Vision - Potential

Vision Within Every Instructor - Potential Within Every Student

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[1] Teaching Philosophy

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I have always known I wanted to be a teacher. As a high school student, I had not yet decided what I wanted to teach, but I did know I wanted to teach something. In my undergraduate program, I sought out opportunities to teach and work with students. I modeled my teaching style after teachers I had in the past whom I admired. Mostly I admired the teachers who were well-organized and gave good notes; the teachers whom, if I just listened in class and took careful notes, I would have everything I needed to do well on tests. This method worked for me, I believed it would work for my students as well.

Once I began taking formal teacher education classes, and learning about the Constructivist philosophy, I started to see that maybe everyone did not learn math the same way I did. I bought into the notion that everyone constructs their own knowledge, however, I still saw my role as the teacher as a transmitter of that knowledge. If I was clear enough and worked through enough examples my students would construct their math knowledge correctly, assimilating everything I said, exactly as I said it. I always tried to be responsive to student questions in class as well as understand their individual needs, so I believed I had a student-centered classroom. Even though I was focused on the students, their role in the classroom was still largely passive.

Over the past few years, I have started approaching my lessons differently. I know that each student constructs his or her knowledge differently based on his or her experiences. As a mathematics teacher, I am responsible for creating those experiences for my students in such a way that the students can make meaningful constructions for themselves. For most students, this means they need to be actively engaged with the material rather than passively waiting for me to impart wisdom to them. I have come to see that a particular student's success in my course has very little to do with what I say in class, and a lot to do with what I have them do on their own.

Novice learners (many college freshmen still fall in this category) need more structure in their courses. I look at it as being similar to

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how many of us learned to ride a bike when we were children. We had training wheels until we got used to the mechanics of how a bike worked – how to pedal, how to steer and how to stop. We then progressed to trying to ride without the training wheels, but with someone that ran behind us to make sure we did not fall. Then we progressed to riding on our own with no safeguards. Some people were naturals, but most of us fell at least once before we got the hang of it.

Similarly, I try to structure classroom activities that scaffold the student learning appropriately. I start with tasks that are closely linked to prior math knowledge, and then advance to more complex concepts. For example, a common topic in college algebra is solving a system of equations. With students working in teams of two, I begin with a simple example – graphically approximate, using the Trace key on their calculator, the solution of the system $\{y = x, y = -x + 5\}$ and then solve the system analytically by substitution (e.g., substitute x for y in the second equation). (Here the students are riding with their training wheels on.) Next I ask them to graphically and analytically solve the system $\{y = 2x + 3, 2y = 3x + 5\}$ and then determine the equation of a third line that passes through the intersection of the given two lines. Thus forming a system of three equations. (We have taken the wheels off, but I am running along behind, ready to catch if they fall.) I then ask them to create two systems of three equations in two unknowns, one that has a solution and one that does not. (Now they are riding on their own.) As a conclusion, I ask some of the teams to present their work, including their reasoning, to the class. Of course not every student is going to be completely successful, however they will all have an experience on which to develop an understanding for solving systems.

I also try to establish a safe environment in my classroom. Students are free to ask questions and make mistakes without fear of embarrassment. Each day, I try to have several problems for the students to work through on their own and I frequently call on students to work through problems at the board or discuss their solution strategies. If a student does not know how to solve the problem, I have them start with what they know and then elicit help from the rest of the class on what they do not know. I try to emphasize the value in learning from one's mistakes.

Regarding assessments, I believe in using multiple measures to evaluate the level of student learning. Typically, I assign problem sets for graded homework, give short quizzes fairly frequently, assign several major projects and then, of course, give mid-term exams and a final exam.

In the homework problems sets and in the projects, I try to give the students exposure to solving more complex and sometimes ill-defined problems. The projects also have a writing component. The students are assigned a problem (usually one that requires some assumptions be made and involves multiple mathematical tasks) which they must solve and then explain their solution in a formal report. I generally use quizzes to assess how the students do when they have a time constraint and no outside resources. I find that giving frequent quizzes helps the students prepare for mid-term exams by making them face what they can do on their own during a timed event.

When I design an exam, I include some questions that are very straightforward. These questions are similar to homework problems and can assess a student's understanding of the basic concepts from the course. I also include some questions that are designed to assess more complex reasoning skills. These questions require the students to apply the skills and concepts covered in class to answer unfamiliar problems. I have found that designing exams this way helps me assess which students truly have a good understanding of the material versus the ones who have just learned the basic skills.

After each mid-term exam, I also require my students to do test corrections on any problems they missed. This is not for points back on the test, but just as an additional homework assignment. However, I do not have them simply do the corrections. I also insist that they include for each problem a short paragraph reflecting on why they did not receive full credit. I find that this helps my students become more reflective on their work in general. They are also less likely to make the same mistake again.

[2] Beginning Class Activities

These two "Beginning Class Activities," are designed to be done by two-person teams. Conclude the activity with two or three teams presenting their work to the class and explaining their reasoning.

a. Determine two linear equations whose graphs intersect at the point (3, 4) with one line having slope three and the other line having slope negative two.
b. Determine two parallel lines, one passing through the point (2, 1) and the other passing through the point (-3, 3).

[3] Query: Debt

According to the U.S. Census Bureau the current population of the U.S. is 303,162,770 and rising at the rate of 2,425,850 per year. The U.S. national debt is currently $9,000,000,000,000 and rising at the rate of $500,000,000,000 per year.

a. What is the current per capita (per person) national debt?
b. Is the per capita national debt rising or falling? At what rate?

[4] Asymptotes

For each of the following, state if the function has a vertical asymptote only, a horizontal asymptote only, both a vertical and a horizontal or no asymptote. If the function has one or more asymptotes, give an example and state the asymptote(s). If the function has no asymptote, explain why it does not have an asymptote.

a. An exponential function.
b. A logarithmic function.
c. A power function with a positive exponent.
d. A power function with a negative exponent.

[5] Query: Oil-Gasoline Prices

Although both oil and gasoline prices fluctuate, their prices are linked and the price trends are increasing. Assume that 50% of the price of gasoline is the cost of the oil used in the refining process for the gasoline. Assume also that the price of gasoline is $3.20 per gallon. If the price of oil declines 10%, how much should the price of gasoline decline?

[6] Pizza

The proprietor of Central Pizza in York, PA estimates that a 16 inch pepperoni pizza that sells for $8 contains 4 ounces of pepperoni, 7 ounces of sauce, 13 ounces of cheese, and 20 ounces of crust.

a. Display this information using a pie chart. showing the weight percentage of each ingredient.
b. What would be a reasonable price to pay for a single slice whose surface area measured 25 square inches? Explain your reasoning.

[7] *Challenger* Explosion

Twelve years ago this month the space shuttle, *Challenger,* experienced a catastrophic explosion shortly after launch killing all the astronauts on board. The resulting investigation headed by William Rogers, a past Secretary of State, concluded that the failure of an 0-ring was the cause of the accident.

The space shuttle system consists of the orbiter, the external liquid fuel tank, and two solid rocket boosters, all joined together at launch time. The solid rocket boosters responsible for giving the initial thrust necessary to launch the space shuttle into orbit are approximately 150 feet in length and 12 feet in diameter. They are manufactured and shipped in sections and assembled at the launch sight. 0-rings, primary and secondary, are used to seal the joints between the sections. The day before the fateful launch, concerns were raised about the effectiveness of the 0-rings in cold weather. The concern was whether or not the cold weather would make the 0-rings too stiff to seal properly. The temperature forecast for launch time was 31°F. The lowest temperature of any of the 24 previous launches had been 53°F. The decision to launch may have been the result of an incorrect analysis of the following data.

The following data on 0-ring performance comes from the inspection of the jettisoned solid fuel rockets that were recovered from the ocean on 23 of the previous 24 launches.

Launch Temperature (°F)	**Number of Primary 0-rings Damaged**
53	2
57	1
58	1
63	1
70	1
70	1
75	2

There was no indication of damage to 0-rings on the remaining 16 launches. The temperatures (°F) for these launches were: 66, 67, 67, 67, 68, 69, 70, 70, 72, 73, 75, 76, 76, 78, 79, and 81.

Form a scatter plot of this data and then, based on quadratic and exponential models, predict the 0-ring damage for launch at 31°F. Interpret your result with the understanding that neither of your models provide a very good fit and thus a much more sophisticated statistical analysis is required.

[8] Notices

1. For those attending the Joint Mathematics Meetings, January 6 - 9, 2008, in San Diego, CA, special attention is called to the NSF Poster Session on Monday afternoon, the session on "Sharing Residues from College Algebra Workshops" on Monday evening, and the NAM Panel session on Wednesday morning.

2. Past issues of the *Vision - Potential* Newsletter are available on our website: www//ContemporaryCollegeAlgebra.org

3. <u>Deadline</u> for contributions to the February Newsletter is February 1, 2008. Opinion articles, suggestions for writing assignments, small group in-class activities, small group out-of-class projects, Queries, announcements, etc. are welcomed.

4. To subscribe to this Newsletter, write to Don Small, Department of Mathematics, U.S. Military Academy, West Point, NY 10996 or contact him via e-mail at don-small@usma.edu