

Leading mathematics: Doings of primary and secondary school mathematics leaders

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Effective middle leading of mathematics is a complex task as it requires a focus on improving learning outcomes for students. This study gathered information about the activities of middle leaders of mathematics using a survey of primary and secondary mathematics leaders. Both primary and secondary mathematics leaders more often focussed on interacting with students in the classroom and participating in team planning meetings. Secondary leaders mentored teachers more often than primary leaders. Time to conduct some of the less frequent but more effective leadership activities needs to be provided.

Previous studies of instructional leadership have theorized the role and responsibilities of middle leaders (Kemmis et al., 2014, Lingard et al., 2003, Sexton, 2018). Studies of mathematics leading have reported on particular projects involving mathematics leaders (for example, Grootenboer et al., 2015b). Few studies have reported on what leaders of mathematics in schools actually do. In this paper we report on the activities of mathematics leaders in primary and secondary schools in Victoria, Australia, in order to understand the support that needs to be provided by school and system level leaders.

Background

Middle leading is a complex task (Kemmis et al., 2014). It involves teaching, administration, managing, and curriculum and pedagogical development (Sexton & Downton, 2014). Grootenboer et al. (2015a) argued that middle leading is significant because middle leaders are located between the school leader and teachers and therefore participate in both the leadership and teaching practices of the school. Also as they are teachers, typically middle leaders are aligned philosophically with their teacher colleagues and therefore are able to collaborate with teachers in their day-to-day practice. Finally, middle leading is significant because it is a practice that involves “the sayings, doings, and relatings of leading rather than the characteristics and qualities of middle leadership” (Grootenboer et al., 2015a, p. 18). Driscoll (2017) argued that the focus of middle leaders’ practice should be on teacher development to improve the learning outcomes of students.

Lingard et al. (2003) claimed that effective pedagogical leading engages teachers in collaborative, critical, and reflective discussion about their practices and students’ learning. Productive leadership relies on school leaders providing the support and opportunities for

middle leaders to create a collaborative culture and practice. Martinovic and El Kord (2018) conducted a review of the literature on leading mathematics in schools. Two of the studies reviewed focused on the ‘doings’ of leaders. Masters (2010) reported that middle leaders analyse samples of student work, co-plan with teachers, co-teach lessons, review efficiency of teaching, and celebrate professional learning. Calderone et al. (2018) reported qualities of middle leaders that included their expertise in teaching, and their practices of leading such as actively listening, encouraging success of colleagues, facilitating communities of learning, confronting barriers in school culture and structure, and striving for authenticity in teaching, learning and assessment.

The role of leaders of mathematics (and other subjects) is not specified for government schools. In Victorian public primary and secondary schools, various titles are used for middle leaders of mathematics. For example, Learning Specialist, Numeracy Leader, Numeracy Coordinator, Maths Domain Leader, Numeracy Learning Specialist, Professional Learning Community Leader, Maths Curriculum Team Leader, and Maths Leader. The Australian Standards for teachers include descriptors of competencies and knowledge for lead teachers concerning professional learning and engaging with colleagues, parents and community and do specify roles or activities for teachers at the level of lead teacher (AITSL, 2017). These include planning and developing professional learning for colleagues (6.1), initiating collaborative relationships (6.2), implementing professional dialogue to improve outcomes of students (6.3), and lead strategies to support professional learning opportunities for colleagues (6.4) (AITSL, 2017). In Victoria, the framework that describes levels of “Instructional shared leadership” expects that school leaders will lead teaching and learning. They “model and demonstrate high levels of pedagogical practice” and “align instructional planning and curriculum planning with the goals of the school” (Department of Education and Training [DET], 2019).

It is therefore not clear what mathematics leaders are expected to do. In this study we invited mathematics leaders in Victorian government schools to provide information about their leadership activities. The research questions were:

- *What leadership activities do school mathematics leaders do and how often?*
- *What are the similarities and differences in the leadership activities of mathematics leaders in primary and secondary schools?*
- *How much time is allocated to primary and secondary mathematics leaders to do this work?*

The Study

This study is part of the Numeracy Leaders’ Needs Analysis (Vale et al., 2020) designed to understand the contexts of teachers who have the responsibility for leading improvement in mathematics teaching and learning. The Numeracy Leaders’ Needs Analysis set out to identify the activities, knowledge, wishes, goals, and challenges of mathematics leaders in primary and secondary schools in order to identify their professional learning needs as well as to seek their preferences for their professional learning. In this paper, we report on the activities and time allocation for leaders.

The *Numeracy Leaders’ Needs Analysis* questionnaire gathered responses online through Qualtrics. The questionnaire included 24 items with a mixture of Likert items, ranking items, multiple-choice items and open-ended items.

There were three Likert items about the frequency of various leadership activities. The sub-items consisted of a range of possible activities drawing on findings from qualitative studies (for example, Driscoll 2017, Cheeseman & Clarke 2005, Sexton & Downton 2014)

and their authors' professional experiences. The sub-items were organised into three sets to reflect the main contexts in which middle leaders work (Grootenboer et al., 2015a):

- Leadership in the classroom (Question 1, includes seven sub-items)
- Leadership beyond the classroom (Question 2, includes twelve sub-items)
- Managing and administration (Question 3, includes four sub-items)

These three items used a seven-point Likert scale from 'Not at all' (1) to 'Very often' (7). The items were checked for face validity by one author and two volunteers. Descriptive statistics, that is, frequencies were calculated for all closed items, including by school sector and regional location of the school. Means and standard deviations were calculated for the Likert items, and a two-tailed t-test conducted to compare the frequency of leadership activities between primary and secondary leaders of mathematics.

One hundred and ninety-six (196) people responded to the questionnaire. The majority (71%) worked as numeracy leaders, specialists, or teachers in primary schools. About a quarter (23%) worked as leaders or teachers in secondary schools. The other participants (6%) included leaders or teachers working in, or with, Special Education schools or with networks of schools. The proportion of responses from primary and secondary leaders approximately corresponds to the proportion of primary and secondary schools in Victoria (69% and 31% respectively). About two-thirds of respondents (65%) were from metropolitan schools and one-third from non-metropolitan schools (35%). Respondents included leaders from very small primary schools with fewer than 50 students (4% of primary leaders) to large primary and secondary schools with more than 1000 students (2% of primary respondents and 26% of secondary respondents).

Findings

Data about the number of years teaching and leading mathematics is provided first followed by findings regarding the doings of primary and secondary leaders and then the time available to do these leadership activities.

Teaching and leadership experience

It was also important to understand the extent of their teaching and leading experience as factors that may influence their activities as leaders of mathematics (see Table 1). Twenty-nine (29) of respondents were not currently the school mathematics leader. Almost all the leaders, 99% of primary leaders and secondary leaders responding to the questionnaire had more than 3 years' teaching experience. However, 30% of primary leaders and 23% of secondary leaders had been leading mathematics for less than one year. A higher proportion of secondary mathematics leaders had been leading mathematics for more than three years (33% compared to 22%).

The two least frequently conducted activities by both primary and secondary leaders were "Co-teach mathematics alongside teachers and review lesson" and "Model mathematics lessons for other teachers" (see Table 2). Secondary leaders tended to "Observe and talk with students about their learning during mathematics lessons, and provide feedback for the teacher" more often than "Collect, analyse and discuss student work samples with the classroom teacher." For primary leaders they tended to analyse student work slightly more often than conducting peer observations.

Table 1
Number of years teaching and leading mathematics

	Teaching (n=196)		Leading mathematics (n=167)	
	Primary n (%)	Secondary n (%)	Primary n (%)	Secondary n (%)
Less than 1 year	1 (0.7)	0 (0)	39 (30.4)	9 (23.0)
1-3 years	1 (0.7)	1 (2.2)	55 (42.9)	15 (38.4)
4-9 years	44 (29.3)	17 (37.0)	28 (21.9)	10 (25.6)
10-15 years	34 (22.7)	13 (28.3)	3 (2.3)	4 (10.3)
Longer than 15 years	70 (46.7)	15 (32.6)	3 (2.3)	1 (2.6)

Table 2
Leading mathematics in the classroom (Q1)

	Primary mean (SD)	Secondary mean (SD)	t-test p
a. Model mathematics lessons for other teachers.	3.7 (1.9)	3.7 (1.9)	0.89
b. Co-plan individual mathematics lessons with classroom teacher(s).	4.6 (2.0)	4.1 (1.9)	0.15
c. Collect, analyse and discuss student work samples with the classroom teacher.	4.2 (1.8)	3.9 (1.7)	0.32
d. Co-teach mathematics alongside teachers and review lesson.	3.5 (2.0)	3.6 (1.9)	0.88
e. Observe and talk with students about their learning during mathematics lessons, and provide feedback for the teacher.	4.0 (2.1)	4.0 (2.0)	0.98
f. Use instructional walks to talk to students about their learning during a mathematics lesson.	5.1 (2.0)	5.4 (1.7)	0.24
g. Teach small groups of students for intervention or extension.	4.0 (2.3)	4.2 (2.4)	0.56

Leading mathematics beyond the classroom

The most frequent activity for both primary and secondary leaders when leading outside the classroom was “Participate in team mathematics planning meetings” (see Table 3). The independent two-tailed t-test found that secondary leaders (m=6.1) conducted this activity more often than primary leaders (m(s)=6.1, m(p)=4.9, t=-3.722, p<0.01). Secondary leaders also “Mentor teachers of mathematics” more often than primary leaders (m(s)=5.3, m(p)=4.2, t=-2.670 p<0.01). A third significant difference showed that secondary leaders more often “Design and lead mathematics assessment programs in the school” than primary leaders (m(s)=5.1, m(p)=4.2, t=2.810 p<0.01). These three activities were the three most frequent activities for secondary leaders. The second most common activity for primary leaders was “Facilitate or conduct professional learning for teachers of mathematics,” an

activity in the top four for secondary leaders.

A fourth significant difference was found for one of the least often activities. Primary leaders more often “Participate in a network of mathematics/numeracy leaders” than secondary leaders ($m(p= 3.4, m(s= 2.8, t=1.938, p<0.01)$). Secondary school mathematics leaders were asked to indicate the number of non-specialist mathematics teachers that is, out-of-field teachers of mathematics, in their school. A third (33%) identified between one and three teachers who were teaching mathematics out-of-field and a further third had four or more teachers of mathematics who were not qualified to teach mathematics. Mentoring non-specialist teachers was among the least frequent activities for secondary leaders ($m=3.2, SD=2.3$), however the high standard deviation indicates that this varies more than other activities and likely reflects the number of non-specialist teachers at their school.

Table 3
Leading beyond the classroom (Q2)

	Primary mean (SD)	Secondary mean (SD)	t-test p
a. Mentor teachers of mathematics.	4.4 (2.0)	5.3 (1.6)	0.00**
b. Facilitate or conduct professional learning for teachers of mathematics.	4.7 (1.9)	4.7 (1.7)	0.98
c. Participate in team mathematics planning meetings.	4.9 (2.1)	6.1 (1.2)	0.00**
d. Facilitate meetings for assessment moderation.	4.0 (2.0)	4.3 (1.8)	0.44
e. Facilitate formative assessment meetings to analyse student work.	3.7 (2.0)	3.7 (1.9)	0.91
f. Facilitate meetings to analyse assessment data to refine and adjust curriculum based on identified needs of students.	4.2 (1.9)	4.6 (1.6)	0.15
g. Design and lead mathematics assessment programs in the school.	4.2 (1.9)	5.1 (1.7)	0.01*
h. Engage parents and community in the school’s mathematics program.	2.9 (1.7)	2.8 (1.5)	0.86
i. Facilitate meetings to evaluate strengths, weaknesses, and opportunities for improving teaching of mathematics/numeracy.	4.0 (1.9)	4.2 (1.6)	0.51
j. Lead the design of goals for improving mathematics/numeracy teaching.	4.4 (2.0)	4.6 (1.9)	0.42
k. Mentor teachers about opportunities for numeracy learning in other subjects.	3.4 (1.8)	3.2 (1.9)	0.49
l. Participate in a network of mathematics/numeracy leaders.	3.4 (2.0)	2.8 (1.8)	0.04*
m. Mentor non-specialist teachers of mathematics	NA	(2.3)	

* $p<0.05$ ** $p<0.01$

Managing and administration.

For the four items that asked leaders about their management and administration tasks both primary and secondary leaders frequently “Manage access to and purchasing of mathematics resources” (m(p)=5.3, m(s)=5.0) and “Manage mathematics assessment programs” (m(p)=4.5, m(s)=4.9; see Table 3). There were no significant differences for any of the four activities.

Most frequent doings

When comparing the frequency of activities across each of these leadership domains primary leaders most often “Manage access to and purchasing of mathematics resources” (m=5.3, SD=1.9), “Talk to students about their learning during a mathematics lesson,” (m=5.1, SD=2.0) and “Participate in team mathematics planning meetings” (m=4.9, SD=2.1). Secondary leaders most often “Participate in team mathematics planning meetings” (m=6.1, SD=1.2), “Talk to students about their learning during a mathematics lesson” (m=5.4, SD=1.7), and “Mentor teachers of mathematics” (m=5.3, SD=1.6) (see Table 4).

Table 4
Managing and administration (Q3)

	Primary mean (SD)	Secondary mean (SD)	t-test p
a. Organise professional learning facilitated by external experts.	3.2 (2.0)	3.1 (1.8)	0.83
b. Manage access to and purchasing of mathematics resources.	5.3 (1.9)	5.0 (2.2)	0.36
c. Timetable and organise allocated planning time (APT).	3.2 (2.4)	3.3 (2.1)	0.82
d. Manage mathematics assessment programs.	4.5 (2.0)	4.9 (1.8)	0.17

Leadership support

School leaders can support mathematics leaders by providing time to complete mathematics leadership activities and responsibilities. Many of the primary and secondary leaders were provided less than two hours per week to complete their leadership activities (42% and 50% respectively) (see Table 5).

Table 5
Number of hours per week allocated for the School Mathematics Leadership role (Q17)

	Primary n (%)	Secondary n (%)
Zero hrs	28 (18.7)	7 (15.2)
< 2 hrs	35 (23.3)	16 (34.8)
2.1 - 4 hrs	16 (10.7)	9 (19.6)
4.1 – 6 hrs	13 (8.7)	9 (19.6)

6.1 – 8 hrs	8 (5.3)	2 (4.3)
8.1- 10 hrs	10 (6.7)	1 (2.2)
10.1 -20 hrs	33 (22.0)	2 (4.3)
> 20 hrs	8 (5.3)	0 (0.0)

Whilst the distribution of time release for leading mathematics corresponds with the number of teachers of mathematics for both primary and secondary leaders, it is not surprising that many leaders have been limited in the opportunity to frequently conduct many of the activities included in the instrument.

Discussion and Conclusion

The activities of middle leaders of mathematics reflect the complexity of this role which includes teaching, working with their teaching colleagues as well as conducting administrative tasks as reported previously (Grootenboer et al., 2015b; Sexton & Downton, 2014). For both primary and secondary leaders talking with students about their learning was one of the most frequent activities and so was participating in team planning meetings. It is not clear from this study what was actually involved in these planning meetings and whether they took a leadership role in these planning meetings to encourage teachers to develop evidence-based practice (Grootenboer et al., 2015b). It seems unlikely, as facilitating meetings to discuss formative assessment of students was among the least frequent activities for both primary and secondary middle leaders. Secondary leaders frequently mentor other teachers rather than use other strategies for professional learning for non-specialist and beginning teachers such as peer observation, co-planning and co-teaching, or conducting professional learning activities. The limited use of these activities by both secondary and primary leaders indicates a need for their professional learning.

Middle leaders are expected to lead the improvement of mathematics teaching in their school, but they have very limited time allowance to enact some of the more effective practices to achieve their vision for teaching and goals for student learning (Roche et al., , 2020). School leaders need to be encouraged to provide more time for middle leaders to develop collaborative practices (AITSL, 2017) and shared meanings of effective practice (Kemmis et al., 2014). Participating in network meetings with other middle leaders of mathematics was not a frequent activity. An implication from this study is for local system leaders of mathematics to be encouraged to provide opportunities for middle leaders to meet to learn from each other and support each other (Proffitt-White, 2017) to effect strategies for improving the teaching of mathematics in their schools.

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