

Interview with Sachiko Nakajima, Jazz Pianist & Composer, Mathematician & STEAMS Educator

Creativity Raised by Taking Pleasure in Learning

By Japan SPOTLIGHT

When we encounter stumbling blocks in our life, pursuing innovative and creative activities could help us break through the bottleneck. Young people in particular in an aging society may find life becoming increasingly difficult, as social and political priorities seem to be given to the elderly to enhance their welfare. Japan is an aging society and one still driven by a seniority system. Most young people will have to wait many years to get promotion in a company or do any work that could really influence society. But we think they must not be disappointed. There are always geniuses who can show us the world in a different light through their unique views and thoughts, and help turn dull reality into a rosy future.

We are happy to introduce one of these geniuses, Sachiko Nakajima, a talented mathematician and jazz pianist. She won a gold medal in 1996 at the International Mathematical Olympiad in India when she was a high-school student. She is currently working on education in mathematics and talking about how education can best develop the uniqueness of each student. We interviewed her on the campus of the University of Tokyo where she occasionally works as a project researcher.

(Interviewed on March 2, 2018)

Introduction

JS: I find your career unique, as you have been a distinguished specialist in two different areas, jazz and mathematics. Could you tell me how and when you encountered these two?

Nakajima: I learned to play the piano when I was a child, since I loved music. I did not know anything about jazz music then, though I liked playing the piano spontaneously. As for mathematics, I started being enchanted by its mysteries when I was a junior high school sophomore, and stopped learning the piano then. I thought mathematics could offer us spontaneous ideas or a world free from preconceptions. Once I worked on one mathematical problem for one month. I had been working on it from morning till night and attempted to apply all kinds of approaches to it, and all failed. After such a tremendous effort, I finally got a solution with just a tiny change in my way of viewing the problem. Thanks to this wonderful experience of solving this problem by myself, I gained confidence in my own mathematical ability and I have been rapidly indulging it since then. I would not



Sachiko Nakajima, Jazz Pianist & Composer, Mathematician & STEAMS Educator

have been able to gain such confidence if I had found a solution in a short time simply by applying a method I had learned in advance. I became fascinated by the world of mathematics which we could see only by continuing to think all the time. I then found many friends who were also attracted by mathematics and finally, when I was a high-school student, I participated in the International Mathematical Olympiad in which some of my friends had also participated.

After entering university, I encountered jazz and started musical activities again. I found something in common between mathematics and jazz. I think jazz is expressing a human world that cannot be explained only by logic. In this regard, jazz has a somewhat chaotic aspect just like mathematics. I became enchanted by the spontaneity of jazz, which also involves collaboration and is somewhat similar to mathematics.

JS: Are jazz and mathematics both artistic?

Nakajima: The question lies in what art is. I think now that both enable us to reconsider what we take for granted. In pursuing both

we can learn that a different view can create a completely new idea and occasionally provide us with the essence of a reality we had not been aware of until then. We can continue to ask ourselves about the essence of any issue in working with jazz and mathematics. In this sense, both have much in common with philosophy.

Merits of Spontaneity

JS: Individuals today are often anxious about the future and this anxiety probably comes from uncertainty. For example, with low economic growth and fewer jobs with high wages, you cannot expect to be as wealthy as your seniors expected a few decades ago. As the lifetime employment system begins to collapse in Japan, job security cannot be guaranteed anymore in a Japanese company. But your talk of the charm of spontaneity suggests that uncertainty could be a source of pleasure in life.

Nakajima: In mathematics and music, our school education was a process of learning what our great predecessors had managed to create and discover after many trials and errors. It is time now for us to enjoy the same experiences and pleasures as our great predecessors did. We are entering an era of creating mathematics and music on our own rather than just appreciating what was created by someone else. Mathematics and music can lead to the discovery of new theories or ideas or help you create new solutions by yourself, let you enjoy the improvisational ideas, and this would help such anxious people.

JS: With artificial intelligence (AI) and robots, human beings' jobs are under threat. But I guess what you say about mathematics or jazz as being something artistic, they could not be replaced by AI.

Nakajima: I am optimistic about the relation between AI and human beings. For the time being, we can share the work between human beings and AI, such as routine tedious work to be done by AI and more creative endeavors to be done by human beings. I believe at this moment human beings are much more creative than AI. With AI, I think human beings could expand their potential further. This is truly exciting and not to be lamented. We Japanese are in particular living in a culture of ambiguity, where human beings and nature have not been clearly divided (like the Shinto idea of "eight million gods"). So I believe Japan has some advantages in coexisting with AI, new fantastic creatures, and can lead the world in this respect.

International Mathematics Olympiad

JS: When did you decide to participate in the International Mathematics Olympiad?



Nakajima: When I was in the fifth grade at elementary school, I saw a newspaper article saying that Japan had participated in the International Mathematics Olympiad for the first time. It was then distant from me, but when I got to love mathematics so much in my high-school days I found the problems to be solved by the participants in the Olympiad very attractive. As the problems were ones that nobody had ever seen before, knowledge was not useful for solving them, but you could see a key to the solutions by trying to see them from a variety of angles. We had three problem sets to be solved within four and a half hours, which was much longer than in university entrance exams. Thus efficiency did not matter but creativity mattered. I was attracted by this aspect of the Olympiad, as it was aiming at raising creativity.

Dr. Kiyoshi Oka, a well-known mathematician, once said, "If you indulge in anything, you would definitely love it." That exactly happened to me in my high-school days. At that time I naturally made contact with other mathematics lovers, who were unique, and talking with them was great fun for me. It might be not so interesting to do mathematics alone, but enjoying companionship with people who have the same taste for mathematics has enhanced my pleasure in learning even further. Among those friends, there were a few who had participated in the Olympiad and I thought why not join them.

JS: You must have met many mathematics lovers from many countries then. How did you find those new encounters? Did they change you?

Nakajima: I truly enjoyed the International Mathematics Olympiad. My first Olympiad was held in India in which I won the gold medal and the country fascinated me. I had stimulating encounters with students from more than 80 countries during my one-week stay in a lodging facility. It was great fun to see the variety of national customs among the participating students. Though some students did not find it easy to communicate in English, we managed to communicate with each other well on mathematical ideas and on our own cultures in broken English. As I found this experience extremely

amusing, I participated in the following Olympiad in Argentina and even after entering university I joined it as one of the supporters in Romania and Scotland. On such occasions, whenever I played the piano, many people gathered around me. This demonstrated to me that music is a global language just like mathematics.

JS: At those international venues, Japanese are often said to be less creative people. But I guess, judging from Japanese poetry like *haiku* or *senryu*, that Japanese were originally very creative in the 17th or 18th century when such short poems were so popular. Even mathematics in Japan was unique and well developed during those periods.

Nakajima: Yes. I think even now there are lots of interesting ideas created by Japanese mathematicians that could not have originated from Western people. Japanese resources of creativity and new ideas are not in logic but in sensitivity. Dr. Kiyoshi Oka also said that you would have to learn the *haiku* of the great master Matsuo Basho in order to be a good mathematician.

“World of Zeta”

JS: You co-authored a book on mathematics for experts titled *World of Zeta*. Could you roughly introduce the essence of the book?

Nakajima: Yes. I wrote this book during a spring break at senior high school, right before entering university. It was suggested by Dr. Shigenobu Kurokawa, emeritus professor at the Tokyo Institute of Technology. He believed that doing research in mathematics should be fun and that one's own views and ideas should be presented to all in language that is easy to understand. He also believed that whoever studies mathematics deserves to be called a mathematician. So he suggested that I write about the zeta function, which I have loved since then.

One of the charms of mathematics is the somewhat mysteriously unknown part of it, even though it has already been proved. For example, the exact sum of the infinite series $1/1 + 1/4 + 1/9 + 1/16 + \dots$ is the square of Pi divided by 6 (Pi: the ratio of the circumference of a circle to its diameter). Leonhard Euler, a Swiss mathematician of the 18th century, found this after doing many calculations. I met this equation in my first year of senior high school and found it so mysterious and wondered why the infinite addition of those numbers would end up in Pi. There have been well known proofs of this equation, but once it is proved it does not necessarily mean the relation between natural numbers and Pi is clarified. Such equations or proofs are totally useless and it looks like an art. But these kinds of mathematical findings on numbers were later found to create a breakthrough in the computer world, where it is used for many cryptographies in a way which a mathematician who proved it had never dreamed about.

The Joy of Learning

JS: Playing with numbers eventually led to important inventions for human civilization, didn't it?

Nakajima: Yes. Amusing yourself by playing with numbers or musical notes (anything!) to the maximum can lead to the discovery of truths.

JS: Mathematics is often considered a way of developing logical competency. But after listening to you, I think the key to learning mathematics is learning how to enjoy working on it. So should mathematics teachers teach students that learning mathematics is not hard toil but the amusement of playing with numbers?

Nakajima: Yes, exactly. But only playing with numbers would end up in just pleasure. By asking why this play would have such an outcome and trying to find the answer by using logic, you could expand your view of the world. You would have to use sensitivity working in the right brain and at the same time logic working in the left brain. This is how innovation is born.

Creating Innovative Minds & Raising Happiness

JS: To make young Japanese more innovative, it would be better to eliminate discrimination between the humanities and natural sciences in university education. You can be more creative by learning interdisciplinary subjects now, as today we see that so many important social and economic issues are of an interdisciplinary nature, such as global warming. Would more spontaneous thought beyond specialties strengthen our ability to innovate?

Nakajima: Yes, I agree with you. In the 20th century we had so many refined classifications in all kinds of areas. Music is no exception. Jazz and rock music were both born in the 20th century. As we see now, there are so many borders among subjects by too refined classification, and we have to cross over these different classifications to achieve some meaningful outcomes.

In business today, a firm's organizational structure is transforming from a hierarchical one with top leaders into a horizontal one based on networking. To take full advantage of such a change in business structure, you would have to be an expert at the center of networking. To be a good expert today, you may as well have a double expertise or triple expertise, since interdisciplinary expertise is now highly appreciated. While in the United States or at European universities such experts with double or triple degrees are not unusual, it is not the case in Japan. I hope there will be many

Japanese universities in the future where you can get a double degree easily.

JS: We are now entering an aging society where people tend to get more anxious about their future. Life-long education could mitigate such anxieties. What do you think about life-long education? Do you think education will be age-free in the near future?

Nakajima: Yes, I think there will be an age when not only elderly people but also the handicapped or even the patients who cannot leave their bed will be able to learn. We will see in the near future if life-long education would become normal.

JS: What do you think about learning venues for adults today such as a further education school? At those venues people from a variety of backgrounds come together to study common interests. Do you think such exchanges of views and thoughts can create innovative ideas?

Nakajima: Yes. In mathematics, young people have been considered smarter than the old before, but I think as you get older you have an expanded viewpoint and a sensitivity different from young people's, so older people could certainly have more fun in learning mathematics. I am now providing mathematics workshops for adults every month. The title of my workshop is something like "mutual interaction of mathematics and XX" and as such we invite all kinds of experts, not only experts on music but also on subjects like cryptography, art, origami, traffic jams, etc. to talk with me as a mathematician. This is so popular and the classroom is always full. There are all kinds of attendees including those who do not like mathematics. These kinds of workshop are arranged for the benefit of all classes ranging from elementary school students to elderly people. They are not learning mathematics from a textbook at school but discovering the joy of learning mathematics by themselves. As such, they can learn regardless of age.

JS: If people can learn regardless of their background and enjoy it, that would make the whole society happy.

Nakajima: Yes. But it depends on how those believing learning is fun could convince those skeptical about it of their view's relevancy. I think there could be a variety of views on it. We do not have to believe in a single value unanimously. Diversity of views and thoughts is to be welcomed. In an age of increasing uncertainty surrounding our economy and society, it is natural to have anxieties. But as we may be able to transform the majority's view of the world into a more pleasant one, we may transform our anxieties into confidence or hope for the future. I think through creative journeys of mathematics or music, people could get the confidence that we



are the ones who could create the future.

Future Ambitions

JS: Could you let us know what you would like to try to do in the future?

Nakajima: There are two things I would like to work on. One is to create a new culture in the 21st century by collaboration with experts in a wide range of domains. I believe that my two areas of expertise, mathematics and music, are at a stage to proceed to the next dimension. What can be done to achieve it? This is my permanent question. I would like to pursue a new culture from an interdisciplinary approach among mathematics, technology, music and arts.

The other is what we call the "STEAMS" project. "STEM" means an educational approach with horizontal combination of science, technology, engineering and mathematics to be applied to practical issues. "STEAM" was proposed by John Maeda at the Rhode Island School of Design, trying to put "art design" at the center of "STEM". I have been interested in an even more comprehensive approach than "STEAM" since its early days. That is a "STEAMS project", adding "sports" to the end of "STEAM". In pursuing this project, I would like to create an education program that enables you to use your body, sensitivity, left brain and right brain. This is not to be taught but to be physically sensed. I organized a workshop for creating a logo after having found mathematical thoughts adopted in the logo design for the 2020 Olympics, and I have also started a collaboration between Tag Rugby and mathematics. It will be necessary to have exhaustive discussions about the essence of both in order to achieve substantive collaboration. I think that would be fun. This is how I would like to work on building up new education.

JS

Written with the cooperation of Naoko Sakai who is a freelance writer.