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Understanding the Outcomes of the China–England Mathematics Teacher Exchange: Observations of a Shanghai Teacher

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Highlights

- This study examines the China–England Mathematics Teacher Exchange program to identify and evaluate the differences in Chinese approach to mathematics education.
- There are numerous differences in terms of national mathematics curricula, organization of mathematics teaching, and evaluation objectives and methods due to different educational and learning cultures.
- China has made great achievements in mathematics education and student academic performance but has much to learn from England.

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In January 2019, Sheffield Hallam University published *Longitudinal Evaluation of the Mathematics Teacher Exchange: China-England Final Report*. Commissioned by the Department for Education (DfE) in England, the systematic and comprehensive report evaluated the outcomes of the Mathematics Teacher Exchange (MTE),[1] a program involving teacher exchanges between England and Shanghai and the implementation of "maths mastery pedagogy." Initiated in 2014, the MTE sought to combine the strengths of English and Chinese mathematics education into a single, "unbeatable" system.

The Sheffield study discusses the background and progress of the MTE program in identifying the differences between English and Chinese approaches to mathematics education. In doing so, the study revealed that the gap between advanced and poor mathematics education in Shanghai and English primary schools is not due to the developments in education, but other factors such as the different approaches adopted by individual teachers in the classroom, choice of assessment methods, and educational and learning cultures. Evaluating these differences provides greater insight into both the MTE and mathematics education in China. Accordingly, this article briefly summarizes a series of evaluation reports on the MTE and examines the literature, media coverage, and experiences of the teachers involved.

The China–England MTE

In the 2010s, England began exploring the mathematics education provided in other countries, making concerted efforts to learn from the teaching practices and materials that had proved effective. England's attention to the teaching practices of other countries continued over the course of the decade. After Shanghai achieved first place in the Programme for International Student Assessment, a global initiative by the Organization for Economic Co-operation and Development, in 2009 and 2012, England focused on Shanghai and began a new round of international education exchange. Frequent communication between England and China in 2013 resulted in an agreement with the Shanghai Municipal Education Commission regarding an exchange program for mathematics teachers, namely, the China–England MTE.

The MTE constitutes an important component of England's "Teaching for Mastery" program and a symbol of learning from East Asia. Three rounds of exchange had occurred by 2018, with more than 600 teachers from Shanghai and England and over 5,000 English schools participating in the exchange (Wang, 2019). The program has been extended to 2023, with plans to cover at least 9,300 primary schools and 1,700 secondary schools. Meanwhile, Shanghai intended to send 70 primary school teachers and 24 secondary school teachers to England for a 2-week English mathematics exchange in 2020 (Mu, 2019).

MTE interim reports and evaluations

The MTE program was formally initiated in 2014, with a total of 60 Shanghai teachers conducting classroom teaching, demonstrations, and seminars in English schools between 2014 and 2015. Commissioned by the DfE, a research team from Sheffield Hallam University released three interim research reports and a longitudinal study evaluating the efficacy of the MTE program.

The first interim report was published in July 2016. Although lacking detail regarding the change in students' academic performance, the report noted that positive changes had taken place in the examined schools since the program's launch, including greater student enthusiasm and confidence in learning mathematics (Boylan et al., 2016). Some of the schools participating in the program also adjusted class schedules, classroom teaching models, mathematics assignments, and the professional training of mathematics teachers.

Published in 2017, the second interim research report sought to capture the impact of the MTE on student attainments in Key Stages (KS) 1 and 2.[2] To achieve this, the research team applied scientific methods to test the quality of the propensity matches at the student and school levels. The report's results further supported the conclusion that the MTE had a positive impact on mathematical learning and that students showed improved attitudes toward the subject (Demark et al., 2017).

The third interim research report was published in October 2017. Many of the teachers who participated in the MTE program indicated that students' progress in mathematical learning had "exceeded expectations," particularly in areas like mathematical language, knowledge, and thinking, as well as in students' participation in classroom activities. Some schools found that the MTE improved students' mathematics performance and academic learning level (Boylan et al., 2017).

Published in January 2019, the *Longitudinal Evaluation of the Mathematics Teacher Exchange: China-England Final Report* provided a more detailed, systematic, and specific explanation of Shanghai's mathematics education, including the influences of Chinese culture and educational beliefs on mathematics learning, the organization of mathematics classroom teaching, unique teaching methods, abundancy of mathematics teaching materials and resources, teacher roles, and teacher professional development (Boylan et al., 2019). Boylan et al. (2019) primarily focused on the schools from the first and second cohorts. Telephonic interviews with and questionnaire surveys of teachers and school leaders revealed that many teachers were affected by the exchange program. Teachers collaborated in planning courses and participated in teaching research groups, thereby improving their professional skills. The report also noted that numerous teaching plans, materials, and exercises had been designed and used for classroom teaching. According to Boylan et al., the mathematical and teaching knowledge of participating teachers improved as a result of the program, as did teachers' professional competencies and abilities to communicate with

students. Participating teachers also showed improved leadership abilities, which impacted or even transformed their schools.

Boylan et al. (2019) also analyzed whether the MTE program had an impact on students' academic performance. In comparison to nonparticipating schools, results showed that the program had a positive impact on the students' mathematics attainment in KS1 in schools directly involved in the MTE program. However, the report provides no quantifiable evidence that the MTE program and the implementation of Shanghai's mathematics teaching method had a positive impact on student achievements in mathematics at KS2 in comparison to other schools. Boylan et al. also note that students' learning results may change with the introduction of different evaluation methods or programs with longer implementation cycles. In this respect, further research and evaluations are necessary to provide evidence for the formulation and improvement of mathematics education policies or reform (Boylan, 2019).

The differences between Chinese and English mathematics education

The interim reports (Boylan et al., 2016, 2017; Demack et al., 2017) and longitudinal study (Boylan et al., 2019), as well as feedback from participants, indicate that there are differences between rather than gaps in English and Chinese mathematics education. Based on the analysis and rationale of the MTE program, this section elaborates on four aspects, namely, the national curricula, organization of mathematics teaching, evaluation purposes, and learning culture.

Differences in national mathematics curricula

Mathematics is just one of the several school subjects. As such, curricular differences mean that the respective starting points of mathematics education in each country vary widely, influencing the comprehension of the MTE program. In September 2013, England's DfE published the latest mathematics curriculum standard, "The National Curriculum in England (Key Stages 1 and 2 Framework document)" (2013), as a sign of curricular reform in England. China has not adjusted its mathematics curriculum standards in recent years, although the Ministry of Education (MOE) of the People's Republic of China issued the "Mathematics curriculum of compulsory education"[3] in 2011. To reveal the differences in primary school mathematics curriculum standards between the two countries, this article compares the Chinese and English primary school mathematics curricula. These differences can be summarized as follows.

First, there are many differences in terms of the nature and objectives of the respective curricula (Shi, 2019). The curriculum standard in England emphasizes students' feelings toward and experiences of mathematics learning, advancing the notion that students need to appreciate the beauty and power of mathematics as a force capable of changing the world (DfE, 2013). In contrast, the

national mathematics curriculum of China focuses on developing basic knowledge and skills, learning methods, and learning attitudes (MOE, 2011).

Second, the difficulty of mathematics learning content also differs between England and China. The English mathematics curriculum is characterized by a gradual and spiral increase in content and difficulty each semester. While the Chinese mathematics curriculum is similar, this spiraling characteristic is less pronounced. Meanwhile, the Chinese curriculum is more difficult, forcing students to concentrate on the more complex content and placing a relatively heavy academic burden on students. Students require more time to learn and complete homework (Shi, 2019). These realities were noted in the final report, with Boylan et al. (2019) pointing out that lack of improvement in English student's KS2 performance may be related to the significant difference in time spent by students in learning mathematics.

Third, schools have different attitudes toward the application of curriculum standards in these two countries. In China, the curriculum standards provide the guidelines for teaching in Shanghai schools, with Chinese schools obeying these curriculum standards and adopting the national curriculum. In contrast, English schools use the curriculum standards to guide curriculum design and planning, with each school enjoying considerable leeway in terms of their mathematics curriculum (Shi, 2019). Indeed, interim reports indicate that not all schools fully adopted mathematical or program training in accordance with the Shanghai model, impacting the evaluation results (Boylan et al., 2016).

Differences in the organization of mathematics teaching

Communication with English and Chinese teachers involved in the program revealed a number of differences in teaching methods. These experiences provide insights into the English classroom teaching method, which comprises collective new teaching, student practice, group guidance, and individual guidance. This approach contrasts with that used in Shanghai classrooms, where teachers follow an "introduction, new teaching, consolidation, practice, feedback, and summary" teaching structure (Cheng, 2018, 221-222).

Several Shanghai-based teachers found English mathematics teaching to suffer from issues like slow progress of teaching, lack of variant training, and insufficient practice in classroom teaching. Nonetheless, numerous Chinese teachers commented positively on English mathematics teaching after participating in the MTE. First, they found that English students had a high degree of interest in mathematics learning. Second, they found that English teachers respect student differences, conduct grade and descriptive evaluations of students' academic performance, and motivate student learning. Third, in observing classroom teaching in England, Chinese teachers were surprised by the degree to which students expressed their learning experiences and opinions freely. In contrast, Chinese students are seldom willing to express themselves in the presence of a teacher

—the Chinese approach replacing students' questioning spirit with mathematical skill. Indeed, although English students are relatively slow in completing mathematical exercises, and the teaching methods are not the simplest and most direct, English students develop sound mathematical thinking through the practice of inquiry and sufficient opportunity and time to participate in classroom learning (Lu, 2016).

Although classroom pedagogy constitutes the main content of what English teachers have learned from China, many schools in England have also tried to integrate Shanghai mathematics methods more broadly. However, many aspects of this implementation remain incomplete and haphazard, with no follow-up or cooperation before and after class. In this respect, while English schools have copied the contours of Chinese teaching, they have been unable to emulate the underlying Chinese cultural attitude toward teaching and learning required to achieve similar outcomes.

Differences in evaluation purposes and methods

By comparing the assessment framework between Shanghai and England, Shi (2020) found that differences exceed assessment objectives, methods, and results and include differences in test paper structure, content, and cognitive field. England has constructed and maintained its own system. After implementing the new national curriculum in 2014, England's DfE implemented the first national mathematics evaluation in 2016 (DfE, 2018). England's evaluation framework is based on the mathematical competencies advanced by the new national curriculum and effectively combines mathematical content with students' cognitive development to form a relatively scientific and effective evaluation system.

Although Shanghai has issued evaluation guidelines, there is no specific plan regarding an evaluation framework or organization. As a result, the test papers vary from one district to another, and even between schools within the same district. Arguably, Shanghai should learn from the large-scale standardized assessment practices of various countries and establish an assessment structure comprising core mathematical knowledge, applications, and reasoning. As Kong (2011) contends, it is necessary to constantly improve teachers' understanding and mathematical competencies—including the skills and abilities required to produce test papers. It is increasingly clear that evaluation should involve students applying mathematical knowledge, problem-solving abilities, and complex thinking (Kong et al., 2015). Essentially, mathematics learning should not only enrich students' mathematical knowledge, but lay the foundation for their future development.

Moreover, in respect to evaluation, England pays more attention to students' ability to solve mathematical problems in real situations than Shanghai. This means that mathematics education should emphasize the solving of situational problems, thereby developing students' understanding

of mathematical tools—an ability integral to recreating mathematics (Xu, 2000). The comparison of English and Chinese test papers revealed that arithmetic is tested in a similar way in both Shanghai and England. However, more than 80% of the exercise problems in the second and third sections of the English test draw on real-life situations, requiring students to apply their mathematical knowledge to real scenarios. In contrast, most of the word problems in Chinese test papers are fictional situations created by teachers and divorced from the reality of students' lives. While mathematics learning and evaluation in China focus on mathematical knowledge, it is necessary to pay more attention to the development of students' mathematical thinking and the competencies involved in solving practical problems (Shi, 2020).

Differences in educational and learning culture

The MTE program involves English teachers learning classroom teaching methods from their Chinese colleagues; however, they often find the Chinese learning culture difficult to learn and replicate. China and England possess different cultures and social systems, resulting in different educational and learning cultures. Indeed, at the beginning of the program, it was pointed out that the high academic performance of Chinese students was influenced by their culture and not just curriculum (Weale, 2014).

Having conducted expansive research on mathematics education in China and England, Fan, Ni, et al. (2018) argue that the mathematics education provided by the two countries differ in terms of curriculum setting and content arrangement. These marked differences are caused by various factors, including social environment, culture, and language. Fan, Xiong, et al. (2018) have also established a comparative framework for the cultural differences between the two countries, determining that cultural factors have a significant impact on mathematics textbooks, which shape overall mathematical education. Similarly, Huang (2016) argues that the differences in English and Chinese mathematics education are rooted in their respective sociocultural traditions.

These differences impact both student learning and the greater society. Certainly, "examination culture" has been the dominant learning culture in China over the past century. Learning is the top priority of students and their families. Chinese students are influenced by Confucian culture, which emphasizes the virtues of hard work and diligence in learning. Accordingly, students are encouraged to focus on all subjects and pursue higher test scores (Rohaidi, 2016). In this regard, mathematics learning prioritizes the acquisition of mathematical knowledge and skills and achieving high scores in examinations and evaluations. This kind of educational and learning culture places significant pressure on Chinese students. In contrast, examinations do not hold such a central position in English learning culture, which focuses on the development of students' abilities and personality while emphasizing the importance of independent thinking. As such, students'

mathematics performance in both countries is largely based on their educational and learning cultures, which are shaped by broader sociocultural dynamics.

Conclusion

Based on the recognition of pedagogical issues, English and Chinese educational experts created the MTE program to encourage the learning of different methods and approaches to mathematics teaching. Many English experts and scholars have begun reflecting on the MTE, noting that the differences between England and China mean that they should use each other as references rather than attempting to replicate their respective learning approaches. Indeed, Boylan et al. (2018) have argued that the "Shanghai model" will not rapidly improve English students' mathematical performance and may take a long time to become embedded in the English education system. It is also necessary that teachers, parents, and general society understand and become familiar with the "Shanghai model" in order for it to be an effective educational approach.

Meanwhile, China continues to produce excellent mathematics teaching models, textbooks, and exercises, demonstrating its success in developing suitable methods and paths in long-term curriculum reform. However, this does not mean that Chinese mathematics education has completely surpassed that of England. While China should be proud of its development and achievements, it cannot overlook existing problems. It is essential to recognize that there is a difference between Shanghai and England, not a gap. In mapping different educational systems and cultures, it is important to have a clear understanding of and reflect upon these differences to enhance Chinese mathematics education and promote the sustainable development of students' mathematical competencies.

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Notes

1. The Mathematics Teacher Exchange is a highly innovative program that aims to foster a radical shift in primary mathematics teaching in England by learning from Shanghai mathematics education—a mastery approach to teaching and learning. The exchange is funded and managed by the Department for Education.

2. In England, Key Stage 1 covers the ages of 5–7 (Years 1 and 2), while Key Stage 2 covers the ages of 7–11 (Years 3–6). In China, Stage 1 covers the ages of 7–8 (Years 1 and 2), Stage 2 covers the ages of 9–10 (Years 3 and 4), while Stage 3 covers the ages of 11–12 (Years 5 and 6).
3. Compulsory education in China is primarily managed by the state-run public education system, which falls under the command of the Ministry of Education. All citizens must attend school for a minimum of 9 years (i.e., 9-year compulsory education). Compulsory education includes 6 years of primary education, typically starting at the age of 6 and finishing at the age of 12, followed by 3 years of junior secondary education (junior middle school).

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