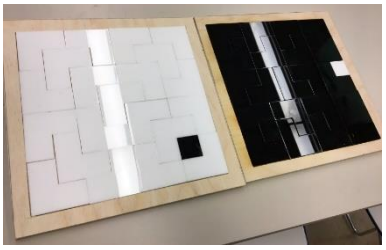
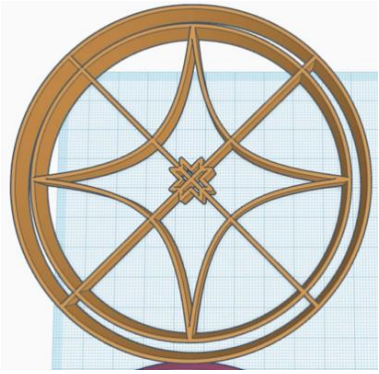
Noticing Humans & Noticing Wonders

Benjamin Dickman[1]



Noticing Humans refers to the importance of students being aware that they are seen by others – including, but not limited to, their math teachers – and that we, as teachers, would do well to interrogate how our external perspectives match or don't match students' internal perspectives.

Noticing Wonders refers to a specific in-class activity related to Paul Lockhart's essay, "A Mathematician's Lament" (pdf), that I designed – based on suggestions from my Middle School English teaching colleagues – to gain insight into how my students were thinking about mathematics.



In noticing and wondering: What do we notice, or not notice, about students as human beings?

Being Noticed

During a summer visit to my childhood home in Boston, Massachusetts, to see my family, I made a point of asking my mom[2] for a very specific suggestion: What can I say to students who voice anxiety or discomfort around an upcoming (math) assignment, especially when my prior knowledge of their quality of work and preparation suggests that they will do well? (For example, I would consider "Don't worry about it!" or "I'm sure you'll do fine" to be suboptimal responses.) Paraphrasing, her idea was that sharing evidence of strong past performance is fine, but that a helpful additional sentence would be one to the effect of: "As your teacher I have confidence in you, and while I know that you may not share in that confidence right now, I wish that you could see yourself through my eyes."

Less than a month later, I was reading a piece in Quanta Magazine about 2018 Fields Medal (an award sometimes called the Math Nobel) recipient Akshay Venkatesh, from which I excerpt (emphasis added):

> Clearly, [Venkatesh's] adviser must have written a glowing letter of recommendation for him — but why? Venkatesh took this question to Jordan Ellenberg, a friend and fellow mathematician. Ellenberg's reply has stayed with Venkatesh over the years: **"Sometimes, people see things in you that you don't see."**

About a week after, I noticed on Twitter an open-request from Professor of Mathematics Education Ilana Horn about her son.

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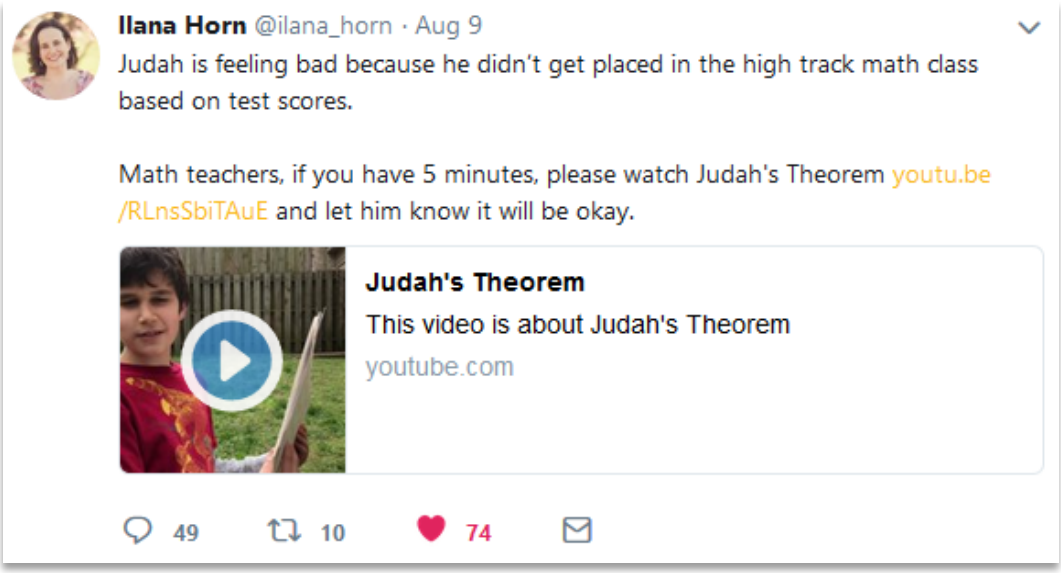
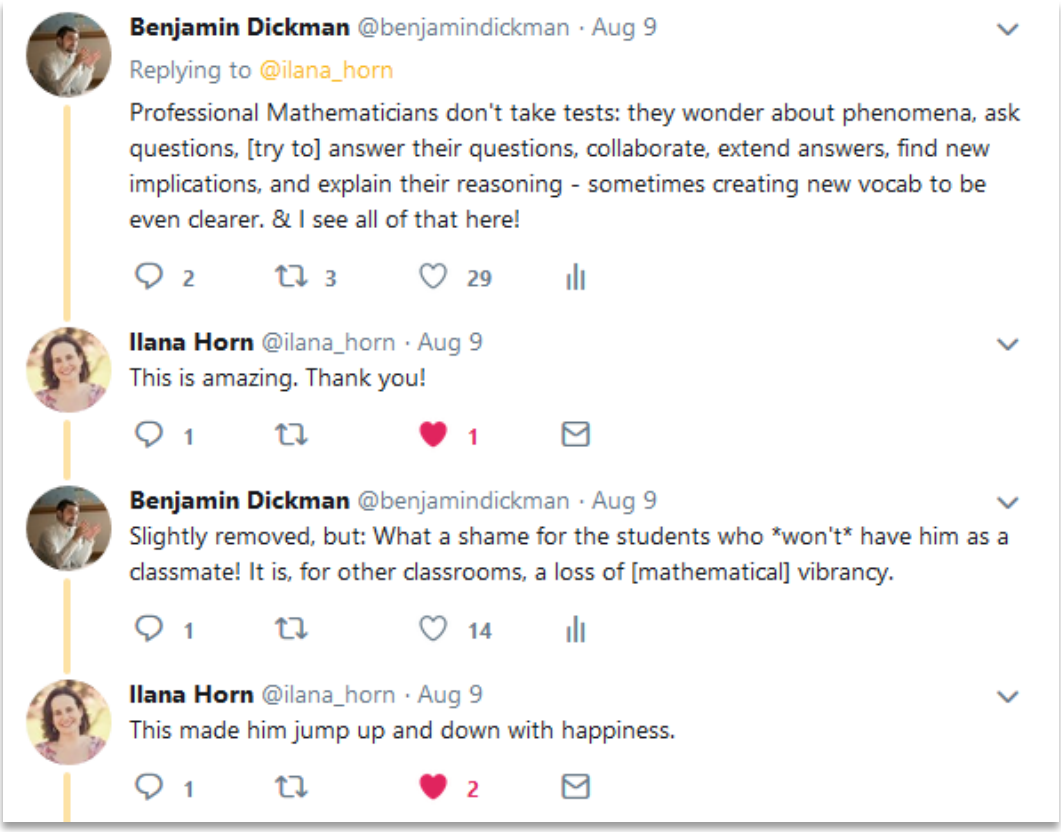
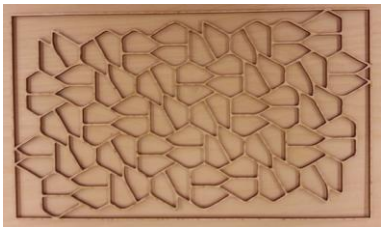
[2] I happen to think "being my mom" is a sufficient criterion for giving good advice, but my mom also happens to be a child psychiatrist whose work includes advising for the PBS show *Arthur,* which created a therapist cartoon character named after her!



I happen to be a math teacher who had 5 minutes, so I watched the video and left a couple of comments. I thought that my first comment got to the heart of the matter, and left a second comment even though I deemed it less relevant. Here are the comments with their respective responses:



In retrospect, I conjecture that my first comment resonated primarily with other math educators, who can see what I see about habits of professional mathematicians, but that it would require more time and evidence to be fully believed by a child. My second comment had a different outcome – to "jump up and down with happiness" – because it comes from a different perspective: how one is seen (or even not seen) by their peers, and the ways in which one's presence and absence are noticed, even from afar. The through line that I perceive in these three items – my mom's suggestion to me, Ellenberg's advice to Venkatesh, and the excerpted tweets – is that, although there is much talk in math education about noticing and wondering, I am concerned that we are (or: I am) not doing enough to ensure that I let my students know that I am noticing them for who they really are: as mathematical thinkers, as students, as humans. I need to attend better to voicing what I notice in them, and thinking intentionally about how they share what they notice in one another. This is true for students who retain an anxiety around (math) assignments; it is true for future Fields Medalists; it is true for students who experience tracking systems in ways that are too often unjust; it is true for so many other students who cannot – or do not yet – see themselves through a caring adult's eyes; and, I strongly suspect, it is true for so many teachers who long to be noticed and seen – knowingly or not – for who they really are: as mathematical thinkers, as teachers, as humans.



In noticing and wondering: How can we follow up on our wonders about the ways in which students see mathematics?

Noticing Wonders

About once a month for each of the past two years, I have met with a group of teachers at my school – some Middle School, some Upper School, some both – to talk about "Writing to Learn" strategies. One of these is called a Focused Free Write, and although it was introduced as a way for Middle School students to get a foothold on Ovid, I decided to adapt it for use with an essay that is somewhat well-known in certain math education communities: Paul Lockhart's "A Mathematician's Lament," which is often referred to simply as "Lockhart's Lament". If you've never read it, or even if you have, you might try to complete the activity below; the students in our Problem Solving & Problem Posing course had no prior familiarity with any of the author's writings[3]. To summarize (over)simplistically, I feel that this essay, or Lament, speaks in a way that resonates with many mathematics teachers. I wanted to use it to gain insight into the specific mathematics learners with whom I was working. Here is the full prompt, for which I wrote the directions in red. No additional information was provided about the source text or its author:

[3] Incidentally, we completed this activity on a day that two visitors were sitting in on our class: One visitor was my mom, who was mentioned in the previous section; the other visitor was my preschool teacher, Ms. Helen Rafiy, with whom I have stayed in touch for over a quarter century. Fittingly for the WikiLetter project: Ms. Helen is an Iranian-born American, and her first language is Farsi.

Focused Free Write

Create a paragraph or a story that reflects your impression or version of what the text might say. Do not change the words or order of the words but you may add as much as you wish in between to fill in the gaps. You may go through the entire prompt, or find somewhere comfortable to stop.

The first thing to understand is that mathematics.... The difference between math and... is that our culture... Everyone understands... create... and are expressing themselves.... In fact, our society is rather generous when it comes to... So why not mathematicians?

Part of the problem is that.... The common perception seems to be... some reason or other. ...if the world had to be divided into ... most people would place mathematicians....

Nevertheless, the fact is that there is nothing as ... as mathematics. It is every bit as... and allows... Mathematics is the purest of the..., as well as the most...

So let me try to explain what mathematics is, and what mathematicians do. I can hardly do better than...:

A mathematician... is a maker

of... If his... than

theirs, it is because they are made with...

So mathematicians sit around making.... What sort...? ... No, those we leave to .... Ideas about ...? No, not usually. These things are all far too ... for most mathematicians' taste. If there is anything like a unifying aesthetic principle in mathematics, it is this: ... Mathematicians enjoy ... and the ... are imaginary.

We spent 10 minutes on the quiet writing part of this task, and, once we wrapped up and it came time to share out, the students organically decided that they would each read aloud one of their classmates' focused free writes. I share this task here because I think it is a meaningful example of how strategies from another subject in another grade can be successfully transferred to the context of a math class. Moreover, I am compelled to point out explicitly that other teachers could pick a different text and/or a different excerpt and/or a different set of words to replace with ellipses. I picked this text, excerpt, and its removals as a function of what I hoped to accomplish with and learn from my students. Below are two student examples, followed by Lockhart's original words. In each case, the portions that replaced the ellipses are in blue. Rather than analyzing the student work, I prefer to let it speak for itself; so, I will conclude with these examples, hoping that they excite the reader to see the other examples in the appendix. There are many ways in which additional context can frame how each student's excerpt reads; here, I note only that I work at an all-girls day school. Part of what made this so meaningful to me was knowing the individual students. For the reader without this shared connection, I simply suggest reading as much or as little as you'd like, and in whatever order you wish – perhaps comparing corresponding parts across the provided examples. Finally, I hope that, if you try this activity with your students – or with other teachers, or with other humans – then you will consider sharing the wonders that you notice.

The first thing to understand is that mathematics is for everyone. The difference between math and English is that our culture attributes mathematics to men and English to women. Everyone understands that math is difficult, but not many people understand that anyone can be good at it if they try.

Part of the problem is that people believe that they are inherently “bad" at math. The common perception seems to be that some people were born good at math and other people should stick to the humanities for some reason or other. And if the world had to be divided into men and women most people would place mathematicians in the men's category.

Nevertheless, the fact is that there is nothing as misunderstood as mathematics. It is every bit as forgiving and doable as the humanities and allows people to explore the ideas in their brain. Mathematics is the purest of the STEM fields, as well as the most satisfying.

So let me try to explain what mathematics is, and what mathematicians do. I can hardly do better than Euclid:

A mathematician knows that she or he is a maker
of patterns, designs, and formulas.

So mathematicians sit around making graphs and equations. What sort of job is that? Is it one we use to build roller coasters? No, those we leave to physicists. Ideas about the economy? No, not usually. These things are all far too trivial for most mathematicians' taste. If there is anything like a unifying aesthetic principle in mathematics, it is this: Mathematicians enjoy simplicity and the rest are imaginary.

The first thing to understand is that mathematics is fun. The difference between math and reality is that our culture does not appreciate failure, and math and failure are inextricably tied. Everyone understands human nature, at least on some subconscious level, and can create problems and are expressing themselves through those problems. In fact, our society is rather generous when it comes to supporting the greedy and rationalizing bias and hatred. So why not mathematicians?

Part of the problem is that we are taught to strive for perfection, which, of course, means failure is unacceptable, and more subtly suggests that kindness and empathy is of less value than your success. The common perception seems to be that success is measured in money — the amount you make or the amount you have (even if you were born into it) for some reason or other. I believe that if the world had to be divided into two groups. capitalists and socialists most people would place mathematicians in the socialist box.

Nevertheless, the fact is that there is nothing as complex, intricate, and open as mathematics.

So let me try to explain what mathematics is, and what mathematicians do. I can hardly do better than Mr. Dickman:

A mathematician is a curious soul and is a maker
of questions. If his/her/their questions are "better" than
theirs, it is because they are made with genuine interest and a desire to explore.

So mathematicians sit around making problems and questions and solutions. What sort of problems and questions and solutions? Hmm, that's a good question. Do we ever really know? Can we accurately categorize the wonders provoked by a curious or wandering mind? No, those we leave to ruminate and grow.

Paul Lockhart [excerpt from "Lockhart's Lament”]

The first thing to understand is that mathematics is an art. The difference between math and the other arts, such as music and painting, is that our culture does not recognize it as such. Everyone understands that poets, painters, and musicians create works of art, and are expressing themselves in word, image, and sound. In fact, our society is rather generous when it comes to creative expression; architects, chefs, and even television directors are considered to be working artists. So why not mathematicians?

Part of the problem is that nobody has the faintest idea what it is that mathematicians do. The common perception seems to be that mathematicians are somehow connected with science— perhaps they help the scientists with their formulas, or feed big numbers into computers for some reason or other. There is no question that if the world had to be divided into the "poetic dreamers" and the "rational thinkers" most people would place mathematicians in the latter category.

Nevertheless, the fact is that there is nothing as dreamy and poetic, nothing as radical, subversive, and psychedelic, as mathematics. It is every bit as mind blowing as cosmology or physics (mathematicians conceived of black holes long before astronomers actually found any), and allows more freedom of expression than poetry, art, or music (which depend heavily on properties of the physical universe). Mathematics is the purest of the arts, as well as the most misunderstood.

So let me try to explain what mathematics is, and what mathematicians do. I can hardly do better than to begin with G.H. Hardy's excellent description:

> A mathematician, like a painter or poet, is a maker
> of patterns. If his patterns are more permanent than
> theirs, it is because they are made with ideas.

So mathematicians sit around making patterns of ideas. What sort of patterns? What sort of ideas? Ideas about the rhinoceros? No, those we leave to the biologists. Ideas about language and culture? No, not usually. These things are all far too complicated for most mathematicians' taste. If there is anything like a unifying aesthetic principle in mathematics, it is this: simple is beautiful. Mathematicians enjoy thinking about the simplest possible things, and the simplest possible things are imaginary. . . .