School Mathematics Leaders' Support of Primary Teachers' Professional Learning in Meetings

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School Mathematics Leaders seek to improve the mathematical learning outcomes of the students in their schools. Recognising that improved learning is dependent on high quality teaching, leaders are often keen to support teachers' knowledge of mathematics content and pedagogy. This paper reports ways in which School Mathematics Leaders support and lead the professional development of teachers in team meetings. Results from survey data and case study research are reported in this paper to describe and highlight the supportive actions undertaken by School Mathematics Leaders as they provide professional learning opportunities for teachers.

Research findings related to the work of primary school leaders of mathematics are scant. Understanding the nature of the work and how to maximize its positive impact is an emerging field. This paper is based on a recent study conducted in Victoria, Australia (Driscoll, 2021). The purpose of the study was to investigate ways in which School Mathematics Leaders in primary schools supported the professional learning of the teachers in their teams.

Like in other parts of the world, there are various titles and responsibilities given to leaders of mathematics in Australia (Clarke et al., 2013; Driscoll, 2017). Here we will use the name *School Mathematics Leader* to mean a teacher working in a primary school who has responsibilities for leading other teachers in that school to improve the teaching and learning of mathematics. The School Mathematics Leader often acts as an *agent of change* (Fullan, 1993) with fellow teachers who need support and encouragement to improve the mathematical outcomes of their students. Little has been written about the nature of the support leaders offer teachers to encourage professional learning. The research question that this paper addressed was:

> *How do School Mathematics Leaders support primary teachers' professional learning in the context of meetings?*

Background

The importance of effective leadership of mathematics in schools has been noted (Cheeseman & Clarke, 2005, 2006; Sexton & Downton, 2014; Sexton & Lamb, 2017). Through their supportive actions School Mathematics Leaders make a difference to the learning of others, including teachers and their students, as they share ideas and insights about effective teaching of mathematics (Faragher & Clarke, 2014; Gaffney et al., 2014). As critical educators in improving mathematics teaching and learning School Mathematics Leaders provide a link between the principal and classroom teachers and possibly "have the greatest impact on teacher learning and development" (Grootenboer et al., 2015, p. 278).

Teacher Learning

Researchers such as Clarke and Hollingsworth (2002) have described models of professional development initiators. Similarly, Goldsmith, Doerr and Lewis (2014) provided important information in relation to the need for teachers to continue to develop their knowledge and skills in teaching. The ways in which practicing teachers continue to learn and develop the knowledge that enables them to teach well are complex. While it could be assumed that "teachers who know more teach better" (Cochran-Smith & Lytle, 1999, p. 249), knowing

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exactly what it is that teachers need to know and how they will learn this knowledge has been the subject of much research. A focus by researchers and educators at all levels is to try and understand the best ways for teachers to "learn to develop and refine their practice" (Hollingsworth & Clarke, 2017, p. 458). According to Kim et al. (2019) developing the ability to analyse, interpret and understand students' mathematical thinking through various means supports teachers to acquire necessary pedagogical content knowledge.

While a number of researchers have emphasised "active learning [that] requires opportunities to link previous knowledge with new understandings" (Cochran-Smith & Lytle, 1999, p. 258) through a process of change (Bransford et al., 2000; Clarke & Hollingsworth, 2002). Learners bring prior knowledge and experience to learning situations and create new concepts by constructing links to their existing knowledge (National Academies of Sciences, Engineering, and Medicine, 2018), rather than being told information by others (Cochran-Smith & Lytle, 1999). Research also suggests that learning "takes place over time rather than in isolated moments" (Cochran-Smith & Lytle, 1999, p. 258) and needs to be situated in meaningful and relevant contexts (Bransford et al., 2000); which are likely to be school-based, collaborative and continuous, and aimed at student learning (e.g., Hiebert et al., 2002).

Learning Communities

Developing communities of practice creates opportunities for teacher collaboration where teachers participate in shared experiences and discourse around student data and learning (Bransford et al., 2000). According to Lave and Wenger (1991), learning occurs through participation in a community of practice, where newcomers are transformed into old-timers, whose changing knowledge and skills became part of a developing identity, and in turn they became a member of a community of practice. The literature emphasises the benefits of working together collectively in professional learning communities and the impact it can have on student and teacher learning (DuFour et al., 2010). According to Cobb and Jackson (2015), teacher collaboration provides significant learning opportunities for professional learning. Teams of teachers gather evidence of student learning, discuss teaching strategies, then implement these ideas and analyse their effectiveness (Darling-Hammond & Ball, 1998). Fullan and Hargreaves (2016) believe that success in schools is achieved through the establishment of a culture where teachers work collaboratively and grow and learn on a daily basis through feedback and joint work, by engaging in pedagogy, and developing mutual trust.

Theoretical Framework

The theoretical lens used to frame the research incorporated leadership (Fullan, 2001, 2020) and teacher learning (Lave & Wenger, 1991). In particular, Fullan's *Knowledge Creation and Sharing*, *Relationship Building*, and *Coherence Making* components of his leadership framework applied to the study of School Mathematics Leaders, and the ways they supported teachers to learn. Components of the leadership framework were used to guide the data analysis and discussion of the findings. Lave and Wenger's (1991) idea of *communities of practice* as a context for learning, also framed observations in schools. Investigating School Mathematics Leaders' creation of learning opportunities allowed these theoretical constructs to be compared to evidence from practice. The broad theoretical underpinning in this research is a socio-constructivist view of learning which holds that meaning is made by the learner building new knowledge on existing knowledge in a social setting (von Glasersfeld, 1987).

Methods

The research reported here is part of a larger study (Driscoll, 2021). The data examined in this paper are three observations of each of four School Mathematics Leaders as they worked

with teachers during planning or Year level team meetings (12 meetings in total). In addition, following each meeting an interview was conducted in the workplace with each School Mathematics Leader (12 interviews). Video recordings were made of the observed team mathematics meetings, audio recordings were made of the researcher's interviews with each leader, and leaders' written reflections of events they considered significant were collected. In these ways the events were documented, and participants' views of the events were recorded. The data were collected and analysed by the first author whose perspective as a researcher and as an experienced School Mathematics Leader enabled a subtle interpretation of the evidence. Data were compiled, disassembled, reassembled, and interpreted, and conclusions were drawn to address the research question (Yin, 2016). Individual case studies were assembled, and a cross-case analysis was conducted to find similarities and differences in the ways that each School Mathematics Leader supported teachers' professional learning in their schools. The findings here describe how School Mathematics Leaders support teachers' professional learning in meetings.

Results and Discussion

Meetings took two different forms in the four schools reported here. Planning meetings and professional learning team meetings often comprised teams of teachers from different year levels attending, depending on the context. Planning meetings provided the opportunity for a team of teachers to meet and discuss, decide on, and record, a sequence of mathematical learning experiences teachers planned to teach the following week. Whereas, Professional Learning Team meetings were focused more on "big picture" data, where teachers engaged in the analysis of student work samples, discussed data and planned and evaluated assessment tasks. Despite the differences in aims and organisation of these meetings, the leaders' supportive actions had characteristics in common. The data in Table 1 is listed to describe School Mathematics Leaders' actions without making a formal distinction between the meeting types. The term collegial team meetings will be used to encompass both meeting types.

Table 1
Team Meetings: School Mathematics Leaders' Actions (n = 4)

School Mathematics Leaders' Actions	*S	J	A	R
Built mathematical pedagogical content knowledge	✓	✓	✓	✓
Focused discussion on students' mathematics learning	✓	✓	✓	✓
Developed mathematics knowledge and understanding of the curriculum	✓	✓	✓	✓
Stimulated teachers to select high quality tasks, representations, and materials	✓	✓	✓	✓
Encouraged teachers to contribute ideas to planning	✓	✓	✓	
Guided teachers with suggestions of possible lesson sequences	✓	✓	✓	
Highlighted important ideas and connections between concepts	✓	✓	✓	✓
Encouraged teachers to reflect on, and evaluate, possible lesson ideas	✓	✓	✓	
Provided teaching and learning documents and teacher reference books		✓	✓	
Challenged teachers' ideas while supporting them to learn		✓		
Analysed and discussed assessment tasks during moderation	✓	✓	✓	✓
Suggested mathematics professional reading	✓	✓	✓	✓
Created and refined a range of whole school 'rich' assessment tasks				✓
Attempted to hold back from telling teachers	✓	✓		✓

* S = Susan, J = Jane, A = Amy, R = Robyn (all pseudonyms)

Table 1 shows that the School Mathematics Leaders (n = 4) supported teachers by sharing aspects of their mathematical pedagogical content knowledge with members of the team; encouraged teacher discourse related to student learning of mathematics; and initiated opportunities for teachers to develop their content and curriculum knowledge during collegial meetings. The School Mathematics Leaders encouraged teachers to select possible tasks and suitable representations and materials as they designed activities. Three School Mathematics Leaders encouraged teachers to contribute their ideas to mathematics planning and guided them to make decisions about sequencing learning steps during the implementation of tasks. The results also revealed that the during these meetings all four School Mathematics Leaders highlighted important mathematical ideas and helped teachers to make connections between mathematical concepts. All four School Mathematics Leaders also spent time supporting teachers in their analysis of salient mathematical content knowledge during moderation of assessment tasks and suggested mathematics professional readings. The actions described in Table 1 were intended to support teachers to build their mathematics knowledge for teaching.

Although many of the actions exhibited by the School Mathematics Leaders in this study were specific to their school context, it became clear that there were commonalities across the cases between the ways in which these leaders supported teachers to learn. Limitations of this paper permit discussion of the first five categories only. An example of the nature of support provided by the School Mathematics Leaders are included, along with a final finding common to all four School Mathematics Leaders.

Built Mathematical Pedagogical Content Knowledge

It was clear that the majority of supportive actions displayed by the School Mathematics Leaders in this study during meetings focused on developing teachers' mathematical knowledge for teaching. Each of the School Mathematics Leaders at some stage shared elements of their mathematical pedagogical content knowledge with teachers in these collegial meetings. For example, during a team meeting as teachers discussed teaching a lesson on the topic of length, one School Mathematics Leader pointed out the advantages of using an open-ended measurement task and said, "I think you should open the lesson up. You've probably got kids who could use a ruler," which indicated that students needed to be provided with more flexibility and challenge in tasks. School Mathematics Leaders who share the depth and breadth of their mathematical knowledge for teaching with others have the potential to support teachers to learn and improve their mathematics teaching (Ma, 1999). In fact, the same School Mathematics Leader when discussing how she promoted the use of challenging tasks at her school, during an interview, pointed out that, "I sort of [felt] like that was my thing to do." During an observation of a meeting, it was obvious that this School Mathematics Leader believed this was part of her mathematics leadership role, as she encouraged teachers to use more challenging problems structured by a "Launch, Explore, Summarise" model and as a result she provided resources to support this approach.

Focused Discussion on Students' Mathematics Learning

During collegial meetings all four School Mathematics Leaders encouraged teacher discourse related to student learning as they reviewed student assessment and data. The teachers were supported to develop data literacy in the context of formal assessment as they discussed student work samples and responses. There were occasions, when teams of teachers worked with the School Mathematics Leaders to moderate assessment tasks and reflect on elements of their teaching, which "is critical for professional development" (Kim et al., 2019). For example, one Year 3/4 team used an assessment task called Packing Pots from *Scaffolding Numeracy in the Middle Years* (DET, 2018), to discuss student responses and strategies for

solving multiplicative situations. Discourse around student learning was encouraged as teachers worked in "a collaborative and collective effort" (DuFour et al., 2010, p. 14) to inform their professional practice. In another school, a team of teachers led by the School Mathematics Leader, created, evaluated, and refined a range of whole school 'rich' assessment tasks. This team of teachers discussed and created the assessment tasks based on the effective teaching and learning of mathematics, then decided on the direction to take with planning, and the suitability of possible follow-up lessons based on their knowledge of curriculum and student needs (Du Four et al., 2010, Timperley, 2008). Structured opportunities that encouraged discourse during meetings, allowed teachers "to share and reflect on each other's practice [which] are all facets of the change environment that act to afford or constrain teacher growth" (Clarke & Hollingsworth, 2002, p. 955). Such opportunities cannot be underestimated.

Developed Mathematics Knowledge and Understanding of the Curriculum

While planning mathematics lessons can be challenging, particularly as the level of teachers' mathematical content knowledge for teaching (Ball et al., 2008) varies, planning in collaborative teams offers many advantages, as it allows School Mathematics Leaders to have more impact across groups of teachers. Supportive actions by the School Mathematics Leaders included encouraging discussion of content and curriculum as teachers planned and evaluated lessons and discussed elements of their practice. One School Mathematics Leader supported teachers at her school by providing them with a detailed curriculum document, that teachers used to inform their planning. This document included a scope and sequence chart linked to curriculum documents, central concepts, common misconceptions, and valuable resources for teaching. There were also regular professional learning community meetings at this school where teachers met and discussed readings related to mathematics content and curriculum. In one case, led by the School Mathematics Leader, teachers debated a reading that emphasised the teaching of mathematics content and its connection to the four proficiencies. While two other School Mathematics Leaders developed documents with teams of teachers at their schools to support teacher content knowledge that outlined the "essential understandings", or the priority areas of the mathematics curriculum. The teachers collectively agreed on the priority areas that needed to be taught, which in the long term supported the development of teachers' knowledge of mathematical content and the intended curriculum.

Stimulated Teachers to Select High Quality Tasks, Representations, and Materials

Results indicated making decisions in relation to the most suitable tasks, representations, materials, and possible lesson sequences to include when planning mathematics, was a constant dilemma for some teachers. Judging from the observations, this was a particular area where the actions of the School Mathematics Leaders influenced teacher learning. For example, teachers in one Foundation team meeting debated for a considerable amount of time the possible tasks and tools to use as they planned a sequence of lessons on measuring length. As the School Mathematics Leader attempted to guide teachers with their choice of task, she questioned the team, and encouraged them to reflect on their prior experiences when teaching the topic. In the end, it was necessary for this School Mathematics Leader to step in and support the teachers to extend their knowledge and thinking. This point was evident in the following comments made by the School Mathematics Leader during a planning meeting:

> Well, the problem is that they have got to be measuring something or comparing different things to say which is longer. It's just that some of them [children] need to able to just hold them [pencils], and go that one, and others you want them to be justifying it [and] measuring it.

> The other thing is you can't say matchsticks because some aren't ready. So, if you think about that. What's your core task so the kids who are ready can do it that way, but the kids who aren't can be doing direct comparisons and going this is longer than this. [She demonstrates using a pen and phone]

There was a constant struggle within the team as they tried to decide on and select the most appropriate tasks and materials, as well as the most effective lesson sequence. Deep discussions created opportunities for teachers to make informed decisions, by reflecting, noticing, anticipating, and negotiating changes, allowing teachers to expand their knowledge related to the complexity of teaching (Kim et al., 2019). As part of their work in collegial meetings, all four School Mathematics Leaders also supported teachers to understand the important mathematical ideas and to make connections between underpinning concepts.

Encouraged Teachers to Contribute Ideas to Planning

There was also evidence that three of the four School Mathematics Leaders prompted and pressed teachers to contribute their ideas to the documentation of teaching plans. While in some cases, limited mathematics content knowledge caused a degree of reluctance by the teachers to contribute to planning, it could also have been that teachers possibly lacked confidence or were worried "about admitting they [did not] know or understand for fear of colleagues' reactions" (Bransford et al., 2000, p. 195). Alternatively, teachers may also have felt that they did not need to contribute when the area team leader and the School Mathematics Leader dominated the discussion, which occurred in one school. There were occasions when two of the School Mathematics Leaders described their struggle between knowing when to prompt teachers, in contrast to telling teachers what to do. One School Mathematics Leader expressed her dilemma in this way:

> At the start, when I worked with them, I'd let them go more, and I'd say, what about this, I'd throw in a suggestion. I wouldn't shoot things down straight away; I'd let them go with things that I probably wouldn't have normally gone for. And then pose that question the week after, how did it go? Okay, but what about you try this? I've been very wary. I've worked with leaders in the past and they would just say, "No, you're not doing it!" and I don't think anyone learns from that. I think that they do need to learn if something's not going to go well, that's fine, because that's reality, and let them go with that, and then maybe after that provide the solution. But then the flipside of that is that some teams will be a little bit too reliant, they will just say, what do you think, or what can we do? They're not willing to go out on that limb. So, it's finding that balance.

Support from a more knowledgeable experienced other, such as a School Mathematics Leader, during these meetings provided a potentially powerful opportunity to improve teacher learning, but as this quote demonstrates, it is about finding the balance prompting and telling.

School Mathematics Leaders Actions in Fostering Opportunities for Team Collaboration and Collegial Support

Examination of the practices and actions displayed by the School Mathematics Leaders during collegial meetings led to a further finding of significance. While the School Mathematics Leaders contributed towards improving teacher practice as they designed, facilitated, attended and advocated for collegial meetings, each School Mathematics Leader established processes and protocols for working with teams of teachers. It was also clear that all four School Mathematics Leaders took steps to develop constructive working relationships with teachers in their schools as they built relational trust, respect and commitment (Goleman, 2000). Developing constructive relationships and relational trust with colleagues is critical to leading mathematics successfully (Fullan, 2001).

Finally, the aim of the study was to understand in detail the ways in which School Mathematics Leaders supported teachers to learn in the context of meetings. While the structure, frequency and effectiveness of each meeting differed according to school context, it

was possible to examine and gain insight into the types of actions and interactions that fostered teacher learning, and that potentially led to improved teacher practice. Although each of the categories discussed were treated separately, for the purposes of this paper, it was obvious that all categories were intertwined and connected.

Interestingly, Vale et al. (2021) found that the most frequent activity School Mathematics Leaders participated in was mathematics team planning. Despite all four School Mathematics Leaders advocating for team planning to occur, time and structures were not in place in two of the schools that participated in the study to allow teams to meet for planning, even though Professional Learning Team meetings were mandatory. This situation is reflected in Table 1 where fewer actions were displayed by two of the School Mathematics Leaders. However, all meetings observed were focused on collective responsibility, linked directly to student learning, and created meaningful opportunities for teachers to learn, while working towards *coherence making* (Fullan, 2001, 2020) in a *community of practice* (Lave & Wenger, 1991).

Conclusion

Implications for school wide improvement in mathematics arose from the study. School Mathematics Leaders who have the opportunity to meet, plan and discuss learning in collegial teams are able to: work with teachers to link decisions to their core purpose of improving mathematics; develop teachers' mathematical knowledge for teaching; and create opportunities for relationship building in professional learning communities. The supportive actions undertaken by the School Mathematics Leaders as they worked to provide professional learning opportunities for teachers in focused team meetings encouraged teachers to build their pedagogical content knowledge, fostered discourse related to student learning, and developed a shared understanding of effective mathematics teaching practice. The support provided by School Mathematics Leaders for teachers' ongoing professional learning is critical, as it has the potential to improve the mathematical outcomes of students.

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