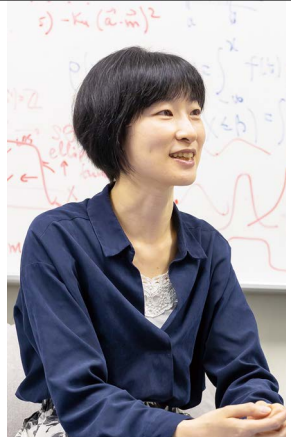

The fact that a research result is useful in some way is just the outcome; that need not be the purpose. Associate Professor Kotorii says, "I want students to know the joy of research that takes simple whys and curiosities and digs deep to discover truths."

Associate Professor,
School of Integrated Arts and Sciences
Graduate School of Advanced Science and Engineering

KOTORII Yuka

Field of specialization

Topology, knot theory

A model of a knot made with a 3D printer. The trefoil knot (top) is the most typical chiral knot. There are many types of torus knots (bottom), and all of them are chiral knots, except for the trivial ones.

Mathematics about string figures

Shoelaces, earphone cables, etc. get tangled, and when they do, do you ever think about "how" they are tangled? My research theme is knot theory, which deals mathematically with such "tangling of strings." This is part of a field in mathematics called topology. Topology deals with the shape of things. In particular, we study the properties that are maintained when things are continuously deformed. In my research, we correlate strings with mathematical expressions so as to be able to handle the elusive shape of strings within a mathematical framework. When temporarily translated into mathematical language, a variety of mathematical knowledge is at your disposal. By using this mathematical knowledge, we can, in the end, find out the shape of the string. However, even now, not all string figures are known, so there are still many things to consider.

You may wonder what the point of such research is, but for me, it's very interesting to figure out something, even if it is not useful. However, it is actually known to be useful. String-like substances exist everywhere. For example, proteins, DNA, and polymer compounds can be thought of as strings. The basic theories that we mathematicians have studied about strings are being applied to elucidate the properties of matter. I am also currently working on interdisciplinary research with researchers from different fields. One of the reasons I became interested in interdisciplinary research was something I experienced when I was a graduate student studying abroad at a university in the UK for several months. This university was a place of regular and active interdisciplinary exchanges, such as mathematics and biology, and mathematics and art. I had spent my life studying only mathematics, but witnessing this taught me that even I could make contributions to the world outside of mathematics by collaborating with researchers in other fields.

In the School of Integrated Arts and Sciences, to which I belong, students can choose lectures that interest them across disciplines. We have an environment suitable for students who are interested in multiple fields or who have not yet decided on a clear direction for their interests. I believe that students with expertise in multiple fields can come up with unprecedented and innovative ideas. Another attractive feature of the School of Integrated Arts and Sciences is that students can make a variety of friends studying different fields.

During the on-site lectures at high schools, in addition to explanations of university learning and research, we also offer hands-on learning about topology and knots using VR.

Similarly, as with the School of Integrated Arts and Sciences, WPI* activities, which I am a part of, aim to provide education that cultivates academically multilingual students. Students are being instructed by domestic and international expert faculty members in a variety of fields, such as mathematics, physics, chemistry, biology, and earth and planetary science, and by having them engage in activities with many foreign students, we aim to cultivate human resources who can pioneer new research fields. Please look out for WPI's future educational research results.

*Hiroshima University's International Institute for Sustainability with Knotted Chiral Meta Matter (SKCM²) was the first in the Chugoku-Shikoku region to be selected by the first World Premier International Research Center Initiative (WPI). Associate Professor Kotorii is participating in SKCM² as a deputy director and a principal investigator.

A scene from the Miyajima outreach activity — a collaboration event using Japanese traditional decorative knot art *mizuhiki* and knots

Creating World Top-level

Network-type Research Center

Network for Education and Research on Peace and Sustainability (NERPS)

The Network for Education and Research on Peace and Sustainability (NERPS) is a network hub widely open to the world and not exclusively linked to Hiroshima University. NERPS aspires to be an education and research center characterized as follows:
1. A research hub focusing on peace, the global environment, and the Sustainable Development Goals (SDGs) backed by research capabilities of international standards
2. A problem-solving-oriented education and research hub in which researchers in the humanities and social sciences can also participate
3. An education and research hub enabling collaboration by diverse actors, including individuals, NGOs, private businesses, governmental entities, and international organizations

NERPS

The logo symbolizes NERPS's priority focus on SDG 4 "Quality education" and SDG 16 "Peace, justice and strong institutions," while contributing to all of the 17 SDGs.