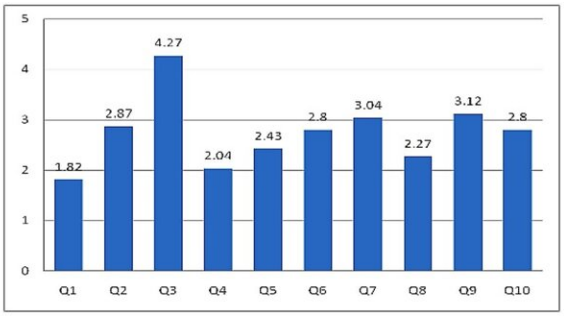
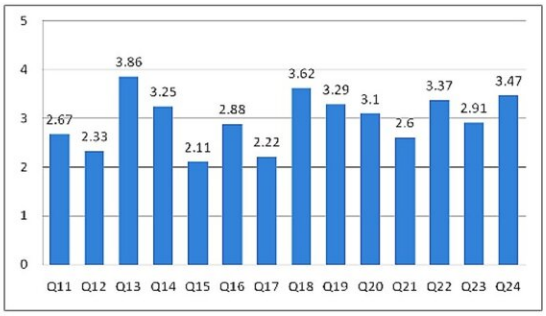
How secondary mathematics teachers' beliefs and knowledge influence their teaching in mainland China

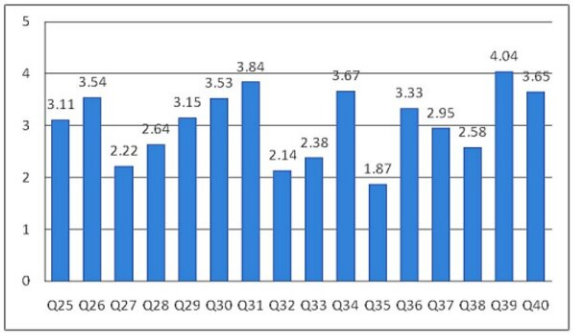
October 4 2023



a. Beliefs about the nature of mathematics (Q1-10)



b. Beliefs about mathematics learning (Q11-24)



c. Beliefs about mathematics teaching (Q25-40)

Descriptive results for teachers' beliefs about mathematics. Credit: *ZDM – Mathematics Education* (2022). DOI: 10.1007/s11858-022-01336-8

Past research on Chinese mathematics teaching has focused mainly on the role of teacher's beliefs and professional knowledge separately in

teaching approaches, or examined three variables—teacher's beliefs, professional knowledge and teaching approaches—in correlational studies. How teaching beliefs and professional knowledge specifically influence teaching approaches remained largely unclear. Also, most studies have focused on pre-service or elementary school teachers in the West. There is a need to know whether these conceptual frameworks can be applied and adapted to the Chinese teaching context at the secondary level.

Dr. Zhang Qiaoping, assistant professor at the Department of Mathematics and Information Technology, The Education University of Hong Kong, conducted a study to help fill this research gap by investigating (1) what kind of mathematical knowledge of functions and beliefs mathematics teachers in secondary schools in mainland China have, and (2) how their professional knowledge and beliefs about mathematics affect their teaching approaches.

Phase 1 of the study was a questionnaire given to 92 mathematics teachers to get a picture of their beliefs about mathematics, along with their subject matter knowledge (SMK) and pedagogical content knowledge (PCK) regarding the concept of functions.

In Phase 2, based on the responses in Phase 1, six teachers were selected from three districts to participate in a case study, which examined the teachers' beliefs about mathematics in terms of their beliefs about the nature of mathematics, mathematics teaching and mathematics learning. The study found that three main beliefs held by the teachers were instrumentalist, Platonist, and problem-solving-oriented. The results are published in the journal *ZDM—Mathematics Education*.

Regarding the nature of mathematics, more than 70% of teachers believed that mathematics is a collection of rules and steps for solving problems. Most teachers believed that learning mathematics was about

both getting answers quickly and understanding why solutions were correct. More than 60% of teachers believed that they should cover all topics in the logical order presented in textbooks, and 70% agreed that teaching activities should be challenging for students.

Teachers with weak PCK lacked variation in their teaching methods, while teachers with stronger PCK used textbooks flexibly according to their students' needs. Their teaching designs were based on practical considerations, and they used many metaphors and analogies to explain concepts.

As for problem-solving, teachers with rich PCK gave counter-examples based on students' mistakes to deepen their overall understanding; and they encouraged students to engage in classroom activities, allowing them to present their ideas and explore new knowledge.

The teachers' professional knowledge scores were relatively high for familiar, everyday teaching questions, but very low on questions about unfamiliar functions.

The study concluded that there is a need to emphasize the integration of teachers' professional knowledge with their mathematical beliefs, and that it is important to know what beliefs teachers hold about both the nature of mathematics and mathematics teaching, and how these beliefs influence their teaching.

More information: Qiaoping Zhang, Understanding Chinese mathematics teaching: how secondary mathematics teachers' beliefs and knowledge influence their teaching in mainland China, *ZDM—Mathematics Education* (2022). DOI: 10.1007/s11858-022-01336-8