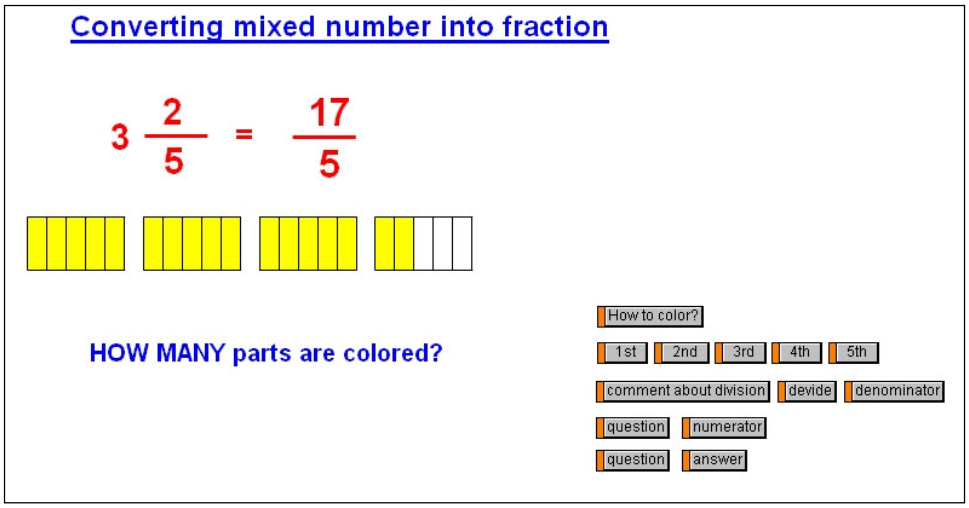
Here, we have the mixed number, $3\frac{2}{5}$. We are looking for the improper fraction that is equal to $3\frac{2}{5}$. To identify the fraction, we look at a picture of the mixed number. Pupils are asked to color $3\frac{2}{5}$ of a rectangle. Pupils realize they must color 3 whole rectangles, draw another rectangle, divide it into 5 equal parts and color 2 of the parts. With each part of the process, the accompanying portion of the illustration is completed.



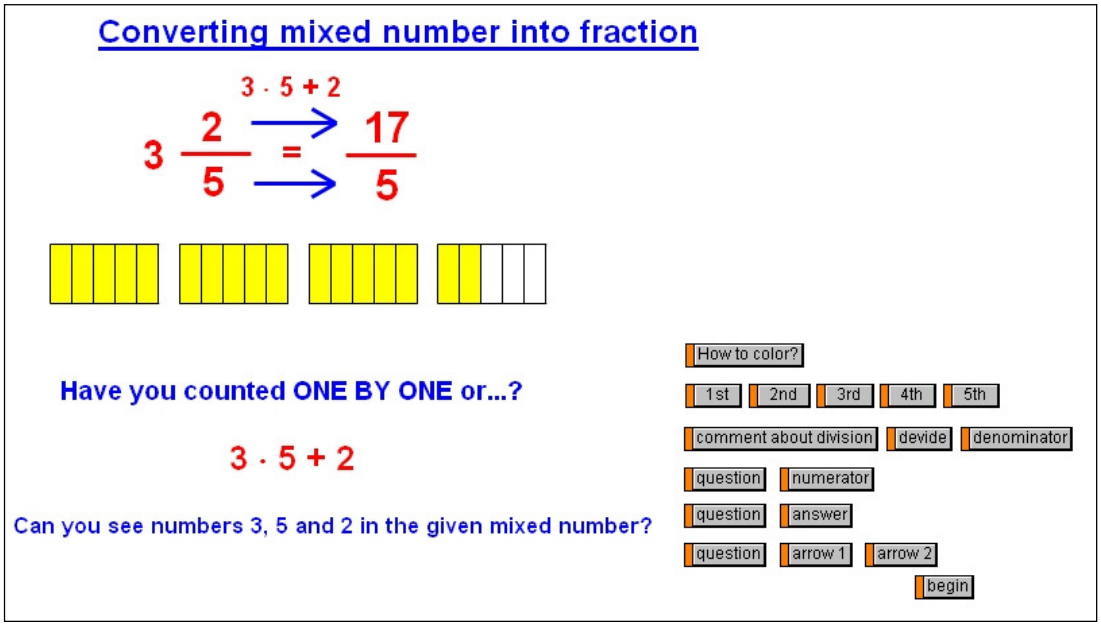
Now, we have an illustration that represents the mixed number. Pupils must determine how to present the colored part with a **fraction**. In order to do so, they need to count the number of total parts in the partially shaded rectangle, as well as the total number of shaded parts in the four rectangles (see the picture below).



Pupils may now see that the denominator of the fraction is 5, since each rectangle may be divided into 5 equal parts. The numerator is 17, since that is the total number of shaded parts, shown in all four rectangles.



Next, we discuss procedures students may use, when calculating the number that goes in the numerator.



At the conclusion of the activity, students have found the rule for converting a mixed number into a fraction, $a\frac{b}{c}=\frac{a\cdot c+b}{c}$.

Presenting Some Steps – Radial Expressions on a Number Line

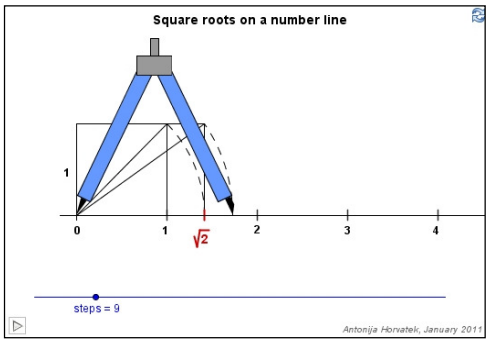
In Croatia, square roots are presented in 8th grade. In our curriculum, it is necessary to teach the graphing of $\sqrt{2}$, $\sqrt{3}$, $\sqrt{4}$, $\sqrt{5}$, etc., on the number line, but it is not necessary to graph numbers like these:

- $-\sqrt{2}$, $-\sqrt{3}$, $-\sqrt{4}$, $-\sqrt{5}$, etc.

- $\sqrt{n}$, $2\sqrt{n}$, $3\sqrt{n}$, $4\sqrt{n}$, etc.
- $a\sqrt{n}+b$

So, I use GeoGebra applets that I created to show **all of these** graphed expressions. The applets present the constructions, in a very short time. You can find these applets on this page:
http://www.antonija-horvatek.from.hr/applets/real-numbers/Square-roots-on-number-line.htm .

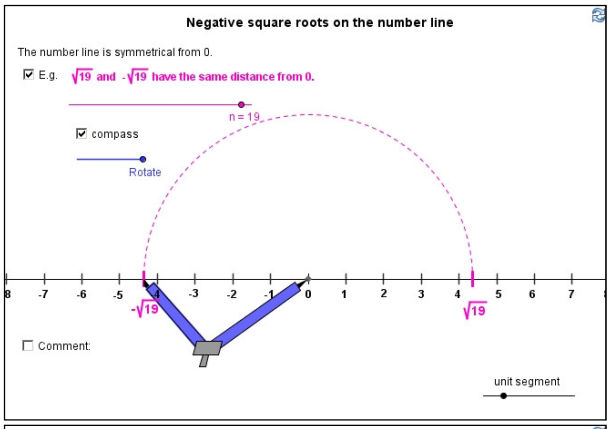
The first applet shows how to graph $\sqrt{2}$, $\sqrt{3}$, $\sqrt{4}$, $\sqrt{5}$, etc. on the number line.

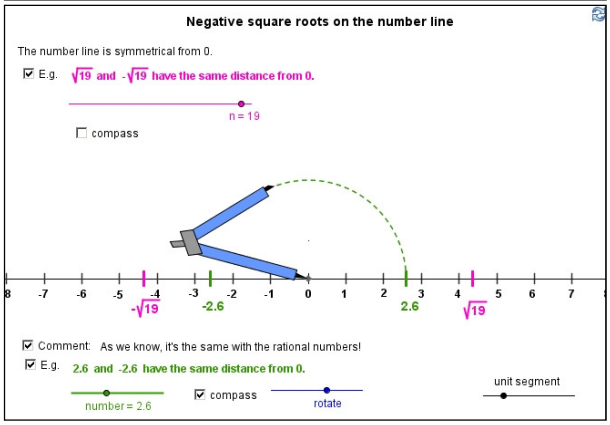


I also like to show the construction on the blackboard. *It is clearer for some kids when the teacher explains the process, while drawing the graph on the blackboard.* At the same time, kids draw the graphs, in their notebooks.

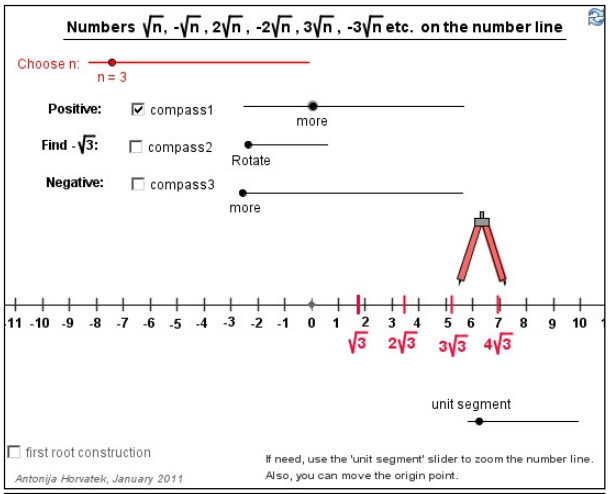
The graphing of other radical expressions are presented via projector:

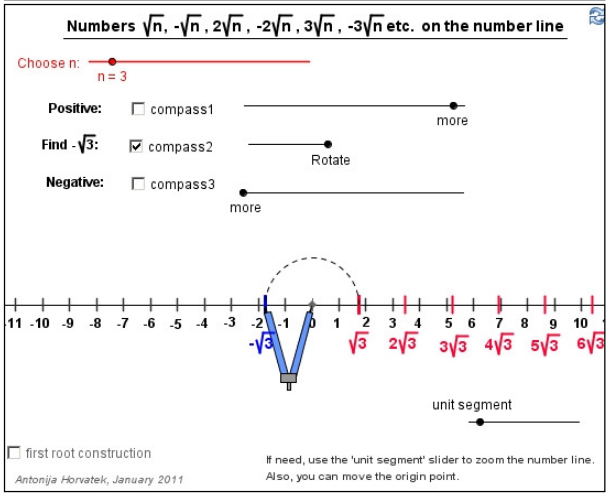
Negative Square Roots





Other Radical Expressions


Numbers √n, -√n , 2√n , -2√n , 3√n , -3√n etc. on the number line
Choose n:
n = 3
Positive:
compass1
more
Find -√3:
compass2
Rotate
Negative:
compass3
more
unit segment
first root construction
Antonija Horvatek, January 2011
If need, use the 'unit segment' slider to zoom the number line.
Also, you can move the origin point.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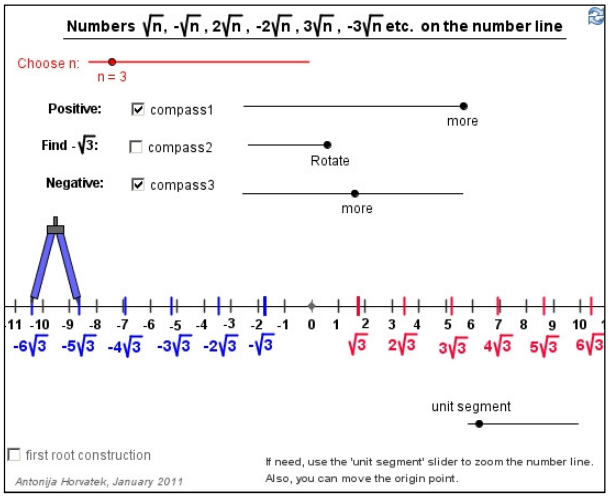
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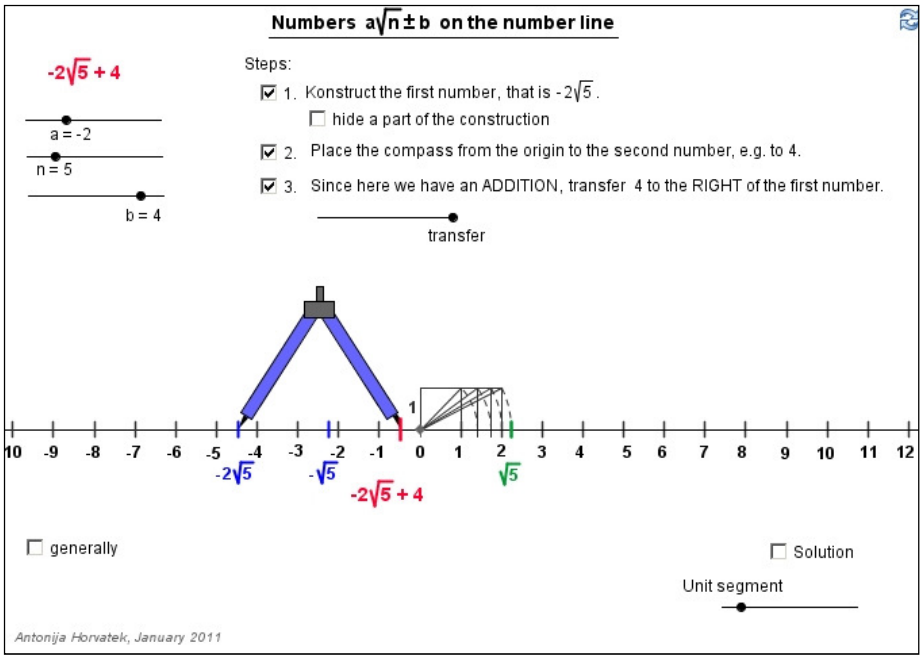

In each of these cases, I ask pupils appropriate questions and try to guide them to the correct conclusions. Also, I give the web address with these applets and ask them to visit it, to study it again, and to solve some (optional) exercises at home.

Revision - Fractions

The link below shows how we use a Power Point, when discussing revisions:

http://www.antonija-horvatek.from.hr/materials-English/Fractions/Fractions-revision.pps

This presentation can be used at home, as well.

Other Ways to Use Technology in Math Teaching

All of the materials presented in this article, plus many others, may be found at: http://www.antonija-horvatek.from.hr/materials-English.htm .

Many of the materials are in Croatian and are not translated into English. Given in Croatian, here is an example that covers the solving of systems of two linear equations in two variables:
http://www.antonija-horvatek.from.hr/7_razred/08_Sustavi_jednadzbi/Sustavi_jednadzbi.zip .

I often use Power Point presentations as a framework, with links to GeoGebra files. Here is an example of integration of these two programs:
http://www.antonija-horvatek.from.hr/7_razred/09_Jednadzba_pravca/Uvod-Jednadzba_pravca.zip . Note. The example is in Croatian.

http://www.antonija-horvatek.from.hr/

Math and Biology: How They Mix - or Don't

Michelle Grzybowski
Biology Major and Preservice Teacher
Texas A&M University
College Station, TX

Math is a complex subject that opens the mind to a whole new realm of possibilities. The concepts are fascinating, and the methods are brilliant. Unfortunately, the students studying biology here at Texas A&M, do not always share this same perspective. What do biology majors think of the distinct field of mathematics? Research was conducted by going straight to the sources themselves.

Enjoyment

As one biology advisor put it, "Math is just one of those subjects that a student either likes or dislikes, and there is not much that can be done to change the student's opinion." This statement may be true, but it shouldn't stop educators from trying to make the subject more appealing to their pupils. Eight, out of the ten biology majors interviewed, said that overall, they do *not* enjoy their math classes. There appeared to be strong factors that influenced these attitudes. A huge contributor was professor likeability. Students said math was more bearable for them when they had a professor who was available for office hours numerous times throughout the week, did not assign excessive amounts of homework, taught the material in an easy-to-understand manner, and whose tests correlated well with the lecture. Several students mentioned that they felt their professors were not approachable and so they shied away from asking questions, in fear of sounding unintelligent. Math was not at the top of any of the student's lists of favorite courses because they felt burdened with too many homework problems that seemed tedious and extreme. Others felt the material is taught at a complex level that is too difficult for them to comprehend in order to grasp the necessary concepts. Most of the biology majors just felt lost in the courses and needed some more direction on how to study and prepare for exams, but also needed ideas on how they could be successful in the class overall.

How will math relate to my desired career field?

This was another major factor in how students perceived math. Biology majors seemed to lose motivation to learn the math, when they saw little correlation between the subject matter and their desired career field. Students looking to attend professional school and become doctors, dentists, nurses, physical therapists, and others, did not find their math requirements to be particularly beneficial. However, students interested in research, felt that they would utilize the material on a daily basis and tended to appreciate the courses more. Several students said that they tried to get their math courses out of the way early in their college career, so they could focus more on their biology classes. The positive of this act is that the rigor of the courses such as MATH 147 and MATH 148 help biology majors better prepare for their upper level science classes. Although, the content may

seem overwhelming a significant amount of the time, the courses help students to develop the skills needed to do well in their later classes and future careers.

How Opinions Can Change

It is important to note that as students progress through their college career, their perspectives evolve, as well. One student who just completed her freshmen year, said that taking the load of biology, chemistry and math (calculus) was "too much and wishes there was a way around it." For a student trying to adjust to the challenges of a college course-load, math would seem daunting. The advisors mentioned, "Many incoming freshmen freak out during their New Student Conferences" because they are intimidated by the idea of difficult math courses. A student going into her junior year had a different take on things. Although she struggled in the courses, she learned to find the balance and worked hard, knowing the courses were required, in order for her to obtain her biology degree. A recent college graduate said, "My math courses were terrible at the time, but they helped me develop a strong work ethic." He can surely carry this quality over into many faucets of his life. The struggles of today can help students prepare for the success of tomorrow; with diligence, any set goals may be achieved.

How to Increase Math's Popularity

When students are able to excel in anything, that activity becomes more enjoyable. That concept can be applied here. If professors can relate to students in a way that increases their success, then the attitudes of the students will change. If the material is presented in a more entertaining manner, students will not be as easily discouraged. According to the article, "Teaching Calculus to Biology Students," biology majors do not catch on as quickly as engineers or math majors because "language of the class is different from what they are used to." This is why a little extra time, patience, and more examples are necessary. Another important factor is to show students the real-world applications of the material. Math can be a very intimidating subject, when it is not broken down into manageable pieces. It is essential to show the correlation, between math and certain career fields. Also, one advisor thought it would be beneficial to show how math skills can be used in many areas of life, such as problem solving, use of logic, and creation of solutions.

Conclusions

Biology majors do not hate math. Science and math have a lot in common, and students appreciate this connection. However, biology students find math less enjoyable when they dislike their professor, are burdened with outside work, or taught the material in a way that is a struggle to understand. When this happens, students feel destined for failure. It is necessary to make students aware of how the content can correlate to their future careers and lives, in general. If students do not see the math's applicability, then they will not be driven to succeed. Both the biology students and advisors agree that the math requirements are just right. The amount of courses is not the problem; learning the utmost possible from these few classes and making them matter is where there seems to be a

discrepancy. However, it is important to note that the advisors tend hear from the ones who struggle the most, while the ones who do well, do not discuss it as much. Math courses pose an obstacle for some, while others do not encounter such an obstacle. It is just as important to acknowledge the positive attitudes, as it is to recognize the negative ones.

Sources:
-Questionnaires filled out by the five biology advisors
-Interviews conducted with ten different biology majors
-http://collegemathteaching.wordpress.com/2012/03/07/teaching-calculus-to-biology-students/

NCTM Regional Conference
One of the NCTM Regional Conferences will be held at the Dallas Convention Center, October 10-12, 2012. Check out http://www.nctm.org/dallas/ for more information.

RGVCTM Conference
The 2012 annual RGVCTM Conference will be held on November 17, from 8:00 to 4:00, at the University of Texas – Pan American, in Edinburg, TX. Visit http://rgvctm.org/ for more information.

A Book to Check Out
You may want to read NCTM's 2001 Yearbook, *The roles of representation in school mathematics*. It covers many representations that may be used, across the grade levels. A chapter on teaching fractions is included in the book.

RCML Conference 2013
The Research Council on Mathematics Learning (RCML) is hosting its annual conference in Tulsa, Oklahoma, from February 28th through March 2nd. Visit http://web.unlv.edu/RCML/conference2013 for more information.

Advertising in the Newsletter
In an effort to expand our newsletter and online offerings, we are looking for support of our monthly newsletter. Please contact Dr. G. Donald Allen at dallen@math.tamu.edu if you are interested in sponsoring our newsletter.

Newsletter Survey
We have created a short survey to determine your areas of need and specific interests, related to the teaching of mathematics. We will use your responses as a reference for future topics, updates, etc.

The survey should take only a few minutes and is located at:
http://www.surveymonkey.com/s/5VGX6TN.

Quote of the Month

"The art of doing mathematics consists in finding that special case which contains all the germs of generality." - David Hilbert (1862-1943), German mathematician of the early twentieth century; regards are profoundly influential

Past Articles
You can view all past (and current) *Focus on Mathematics Pedagogy and Content* articles at http://distance-ed.tamu.edu/newsletter/index.htm.

External Article Submissions
Texas A&M University is accepting external article submissions for this newsletter. External submission guidelines are as follows:

1. Length restriction of 1000 words
2. Free of grammatical errors
3. Figures should be clear and legible, with black type on white background.
4. Tables should use a font size no smaller than 11-point for text.
5. Mathematical symbols and equations should be created using a mathematical notation tool, such as Equation Editor or MathType.

Articles may focus on a variety of topics, including but not limited to:

- Increasing middle or high school teachers' pedagogical and/or content knowledge
- History of mathematics
- Real-world mathematical connections and applications
- Suggestions for successful instructional practices in the classroom
- Action research

The focus should be on middle and/or high school mathematics. All articles must be the original work of the author(s). The editors are currently accepting article submissions for the September 2012 issue (vol 4, no 7). Please send article submissions to aamr200607@yahoo.com.

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