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Expanding the world of mathematics

Connecting different fields through abstraction

Kenichi Bannai is interested in solving problems in number theory using a geometric approach. He spent most of his childhood in the United States before permanently returning to Japan in high school. It was during this period that he became increasingly fascinated by mathematics. He loves mathematical speculation so much that it has now become his major “hobby.” Bannai has found in mathematics the capacity that could guide our relationships with society or with other members of community. Based on this experience, he aims to promote mathematics in a more open way.

You spent your childhood in the United States. Since when?

Since when I was 2-years old. Both of my parents are mathematicians, and our family moved to the States in the mid 70's when my father was offered a position at the Ohio State University. Except for two years of kindergarten, I lived in the States until I returned permanently to Japan near the end of high school.

Growing up in the States, did you consider going to an American university?

At the time when my family was thinking about returning to Japan, I had graduated early from high school and received offers from several American universities to attend. It was in the late 80's, when the world was feeling threatened by the rapid rise of the Japanese economy. Japan was portrayed as a country of people who were forced to work like machines all year around. Viewing repeated TV footage showing Japanese employees exercising in unison, I received the depressing impression that Japan was a country without freedom or individuality.

Then one day, I encountered Hayao Miyazaki's film “Nausicaä

of the Valley of the Wind.” It was a fantastic visual depiction of an ecosystem totally different from our world, and I was totally overwhelmed by the force of imagination that could create such a world. This experience deepened my interest in Japan, and influenced my decision to return to Japan with my family.

Why did you become interested in mathematics?

I started seriously thinking about mathematics in high school. Then, something happened which made me think that mathematics may be good.

It happened during a class in chemistry; I came across a differential equation describing the change in concentration of a substance during a chemical reaction. It was an equation I had just learned during a class in mathematics, but at first, I did not think much of it. Then immediately after, during a university biology class that I attended, when calculating the growth of a population of an animal in a certain ecosystem, I again encountered the exact same differential equation. “Wow!” I thought. Furthermore, I saw the same equation being used in an economics class. In other words, I found the exact same abstract



Mathematics has the capacity to abstract things and draw out their essences. Abstraction and other mathematical approaches to problem solving will become an important tool in solving real world problems.

Kenichi Bannai

Kenichi Bannai is a researcher in arithmetic geometry, a field of mathematics which uses geometric intuition to solve problems in number theory. Using arithmetic geometric objects such as the polylogarithm, he has been studying the relation between abstract arithmetic geometric objects and special functions, with an eye towards solving conjectures concerning special values of L-functions. He received his doctoral degree in 2000 at the Graduate School of Mathematical Sciences, the University of Tokyo. The following year, he became an Assistant Professor at the Graduate School of Mathematics, Nagoya University. He visited the École Normale Supérieure in Paris from 2005 to 2007 as a JSPS Postdoctoral Fellow. In 2008, he joined the Faculty of Science and Technology at Keio University. He was promoted to associate professor in 2012.



mathematical equation used with a specific meaning in a wide range of fields. I was convinced that mathematics would be useful in doing anything.

You said you noticed that mathematics was being used in many fields. What do you think now that you are an active mathematician?

Mathematics has the capacity to abstract and draw out the important essence of things and events. I believe that in this increasingly complex modern society, mathematics can play a major role by using its power of abstraction. For example, there are situations where people have so many different opinions that it may seem impossible to come to an agreement. However, if we think deeply about what each person wants to achieve, we may realize that in fact, the goals are actually very similar. Even in cases where specific methods or situations are so different that negotiation seems impossible, if we capture the problem in a sufficiently abstract way, we could achieve a common ground and begin to discuss how to solve the problem in a calm and rational manner.

Although mathematics itself mainly deals with such objects as equations and geometric figures, I am beginning to realize that the mathematical approach to problem solving, including the method of abstraction, is potentially a powerful instrument in solving real world problems.

What do you do when you are not doing research?

I've always enjoyed spending time with my wife. After the birth of my daughter two years ago, my family life is even more fulfilling. However, I don't feel that time with my family is separate from the time I spend doing mathematics. I feel I'm using my brain in the same way – when engaging in research, dealing with my students, or enjoying playing with my daughter. Dealing equally with mathematics and my dearest daughter may sound as though I am a bit too cold as a father, but I feel that I have the same great affection for mathematical issues as I do for

my daughter.

Thinking about the essentials of how to associate with or how to establish proper relationships with people has become so much fun that having such an abstract perspective or a mindset based on mathematical speculation is now almost a hobby for me.

What do you think are good points of Keio University?

First of all, the students are very highly motivated. While I was staying in France in 2007, I had the opportunity to participate in a number theory workshop known as the UK-Japan Winter School jointly sponsored by Cambridge and Keio universities. I was very impressed with the enthusiasm of Keio students.

At many Japanese universities, the department of mathematics belongs to the faculty of science. Furthermore, at the University of Tokyo where I studied and Nagoya University where I previously worked, Mathematics belonged to an independent graduate school, which made me feel somewhat isolated from other departments. At Keio University, the Department of Mathematics belongs to the Faculty of Science and Technology, allowing us to be in close contact with the technological departments. I have many opportunities to discuss with faculty from other departments – an advantage creating a health synergy between science and technology. Such a campus environment is probably one reason we have many creative and lively students.

◎ Some words from students . . . ◎

● Prof. Bannai is free of the stereotypical image of a mathematician. He is always willing to advise us even on simple questions and is open-minded enough to take interest in what we say or ask. This broad-mindedness makes his character very attractive. During lectures, he is very enthusiastic and inspires us to study mathematics. When we become stuck with a problem, he kindly gives us hints, often in a subtle manner, to help us along.

(Reporter & text writer: Kaoru Watanabe)

For the full text of this interview . . .

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