Exploring Joint Reflections in 'Mathematics Teacher Educator - School Mentor-Student Teacher' Triads: A Case Study from the UK and China

Cosette Crisan[1], Bohan Liu[1], Zhongtian Ji[2] and Kan Guo[2]
[1] UCL Institute of Education, [2] Beijing Normal University

Joint reflections on teaching among Mathematics Teacher Educators (MTE), School-based Mentors (SM), and Student-Teachers (ST) are crucial to the development of STs' professional knowledge. The MTE-SM-ST triad is a long-standing structure in place to support the development of STs during their school placements in their teacher education programmes. However, few studies have examined the content and forms of MTE-SM-ST conversations in any school subject, mathematics in particular. While research in mathematics education suggests that learning within and as a result of working in such a triad is complex, there remains a gap in understanding the opportunities that such interactions create for promoting subject-specific professional learning of all involved in a triad. This paper presents how the use of a data mining software to analyse the data collected from post-lesson discussions of two such triads (one from UK and one from China) facilitated an understanding of interactions within MTE-SM-ST triads.

Keywords: mathematics teacher educator; school-based mentor; student teacher; professional learning; post-lesson conversations; de-briefs.

Background and rationale

Internationally and nationally, there is a new emerging interest in those who teach prospective/novice teachers, commonly to as *teacher educators*. In their introduction to the new thematic group of the 12th Congress of European Society for Research in Mathematics Education, TWG27: The Professional Practices, Preparation and Support of Mathematics Teacher Educators, Karsenty et al. (2022) acknowledged that the triad comprising of a student-teacher, a mentor-teacher (or *school teacher educator*), and a university supervisor (or *teacher educator*) was a long-standing structure intended to support the development of prospective teachers. In this international working group, terminology aside, it became apparent that there was a lot to learn about each other and from each other's mentoring practices.

In the study reported in this paper, mathematics educators from University College London (UCL, UK) and Beijing Normal University (BNU, China) are interested in doing just that, namely learning from each other and developing insights into how triad members engage and interact with one another during joint post-lesson discussions. As part of a UCL-funded initiative to support and sustain the development of international collaborative activities, Crisan (UCL) and Guo (BNU) together with their doctoral students Liu (UCL) and Ji (BNU) acting as research assistants in this project, took on the opportunity to examine and learn about the typical patterns of interactions and subject-specific content of the 'MTE-SM-ST' triads' de-brief conversations in our respective teacher education courses.

Post-lesson discussions

A review of international work within education on mentoring of prospective and practising teachers carried out by Brown et al. (2019) highlights a lack of attention given to the orchestration of the discussion of post-lesson conversations, as well as a lack of attention given to the specifics of those de-brief conversations.

In mathematics education, researchers did not seem to 'have placed primary focus on professional learning related to student-teaching triads joint work in planning, enacting, and reflecting on classroom mathematics instruction' (Loyd et al., 2020, p. 500). Besides, Wood and Turner (2015), as cited in the work by Brown et al. (2019) found that the activities of this form of triad were investigated in the context of analysis of student work, rather than that of carrying out a joint lesson observation.

In the cultural circle of East Asia, lesson study is an effective approach to promoting teachers' professional development in a collaborative environment (Takahashi & McDougal, 2016). As for China, knowledgeable individuals (e.g., school teacher educators, teacher educators) along with student-teachers, engage in a series of activities together, including post-lesson debriefing and reflection, followed by feedback and revisions for improvement (Huang et al., 2017).

England

In England, typically, STs spend two-thirds of their one-year Post Graduate Certificate of Education (PGCE) in Secondary mathematics (age 11-18 years) courses in placement schools. At various points in their placement, STs teach lessons that are observed jointly by their school-based mentor (SM) and a university tutor (MTE). Each such observation is usually immediately followed by a post-lesson discussion, which focuses on both the content and the context of the lesson and class taught.

China

In China, mathematics teacher training programmes are called 'Normal courses' embedded in standard university education. They span 3-4 years for undergraduates and 2-3 years for master's degrees, including several months of school placements typically in the final year of each programme. During placement, STs' lessons are more frequently observed by their SM, with post-lesson discussions focusing on subject knowledge, lesson design, and teaching practices. A university tutor (MTE) regularly monitors and discusses the STs' progress.

Methods

Participants

Four MTE-SM-ST triads participated in this study, two from each country. The MTEs were mathematics educators from UCL and BNU, both renowned for their research-informed practices and who volunteered to participate in this study. The SMs were selected for their recognised effective mentoring practices. Their STs were then invited to participate in this study.

The educational settings and student ages in either country are slightly different. All four lessons were taught to Year 7 (11-12 years old in the UK, and 12-13 years old in China) to make them relatively comparable.

Data collection

Data was collected in May 2022 during school visits, face-to-face in the UK and online in China due to the lockdown. First, in each triad, the MTE and the SM observed the ST's lesson. A series of audio-recorded discussions within each triad was collected during the post-lesson discussions. Then, the data was transcribed, and the Chinese transcriptions were translated into English. Other data sources included student teachers' lesson plans, and triad members' notes during and after the meeting were also collected.

Data analysis

Coding

We considered employing frameworks such as the Mathematics Knowledge for Teaching (MKT) framework (Ball et al., 2008) to categorise and describe professional knowledge and skills. Although there is a certain relationship between professional knowledge and practical performance, there also exist certain differences.

How to transform theoretical knowledge into teaching practice is an important issue that teachers need to pay attention to. Since we were interested in subject-specific practices, we finally decided to code the texts by using Coon-Kitt et al.'s codes (2015). By using these codes, we can better understand the real and observable practical behavior of the teachers, and summarise the engagements or the interactions of the triads. Four theme codes were employed, namely MK for mathematical knowledge of individual triad members, IP for instructional practices (such as the ST's use of real-life scenarios and organisation of classroom interactions), SU for student/pupil understandings, and INQ for instances of inquiry correlated with MK, IP, or SU (such as when the MTE inquires about the ST's instructional practice (IP) and student understanding (SU), followed by all three members discussing lesson design and classroom teaching implementations, thereby identifying causes and solutions and promoting a deeper understanding of the particular issue under consideration).

Data mining

We then used a process mining tool, Disco, to analyse data that involved sequences of activities in each triad. Disco uses an algorithm that simplifies complicated process models by highlighting the most frequent events and relationships. Disco software is useful for analysing process data, such as human-to-human interaction and human-to-computer interaction. There are three core types of analysis facilitated by Disco: discovery, conformance, and enhancement (Van der Aalst, 2016). This study will mainly use the first type — discovery, which creates a process model that provides a clear picture of the sequence of events and any concurrent activities.

Results and findings

We counted the number of occurrences (frequency) of each theme initiated by each person in the triad, and results for each of the two cases are shown in Tables 1 and 2.

Table 1
Number of occurrences of each theme by each person in China Case 1

	MK	IP	SU	INQ
MTE	5	29	9	MK1, IP3
SM	6	35	7	MK1, IP4
ST	4	15	4	MK1, IP3, SU1

Note: For example, "MK1, IP3" indicates that the MTE initiated instances of inquiry about mathematical knowledge once, and instances of inquiry about instructional practices three times.

Table 2
Number of occurrences of each theme by each person in UK Case 1

	MK	IP	SU	INQ
MTE	10	16	4	0
SM	4	15	5	MK1, IP4, SU2
ST	2	12	7	0

Apart from the number of these occurrences, we were also interested in the changes during group discussions and the sequence of events. Information about the flow from 'who is talking about what theme' to 'another person talking about another theme' was provided by the Disco diagrams, and the number of occurrences is indicated by the numbers near each flow arrow. This is shown in Figures 1 and 2. For example, in Figure 1, the number "2" below the arrow from SM-IP to SM-MK means that there were 2 occasions from 'the school-based mentor talking about instructional practice' to 'the school-based mentor talking about mathematical knowledge'. This helps us identify the dynamic within the triad discussion.

Figure 1
Disco diagram for China Case 1

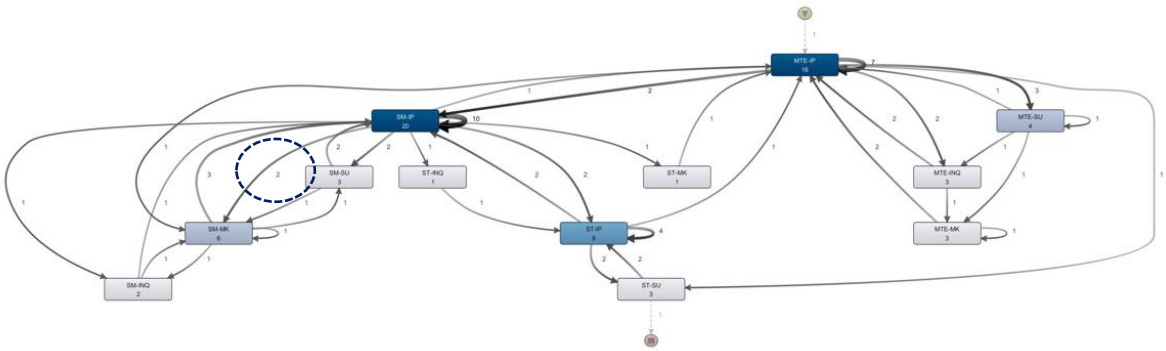
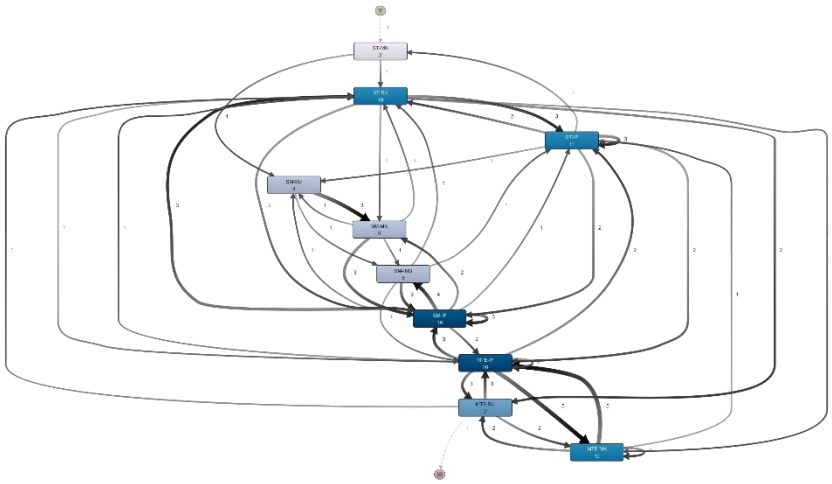


Figure 2
Disco diagram for UK Case 1



From the analysis of Tables 1 and 2, and the Disco diagrams in Figures 1 and 2 of both cases, we noticed some typical patterns of interactions. In China Case 1, although there was some interactive dialogue, the three participants in the triad seemed to form their own talking 'circle'. The triad participants tended to express all their views first, in turn, and then join in the conversation. When all three people took part in the discussion, they tended to mostly discuss the student teachers' instructional practices. There was a clear and well-maintained hierarchy in China Case 1: the conversation flows from MTE to ST, and also between SM to MTE, bi-directional. The interactions between the MTE and the SM were mostly about instructional practices and mathematical knowledge, and their dialogues were intended to model for the ST and give suggestions on how to improve subject knowledge and pedagogy. The ST was usually left at the end to respond to the issues about instructional practices raised by SM and MTE. We suspect that the ST might feel uncomfortable breaking in to ask questions, and there were still problems that were not yet revealed during the observed lessons, nor had they been fully addressed by the ST herself. However, given the encouraging approach of the SM and MTE, we still hope that over time, the ST can become more experienced and mature, and then her increased confidence over time means that she too will initiate and make inquiries herself.

In the UK Case 1, there were more interactions and discussions. Overall, each member of the triad talked about a particular aspect, then invited other triad members to make contributions to the conversation. The triad interactions were mostly about instructional practices, which is similar to the China Case 1. The UK MTE focused more on mathematical knowledge, while the ST seemed to be concerned about the pupils' understanding the most. The SM in the UK Case 1 showed a heightened interest and focus on discussing mathematical knowledge, which is different from the Chinese Case 1 example.

Implications and future actions

Following a detailed analysis of the two cases, we plan to carry out an analysis of all four cases in order to obtain a more comprehensive understanding of the data we collected. The comparative research on the foci and forms of triad conversations in China and UK contexts of teaching and mentoring may contribute to the sharpening

of our understanding of how to best facilitate subject-specific mentor-novice interactions, by identifying distinctive but also familiar interactions, as well as contextual but also universally applicable interactions. More importantly, we plan to collect more data from UK and China to make the conclusion richer and more generalisable.

As future implications of our work, we envisage that teachers could be provided with personalised insights into their educational practice in the form of Disco diagrams, which can then be used for targeted improvement suggestions. Moreover, by collecting multiple practical cases from a single teacher (being either an ST, an SM, or an MTE), one can identify those aspects they prioritise during the interaction process and the teaching or feedback. For instance, STs may focus more on their own mathematical knowledge at the expense of paying attention to their pupils' understanding of the mathematics they teach. This information will then serve as a point of reference for the STs' future professional growth.

References

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, *59*, 389. https://doi.org/10.1177/0022487108324554

Brown, J., Brown, L., Coles, A., & Helliwell, T. (2019). Learning to teach mathematics: The lesson de-brief conversation. In *International Handbook of Mathematics Teacher Education: Volume 2* (pp. 85-108). Brill. https://doi.org/10.1163/9789004418967_004

Coon-Kitt, M. J., Nolan, J. F., Lloyd, G. M., & Romig, G. (2015). Professional Development School Triads Inquiring about Student Work in Elementary Mathematics. *School-University Partnerships*, *8*(2), 33-40.

Huang, R., Fang, Y., & Chen, X. (2017). Chinese lesson study: A deliberate practice, a research methodology, and an improvement science. *International Journal for Lesson and Learning Studies*, *6*(4), 270–282. https://doi.org/10.1108/ijlls-08-2017-0037

Karsenty, R., Zehetmeier, S., Borko, H., Rösken-Winter, B., Coles, A., & Friedrich-Pöhler, B. (2022, February). Introduction to the papers of TWG27: The Professional Practices, Preparation and Support of Mathematics Teacher Educators. In *Twelfth Congress of the European Society for Research in Mathematics Education (CERME12)* (No. 00).

Lloyd, G. M., Rice, C. L., & McCloskey, A. V. (2020). Opportunities for professional learning about mathematics instruction: the role of joint work in student-teaching triads. *Journal of Mathematics Teacher Education*, *23*(5), 499-525. https://doi.org/10.1007/s10857-019-09439-y

Takahashi, A., & McDougal, T. (2016). Collaborative lesson research: Maximizing the impact of lesson study. *ZDM*, *48*(4), 513–526. https://doi.org/10.1007/s11858-015-0752-x

Van der Aalst, W. M. P. (2016). Process Mining: Data Science in Action. Springer. https://doi.org/10.1007/978-3-662-49851-4_1

Wood, M. B., & Turner, E. E. (2015). Bringing the teacher into teacher preparation: Learning from mentor teachers in joint methods activities. *Journal of Mathematics Teacher Education*, *18*, 27-51. https://doi.org/10.1007/s10857-014-9269-4