

Primary School Mathematics Leaders' Actions that Facilitate Effective Mathematics Planning and Support Teachers' Professional Learning

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All teachers of mathematics aim to provide productive learning experiences that cater for students in their care. The planning of effective and engaging mathematics lessons is complex and requires expertise. In a larger study survey data, observations and interviews were used to investigate the ways in which School Mathematics Leaders supported teachers to learn. This paper reports results from case study research and focuses on the actions of one School Mathematics Leader during planning meetings. Findings highlight a range of supportive actions, which included developing constructive working relationships with teachers, fostering knowledge of mathematical content and curriculum and facilitating collaborative team planning.

Prior to teaching mathematics, teachers need to have given some thought to, and ideally planned in detail, the lessons they are about to teach. Planning decisions made by teachers, whether working in isolation or in teams, involve deciding what it is they are hoping to achieve with careful thought given to the curriculum, suitable tasks, the possible pedagogy, differentiation and the use of assessment data (Davidson, 2017). Earlier studies have suggested the importance of a School Mathematics Leader in supporting teachers to plan (Clarke et al., 2012a; Davidson, 2017, 2019; Sexton & Lamb, 2017). This paper aims to document the actions of School Mathematics Leaders as they support teachers' mathematics planning.

For the purposes of this paper, one case study has been chosen from a larger study of mathematics leadership (Driscoll, 2021), where primary School Mathematics Leaders were observed working with groups of teachers in their school settings. According to Vale et al. (2021), "few studies have reported what leaders of mathematics in schools actually do" (p. 401). The evidence provided here will address a gap in the research. The research question addressed in this paper is:

How do primary School Mathematics Leaders support teachers' mathematics planning?

Literature Review

It is an expectation in Australian schools that teachers of mathematics will plan lessons based on the curriculum, before they actually teach (Davidson, 2019; Sullivan et al., 2012). Planning plays a critical role in teacher practice. According to the Australian Professional Standards for Teachers (Australian Institute of Teaching and School Leadership [AITSL], 2017) Standard 2.3 Curriculum, assessment and reporting, teachers are expected to "use curriculum, assessment and reporting knowledge to design learning sequences and lesson plans" (p. 12). It is difficult to imagine how teachers can teach mathematics effectively without substantial planning (Roche et al., 2014). However, while curriculum is important, it is also critical that teachers consider experiences and approaches that are student-centred (Davidson, 2019; Vale et al., 2010) and that take into account appropriate challenge, student commitment, confidence, and understanding (Hattie, 2012).

Previous studies (e.g., Davidson, 2017, 2019; Roche et al., 2014) have focused on teachers' planning of mathematics lessons. According to Clarke et al. (2012a, 2012b), when planning mathematics lessons, teachers will draw on: their own knowledge and experiences, resources and influences that include curriculum documents, commercial publications, web-based resources, information about students based on assessments, and experienced colleagues. It is

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also reasonable to assume that teachers' mathematical knowledge for teaching is important when it comes to the decisions teachers make when planning (Davidson, 2017, 2019). Teachers need to "know their mathematics and know how to teach it" (Gaffney, Clarke et al., 2014, p. 4). Teachers also need to understand the most important mathematical ideas on which to focus (Clarke et al., 2012b).

Interestingly, according to Roche and colleagues (2014), it is the processes that teachers use as they plan mathematics lessons that need further investigation. Sullivan et al. (2012) found that planning processes could be improved and suggested that any related professional learning from teacher educators should begin with processes used by teachers as they plan. Given the fact that teacher leaders have the potential to significantly affect the quality of teaching and learning in schools (Calderone et al., 2018), it could be assumed that necessary support would be provided through the actions of teacher leaders, or in this case School Mathematics Leaders, when they attend planning meetings.

School Mathematics Leaders are teachers with the responsibility of leading improvement in the teaching and learning of mathematics in schools and play an important role in improving mathematics education (Driscoll, 2021). These leaders "are knowledgeable, on-site teachers who support their colleagues' efforts to interact about all facets of mathematics teaching" (Campbell & Malkus, 2013, p. 198). School Mathematics Leaders are considered by some as an exemplary source of in-school support, and "the most immediate source of professional development in mathematics for the primary teacher" (Millet & Johnson, 2007, p. 19). As instructional and curriculum leaders, School Mathematics Leaders are key to providing professional learning related to content and pedagogy and in-class support for teachers to develop quality practices (Jorgensen, 2016). It is through their actions and interactions with teachers that School Mathematics Leaders "make a difference to the lives and learning of others" (Gaffney, Bezzina et al., 2014, p. 68), including their colleagues and students.

While it is common in Australian schools for teachers to plan in collaborative teams (Davidson, 2016) and to discuss evidence of student learning, achieving maximum impact "depends on teams of teachers working together with excellent leaders" (Hattie, 2012, p. 35). Cobb and Jackson (2015) also noted that teacher collaboration provided significant learning opportunities. However, the extent to which this collaboration supported teacher learning depended on the quality of leadership and the inclusion of already accomplished teachers (Cobb & Jackson, 2015). Accomplished teachers in the form of School Mathematics Leaders, while working together in professional learning communities, share their "wisdom of practice" (Clarke, 1994) and expertise as they review student work, and discuss curriculum and pedagogy with colleagues.

Furthermore, Fullan and Quinn (2016), proposed that teachers need deeper collaborative experiences built on teacher input and choice, connected to their daily work of designing and assessing tasks that have the power to influence student learning. While Davidson (2019) reiterated this view, she also contended that schools aiming to promote productive collaborative planning practices may benefit from providing support in the form of an experienced team leader or School Mathematics Leader.

Theoretical Framework

The purpose of the larger study was to identify the ways in which School Mathematics Leaders supported teachers' professional learning about effective teaching of mathematics. Teacher learning was the theoretical lens used to frame and guide the research design and data analysis. In addition, a leadership framework (Fullan, 2001) was used for describing and analysing the practice of leaders of mathematics. Therefore, two fields of research literature were interrelated throughout the research—how teachers learn and leadership. Specifically, Lave and Wenger's (1991) work on social theory and Fullan's (2001) Framework for

Leadership (Figure 1) were used to guide the study. As part of this framework for leadership, Fullan (2001) described five components which included: moral purpose, understanding change, relationship building, knowledge creation and sharing and coherence making. Leaders who displayed all five components with the personal characteristics of energy, enthusiasm, and hope were found to be most effective (Fullan, 2001). These attributes of effective leadership practice were used to frame this study and the interpretation of the results.

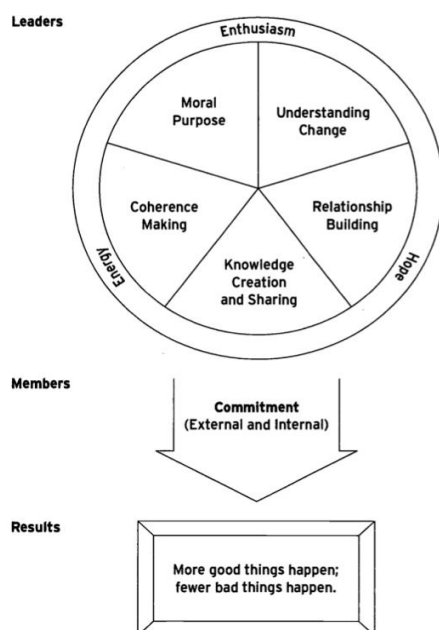


Figure 1. A Framework for Leadership (Fullan, 2001, p. 4).

Methodology

Qualitative research was chosen for the larger study because it enabled exploration of the ways in which School Mathematics Leaders supported teachers' professional learning. The qualitative research design was a combination of two types, case study together with open coding procedures, which were used for data analysis (Yin, 2016). This research was comprised of two phases. Phase 1 included collecting and examining data from a survey of leadership practices. Phase 2 comprised of observations and interviews that contributed towards the reporting of case studies. Phase 2 also included a series of prompted written reflections from the School Mathematics Leaders as well as field notes and other documents. Prompted written reflections were completed by the School Mathematics Leaders based on events that they believed were significant in their interactions with teachers. To allow for triangulation of data all sources of evidence were used when examining the case studies.

Initially, a state-wide survey ($n = 56$) was designed and implemented to collect data about the nature of the role of primary School Mathematics Leaders, and aspects that influenced the effectiveness of the role. The survey also documented ways in which School Mathematics Leaders supported the professional learning of their colleagues, including the support given to teachers during the planning of mathematics lessons. Finally, information gathered from the data collected about individual School Mathematics Leaders was used to select participants for the case studies.

As a means of understanding the ways in which support was provided with mathematics planning, it was necessary to observe the actions and interactions that occurred between School

Mathematics Leaders and teachers as they worked in their specific school settings. This paper reports on one case study participant, who was selected because of her experience as a School Mathematics Leader. Jane (pseudonym), the School Mathematics Leader, was observed and interviewed in her primary school workplace on four occasions over a ten-month period. During two of these observations, Jane supported teachers in the Foundation team during two-hour long planning meetings. Jane was also interviewed following the observations.

Data Collection and Analysis

Interviews and observations occurred during the same day of each visit. The planning meetings were video-recorded, and the interviews were audio-recorded. The most effective method for recording evidence of the meetings and capturing the actions and interactions of participants was to use a video-camera. Video recording allowed for detailed analysis through repeated viewing and reviewing of the footage. Events of interest were transcribed. The events chosen were based on themes that were emerging and were related to the research literature that framed the study. One of the advantages of using image-based methods, is that it is possible to capture a scene far more discreetly and effectively than you can with recorded notes (Thomas, 2016). Comparisons can also be made between the direct observation of School Mathematics Leaders' actions in meetings, and their statements recorded in the interviews, which leads to "very rich, high-quality data" (Punch, 2014, p. 155).

Data were collected and transcribed then added to NVivo. Printouts were also viewed many times. The coding process began by reducing the data into categories based on the two fields of research that informed the study, leadership and teacher learning. As the coding process continued, codes moved to higher conceptual levels and themes and concepts began to be identified in the data. Analysis for this research aligned with a grounded theory approach and was based on the five-phased cycle proposed by Yin (2016): compiling, disassembling, reassembling, interpreting and concluding. These processes supported the purpose of this study and enabled analysis to proceed in a methodical manner.

Results and Discussion

Working with Teachers During Planning

Evidence was gathered related to the ways in which School Mathematics Leaders supported teachers' professional learning during planning with the intention of analysing and interpreting the ways this occurred. The evidence highlighted the important role that the School Mathematics Leaders played in supporting teachers as they offered guidance and advice in planning meetings. While in many schools, School Mathematics Leaders do not have the time or opportunity to support teachers in the planning of mathematics lessons, and in some cases do not possess the pedagogical content knowledge to do so (Driscoll, 2021), this paper reports the actions of one School Mathematics Leader who was fortunate to be involved in planning.

In each of the two observations, the year-level team leaders facilitated the meeting, supported by Jane as the School Mathematics Leader. Jane's perceptions of aspects of the meeting outlined at the follow-up interview provided further evidence of the situation and were triangulated with the survey data and Jane's written reflections. Emerging themes informed by the findings and the literature became apparent. These themes identify actions that could be considered to be part of School Mathematics Leaders' practice in supporting teacher planning.

The Story of Jane

Jane worked in a modern, government primary school located in an outer suburb south-west of Melbourne in the state of Victoria, Australia, and had worked for a number of years as

a School Mathematics Leader. When working with teachers to support the planning of mathematics lessons, Jane demonstrated some specific key actions. These actions included:

Developing constructive working relationships with teachers. As Jane worked with the Foundation team, it was apparent through her actions and interactions that she was aware of the importance of developing constructive relationships with teachers in her school and made attempts to enhance this. Relationships are complicated, but at the same time are crucial and make a difference to the success of an organisation (Fullan, 2001). Jane explained that the teachers at her school had built a close professional relationship with her as she supported them during mathematics planning sessions, and with weekly analysis of student assessment data. For example, as the team discussed possible lesson ideas and teaching strategies, Jane spent time encouraging the teachers to contribute using open-ended questions, which served as prompts to focus the discussion. For example, “What do you want them to know?” and “Where are you starting?” occasionally directing questions at certain teachers by name. Questioning encouraged teachers to feel included in the discussion, showing that their opinions and ideas were valued, and contributed to building a constructive working relationship. Seeking teacher input is likely to build “trust, respect and commitment” (Goleman, 2000, p. 10) and contribute to building positive relationships.

However, “relationships are not an end in themselves” (Fullan, 2001, p. 65) and teachers often express doubts and differences of opinion. During one planning meeting a particular teacher in one of the teams demonstrated signs of resistance through her limited participation in the discussion and her demeanour. As Jane mentioned in one of the interviews, “there’s a lot of work going on there,” referring to open-to-learning conversations as a strategy to improve the relationship. While the relationship was definitely strained, an effective leader understands teacher differences of opinion and appreciates resistance (Fullan, 2001) and can learn from this. It was obvious from Jane’s comments that the focus was on improving this relationship with the aim of making the mathematics planning sessions more productive.

Fostering knowledge of mathematical content and curriculum. The planning of mathematics lessons often brings many challenges related to curriculum knowledge, mathematics content knowledge and pedagogical content knowledge. At Jane’s school, building teachers’ mathematical knowledge for teaching was important. Jane explained as a reasonably new school it had taken individual teachers a long time to establish pedagogy and build mathematics content knowledge amongst the teachers. During planning meetings, Jane supported teachers by offering guidance and advice as they planned sequences of mathematics lessons. Jane suggested resources, lesson ideas, professional reading options, and posed questions as she challenged teacher thinking.

Early in her role, Jane also provided a mathematics teaching and learning curriculum document to support teachers with developing their mathematics knowledge. This document was used by teachers as they planned and included links to the curriculum, big ideas and understandings, games, equipment, misunderstandings, key resources, and teaching sequences. Jane created this document with teacher input to support teacher planning, as according to Jane, it was one way to ensure teachers were covering the expected curriculum and it built their mathematical content knowledge. The fostering of knowledge building and sharing in an organisation is an important element of effective leadership (Fullan, 2020).

Prompting and pressing teachers to contribute ideas. As Jane enacted her leadership role during planning meetings, the actions of prompting and pressing teachers for further ideas were obvious. School Mathematics Leaders can influence how planning meetings progress by prompting and pressing teachers on key issues (Cobb & Jackson, 2015). Jane attempted to provide a balance between pressure and support based on individual teacher needs. While Jane encouraged teachers to construct and develop their mathematical knowledge, she prompted

teachers to choose the most appropriate tasks based on the effective teaching and learning of mathematics. However, the challenge experienced by Jane was to know when to prompt and press for ideas to add to the planning, as opposed to “telling” teachers what to do, which intentionally leads to the next action.

Attempting to hold back from telling. As a means of encouraging teachers to make a decision and build their confidence in planning, on several occasions, Jane purposefully asked a question and held back from sharing her opinion. For example, in one observation the team leader asked, “So what is the learning focus? The learning focus is about multiplicative thinking” and Jane replied, “I don’t know. Is it?” On this occasion Jane sat quietly without adding any more comments letting the teachers take responsibility.

During another observation, it was apparent that Jane was waiting for teachers to respond as she sat with her chin on her hand and did not participate in a discussion that was occurring between members of the Foundation team. After some time, and some initial holding back, Jane finally stepped in and shared her thoughts on teaching problem-solving in a context, not just as a topic. Jane explained this point further in an interview with this comment, “Sometimes you can let them go, but other times you have to go, ‘No, I don’t want you to do a unit on problem solving. I want problem solving in your practice.’”

During an interview, Jane commented that although “I was really conscious at the start in my role that I was always telling ... I was really aware of that,” there were times when “I still [couldn’t] help myself from blurting out, ‘I think you should do this.’” Jane went on further to say, “I am getting much better at waiting. But sometimes, they just don’t know what they don’t know.” Jane believed that more professional reading by teachers would help, and went on further to say, “At the end of the day, they’ve just got to get their planning done” and sometimes “there are some gaps in their knowledge, where I have to go, ‘Hey, this is the sequence, you’ve got to get this in.’” For Jane knowing when to “hold back from telling” (Roche & Clarke, 2014) was not always obvious, and in the end, it was about finding the balance between allowing teachers to make their own decisions and voicing her opinion based on her experience. Although Jane admitted it became easier as she became more experienced working with teachers and understood more about how teachers learn.

Encouraging teachers to reflect on and evaluate possible lesson ideas. Significant learning opportunities occur when teachers and School Mathematics Leaders are engaged in actions that have the potential to improve teacher knowledge and practice. Such actions include, encouraging teachers to reflect on ways to facilitate student learning, and planning lessons by anticipating students’ responses and solutions. Actions also include, supporting teachers to reflect on previous lessons in relation to student engagement and possible misunderstandings, and encouraging them to ask themselves if a task has the potential to engage students in exploring and understanding mathematical concepts. Reflective practices can maximise student engagement and learning, and potentially affect the actions of School Mathematics Leaders like Jane, as they work with teachers to plan mathematics lessons.

There were many occasions when teachers were observed evaluating lesson ideas. At one stage as the teachers discussed possible lessons, one teacher explained how she had implemented the “Cookie Count” lesson in a previous year, then the teachers in the team discussed the possible sequencing of lessons that would work best based on the students’ previous experience. Teachers often make decisions based on reflective practice, and decide on the direction to take, and where to go to next based on their knowledge of curriculum and student needs (Hattie, 2012).

Facilitating regular collaborative team planning. Many teachers plan in collaborative teams and are supported by a year-level team leader, and in some cases School Mathematics Leaders. The value of collaboration cannot be underestimated, as teachers working together

discuss, and influence others, as they draw on a variety of assessment data and curriculum documents, then select appropriate learning activities. In this study, working in a collaborative team to plan helped build a sense of community (Gaffney, Faragher et al., 2014), and provided an opportunity for sharing of ideas, shared decision making, and shared responsibility for student learning (Du Four et al., 2010). Jane encouraged teacher collaboration as a means of developing a common understanding of the mathematics content and ways to evaluate the impact of planning on student learning. Teacher learning is enhanced when teachers participate in shared experiences, and in Jane's case, being an active participant in a community of practice (Lave & Wenger, 1991) led teachers to plan activities that had the potential to cater for their students' needs.

In summary, although the mathematics planning in the Foundation team was not always what Jane considered "the best," and at times she believed that she needed to step in and give the team more direction, Jane continued to challenge her team while supporting them to build their mathematical knowledge for teaching. Through implementation of these identifiable actions, Jane supported teacher learning during mathematics planning meetings in multiple ways.

Conclusions

Findings from this study support the notion that successful mathematics planning promotes teacher professional learning. Teacher learning is ongoing and more effective when it is embedded into the regular practices of a school community. Engaging in discussions of curriculum and pedagogy, analysing student data, evaluating previous lessons and collaborating to plan possible learning tasks provide significant learning opportunities for teachers. In terms of the theoretical lens used to frame this research, through her actions, Jane incorporated elements of Fullan's (2001, 2020) leadership framework as she developed relationships with teachers, fostered mathematics content and curriculum knowledge, and attempted to seek coherence. These key actions, which also included: stimulating discussion amongst teachers as they planned, probing and questioning teachers' contributions, developing data literacy, encouraging mathematics related professional reading, evaluating mathematics planning, and suggesting possible lesson sequences, potentially led to improved planning practices. The implication here is that for School Mathematics Leaders to implement actions that contribute to supporting teachers to build their mathematical knowledge for teaching during planning, these leaders of mathematics require opportunities to be involved in the meetings, to bring knowledge and expertise to encourage ongoing professional learning and to make a difference.

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