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# Collaborative lesson research as an effective space for teacher learning and improved student outcomes

Geoff Wake<sup>1</sup> and Marie Joubert<sup>2</sup>

<sup>1</sup>University of Nottingham, Nottingham, United Kingdom; [geoffrey.wake@nottingham.ac.uk](mailto:geoffrey.wake@nottingham.ac.uk)

<sup>2</sup>University of Nottingham, Nottingham, United Kingdom;

*In this article we draw on lessons for collaborative lesson research (CLR) from its effective functioning as part of the design of a large-scale intervention, which aimed to improve student attainment in mathematics. The context of the research is that of post-16 students in England retaking the national examination for 16 year-olds because they failed to attain what is considered a good grade at first sitting. Improvement rates for these students is notoriously low. However, our large scale randomised controlled trial that allowed us to investigate the efficacy of CLR found that this leads to improvements in student outcomes, above and beyond teaching with access to the same accompanying professional development programme and resources. Here we reflect on what we might learn for CLR more generally.*

*Keywords: Lesson study, collaboration, Teaching for Mastery, randomised control trial.*

## Introduction and background

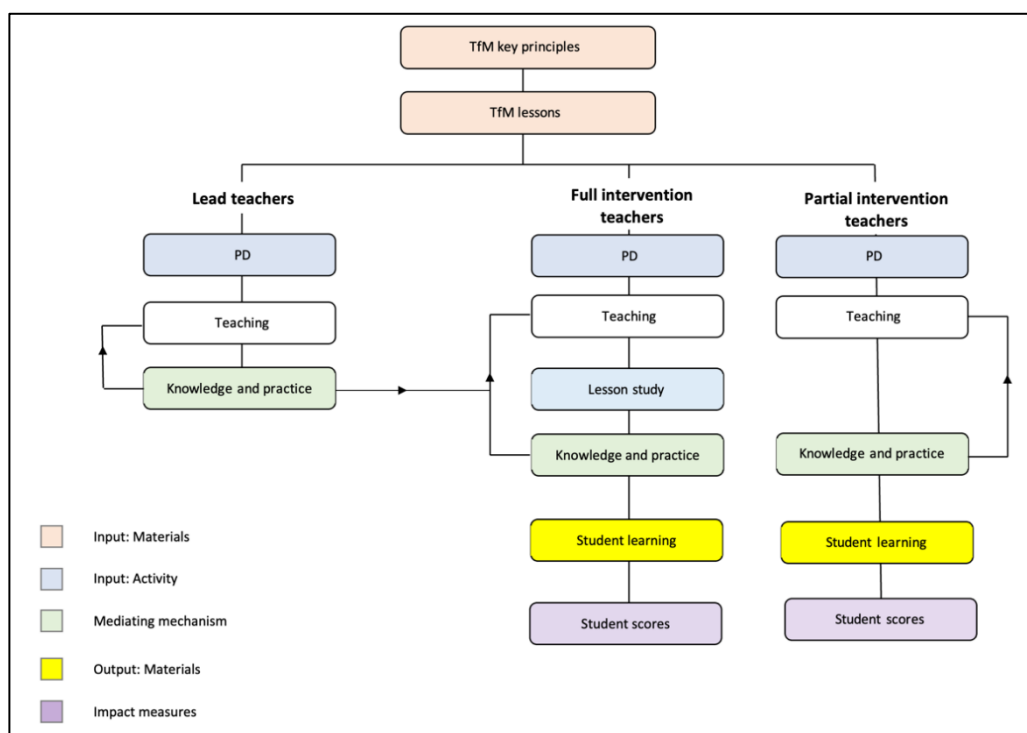
There is little research that provides evidence that Lesson Study or Collaborative Lesson Research (CLR) (Takahasi & McDougal, 2016) is effective (Lewis & Perry, 2017). This paper addresses this issue: we report results from a large-scale randomised controlled trial that suggest that in the form used in a carefully designed intervention with teachers, CLR can lead to changes in teachers' practices in turn leading to improved student attainment in national assessments in mathematics.

In England, all students at age sixteen reach the end of the national curriculum marking the end of compulsory schooling (although the vast majority of students remain in full-time education for at least a further two years). This is marked by national examinations in qualifications known as GCSEs, (General Certificates in Secondary Education). These are graded on a 10-point scale 1 – 9\*, with grade 1 being lowest and grade 4 designated as a pass. Students who remain in full-time education post-16, who failed to attain a grade 4 or above, are required to continue to study mathematics and resit the examination with the aim of (eventually) achieving this. Improvement and success rates in these 'resit courses' are notoriously low (DfE, 2019). Consequently, the government funded a substantial programme of intervention, the Centres for Excellence in Mathematics (CfEM) programme, in Further Education Colleges in which the majority of these students study post-16.

As part of the programme, a large-scale randomised controlled trial (RCT) of a new 'Teaching for Mastery' (TfM) approach was developed and carried out by the Centre for Research in Mathematics Education at the University of Nottingham between September 2021 and June 2022. This was a three-armed RCT: (i) a full-intervention programme that included: well-defined key principles to inform TfM, a suite of carefully designed lessons that exemplified the teaching approach which teachers were required to teach to all their GCSE classes, some online professional development, and a collaborative lesson research element that involved teachers in classroom-based research, led by

‘Lead teachers’, (ii) a partial intervention programme that involved teachers in all of the elements of the full-intervention apart from the collaborative lesson research, and (iii) a business-as-usual group. The RCT research investigated the extent to which the attainment scores of the intervention groups differed from the business-as-usual group. Figure 1 summarises the two intervention arms of the trial.

The hypothesis underpinning the design of the full- and partial-interventions was that the learning and understanding of those teachers participating in the full intervention would be deeper than that of the partial intervention teachers, leading to more effective implementation (which would be evidenced by higher student scores).



**Figure 1: Logic model setting out elements of the three-armed Randomised controlled trial**

Although the research was initially severely affected by the Covid-19 pandemic, it went ahead during the academic year 2021-22 when Covid prevalence and restrictions in educational settings were relatively low. Results are promising in terms of improved student outcomes (Wake et al., 2023). In particular, the results point to teacher collaboration in the form of collaborative lesson research as being the important mechanism in bringing about effective change in teachers’ professional knowledge and practice.

### **Theoretical framing: Designing boundaries and boundary objects**

Star & Griesemer (1989) define a boundary object as a single object that has different meanings in different communities with different intentions, while retaining a common essence. They identify boundary objects or artefacts as inhabiting ‘several intersecting worlds’ and being ‘both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites’ (Star & Griesemer 1989, p. 393). In CLR, we identify, for example, lesson plans as such boundary objects (Wake et al., 2016): they have an important role to play in both the classroom and the CLR group. The lesson plan as research lesson

proposal embodies the professional question(s) of the planning team and “fundamentally encapsulates the values, understandings, beliefs, and intentions of the group” (ibid). It also focuses the discussions of the community in the post-lesson discussion. For the teacher of the research lesson, it acts as a script during the lesson that provides direction for their interactions with students in relation to the mathematics at issue.

To clarify our conceptualisation of what constitutes a “boundary” in this instance, Akkerman & Bakker (2011) suggest that:

“A boundary can be seen as a sociocultural difference leading to discontinuity in action or interaction. Boundaries simultaneously suggest a sameness and continuity in the sense that within discontinuity two or more sites are relevant to one another in a particular way.”

Further to this in their review of boundaries and boundary crossing they make the claim that all learning involves boundaries. They write:

“Whether we speak of learning as the change from novice to expert in a particular domain or as the development from legitimate peripheral participation to being a full member of a particular community (Lave & Wenger, 1991), the boundary of the domain or community is constitutive of what counts as expertise or as central participation. When we consider learning in terms of identity development, a key question is the distinction between what is part of me versus what is not (yet) part of me” (ibid, p. 132).

In this sense, it is therefore the case that participating in collaborative lesson research provides such a boundary with the possibility of facilitating teacher professional learning: the active boundary in this instance is between the activities of the CLR professional teacher learning community and the activities of classroom community with students as learners.

Our design of the intervention for the research trial required our design of boundary objects that would act to facilitate learning at this boundary. Overall, the study was designed to a bespoke Theory of Change, in the sense that Lesson Study (LS) or CLR is used more widely as a change theory: that is, LS is considered as a change mechanism to improve teacher learning in Japan (Takahashi, 2021) or to improve lessons in China (Huang et al., 2017). As part of the CfEM programme the Theory of Change, as encapsulated by Figure 1, identifies that we designed (as boundary objects) five key principles of TfM and seven exemplary lessons. The key principles were determined in collaborative consultation between teachers, maths educators and other stakeholders. These we were exemplified in a Handbook that was made available widely in the sector (see [https://www.et-foundation.co.uk/wp-content/uploads/2020/03/CfEM\\_Mastery\\_Handbook.pdf](https://www.et-foundation.co.uk/wp-content/uploads/2020/03/CfEM_Mastery_Handbook.pdf)). In addition, two Research Questions were developed to support teacher engagement with each of the Research lessons. One of the questions had a pedagogical focus and the other a didactical focus. These were available to teachers in both the full and partial interventions.

Consequently, we identify six important boundary objects or artefacts that underpinned our design of the full intervention: the five TfM key principles, the TfM Handbook, the PD sessions introducing TfM, the seven exemplary TfM lessons, the research questions for TfM lessons and the five instances of research lessons that formed the basis of the modified form of CLR in the full intervention.

## The study

For both intervention groups, the study involved five cycles in which teachers taught a given lesson, often to more than one class. Essential to the full intervention group was participation in a (modified) form of CLR in which groups of teachers met with a Lead Teacher at a ‘cluster meeting’. The Lead Teacher organised and led the CLR, which involved two main components: the observation and research of the research lesson, with one member of the group teaching the lesson; and the planning for the next cycle. Two of the five cluster meetings took place online.

The process that is usually described as CLR was modified in two ways. First, the research team working with a dedicated author planned the lessons, to ensure that the lessons were aligned with the five key principles of TFM, whilst also ensuring that their focus was mathematics that was known to be important for the GCSE examinations. The ‘planning’ phase was effectively replaced with a lesson familiarisation phase in which the CLR groups were introduced, by the Lead Teachers, to the lessons.

Second, whereas in CLR it is usual that teachers pay attention to the research questions or research theme developed and agreed by them or their school, in this project the research team devised the research questions and the teachers did not contribute to developing them.

The trial was evaluated in terms of impact and also implementation and process. Teachers were surveyed before and after the intervention, and case studies of eight teachers in the two intervention groups were developed. The case studies involved observation of the research lessons and cluster meetings and interviews with teachers, Lead Teachers and small groups of students. While the trial was concerned ultimately with the scores of students, for this paper the key interest is whether, and how much, the mediating mechanisms of teachers’ knowledge and practice (see Figure 1) were present and the extent to which they were better represented in the full intervention group.

## Results

In a survey teachers self-reported that participating in the trial had some influence on teacher knowledge and learning, and actual and intended changes in practice. For example, all teachers reported learning about teaching mathematics, student learning of mathematics and student understanding of mathematics through teaching the lessons. Almost all reported that teaching the lessons led them to think more about teaching mathematics. Figure 2 summarises the data.

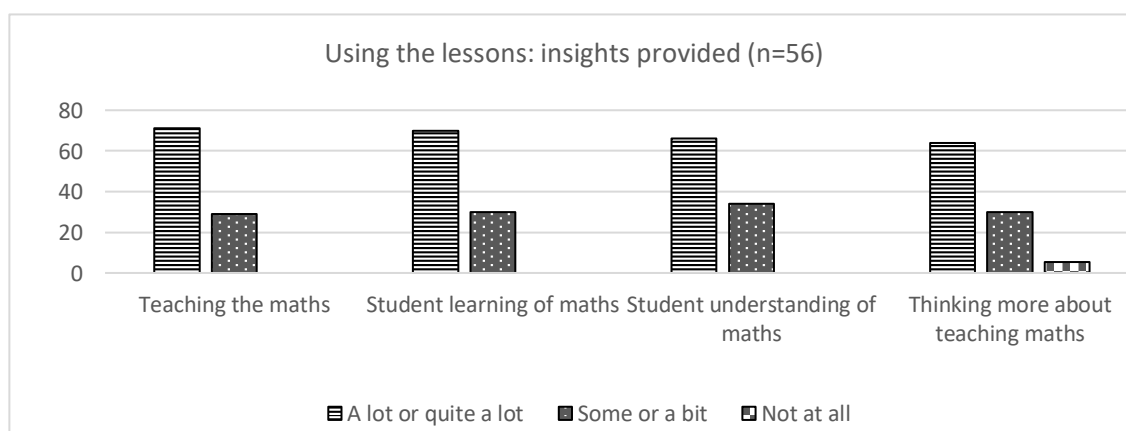
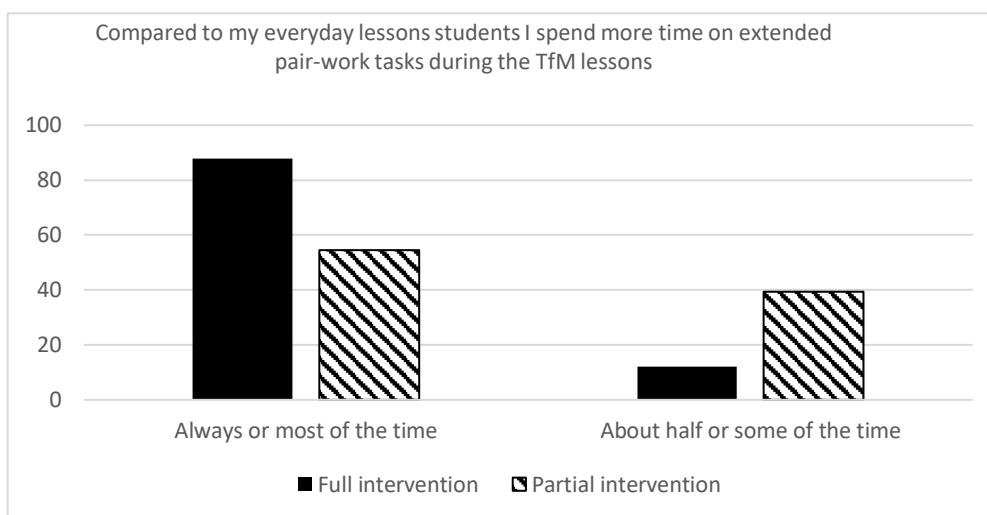


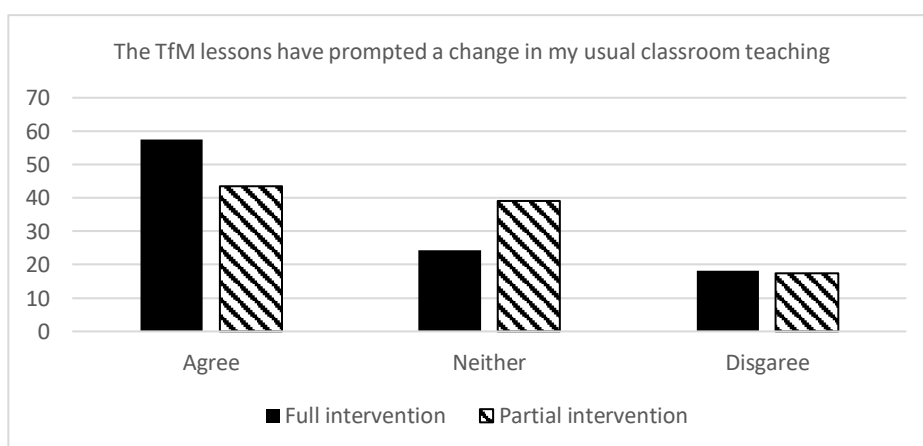
Figure 2: All intervention teachers’ learning from teaching the intervention lessons (post-intervention)

There is evidence that teachers understood how to put the TfM principles into practice. For example, an important characteristic of the TfM lessons is pair work on extended tasks. Teachers appeared to understand the importance of this when they taught the lessons, and as Figure 3 demonstrates, almost all the full-intervention and about half the partial-intervention teachers reported they always or mostly spent more time on these tasks compared to their everyday lessons.



**Figure 3: Teachers' self-report (post-intervention) of time spent on extended pair-work**

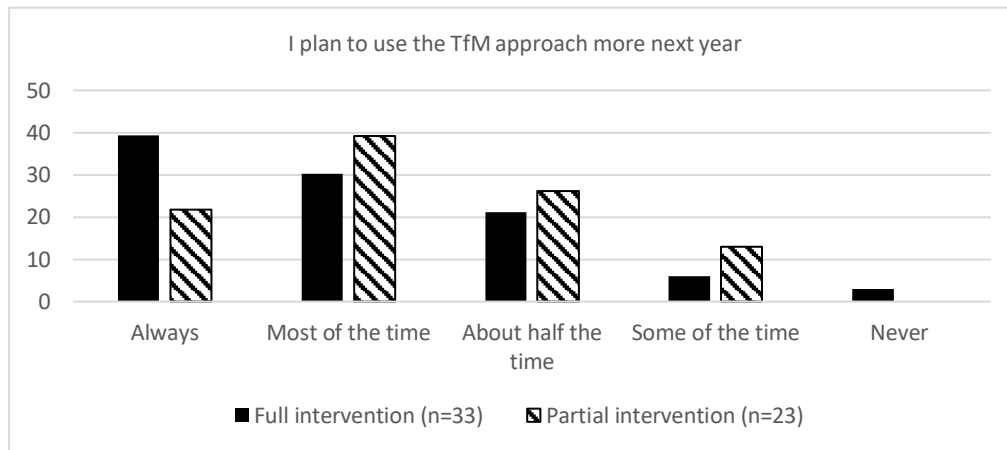
Teachers in both intervention groups report that taking part in the PD intervention programme and teaching the exemplary TfM lessons led to changes in their teaching practice. Teachers were asked to what extent they agreed with a set of statements related to their use of the TfM lessons. As Figure 4 demonstrates, over half the full intervention teachers agreed that the use of the lessons had prompted a change in their practice and just under half the partial intervention teachers agreed. Fewer than 20% of the respondents in each group disagreed.



**Figure 4: Teachers' self-report (post-intervention) of change in their teaching practice**

There is also evidence from the case studies (interviews and observations) that teachers had changed their practice, beyond teaching the lessons, over the course of the intervention. One teacher, for example, explained that he aimed to teach for understanding in an early interview. In a later interview, he reported that "I'm trying to plan all my lessons in line with mastery as best I can." (TT14\_Int 3). He explained that, in his lessons, he began by exploring what the students already knew.

Teachers were asked if they intended to use the TfM approach more in subsequent years. Figure 5 indicates that all teachers, apart from two, plan to use the approach, with almost 40% of full intervention and over 20% of partial intervention teachers intending always to use the approach.



**Figure 5: Teachers' self-report at the end of the intervention of their intentions to change their teaching practice**

The results above provide evidence of teacher learning and changes in practice, but ultimately the concern here is with whether the CLR element of the full intervention is an effective space for teacher learning. Data related to the teachers' experience of the cluster meetings comes from the case studies, which does indeed provide evidence of high levels of teacher engagement and learning.

For example, case study teachers reported in interviews on what they gained from the observation of the research lesson and the post-lesson discussion. One, for example, explained:

What I love about taking part in discussions like that, with practitioners from different colleges, because you are like-minded people but it's also great to hear other people's opinions and views as well. And whilst you're all in this same classroom and other people notice things that you actually don't notice and it's great to share that because as a teacher as well in your own classroom without realising it, you're missing out on what maybe light bulb moments a student has or connections that they're making. (IPE\_casestudy\_TT149\_Int2\_131221)

In the part of the cluster meetings where Lead Teachers introduced the lesson for the next cycle, teachers were also usually fully involved, although (unsurprisingly) more so in the face-to-face meetings. For example, Lead Teachers typically asked teachers in their CLR group to take the role of students when working through the main student task, and generally the researchers observed that the teachers took on this role with enthusiasm.

Interviews with the case study teachers confirmed that the teachers found these activities useful. One, for example, reflected:

I think being able to do the tasks yourself is really important and so many times we design tasks and then we might have an answer key, but we haven't actually been the student, so I think that's really important. And doing that with someone else as well. Someone who's completely different

to you and teaches differently than you do just throws up ideas and possible points of conflict that their students might have that you hadn't thought about. (IPE\_casestudy\_TT157\_Int2\_141221).

Finally, we briefly report the impact on student attainment outcomes. Both the partial and full interventions had an effect in terms of the primary outcome measure of the intervention, that is the student exam scores. Measured against a business-as-usual arm of the trial, the full-intervention had a slightly greater impact (effect size of 0.06 equating to 1 additional learning month<sup>1</sup>), but most interestingly it impacted most on those students coming from the most deprived backgrounds (effect size of 0.12 equating to 2 additional learning months). Given, that these students tend to make up a disproportionate number (approaching 50% using one measure) of low-attaining students in terms of social class, this is a significant outcome (if not in the statistical sense of significance).

## Discussion and conclusion

In summary, although complex in design, our research trials lead us to conclude that in both full and partial interventions our design intentions were implemented with fidelity and teachers self-report their alignment with TfM and their intention to use the approach in their future teaching. Although lower than required for statistical significance we do detect improved attainment outcomes: to a greater degree for students taught by teachers in the full intervention than those in the partial intervention. The greatest impact was for full intervention students from the most deprived backgrounds, equivalent to an average learning gain of 2 months.

The (deliberate) design of the RCT has allowed us to expose CLR/LS as the major factor that 'makes a difference'. Only five of the six designed boundary objects were available to the teachers in the partial intervention: the five key principles of TfM, the TfM Handbook, the PD sessions introducing TfM, the seven TfM lessons and the research questions accompanying these lessons. Our study points to the additional boundary object, TfM *research lessons*, as being important in ultimately leading to students' improved attainment outcomes. It can be concluded that the boundary crossing activity that is central to the CLR process provides opportunities for teachers to work collaboratively with colleagues across colleges to implement TfM most effectively in their classrooms. This opportunity for teachers to learn collaboratively to more deeply and effectively engage with their students appears to lead to enhanced professional learning.

Our reflections at this stage suggest that, when attempting to bring about a change in teachers' classroom practices, we should attend carefully to the design of tools/devices/artefacts considered as boundary objects to facilitate teacher learning. At a more general level than the case of the specific intervention here we point to how consideration should be given to:

- (i) Clarifying a vision of the intended desired teaching practice (here the TfM key principles and handbook)
- (ii) Exemplifying what this practice looks like by providing carefully scripted and explained lesson plans

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<sup>1</sup> In the U.K. the Education Endowment Foundation, who fund the majority of RCT research, usually report effect sizes in terms of 'additional months progress', allowing comparison with students who did not experience the intervention.



- (iii) Providing opportunity for teachers to engage in cycles of collaborative lesson research.

It is our contention that each of these factors needs to be present for maximum potential for successful implementation of programmes that seek to bring about change in teachers' practice.

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