



California Mathematics Council Community Colleges

President’s Report

Katia Fuchs, City College of San Francisco



Once again, beautiful Lake Tahoe Community College hosted our Spring Conference. And once again, it was a huge success! Special thanks go to Larry Green and Mark Harbison who put together the speakers and the logistics of the conference, as well as Lake

Tahoe Community College for allowing us to once again use the space. A separate and extra special Thank You goes out to our Food Committee, headlined by Leslie Banta from Mendocino and Darryl Allen from Solano College. We had delicious sandwiches and salads to enjoy during lunch, and some of us participated in the geocaching adventure to enjoy the gorgeous meadows outside. We also had

a record number of student attendees! Please read the full report on the conference later in the newsletter, but I wanted to make sure to acknowledge the truly remarkable work the conference committee put in. We look forward to continuing to hold our Spring Conference at LTCC, and very much look forward to seeing you there!

Our elections are around the corner! Please contact Joe Conrad if you are interested, and feel free to contact any of us if you have questions about our positions. Even if you’re not considering running for the board, please remember our meetings are open to all, and we would be happy to see you there!

With fall 2019 around the corner, all of us are ready to roll out our full implementation plans for AB705. CMC³ has worked tirelessly to both give the voice to Mathematics Faculty of Northern California at the State level, and to keep our membership informed. Should you have any questions that we have not addressed, however, please feel free to reach out to anyone on the board and we will happily try our best to help you.

I would like to close by reminding you that our fall conference is set to take place in beautiful Monterey, CA, in December 2019. We hope to see you there Friday December 6 and Saturday December 7. If you are interested in presenting, please see our newly redesigned website, www.cmc3.org for instructions for submitting a speaker proposal.

As we transition to our new website, online registration for conferences is temporarily unavailable.

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President: Katia Fuchs, City College of San Francisco, (415) 452-5395, efuchs@ccsf.edu

Past President: Joe Conrad, Solano Community College, (707) 864-7000 x 4372, Joseph.Conrad@solano.edu

President-Elect: Jen Carlin-Goldberg, Santa Rosa Junior College (707) 527-4746, jcarlingoldberg@santarosa.edu

Secretary: Tracey Jackson, Santa Rosa Junior College, tkkjackson@yahoo.com

Treasurer: Leslie Banta, Mendocino College, (707) 467-1053, lbanta@mendocino.edu

Members-at-Large:

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Articulation Breakfast: Steve Blasberg, West Valley College (408) 741-2564, steve_blasberg@westvalley.edu

Awards Coordinator: This position will be filled in the future.

Business Liaison: Dean Gooch, Santa Rosa Junior College, (707) 527-4704, dgooch@santarosa.edu

Campus Reps Coordinator: This position will be filled in the future.

CMC Liaison: James Sullivan, Sierra College, (916) 660-7973, jsullivan@sierracollege.edu

Conference AV Specialist: Steve Blasberg, West Valley College (408) 741-2564, steve_blasberg@westvalley.edu

Fall Conference Chair: Jen Carlin-Goldberg, Santa Rosa Junior College (707) 527-4746, jcarlingoldberg@santarosa.edu

Foundation Board Member: Casey Terrill, Mendocino College, (707) 468-3228, cterrill@mendocino.edu

Foundation President: James Sullivan, Sierra College, (916) 660-7973, jsullivan@sierracollege.edu

MAA Liaison: Wade Ellis, West Valley College (retired) (408) 374-0741, wade25@sbcglobal.net

Membership Chair: Kevin Brewer, Solano Community College, (707) 864-7000 ext. 4396, kevin.brewer@solano.edu

Monterey Speaker Chair: Wade Ellis, West Valley College (retired) (408) 374-0741, wade25@sbcglobal.net

Newsletter Editor: Jay Lehmann, College of San Mateo, (650) 863-5305, MathNerdJay@aol.com

Spring Conference Chair: Larry Green, Lake Tahoe Community College, (530) 541-4660 ext. 341, dlarrygreen@gmail.com

Student Poster Session: James Sullivan, Sierra College, (916) 660-7973, jsullivan@sierracollege.edu

Tahoe Speaker Chair: Katia Fuchs, City College of San Francisco, (415) 452-5395, efuchs@ccsf.edu

Web Page Coordinator: Darryl Allen, Solano Community College, (707) 864-7000 x7853, darryl.allen@solano.edu

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President's Report (continued from page 1)

registration for conferences is temporarily unavailable. We hope to have this back up and running in time for the Monterey conference, however.

Finally, I would like to wish you all a successful summer! If you are teaching (like me), I hope you are able to get in a little rest between sessions. If you are not, I wish you a restful and enjoyable summer, full of good books, good friends, and good times galore!

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Monterey Conference: 2018 Wrap Up and Looking Ahead to 2019



*Jen Carlin-Goldberg,
President Elect/
Conference Chair,
Santa Rosa Junior
College*

The 46th CMC³ Fall Conference was held on Friday December 7 and Saturday December 8, 2018, at the Hyatt Regency Monterey Hotel and Spa. We had a wonderful program that was enjoyed by the nearly 200 attendees. Our Friday keynote, Cornelia Van Cott, regaled us with different ways to define measurement between two points and what effect that has on the value of Pi. Our Saturday keynote, Adam Glesser, shared knowledge gained when he and his colleagues taught their students how to read mathematical texts. And then they required students to actually do it! We also heard many comments about the high quality of the regular sessions and appreciate our many presenters and presiders.

We had many sessions on AB 705, beginning with a session led by a representative from ASCCC, Ginni May, and our own CMC³ president, Katia Fuchs. Representatives from five community colleges, Skyline College, Foothill College, College of San Mateo, Mt. San Antonio College, and City College of San Francisco, shared with us

their college's plans to comply with AB 705. We hope that this year we will have a few sessions on how these AB 705 plans have been effecting enrollment, retention rates, etc. Sharing these experiences and this information is important as we support each other during this transition.

We also hosted sessions on sustainability and open education resources—both very important topics for the future of our colleges and our world.

This year, we tried out two new panels in the last session on Saturday. The What Does Industry Want From Our Students panel, featuring a data analyst and a civil engineer, was so popular it had standing room only. We got your message! This panel will be part of a regular rotation: odd years we will have the Adjunct Panel and even years we will run the Industry Panel.

Also new this year was the Student Poster Contest in its very own 10:30 AM session. We had many good student posters. I hope that this year we can have even more. Please encourage your students to enter. There is a cash award for all entries, and it is a great experience for them! You can find the entry form and more information on the website CMC³ www.cmc3.org.

This year's adjunct panel will be run by our Adjunct Advocate, Chantal Cimmiyotti, from Mendocino Community College. If you are an adjunct, this panel is for you!

The Fall 2019 conference will be December 6 – 7 still at the Hyatt Regency conference center. I am excited to start accepting session proposals. If you have

(see "Monterey Conference" on p. 9)

Math Nerd Musings: Student Accountability



*Jay Lehmann, Editor,
College of San Mateo*

A little over a month ago, a colleague I'd worked with for almost 30 years retired. He was an effective instructor, respected by students and faculty. Aside from his excellent instruction,

the

thing that stood out the most about this instructor was how far he'd go in his attempts to have students be accountable. He would often pull students out of the classroom and have heated confrontations with them. He would kick students out of class if they hadn't done the homework. Many of my colleagues told me that even if this approach worked, they could never stomach using it. To me, the key question is whether the instructor's students became more accountable not only in the current course but in their subsequent courses. Anecdotal evidence was mixed, so I never tried such an approach.

But even if such an aggressive approach were effective, what can those of us do that aren't capable or willing to use it do?

Just today I received an e-mail notice from Google about research the company has performed about employee accountability. The report emphasized that mandating employees to be accountable doesn't work. Such top-down approaches make employees "feel like a kid again—it doesn't cultivate trust and freedom—

and it doesn't motivate people to find their own way to stay on top of things."

So, what should employers do? The report includes 5 recommendations. While reading the report, I kept wondering if the recommendations might apply to college students as well. What follows are the recommendations and how they might be relevant in a college setting.

1. Define what people are accountable for.

Students think they're accountable for passing the course. Instructors think students are accountable for learning. In a well-designed course, students pass only if they have learned. Perhaps more students would learn (and pass) if

they were clear on what it means to learn a concept or skill. Of course, that means *instructors* must be clear on this and communicate it well to students. In recent semesters of trying to address affective domain in my classes, I have discovered that students are much more

receptive to changing their study habits if they hear about best practices from other students. So, after each test, I have students who have done well or improved substantially on the test share what it means to learn a concept.

2. Set and cascade goals throughout the organization.

No two students are the same when it comes to math background, problem-solving ability, and learning style. Two students can complete all homework assignments, yet one student might earn an A on a test and the other student might earn an F. Students need *individual* goals. Some of those goals can emerge from an instructor having a one-on-one, in-depth, supportive conversation with a student. Other goals might

Students are much more receptive to changing their study habits if they hear about best practices from other students.

emerge from an instructor facilitating effective affective domain activities in which students become more self-aware, as well as learn from other students. The Gallup report says that employee goals should be *measurable*. Many students are not clear going into a test whether they are well-prepared. For example, if a student completes the all homework yet does poorly on tests, they need a better way to measure their preparedness. For example, they could select 10 appropriate problems from the chapter review problems in a textbook and see if they can get 9 problems correct in a limited amount of time without getting help from others, technology, or their notes. If this measurable goal does not prove to be effective for a particular student, then the student and instructor can sort out a better one.

When I meet with students, I find myself asking many, many questions before offering any advice.

3. Provide updates on progress.

Many students need early and frequent feedback on how well they are learning the material. Many instructors give about four tests in a semester. If a student does poorly on the first test, they may realize they are not learning well around the fourth week of the semester; that is far too late. Ideally, students would get that type of feedback within a few days of the start of the semester so they could adjust their study practice. Weekly quizzes and/or tests greatly increases the chances that students will get feedback before it is too late. But not all feedback need come through quizzes and tests. Frequent (such as daily) group work can be effective for some students, although others make the mistake of believing that being able to solve problems collaboratively implies they will be able to solve problems individually.

The Gallup report says that the most effective form of feedback comes from *frequent* conversations between managers and employees. Group work can create opportunities for instructors to have short one-on-one meetings with students to discuss their progress.

4. Align development, learning, and growth.

The report says, “Gallup analytics show that millennials rank the opportunity to learn and grow in a job number one—above all other job considerations—and it’s high on the ranks for other generations as well.” The report also says that a key ingredient is to help workers address roadblocks that prevent their ability to deliver on goals. Although instructors cannot remove challenges in students’ personal lives, they can help students sort out ways to work around those challenges. This, again, suggests that one-on-one conversations with students are important. When I meet with students, I find myself asking many, many questions before offering any advice.

5. Recognize and celebrate progress

The report says that praise for good work is the most motivating of all forms of feedback. I’ll add that research on fixed mindsets suggests instructors should applaud students for their *effort*, not their *performance*. Students who are complimented on hard work tend to take more risks and learn more than students who are complimented for correct answers.

With over a month until my fall semester
(see “Student Accountability” on p. 9)

The 23rd Annual CMC³ Recreational Mathematics Conference in Lake Tahoe

Larry Green, Lake Tahoe Community College



We had another fun and informative Tahoe conference this spring. The fabulous weather for this year's 23rd annual recreational math conference in Lake Tahoe

was only outshined by the extraordinary speakers who presented their creative use of mathematics. Not only were there an impressive number of math faculty at that conference, but we also had dozens of students from all over California come to the conference. On Friday early evening, we connected with each other at the foundation event and unsuccessfully guessed at the number of jelly beans in the jar. Thank you all for supporting our students financially by donating to the foundation scholarship fund. It really makes a difference to our students.

After the foundation event, Dr. Naoki Saito explained to us all how Laplacians are instrumental in the effective creation of JPEGs and other applications. It was a great start to the conference, which continued to bring mathematical delights. We got an early start on Saturday with a breakfast where we were able to continue connecting with our colleagues in math. After breakfast, we had two sessions of talks on knots, Indian math, proofs, challenge problems, spectral numbers and circles. Everyone had to make the tough decision over which talk to attend because they were all amazing. Then we had a delicious lunch and a mathematical geocache event where the answers to the provided math

questions were the locations of the hidden caches. Any excuse to do math and get outside in beautiful Tahoe is a good excuse.

Next, Terry Krieger entertained us with mathematical oddities and humorous mathematical anecdotes. This was followed by talks on ham sandwiches, Dodgson, hilarious mathematical errors, and poker. I am confident that many made some serious money at the poker tables after the conference was over. The grand finale was our student, Nathanael Case from San Joaquin Delta College, who presented on the Euler-Lagrange equation.

I want to give a special shout out to our board members who volunteered to help with the conference, preparing all the food, working registration, helping with the foundation activities, and spending weeks beforehand to put on this conference. It was such a success that we plan on hosting the 24th annual Tahoe Recreational Math Conference again at Lake Tahoe Community College on April 24 and April 25, 2020. Look for more information about it in future newsletters.

Mark Your Calendar:

**47th Annual CMC³
Conference**

December 6th and 7th, 2019

**Hyatt Regency Monterey
Hotel and Spa**

Discovering and Cleaning out Shuhaw Hall

Jen Carlin-Goldberg, President Elect, Santa Rosa Junior College

It is likely that we have all experienced this on some scale; perhaps you have cleaned out an overly stuffed closet, perhaps you were unfortunate to have to clean out a late family member's house. I made some wonderful discoveries just cleaning off my children's shoe and hat shelf one weekend, discoveries that had nothing to do with hats or shoes. You find things that you thought you had lost, you come across things that you never realized that you had, and you discover bits and pieces of your history then agonize over what you should save and what you should properly dispose of.

This summer the entire Santa Rosa Junior College's Mathematics Department must relocate across Elliot Street to its new home, which we affectionately call the Elliot Swing Space but are trying to remember to call Kunde Hall. We must move because the building our department has called home for about 50 years is to be destroyed starting this fall and replaced with the new STEM 1 building in the same place. The logistics of this entire endeavor is daunting and handled by better heads than myself, but it is one our department has had a hand in before we even knew for sure that it was going to happen. The project has had its ups and downs, but that is not what this article is about. It is about discovery, both amazing and cringe worthy, laughable and reverent. It is time to clean out the spaces in our building that many of us have never even seen the insides of.

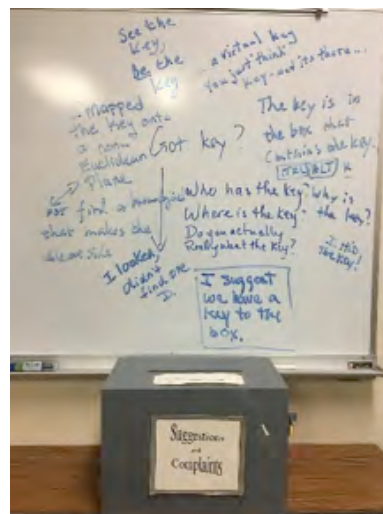
It is time to clean out our closets.

Over several Fridays we gathered a handful of volunteers to tackle our closets, staff room, and adjunct offices. Protected by rubber gloves, we have discovered boxes of Apple

posters for long outdated computers, a ratty old homemade-looking CMC³ banner that bears no resemblance to our current logo, two unopened boxes of coffee mugs decorated with fractals, and boxes of dusty software CDs for long forgotten computer programs. In one box we found an impressive collection of chalk. We created piles of electronic recycling and paper recycling, filling recycling barrels provided by Waste Diversion. In a public space we have an "anyone can take" pile, where we put things that were both in good condition and that we thought a student might want to have. But in this clutter of junk and curiosities, we have found some amazing things.

Early on, we found an old locked comments box. We placed it in our Staff Room and the joke over the missing key has provided many weeks of amusement.

In a closet, resting on the floor, sat

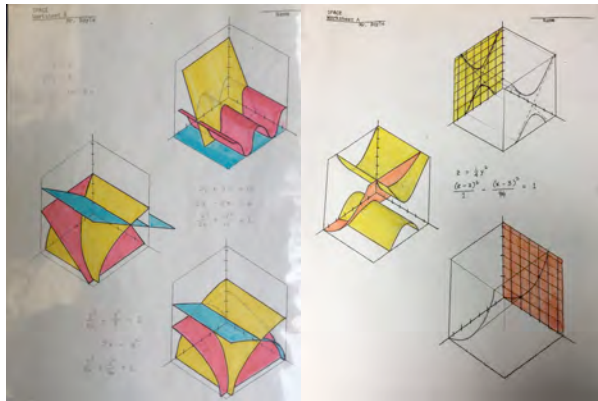


several index card file drawers, grey and dusty, they contained hundreds, perhaps thousands, of index cards each containing multiple choice problems for a broad swath of

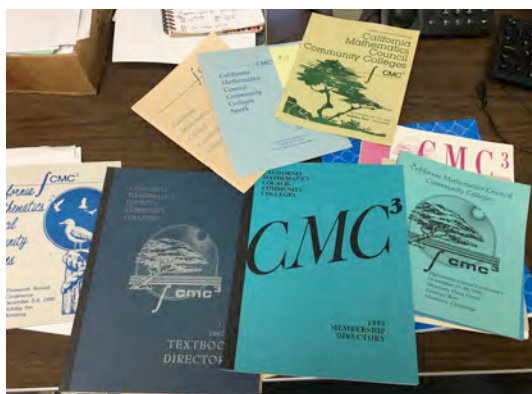
subjects collected by one of our Math Department icons, Patrick Boyle. It was the collection of a career. Something we couldn't possibly throw out, but at the same time, wasn't practical to keep. We will work to archive the collection to make it available to the whole department.

Another faculty member revealed a file

full of perfect hand-drawn 3D surfaces also by Patrick Boyle that had been tucked away in their office.



In an office that we use as a testing room, we keep our math journals. Kirby Bunas and I tackled that one, and over the course of more than two hours picked apart the shelves to see what we could keep, what we could offer up to students and faculty to take, and what we really needed to recycle. We found old journals with a circulation list attached to the cover. The list contained the names of department faculty and were all checked off as each got their turn with the journal. The collection contained hundreds of *Mathematics Teacher* issues, the earliest of which dated back

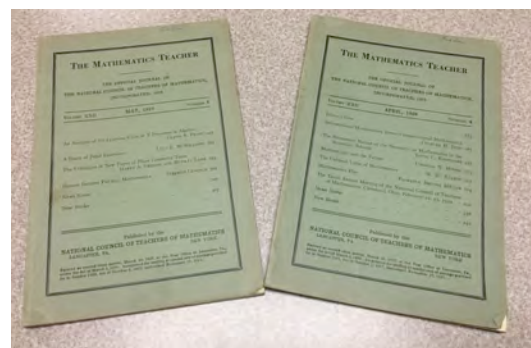


to April, 1929. There were a handful of

Journals entitled *Soviet Studies in the Psychology of Learning and Teaching Mathematics*, collected by Bob Coombs.

Kirby and I got a giggle from the titles and set them out with the other free for anyone to take items. Come Monday morning, I could hear students exclaim excitedly over those journals, both as something that they were genuinely interested in reading, but also because the titles were just plain funny! One student declared that they have found their new coffee table book!

Amongst the journals were CMC³ conference programs, a textbook directory from the late 90's, and a membership directory from 1996. There was a larger pile of programs from CMC Asilomar Conferences.



In the high cupboards in our Staff Room, we discovered some old Math Art projects and long stored packages of instant oatmeal. We found relics from the chalkboard days; drawing and measuring tools and a retractable paper roll with a grid of holes that you can use to put a grid of dots on the chalkboard. While reveling in the nostalgia from all of these discoveries, we ruthlessly discarded much of what we found. We were constantly flowing through the cycle of “Oh, wow! Look what we found!” to “We used to use this for...” through the “Should we keep this?” and ending on “We

don't need it, no one wants it, time for it to go.”

Our job is far from done as each of us must tackle our own offices as well as the public spaces. Some of us have already been at it for weeks already, slowly digging out their offices from the decades of accumulation. The cleaning, sorting, and discoveries have been somewhat cathartic helping us to say goodbye to our long time home. Personally, I feel both sadness and joy at the move. On one hand, this is the building I still remember taking math classes in when I was a new college student (1995-1997 if you must know.) I enjoy helping students find their classes or the bathroom in the beginning of each semester. On the other hand, it would be nice being in a building with a fully working heating and cooling system and having bathrooms with hot water. When the time comes, I may get the privilege of destroying something with a sledge hammer, but I will do it with gratitude for the building that has sheltered hundreds of thousands of students in its lifetime and nurtured our Mathematics Department. Thank you and farewell Shuhaw Hall.

Monterey Conference

(continued from page 3)

any talk you'd like to give, please fill out a speaker proposal which can be found at the website: www.cmc3.org/conference/callForProposalsMonterey.html.

We are living in some interesting times. CMC³ is here to support Community College Math Faculty as we adjust to these changes and continue to find better ways to support our students.

See you this December in Monterey!

Student Accountability

(continued from page 4)

begins, I look forward to reflecting more on how to enhance my students' accountability. This could benefit my students in *all* their courses as well as their careers.

If you'd like to read the full report, search online for “Gallup” and “5 Ways to Create a Company Culture of Accountability.”

Hal Huntsman's article “The Effect of Teacher Expectations” (see page 14) has many great ideas as well.

Call for Nominees

Please consider joining the CMC³ Board. Contact Past President Joe Conrad if you are interested in running.

(See page 2 for contact information.)

The History Corner



*Joe Conrad, Solano
Community College*

The quadratic formula is an indispensable tool in algebra, but did you know that the first

time it appeared in print in the version we all know and love was only in 1896? When I teach it to algebra students, I make a big deal about the wonders of the formula: It allows us to solve any quadratic equation whether it factors or not, whether the roots are real or not, and it is an example of how going to the general case makes the particular case easier. In this column, I would like to review the history of the quadratic formula and of solving quadratic equations.

As with many other things, it all appears to have started 4000 years ago with the Babylonians. Sometimes we say the Babylonians knew the quadratic formula. This is not technically correct. The Babylonians knew how to solve many equations that, in modern terms, are quadratic. Of course, they did not have our symbols and did everything verbally and often couched their work in geometric terms. Fortunately, they did their work in cuneiform on clay tablets, so many original works still exist. (This contrasts with the future work of the Greeks and Egyptians in which there are no originals, just copies of copies of copies of) For instance, the British Museum has many cuneiform tablets with mathematical content including BM 13901 (ca. 1600 BC), which contains a sequence of 24 problems that (in our terms) reduce to quadratic equations. It is arranged so that the problems

are in increasing order of difficulty. The first problem is: I added together the area and the side of my square [the result is] $\frac{3}{4}$. (The $\frac{3}{4}$ was written in base-60, but let's not worry about that.) Then there are directions to find a solution. These directions are equivalent to what we call completing the square.

The Babylonians did not solely use completing the square to solve quadratics. Another common type of problem took the form of knowing the product of two numbers and their sum or difference. We would see this as a system of two equations in two unknowns that reduces to a quadratic in one variable. Since their method of solution is not what we would do, let me give an example. Assuming two numbers have a difference of 6 and a product of 16, find the two numbers. Using modern notation, we note that two numbers with difference 6 can always be expressed as $a + 3$ and $a - 3$. So we get:

$$\begin{aligned}(a + 3)(a - 3) &= 16 \\ a^2 - 9 &= 16 \\ a^2 &= 25 \\ a &= 5\end{aligned}$$

Thus, the numbers are 8 and 2. They also used this method to solve quadratics. For example, if we want to solve $x^2 + 6x = 16$, the Babylonian solution is to express the equation as $x(x + 6) = 16$. Letting $y = x + 6$, reduces the problem to the one we just did.

The Babylonians could adjust this method to solve non-monic quadratics. Whereas we might divide both sides by the coefficient of the square, they found fractions hard to deal with in base-60, so they multiplied through by the coefficient and then essentially changed

variables so the new unknown became the coefficient times the original unknown. Here's an example where dividing would be simple, but it illustrates the method:

$$2x^2 + 6x = 8 \text{ (Multiply by 2.)}$$

$$4x^2 + 12x = 16 \text{ (Let } u = 2x.)}$$

$$u^2 + 6u = 16$$

The problem is now reduced to the previous example, so $u = 2$ and so $x = 1$. (I will note that in playing around with this method, I found a factoring method for non-monic quadratics that is equivalent to the slide and divide method but is not as mysterious as slide and divide.)

Despite having all these methods, there is no evidence that there was any attempt to make a general formula. All the examples known (and there are many more than the 24 in BM 13901) are of the form of a stated problem with steps to solve the problem. They all appear to be part of a training process for students.

Moving forward over 1000 years, we come to the Greeks. Euclid, who lived ca. 300 BC, left us the most influential textbook in mathematics history, namely, "*The Elements*." We typically think of it as a geometry book, but it contains topics that we would call number theory and algebra. In particular, he solves problems that reduce to quadratic equations. Of course, he did not have algebra and worked geometrically, so it should not come as a surprise that his method is essentially completing the square. It is perhaps ironic that we sometimes draw a picture to illustrate completing the square after we have shown students the algebraic technique when, in fact, the geometry preceded the algebra by many centuries.

The next major figure in the development of generating the quadratic formula is found in India. In particular, Brahmagupta (ca. 598 – ca. 668) wrote several major texts and was the first to describe in words what we would recognize as the quadratic formula. His procedure (as quoted from Irving) is as follows:

Now, from the absolute number [the constant], multiplied by four times the coefficient of the square, and added to the square of the coefficient of the middle term, the square root extracted, and lessened by the coefficient of the middle term, the remainder is divided by twice the coefficient of the square, yields the value of the middle term.

(Notice the transition to more algebraic terminology. However, this is perhaps overstated in that the translation is probably biased toward modern terms.) He did this in the context of solving problems. It is not clear—in fact there is some doubt—whether he was the discoverer of this method or just a reporter, but he clearly described a general process for solving a quadratic in more algebraic terms rather than purely geometric ones.

The first true algebra treatise was written by Muhammad ben Musa al-Khwarizmi in about 825. He was a Persian who lived near Baghdad in the golden era of Arabic culture. The title of the book in English is "*The Compendious Book on Calculation by Completion and*

Balancing” which became known in Europe after it was translated into Latin by Robert of Chester in 1145 as “*Liber algebrae et almucabola*.” It is from this title that we get the word “algebra.” (As a side note, it was Chester’s mistranslation of the Arabic word for a certain trigonometric function that gave us the word “sine” as well.)

Al-Khwarizmi’s book was significant in several ways, not least of which is that instead of starting with problems and producing solutions as had been done, he started with showing how to solve problems in general and then applied the techniques to particular problems. Being handicapped by not having negative numbers, he divided quadratic equations into three different types. For example, one type he called “square and roots equal to numbers” which we would write $x^2 + ax = b$. He proved his results using the same geometric techniques as Euclid. As those who came before, he only recognized positive roots; in fact, only rational, positive roots. Later Arabic mathematicians, notably Abu Kamil (ca. 900), started to allow irrational roots.

As algebra became known in Europe and symbolism developed, mathematicians tried to develop a single formula to solve quadratics. Again, early attempts were thwarted by the lack of knowledge of negative numbers. For example, attempts were made by Michael Stifel in 1544 and by Geronimo Cardano in 1545. Cardano did allow negative roots in some circumstances. Finally, Simon Stevin in 1585 produced a technique that worked for all cases. He did this by using Stifel’s method, but allowed the coefficients to be negative. This reduced the problem to one case rather than three. He accepted negative roots but felt the need to say that the negative roots were just the positive

roots when x was replaced by $-x$, so he was still not comfortable with the idea. He did not accept complex roots but did recognize double roots.

Stevin gave the general solution of $x^2 + px + q = 0$ as

$$x = -\frac{p}{2} \pm \sqrt{\frac{p^2}{4} - q}$$

He proceeded to prove this is correct in three ways. Namely, he did a direct substitution, he did the classical Euclidean construction and, finally, he solved it algebraically using completing the square. After Stevin, it appears that mathematicians used a similar formulation with their own values for the constants. For instance, Descartes in his book *Geometrie* used a and b^2 instead of p and q .

It was not until 1896 that Henry Heaton exhibited the familiar formula that we all know. Heaton was a carpenter and teacher who enjoyed solving math problems. In a Math Monthly article he gave a different way to derive the solution of a quadratic starting with the general equation in the form $ax^2 + bx + c = 0$. He shows the method and gives an example. He ends the article with the question, “Is this new?” The editors actually wrote an afterward that asked the same question. I’ll finish with Heaton’s method and ask the question, “Has anyone seen this before?”

$$\begin{aligned} ax^2 + bx + c &= 0 \\ ax^2 + c &= -bx \quad (*) \end{aligned}$$

Square both sides and then subtract $4ax^2c$ from both sides:

$$a^2x^4 + 2ax^2c + c^2 = b^2x^2$$

$$a^2x^4 - 2ax^2c + c^2 = b^2x^2 - 4ax^2c$$

Factor both sides and take the square root:

$$ax^2 - c = \pm x\sqrt{b^2 - 4ac}$$

Add (*) to both sides and divide by $2ax$:

$$2ax^2 = -bx \pm x\sqrt{b^2 - 4ac}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Now this is what we all know and love!

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The Pleasures of Problems

Kevin Olwell, San Joaquin Delta

Summer 2019: Suppose a cross country runner completed a 6 mile race in exactly



30 minutes. Show there must be a one mile stretch which the runner covered in exactly 5 minutes.

Spring 2019: $ABCD$ is a square inscribed in a circle of radius 1.

$EFGH$ is another square with vertices E and F on side CD and vertices G and H on the circle. How long is one side of square $EFGH$?

Thanks to David Jones, Fred Teti, Melvin Hom and Mike Greenberg for submitting a solution.

Let P denote the center of the circle. Then PAB is an isosceles right triangle. Since PA and PB are radii, $|AB| = \sqrt{2}$.

Let M be the midpoint of GH . Then $\triangle PMG$ is a right triangle whose hypotenuse is a radius. Set $s = |GH|$. Hence

$$\left(\frac{1}{2}\sqrt{2} + s\right)^2 + \left(\frac{1}{2}s\right)^2 = 1^2$$

Some routine algebra gives $s = \sqrt{2}/5$.

All are invited to submit a solution to the Summer 2019 problem either via email at the address kevin.olwell@icloud.com.

The Effect of Teacher Expectations

Hal Huntsman

According to the results of a study published in February 2019, “STEM faculty who believe ability is fixed have larger racial achievement gaps and inspire less student motivation in their classes. Faculty mindset beliefs predicted student achievement and motivation above and beyond any other faculty characteristics, including their gender, race/ethnicity, age, teaching experience, or tenure status.” This study, which included 150 STEM professors and over 15,000 students, challenges the idea that student success is only about the effort and ability of our students.¹ It adds to a growing body of work that suggests that our expectations as teachers have profound effects on the success of our students.

As I read this study, I started thinking about the class I’m teaching for the first time this semester – a college-level statistics course, with corequisite support. It’s the same statistics class I’ve taught many times over the last ten years, but with an additional two hours of class time per week for supporting students in the class.

Before the semester started, I worked with my colleagues to prepare for the new corequisite course. We talked about what to expect from our students and how to help them succeed. Our expectations included:

- The students would be less prepared than students in our statistics course without support.

- The students would need extra help with things like converting fractions to decimals and percentages, solving linear equations, and order of operations.
- The students would have trouble with abstraction.
- The students would be less motivated to learn statistics than students in our statistics course without support.

Most of our expectations had to do with prerequisite skills gaps that students might have and how we could fill them. In addition, we speculated about why students would take our class and what that might mean for their motivation and achievement.

But, as I’ve worked with my students this semester, I’ve come to question my expectations about them. Yes, it’s true that the students in my class sometimes make mistakes with percentages, or calculating confidence intervals, or have trouble with the logic of hypothesis testing – but that has always been true of my statistics students. I don’t think my students are more unprepared than in other classes. Nor do they work less hard or cheat more. In fact, the biggest difference I see between students in my corequisite supported statistics course and student in the unsupported class is their belief in their own ability to learn and do well in math. Over and over in my class, I watch bright, inquisitive students doubt themselves, even when they are right on track. I see students reacting to difficulty with a resignation – “I knew I was not

going to be able to do this” – that has little to do with their ability and more to do with their previous experiences in math.

That belief in their ability to learn is the biggest difference should not be surprising. The students in my corequisite class almost all have low high school GPAs, because that’s who was required to take the corequisite course along with regular statistics. For years, probably most of their lives, the majority of my students have been told through grades, testing, and the myriad of other vehicles educators use to classify students that they are not good at school. Often, they’ve been explicitly told they are not good at math. It is common sense that people will internalize these messages. It becomes a self-reinforcing system: students are told they are bad at math; they believe it; and they do poorly in math class.

This brings me back to the study with which I started this discussion. The researchers write that students in the study “reported less ‘motivation to do their best work’ in classes taught by faculty who endorsed more fixed mindset beliefs. Students also reported that fixed mindset professors were less likely to use pedagogical practices that ‘emphasize learning and development.’ . . . [F]aculty who endorsed more fixed mindset beliefs used less motivating pedagogical practices (at least as reported by students), and these practices were associated with lower course performance for all students on average and especially for underrepresented minority students.” In short, these professors’ beliefs and behavior were telling students they can’t learn well, and the students don’t.

These findings remind me of advice Dr. J. Luke Wood shared on how to build relationships

with our students that promote their success. His list includes:

- Warmly welcome students to each class session
- Send validating messages that affirm ability and promote effort
- Know students’ names and use them
- Critique privately, praise publicly
- Discuss challenges you’ve experienced and overcome
- Connect students with people, not services

In light of the kinds of research emerging and the changes our classrooms are undergoing, I believe actions like these are all the more important.

As a result, I’m taking time to think through everything about my class with an eye for the messages I’m sending about students’ ability to learn. This includes the way I welcome students to class, the way I hold all students accountable for participating in class, the way I communicate my policies in my syllabus, and the way I respond to questions and celebrate errors as opportunities for learning. I’m working to structure second chances into my grading policies, because few things I can do say “I believe in your ability to learn” better than giving students another opportunity to do just that. And I’m trying to show more of my own struggle to learn math and to teach math more effectively.

Since my expectations about students have strong effects on students, I’m doing all I can to make sure my expectations help my students. I know I’ve made mistakes this semester, but I also know that, just like my students, I can learn and grow and do better next time.

¹ <https://advances.sciencemag.org/content/5/2/eaau4734>

CMC³ Foundation Report



*James Sullivan,
Foundation
President, Sierra
College*

The CMC³ Foundation hosted a welcome reception

to open the 23rd Annual Recreational Mathematics Conference at Lake Tahoe Community College. Attendees got to sample an assortment of drinks, fruits, vegetables, rolls, meatballs, cheese and crackers as they socialized and awaited the Friday evening keynote presentation. The welcome reception concluded with the announcement of the 2019 CMC³ Foundation Mathematics Scholarship recipients. The following six outstanding California Community College students were awarded a Scholarship from the CMC³ Foundation.

Daniel Lucas is a re-entry student at Mendocino College. He received straight A's in all of his mathematics coursework and plans to transfer to a four-year university in the fall as a mathematics major. Daniel's goal is to eventually earn a graduate degree in mathematics and pursue a career as a professor of mathematics.



Mukul Sharda from American River College wants to transfer to a four-year university and major in neurobiology with a minor in mathematics. He has maintained a



4.0 GPA and is a member of the American River College STEM Center Leadership Council.

Jeremiah Barron from Fresno City College wants to earn a bachelors degree in electrical engineering and ultimately a Masters degree. He is a 12-year veteran of the United States Marine Corps where he worked as an avionics technician. Jeremiah has a 4.0 GPA. He enjoys working as a tutor at Fresno City College and hopes to become a teacher after his engineering career.



Nathan "Ry" Simmons-Davis from

Mendocino College will transfer to Sonoma State University in the Fall where he will work on a bachelors degree in applied mathematics. He has earned a 4.0 GPA throughout his college career and is a member of the Phi Theta Kappa honor society.



Cody Vig from Solano Community College will pursue a double major in mathematics and physics at either UC Berkeley, UC Santa Barbara, or UC Davis. His ultimate goal is to earn a Ph.D. and both teach and conduct research as a university professor.



Junting Tiffany Huang from the City College of San Francisco will attend a four-year university

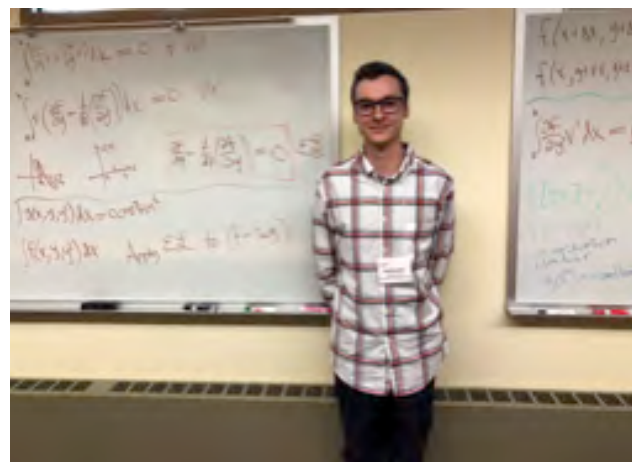


and work to obtain a bachelors degree in economics. She received As in all the mathematics courses she completed. Junting works as a Math and English tutor in the DSPS Strategy Lab, and she volunteers in the Kaiser Hospice care program.

The CMC³ Foundation also oversees the Tahoe Conference Student Speaker Award Contest. The student selected to receive this award has the honor of making the closing presentation at the Spring Recreational Mathematics Conference and receives a \$500 Scholarship. This scholarship is supported via an annual donation made by Debra Landre, a retired San Joaquin Delta College faculty member and former CMC³ President. This year's Tahoe Conference Student Speaker Award winner was Nathanael Case from San Joaquin Delta College. Nathanael's presentation on "How the Euler-Lagrange Condition of Variational Calculus Comes from Multi-Variable Calculus" was well attended and received. He showed how the Euler-Lagrange equation can be derived by analogy with

directional-derivatives in a way that is accessible to community college calculus students. The CMC³ Foundation would like to express our appreciation and gratitude to Nathanael for providing us with such an impressive presentation.

Daniel, Mukul, Jeremiah, Ry, Cody, Junting, and Nathanael are prime examples of the types of extraordinary students who study and learn mathematics in the California Community College system. If the CMC³ Foundation were to receive more donations to its Annual Scholarship Fund, we could recognize and reward additional worthy and deserving students. So, please consider supporting our scholarship fund by making a



tax deductible cash donation either by credit card or PayPal using this QR code or the "Donate" button on the CMC³ Foundation website <http://www.cmc3.org/foundation/donate/> or by mailing a check directly to Leslie



Banta, CMC³ Treasurer, Mendocino Community College, 1000 Hensley Creek Rd, Ukiah, CA 95482.

Calendar

July 31—August 3: MAA MathFest 2019, Cincinnati, OH Website: <https://www.maa.org/meetings>

September 20, 2019: InMATYC Fall Meeting, Ivy Tech Community College - Columbus IN Contact: Luanne Benson-Lender Website: <http://inmatyc.matyc.org/>

September 28, 2019: WisMATYC 2019 Conference, Northcentral Technical College, Wausau WI Contact: Turi Suski Website wis.matyc.org

September 28, 2019: 2019 LaMsMATYC Conference, Copiah-Lincoln Community College; 11 Co-Lin Circle; Natchez, MS Contact: Eddie Britt Website: <https://lamsmatyc.wixsite.com/home/2019-at-colin>

October 4 - 5, 2019: FTYCMA Fall Retreat, Polk State College, Lakeland Campus Contact: Cengiz Ozgener Website: <http://scf1.scf.edu/ftycma/html/events.html>

October 11, 2019: Fall 2019 ArizMATYC Conference, Northern Arizona University, Flagstaff, AZ Contact: Brian Beaudrie Website: <http://arizmatyc.org/wp/fall-2019-arizmatyc/>

October 11 - 12, 2019: 2019 MichMATYC Conference "Mistakes Allow Thinking to Happen", Henry Ford College (Dearborn, MI) Contact: April Falardeau Website: <http://www.michmatyc.org/>

November 14–17, 2019: 45th AMATYC Annual Conference, Milwaukee, WI. Website: <https://amatyc.site-ym.com/page/2019ConfHome?>

December 6–7, 2019: CMC³ 47th Annual Conference, Hyatt Regency Monterey Hotel and Spa, Monterey, CA. Contact Jen Carlin-Goldberg, Santa Rosa Junior College (707) 527-4746, jcarlinggoldberg@santarosa.edu

December 6—8, 2019: CMC North 62nd Annual Conference, Embracing Cultural Diversity in Mathematics, Pacific Grove, CA. Website: www.cmc-math.org/conference-overview

January 14—18, 2020: MAA-AMS Joint Mathematics Meetings, Denver, CO Website: <https://www.maa.org/meetings>

April 24-25, 2019: CMC³ 23rd Annual Recreational Mathematics Conference, Lake Tahoe CC, South Lake Tahoe, CA. Contact: Larry Green, Lake Tahoe Community College, (530) 541-4660 ext. 341, drlarrygreen@gmail.com

Jay Lehmann
Editor
CMC³ Newsletter
MathNerdJay@aol.com