Dr. Francis Su
Professor of Mathematics, Harvey Mudd College
Every being cries out silently to be read differently.
— Simone Weil, Gravity and Grace

MATHEMATICS FOR HUMAN FLOURISHING

FRANCIS EDWARD SU
(HARVEY MUDD COLLEGE)
Dear Professor Francis Su

Hello Mr. Su, my name is Christopher. I am 21 years old and I've been at United States Penitentiary McCrory. I've been here for 2 years now.
SIMONE WEIL
1909-1943
WHY DO MATHEMATICS?
VOICES

• “high school students don’t need geometry”

• “let’s leave advanced math for the mathematicians”
WHY DO MATHEMATICS?

• Because mathematics helps people flourish
HUMAN FLOURISHING

- eudaemonia
HUMAN FLOURISHING

• eudaemonia

• shalom
HUMAN FLOURISHING

- eudaemonia
- shalom
- salaam
VIRTUE

• Excellence of character that leads to excellence of conduct
PRACTICE OF MATHEMATICS CULTIVATES VIRTUE

• Virtues help people flourish

• Movement towards virtue happens through basic human desires.
It is a happy talent to know how to play.”
— Ralph Waldo Emerson

BASIC HUMAN DESIRE

1. PLAY
PLAY

- Structure
- Freedom
- Investigation
- No Great Stake
- Surprise
- Imagination
VIRTUES

- Hopefulness
- Community
- Perseverance
TEACH PLAY

• Use Structure and Freedom

• Make Room for Investigation, Surprise, Imagination

• De-emphasize grades: “a measure of progress, not a measure of promise.”

• Encourage reflection: “What have you learned in this class about the process of doing or creating mathematics?”
Active Learning in Post-Secondary Mathematics Education
15 July 2016

Classroom environments in which students are provided opportunities to engage in mathematical investigation, communication, and group problem-solving, while also receiving feedback on their work from both experts and peers, have a positive effect on learning. Teaching techniques that support these activities are called active learning methods. Because there is not a unique definition of active learning, either in popular use or in the research literature, we use the phrase active learning to refer to classroom practices that engage students in activities, such as reading, writing, discussion, or problem solving, that promote higher-order thinking. Recent years have seen an increased awareness of the critical role of active learning techniques, a refined understanding of how they can be implemented effectively, and a substantial increase in their implementations in post-secondary mathematics courses. A wealth of research has provided clear evidence that active learning results in better student performance and retention than more traditional, passive forms of instruction alone. Post-secondary faculty and P-12 educators have successfully used active learning methods in a diverse set of institutions and across a broad range of teaching environments. These methods have been shown to strengthen student learning and achievement in mathematics, to foster students' confidence in their ability to do mathematics, and to increase the diversity of the mathematical community. In recognition of this, we call on institutions of higher education, mathematics departments and the mathematics faculty, public policy-makers, and funding agencies to invest time and resources to ensure that effective active learning is incorporated into post-secondary mathematics classrooms. We further call on professional societies and funding agencies to continue their support of training and resources for the use of active learning. We believe that using active learning methods in a way that builds on the extensive previous and ongoing work to modernize mathematics curriculum and pedagogy will lead to richer and more meaningful mathematical experiences for both students and teachers.
It is impossible to be a mathematician without being a poet in soul.
—Sofia Kovalevskaya

BASIC HUMAN DESIRE

2. BEAUTY
BEAUTY

• Wigner: “the unreasonable effectiveness of mathematics”

• Einstein: “How can it be that mathematics, being after all a product of human thought independent of experience, is so admirably adapted to the objects of reality?”
VIRTUES

• Transcendence
• Joy
TEACH BEAUTY

• Make reflection a regular part of your class: “What do you think is beautiful about math and why?” “Is it amazing to you that math is ‘unreasonably effective’?”

• Motivate beauty in multiple ways: art, music, diverse cultural sources, patterns, elegant proofs, applications
3. TRUTH

Quid est veritas?
—Pontius Pilate
VIRTUES

• Rigorous thinking
The real reason why the US is falling behind in math

Maths isn’t the problem - the way it’s taught is
Tim Gowers

Don’t Teach Math, Coach It
By JORDAN ELLENBERG   JULY 24, 2014
MATHFEED

- math news aggregator
- for iPhone/iPad
- Android (soon)
- @MathFeed
VIRTUES

• Rigorous thinking
• Humility
• Circumspection
Justice. To be ever ready to admit that another person is something quite different from what we read when he is there (or when we think about him). Or rather, to read in him that he is certainly something different, perhaps something completely different from what we read in him. Every being cries out silently to be read differently.

— Simone Weil
ARE WE JUST?

• The mark of a just society is how it treats its most vulnerable members.
Race, Space, and the Conflict Inside Us

—Francis Edward Su

Talking about race is hard. Our nation is wrestling with some open wounds about race. These sores have been around a while, but they have been brought to light recently by technology, politics, and an increasingly diverse population. And regardless of the outcome of the U.S. presidential election, we will all need to work at healing these sores,
“I DON’T THINK ABOUT RACE.”
ANGRY ASIAN MAN
“FINALLY, AN ASIAN GUY WHO'S GOOD AT MATH!”
RICARDO
AGE 40, NONTRADITIONAL STUDENT

• While the rigor and pressure of being in a really tough academic environment have been almost impossibly difficult — especially after being out of practice for so long — it is the entrenched feeling that I don’t belong in those Math and CS classes that has sometimes been the most harmful.

• Those feelings are most probably tied to my early life and the fact that any dreams I may have had then were in discord with the cold realities of my neighborhood and life, and that I didn’t have any mentor then to disabuse me of that great untruth.

• That distorted reality, the "I’m not supposed to be here" runs as an infinite loop process in even unseen ways. It is a constant struggle.
PRESIDENT'S MESSAGE
The Value of Struggle

My stomach sank as I read these two students’ take-home exams. Their proofs looked unusually similar in notation and phrasing; yet I was quite sure neither student knew the other. So, on a hunch, I Googled the problem I had posed and found a solution online that was the likely source of both answers.

always been there. But the internet has greatly amplified our ability to compare ourselves to others and lowered barriers to indulge our immediate desires—even ones that aren’t good for us. A dozen years ago Facebook didn’t exist, but now it’s far easier to feel inadequate when we see only highly curated versions of

I’m of Chinese descent, I speak perfect English. They treated me differently because I didn’t fit their stereotype of an American.

This is an example of a micro-aggression: a tiny insult that one repeatedly experiences as a member of a stereotyped group. Often the offender is unaware. Each insult

Mathematical Microaggressions

By Francis Edward Su

I enjoyed many things about growing up in Texas. People there are friendly, hospitable, and love to make small talk with strangers. Nevertheless, as an Asian American in a predominately white and Latino

insulting in light of one’s identity in a stereotyped group. For example, what Friendly Person said to me would have sounded ridiculous if it were said to a white Texan, but Asian Americans are often viewed as foreign.

To the Mathematical Beach

By Francis Edward Su

I thought I had chosen the right book for the occasion. On this Saturday morning, I was volunteering with a program called Reading to Kids that seeks to inspire underserved youth in Los Angeles to enjoy reading. Assembled before me was a group of eager Latino and African American children from the neighborhood.

my connection with my students? How often do I take the time to get to know their backgrounds? What are the primary experiences that shaped them, and do those present obstacles or opportunities for learning? And in what ways does the mathematical beach say “open to all” but still feel restricted?

These questions appear unrelated

—FRANCIS EDWARD SU
BE SOMEONE’S ADVOCATE
If I speak in the tongues of men and of angels, but have not love, I am a noisy gong or a clanging cymbal. —Paul, the apostle
SIMONE WEIL

• “The love of our neighbour in all its fullness simply means being able to say to him: ‘What are you going through?’ It is a recognition that the sufferer exists, not only as a unit in a collection, or a specimen from the social category labelled “unfortunate,” but as a man, exactly like us, who was one day stamped with a special mark by affliction.
For this reason it is enough, but it is indispensable, to know how to look at him in a certain way. This way of looking is first of all attentive. The soul empties itself of all its own contents in order to receive into itself the being it is looking at, just as he is, in all his truth. Only he who is capable of attention can do this.
So it comes about that, paradoxical as it may seem, a Latin prose or a geometry problem, even though they are done wrong, may be of great service one day, provided we devote the right kind of effort to them.

Should the occasion arise, they can one day make us better able to give someone in affliction exactly the help required to save him, at the supreme moment of his need.
• For an adolescent, capable of grasping this truth and generous enough to desire this fruit above all others, studies could have their fullest spiritual effect, quite apart from any particular religious belief.

• Academic work is one of those fields which contain a pearl so precious that it is worthwhile to sell all our possessions, keeping nothing for ourselves, in order to be able to acquire it.”
I’m in classes with 20 year olds. I’m having the time of my life...the learning has unlocked much I didn’t know existed in myself.

Since I’ve been back I’ve struggled with math. Calculus has really beat me up. After a 20 year break from it I’m finding it harder to relearn, finding it impossible to imagine I was ever really good at this. But even in the pain and failure of trying to reshape my brain to comprehend, I feel more alive than I ever have before.
FROM MAX, WHO RETURNED TO MATH

• I just finished reading your wonderful article "Mathematics for Human Flourishing" and felt compelled to reach out with a small personal story. When I was in second grade, I struggled with subtraction and asked my teacher for help. She snapped, told me some mean spirited equivalent of "you need to go figure this out because it isn't hard," and I returned to my desk feeling like the biggest idiot. I barely ever asked for math help after that and struggled for mediocre grades until college.
FROM MAX, WHO RETURNED TO MATH

• In college I fell in love with an aerospace engineering major and her deep understanding of mathematics was almost intimidating. And at the same time I discovered a passion for economics and through that, math's ability to elegantly explain complex phenomena. I only have an undergraduate degree, but I've managed to work in applied math ever since graduating and today do time series analysis in healthcare. If only I could tell 8 year old me of this trajectory.

• Discovering the beautiful intersection of mathematics and humanities will always have a very special place in my heart and I love to share it with others. The path I've been on has shaped my perspective that anyone, regardless of gender, ability, race, or otherwise can be apart of this wonderful thing.
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