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STEAM – Science, Technology, Engineering, Art, and Math

Prove that cn is not zero in any situation of n. $(1+4*â^›2−4*â^›4)^n = a\_n+b\_n*â^›2+c\_n*â^›4$

On the day of the deadline for the submission, in bed and out of school with a 102.2 degree fever, Sachiko Nakajima knew that she had finally solved the problem that had been posted in a mathematics magazine published by Tokyo Shuppan a month ago.

Thinking through the same problem over and over for a month. And then feeling the euphoria that washes over you when you finally solve and just instinctively know that "this is the answer". That's how Ms. Sachiko Nakajima opened her eyes to math; she still remembers this exact problem today and recited it to me number by number.

Ms. Nakajima is not a run-of-the-mill mathematician. Today, she works for a global leader development corporation as a consultant for creative learning, and analyzing data. She also provides numerous seminars and workshops all over Japan on creativity of math and music world. She was the first female Math Olympian from Japan, and is the only holder of the female Math Olympics gold medalist title in Japan. In addition to being a mathematician, she also has a career as a jazz pianist and as a composer. After forming a trio band under her own name, she released an album titled "REJOICE" in 2010. She recently gave a TED talk at the University of Tokyo.

"Choosing your own path from an infinite number of choices". That's what she said to me that day over Skype. That's what Ms. Nakajima did when she finally was able to finish the proof. And that's also what she does in her life. Ms. Nakajima is the epitome of that quote; even with a wall of two computers and 6,701 miles, her passion for math and music shines through. She tells me how when she gets stuck on a math problem, she practices music, and vice versa.

But her path wasn't always so clear. When she graduated from the University of Tokyo, she realized the dearth and depth of the topics of both math and music and decided that she could only pursue one. For ten years, she left the world of mathematics to pursue music. At this point in her life, she couldn't see the link between music and mathematics that she sees today and struggled with the decision she supposed she had to

make. Then one day, one of her past professors came to one of her live concerts with three books on zeta functions, and she felt her passion for math reawaken. She dived into the world of research. Today, she says that this experience helped her see both subjects in a new light. She tells me that "Taking the longer path is never wasteful."

I ask her whether there's a connection between math and music. "Yes, definitely!" she says. Apparently the sound waves of C, E, and G, make a perfect ratio of 4:5:6, while the sounds waves of C and F sharp make a ratio of 1:2. In both music and mathematics, you create new things. Mathematics involves making proofs, conjectures, and theories, and music involves composition and improvisation. The logic of math, and the sensibilities involved in music help each other to innovate.

Her passion for both has led her to a new project recently.

Growing up in Japan, she explained how mathematics is seen as something for girls who seem overly boyish or overly fanatic. Today, she's trying to change that stereotype by creating STEAM, a Science, Technology, Engineering, Art, and Mathematics program for young girls.

"What is the beauty of math?" I ask. She gives me an answer after a few silent seconds. "I believe that there's a certain way you have to look at math. You have to look at from your heart, your soul. What it seems to be on the surface, there's more to it than that. There's an essence."   Ms. Nakajima believes that the beauty of math also lies in how it all connects. "$1-1/3+1/5-1/7+... =PI /4$. Why is there a four here? Because there's only four integer points on the unit circle." she laughs. Her explanation makes sense even to me; there is a certain connectivity in math that only certain people try to see, and Ms. Nakajima wants to make this more accessible for everyone. While talking, even I, in no way a mathematical genius like her, feel the magnificence and weight of the numbers on the page.

Ms. Nakajima dreams of the day when there's equal numbers of girls and boys at STEM conventions. She tells me: "There's a certain math that only females can understand that uses their soft touches, their delicate senses. The connection between math and art is going to be the catalyst for the use of those senses. I think there's going to be a revolution for female mathematicians in the future". So to future female mathematicians and scientists, she says "Don't be scared. Time is changing".