Mathematics and What It Means to Be Human, Part 1

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Manil Suri

In May 2009, Michele Osherow, an English professor at the University of Maryland-Baltimore County and dramaturg at the Folger Theatre, in Washington, invited her colleague Manil Suri, a mathematician at the university, to act as mathematics consultant for the Folger's production of Tom Stoppard's Arcadia. *The play explores the relationship between past and present through the characters' intellectual pursuits, poetic and mathematical. That led to a series of "show and tell" sessions explaining the mathematics behind the play to both cast members and audiences. In the fall of 2011, the two professors decided to take their collaboration to the classroom and jointly teach a freshman seminar, "Mathematics and What It Means to be Human." Here is the first of a three-part series on how the experiment played out. (Read Part 2 here and Part 3 here.)*

Manil Suri: The pre-theater talks I gave at the Folger really fired me up. Few intoxicants are as dangerous to a mathematician as an audience of laypeople willingly listening to a math lecture. So when Michele tantalized me with a whole semester's worth of such highs with a class full of enthusiastic (OK, at least captive) students, the endorphin factory in my brain went into high alert.

I could be Johnny Appleseed, strewing impressionable young minds with the seeds of logic and algebra; or Florence Nightingale, bringing mathematical succor to these poor, deprived humanities rookies. This was a chance to engineer a grand meeting of diverse disciplines and worldviews—to create, in one corner of the university, our very own Arcadia.

My chairman was less enchanted by those lofty aspirations. In fact, he seemed downright distracted by the mundane matter of course release. "Who will cover the extra cost over what they're offering?" he asked. I'll skip the next part—squeezing out money, like squeezing out sausage, is best left off-screen. Suffice to say, we managed to get the go-ahead.

Which meant it was time to figure out a syllabus (http://www.math.umbc.edu/~suri/HUM120H_syllabus.doc). My evangelistic fantasies resurged, stronger and surer than before. There was so much to dazzle the students with the joy and beauty of math—all the "top 10" hits from Fermat to fractals. Even though the focus of the course wasn't to teach actual mathematics, how nice if some students went on to take something useful, like calculus!

My mind racing with the possibilities, I lavished Michele with a series of popular books on math (Keith Devlin's *The Math Gene* and Barry Mazur's *Imagining Numbers*). Since one of our themes was going to be "the two cultures," I even came up with an elaborate scenario: In the first lecture, I would join the class in disguise as a student, to make provocative comments from the back row, pitting the humanities against the sciences. Surely with Michele's experience in the theater, she could appreciate how that would start off the class with a bang? "You have a very strong sense of drama," she said.

Michele Osherow: After countless (in the metaphorical, not Cantor set-theoretical sense of the word) sessions hashing out the syllabus with Manil, I held a June 2011 orientation for the 13 incoming freshmen chosen for our Humanities Scholars program. They would take the seminar in the fall. When I revealed the title and focus of the seminar, I noted their horror. "Don't worry;" I told them. "You can't find this more frightening than I do."

And it was true. Ever since the word problems my father forced on us at dinner, I've always been terrified of math. I probably skipped dessert for all of fourth grade in order to escape some design to have me calculate how to share five ice-cream cones among eight friends who had a variety of flavor preferences. (As if I'd ever share ice cream, no matter how good the friend.)

So how did I find myself cheerleading for a course involving math?

Blame it on Stoppard's *Arcadia*—a gorgeous play filled with poetry and math, English professors and mathematicians and students and teachers (and turtles), all inhabiting a very rich, very smart world. It was a world in which I wanted to live, or at least visit for two class periods a week. Manil had made the math in the play interesting and almost familiar; the complexities hypnotized me a bit. The images of fractals he'd generated on his laptop mirrored the *mise-en-abyme* of deconstruction; the proofs he'd talked about reproduced the precision of poetry in dazzling ways.

Might the allure of mathematics captivate the incoming freshmen? Hard to tell, but if it could, I was sure Manil was the person to supply it.

I was significantly (exponentially?) less confident in my own abilities, but after a series of communications (equal parts enthusiasm and uncertainty), the plot had been laid. Our first collaborative task was to give the students their summer assignment. After rejecting a variety of texts (Manil rejected *Alice in Wonderland*; I rejected *Fermat's Enigma*), we settled on Mark Haddon's *The Curious Incident of the Dog in the Nighttime,* and an excerpt from Keith Devlin's *The Math Instinct.* The students would have to read and write. But they were humanities students; they should be able to do that.

Manil: The week before the fall semester began, students began blitzing my e-mail inbox with their summer writing assignments. I tried to grade one at random and quickly realized how ill equipped I was for the task.

Throughout my career, I'd graded only problems, not papers. Beyond negotiating the minefield of creative syntax and convoluted arguments, how did one evaluate something as subjective as opinion? I missed the reassuring certitude of the crisp red marks that I made across math homework. Proofs and calculations were either wrong or right. In my heart, I wept in sympathy for my long-suffering colleagues in other fields.

Having stared at the same paper for two hours without making any headway, I also shed several tears for myself. What had I blundered into? The semester hadn't even begun yet.

Fortunately, Michele turned out to be a true grading maven: "87," she would pronounce, or "79," or "91"—an exact percentage arrived at through a precisely calibrated grading system seemingly hard-wired into her brain. She tried explaining it to me a few times, but I never could quite get the hang of it. What mattered was that she was there to unobtrusively neutralize the more egregious of the grading crimes I had probably committed.

Michele also solved the mystery of why so many of the papers ended on an alarming "Let's make the world a better place!" note. Apparently this was one of the lessons students took away from high school: Find the "message" in any assignment and parlay it into an uplifting call for action. Part of our assignment in the course would be to liberate them from such training, and nudge them into more-scholarly modes.

In other words, I had apparently signed on to teach one of those dreaded "writing intensive" courses. As I would learn through much effort over the semester, merely being a writer oneself isn't preparation enough to teach such skills.

Michele: One of the first texts on the syllabus was *Pi.* When Manil suggested it, I assumed he meant Yann Martel's book, *Life of Pi.* "No. That isn't mathematical at all," he corrected, "I mean the film *Pi. (beat)* Aronofsky."

Manil liked the way the film riffed on fractals and chaos theory, but what came to interest me was the deconstructive potential in attending to patterns in a film whose hero sought to expose the ultimate pattern of pi. I alerted students to the repeating tactics employed by stockbrokers and Talmudic scholars: The brokers wanted pi to reveal patterns in the stock market; the Hasidim hoped pi would reveal God's ineffable name. The trade on Aronofsky's Wall Street was stocks and gods: I wanted students to unpack both forms of power. I wanted them to consider ways in which the hero was dehumanized and what that revealed about our culture's attitude toward math and mathematicians.

The students were quick to pick up on the dangers of math as presented in the film and applied the concept of hubris to mathematicians with marvelous precision. (Manil was out that day.) Then someone linked the film to *Fight Club,* and our class discussion descended into a gala of gore. The students recounted (and enacted) moments of *Pi's* hero ingesting discharge from his computer or drilling a hole into his head. When the last bit started to appeal to me, I knew I had to shift the focus.

"But what prompts him to make these choices?" I asked, too cheerfully. I was hoping we'd move toward a discussion of man versus machine. Instead the students wanted to talk about God and kabbalistic numerology ... and Madonna.

I might have realized that beginning the course with a film that locates God in 3.1461592 ... would trigger students to seek out the sacred in every text. And sure enough, mathematical links to divinity began surfacing everywhere: in Blake's poetry, in the fractal designs of Hindu temples. The students found math and God in everything from unicorns to infinity. One student remarked that mathematics might prompt people to faith.

That was not on the list of course objectives. My remedy: We'd substitute one God for another. Next up: Shakespeare. There's reference to the gods in *King Lear,* but it's hardly a play to compel faith. And there's the added bonus of reminding students who went off topic, "How sharper than a serpent's tooth it is to have a thankless child!"

Manil: I still wake up some mornings wondering how, exactly, *King Lear* ended up on the syllabus. There was something about connecting his predicament to the madness suffered by mathematicians in movies like *Pi,* something about linking the multiple mentions of "nothing" in the play to the concept of zero, newly emergent in Europe at the time of writing. But Shakespeare and math? Really? Plus (and this was not something to complain about to my colleague, who is the interim director of the Shakespeare Association of America), I'd actually have to read the darn thing.

Which proved harder than I thought. I carried it all the way across the Atlantic and back on a conference trip, barely getting past the copious explanatory notes on the first page. Why had I allowed myself to fall victim to such cruel and unusual punishment? It wasn't as if I was torturing Michele with a tome on calculus. Eventually I did read it and—score one for the humanities—found it compelling. The novelist in me marveled at the masterful craftsmanship, the economy in developing character and plot. But the mathematician remained scratching his head.

Michele: Was it my imagination, or was Manil more resistant to reading *Lear* than the freshmen were?

Still, I couldn't let it go: If the goal of the course was to enable students to make connections betwixt and between subjects—the mark of intelligence to some—who opened more windows than the Bard? Besides, I needed something familiar in this course. Surely this play was relevant: It begins with a math problem (poor division!), features a constant reappraisal of value, and pitches the term "nothing" some 29 times. I persuaded myself that the play was as close to math as I'd gotten in the past 15 years (aside from *Arcadia* and taxes). I'd never thought about *Lear* and figures, but I wanted to; I wanted to know if "nothing can come from nothing" philosophically, metaphysically, mathematically.

We enlisted a colleague to discuss nihilism with the students (a common interpretive frame for *Lear,* and one related to discussions of zero and nothing), and considered the play's hero in relation to Joseph Campbell's theories of the archetypal heroic journey but it didn't feel like we were getting any closer to the mysteries of *Lear* or zero. I pointed out the way the play alerts us to disappointing math: the inequitable division of land; the attention to diminishing numbers of daughters, sons, servants; the difficulty reckoning equivalences among citizens. (For a fascinating examination of mathematics and Shakespeare, giving particular consideration to Renaissance units of measurement, see Paula Blank's 2006 book, *Shakespeare and the Mismeasure of Renaissance Man.*)

I could sense my colleague's increasing despair; so we cut to it: "Does the play suggest that Lear's observation on 'nothing' is correct? Yes or no?" The students spoke about the significance they assigned to the acquisition of knowledge (this was worth hearing). They recognized that the more Lear lost, the more he learned. Nil was proving to be a rich subject.

Manil shot up from his seat and introduced set theory and questions of the empty set. Elaborate, bracketed images found their way to the board: Zeros seemed to amount to things—and, when paired with a number like 1, amounted to a lot. That number proved useful in speaking about the individual in Shakespeare's world and the ways in which the value of 1 (or I) is determined by what surrounds it. It was inspiring to see those connections made and, although it took us some time to distinguish them, I'm glad we duked it out. I read *Lear* a little differently now, and never without hearing Manil's surprised aside: "Really, this play is very good."

Manil: Yes, I did shoot up from my seat to rein in the proceedings when they strayed too far from being math-related. To me, the characterization of Lear's gains and losses as a mathematical question remained strained. Although exercises like comparing 1 to I were interesting, I worried we were gliding over the careful truths that symbols and equations represent. Would we produce a class full of students who went around believing that math was no more than the language used to express it?

On the other hand, this was not a course in mathematics, it was all about connections, as Michele reminded me in our nightly e-mail exchanges. Using math as metaphor to shed light on other areas might be startling, but was intellectually legitimate. (Certainly my own horizons were getting challenged and stretched every day.) Still, there was the danger of moving too far off, so I gave them a mathematical version of King Lear's division problem to compensate. "Find a way to trisect any angle using only compass and straight edge." It's a classical problem, I announced, although I neglected to mention that it was one proven to be mathematically impossible.

See Part 2 : Poetry versus Math: The battle escalates.

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