Chinese students are renowned for outperforming their peers in international mathematics tests, such as PISA. This excellent academic achievement, however, does not mean that school mathematics teaching and learning is perfect in China. Studies have shown that while Chinese students are very fluent at solving routine mathematics problems, they tend to find non-routine problems more challenging. They are also less likely to take risks and use creative ways to solve problems. Mathematics classroom teaching has also been criticised for being teacher-dominated and exhibiting little student participation. Recent reforms in China’s mathematics curriculum mean that teachers are now being encouraged to concentrate on the learning processes, rather than just the learning results. Yiming Cao, Professor of Mathematics Education at Beijing Normal University, examines how the focus has moved towards facilitating students’ interaction through promoting student engagement and opportunities for classroom discussion.

Professor Cao highlights the importance of interaction within mathematics classroom teaching and lists the main forms of teacher-student interaction within the classroom as: teacher–individual interaction, teacher–group interaction, teacher–class interaction and teacher–led discussion. His analysis of the LPS data found teacher interaction to be the main type of interaction within the maths classroom.

Having established that teacher-student interaction is the key teaching behaviour in the middle school mathematics classroom, Professor Cao and his team of researchers went on to study teacher-student interaction in four middle schools in China, Finland, France and Australia. Videos of the mathematics classes were examined in order to explore the different types of interaction between teachers and students.

The researchers found that the teacher–student interaction in the Chinese classroom was relatively static, and tended to be teacher-dominated. This contrasted with the more dynamic interactions of the Australian and Finnish students. Classroom management was observed to be an important factor of teacher–student interaction in the Australian and Finnish schools, but it was less so in the Chinese classroom where there was less communication and interaction among students.

Professor Cao and his research team have compared and contrasted various aspects of the teaching and learning of mathematics in China with other countries in order to inform teaching and learning practices.

**INTERNATIONAL STUDIES OF TEACHER-STUDENT INTERACTION**

The interaction between teachers and students is of particular interest to Professor Cao. He has carried out video analysis of lessons using the data and methods of the Learner’s Perspective Study (LPS), an international comparative research study of mathematics education. This study examined the national norms of teaching practices via an in-depth analysis of eighth grade mathematics classrooms in Australia, Germany, Japan and the USA. The project later expanded to include China, Sweden, New Zealand, Singapore and the Czech Republic.

**COMPARING CHINESE AND AMERICAN MATHEMATICS LESSONS**

The researchers also explored the mathematical tasks used in mathematics lessons. After examining 30 Chinese and American mathematics lessons, they found that the Chinese lessons contained more mathematics tasks than the American lessons. The Chinese students, however, tended to solve pure mathematics tasks, while the American students spent more time solving ‘real life’ problems.

**TEACHERS’ PERCEPTION OF HIGH-QUALITY TEACHING**

The research team also sought the views of a group of 20 outstanding teachers in China and the USA to elicit their perception of what constitutes high-quality teaching. Comparative analyses revealed that teachers from both countries recognised the significance of both active student participation and the classroom atmosphere influencing the quality of the teaching and learning. Other contributing factors included the choice of teaching methods, teaching and learning objectives, and classroom interaction.

Chinese teachers were found to be more consistent in their understanding of what makes up high-quality classroom teaching than American teachers; but the American teachers’ perception of high-quality classroom teaching was more in line with their curriculum standards than their Chinese counterparts.

**IMPLEMENTING CURRICULUM REFORM IN MATHEMATICS CLASSROOMS**

During the last two decades, curriculum reform has been implemented in China’s schools. One aim is to create more opportunities for classroom interaction, particularly in large classes. In mainland China the average primary school class has 38 students, while the average lower secondary school class has 50 students. These are much larger than other nations and overcrowded classes pose challenges to teachers in their attempts to promote peer interactions and encourage student participation in classroom discussions.

**THE DJP MODEL**

The Longquanyi district of Chengdu city, in mainland China, was the focus of their study. The researchers investigated how educators and teachers have gone about implementing this curriculum reform in mathematics classrooms. They selected one district, the Longquanyi district in Chengdu city, as the focus of their study.

The DJP model promotes the ‘Dao Jing Ping’ instructional model (the official romanisation system for Standard Chinese in mainland China) of three Chinese characters which represent the three main elements of the DJP model. ‘Dao’ means ‘self-study’ where students explore the learning content prior to being taught by the teacher; ‘Jing’ means ‘student–teacher’ with students going to the front of the class to teach their peers and ‘Ping’ means ‘peer-comment’ and refers to students making comments on other students’ answers.

The DJP model aims to develop the students’ learning ability via self-study, student-teach and peer-comment, while still under the guidance of their teacher.

**A student gives a presentation to his peers in an example of peer-led teaching.**

**Students solve mathematical problems on the board.**

**Group work allows students to discuss mathematical concepts.**

**Professor Cao and his international collaborators.**
The implementation of the DJP model by 16 teachers was followed over a two-year period. During this time, 64 classroom videos were made showing how students participated in classroom activities and discussing the teachers’ thoughts on the model’s implementation. The researchers found that the DJP model had a positive effect on increasing student participation with the teachers playing a key role in the process.

Professor Cao notes that this project could have broader applications, informing the teaching and learning community of effective ways to increase student participation and highlighting the vital role played by teachers in the implementation of curriculum reform.

PEDAGOGICAL TENSIONS

The research team observed the emergence of pedagogical tensions from the use of the self-learning guide intended to reform classroom questioning. Professor Cao mentions that prior to the reform, pedagogical tensions came from the imbalance of time allocated to lecturing and classroom discussion, whereas now it’s the imbalance of opportunities for guided and elaborated classroom discussion that create pedagogical tensions. Their examination of the IRF (Initiation – Response – Follow-up) structures of the reform-based mathematics classroom interactions found that students were given sufficient opportunities to present their ideas, which in turn created an imbalance of opportunities for guided and elaborated classroom discussion. The research team’s observation of a sequence of 10 consecutive maths lessons revealed that in some lessons, students’ talk added up to a longer duration than the teacher’s. Individual students were observed to have unequal opportunities to participate in classroom discussions. Nevertheless, this study demonstrated the value of student talk in the classroom and showed that even in a large class almost all students had the opportunity to talk in public.

TEACHER VERBAL FEEDBACK

Teacher verbal feedback also plays an important role in the classroom. Different types of feedback, such as praise and blame, can have positive and negative effects on students’ learning. Professor Cao’s team analysed feedback from 24 junior secondary mathematics teachers in four regions (Shenyang, Beijing, Hangzhou and Chongqing). This study showed that the teacher’s attitude may be culturally dependent. The teacher’s attitude, blame, can have positive and negative effects on students’ learning. Professor Cao’s team analysed feedback from 24 junior secondary mathematics teachers in four regions (Shenyang, Beijing, Hangzhou and Chongqing). This study showed that the teacher’s attitude may be culturally dependent. The teacher’s attitude, blame, may be culturally dependent and encouraging feedback contributes to students’ achievements.

Professor Cao has been investigating mathematics teaching and learning in China for over 30 years. He explores the features and characteristics of mathematics teaching from the perspective of an insider’s viewpoint. This research has produced a data set containing classroom videos, teacher and student interviews and a collection of teaching and learning materials from a number of different regions within China. This rich data enables Professor Cao and his collaborators to provide an overall picture of mathematics teaching and learning in China. Furthermore, while Professor Cao’s investigation takes place in a different cultural setting, it offers some alternative strategies for western educators to encourage student participation within their mathematics classroom.

The teacher’s attitude may be culturally dependent, but thoughtful and encouraging feedback contributes to students’ achievements.

Research Objectives

Professor Cao has dedicated his research to better understanding and improving mathematics teaching and learning in China.

References


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