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Synopsis

This short note offers some reflections on the teaching and learning of mathematics inspired by the news about a feat accomplished by the Austrian mathematician-cyclist Anna Kiesenhofer in the Summer Olympic Games held in Tokyo in 2021.

1. A gold medal in the Olympic cycling road race

The Summer Olympic Games held in Tokyo in July and August of 2021 attracted the attention of the general public all over the world. In Hong Kong the event set off a local craze for sports, especially because the Hong Kong delegation achieved an unprecedented good result with one gold, two silver, and three bronze medals, which aroused excitement for quite a while.

My attention was instead drawn to an Austrian athlete. On July 26 it was reported in the news that Austrian cyclist Anna Kiesenhofer won the gold medal in the Olympic cycling road race. She is a mathematician who works on dynamical systems and symplectic geometry when she is not cycling. Her performance exceeded everyone's expectations and took everybody by surprise, including the other contestants. When the Dutch cyclist Annemiek Van Vleuten crossed the finish line, thinking that she had won the race, she did not realize that Kiesenhofer had reached the finish line before her!

2. What the mathematician Anna Kiesenhofer said

Out of curiosity, I looked for more information about Kiesenhofer's feat on the internet. I found what she said at a press conference displayed a characteristic trait of a mathematician. She regards the competition as a problem-solving

process, like solving a mathematical problem, relying on one's own knowledge (and understanding of one's own abilities). Her development of training plans and on-the-spot tactics do not necessarily follow the opinions and methods of others, including the experts. She dares to be different in taking new approaches to solve a problem. When asked what advice she would give a young cyclist who just started out in the sport, she immediately said:

> "Don't trust authority too much. I started to realise that all those people who say they know, they actually don't know. Many of them don't know, and especially those who say that they know, don't know, because those who do know say that they don't know."

Her remark towards the end can be supplemented by borrowing a bit of wisdom from the Chinese sage Confucius, namely, "When you know a thing, to hold that you know it; and when you do not know a thing, to allow that you do not know it - this is knowledge [知之為知之, 不知為不知, 是知也]." (English translation in [3, *Analects* (論語), *Wizheng II*(為政二), page 151]. (By the way, as an exercise in propositional calculus, show that the two statements about knowing or not and saying that one knows or not made by Anna Kiesenhofer, a mathematician true to her salt, are equivalent as they are contrapositive to each other, while the statement made by Confucius is a conjunction that means another thing.)

3. On the teaching and learning of mathematics

In mathematics it is important to convey this kind of anti-authoritarian attitude to students in the teaching and learning of mathematics. One should not blindly follow authority without thinking on one's own. In mid-June of 2021 a production team of the TV Section of the Hong Kong Education Bureau came to our Department of Mathematics to film a three-minute part of a video in which I offered the following comment:

> "Mathematics makes sense, so it can be comprehended. There is no lack of knowledgeable and thoughtful mathematicians, but there is no so-called authority. Mathematics is not what one single person dominates with the final say. It is not just talking without ground, but arguing based on reason. During the exploration period, you can go wild and let your imagination and

> creativity soar into the sky; once you make an assertion, you must have a basis, never be sloppy, let alone try to muddle through."

The French mathematician André Weil (1906-1998) once said in an address delivered at the Conference of the Indian Mathematical Society held in Trivandrum in April of 1931,

> "Rigour is to the mathematician what morality is to man." [1, page 23].

The Russian mathematician and mathematics educator Igor Fedorovich Sharygin (1937-2004) said,

> "Learning mathematics builds up our virtues, sharpens our sense of justice and our dignity, strengthens our innate honesty and our principles. The life of mathematical society is based on the idea of proof, one of the most highly moral ideas in the world." [4, page 45].

The Chinese official-scholar Xu Guang-qi (1562–1633) of the Ming court, who collaborated with the Italian Jesuit Matteo Ricci (1552–1610) in compiling the translation of the first European mathematical text *Elements* into China in 1607, made the following remark about the book in a preface,

> "The benefit derived from studying this book is many. It can dispel shallowness of those who learn the theory and improve their concentration. It can supply fixed methods for those who apply to practice and kindle their creative thinking. Therefore, everyone in this world should study this book. […] Five categories of personality will not learn from this book*:* those who are impetuous, those who are thoughtless, those who are complacent, those who are envious, and those who are arrogant. Thus to learn from this book one not only strengthens one's intellectual capacity but also builds a moral base [此書為益, 能令學理者祛其浮氣, 練其精心, 學事者資其定法, 發其巧思, 故舉世無一人不當學. …此書有五不可學: 躁心人不可學, 麤心人不可學, 滿心人不可學, 妬心人不可學, 傲心人不可學. 故學此者不止增才, 亦德基也]." [5, Volume 1, pages 76–68].

4. Concluding remark

Mathematics as a school subject should be far removed from an authoritarian shadow by its nature. It is a subject that can be comprehended through one's own independent thinking. It is a great pity, as well as a huge injustice done to the subject, that mathematics is frequently taught in a way which gives pupils a different impression, an incorrectly painted picture as depicted by the American educator Magdalene Lampert:

> "These cultural assumptions are shaped by school experience, in which doing mathematics means following the rules laid down by the teacher; knowing mathematics means remembering and applying the correct rule when the teacher asks a question; and mathematical truth is determined when the answer is ratified by the teacher." [2, page 32].

The accomplishment of Anna Kiesenhofer reveals to us the other side of the story, as well as the truer story.

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