Supporting the Leadership of Mathematics in Schools

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This MERGA symposium addresses three aspects of the Numeracy Suite professional development program for leaders of mathematics in schools. The papers include: a description of online courses offered in the program and an analysis of their effectiveness, a report of action research projects conducted by leaders as short "teaching sprints", and an analysis of leaders' thinking about their role in improving mathematical outcomes for students stimulated by a one-day workshop.

The Numeracy Suite (2019–2022) was initiated by the Department of Education and Training in Victoria and implemented though the former Bastow Institute of Leadership now the Victorian Academy of Learning and Teaching. A team of mathematics educators from Monash University developed and delivered the program, which was designed to facilitate the professional learning of leaders of mathematics and numeracy in primary and secondary schools in Victoria. To establish leaders perceived professional development needs, a state-wide survey was conducted online, and the leaders' responses were analysed to inform the program design. The purpose of the Numeracy Suite was to challenge numeracy and mathematics leaders to develop a deeper understanding of themselves as leaders and teachers of mathematics and numeracy. The Numeracy Suite supported the leaders to create conditions for effective teacher professional learning and strategic planning for whole-school improvement in mathematics teaching and learning. It also supported the leaders to improve the learning experiences, mathematical dispositions, and achievement of all learners. In analysing the results of the professional learning our purpose was to understand the current practices, views and aspirations of leaders of mathematics and numeracy in primary and secondary schools and to evaluate the professional learning opportunities we offered to the leaders.

Chair & Discussant: Jill Cheeseman

Paper 1: *Online Courses for Leaders of Mathematics and Numeracy in Primary and Secondary Schools: Overview and Effectiveness*
[Ann Gervasoni, Aylie Davidson, Ann Downton, A., Sharyn Livy, & James Russo]

Paper 2: *Teaching Sprints: Action Research Led by School Mathematics Teacher Leaders*
[Colleen Vale & Carmel Delahunty]

Paper 3: *Ways in Which a Workshop Stimulated Leaders' Thinking*
[Jill Cheeseman, Penelope Kalogeropoulos, Marj Horne, & Michele Klooger]

Acknowledgement. The Numeracy Suite discussed in each of the three symposium papers was funded by the former Bastow Institute of Educational Leadership, Department of Education and Training, Victoria.

2022. N. Fitzallen, C. Murphy, V. Hatisaru, & N. Maher (Eds.), *Mathematical confluences and journeys* (Proceedings of the 44th Annual Conference of the Mathematics Education Research Group of Australasia, July 3–7), pp. 28-40. Launceston: MERGA.

Online Courses for Leaders of Mathematics and Numeracy in Primary and Secondary Schools: Overview and Effectiveness

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Professional learning for school mathematics leaders is a key aspect of the Victorian Government's strategy for improving mathematics for Victorian students. This is because middle leaders in schools play a vital role in designing and leading school improvement. As part of the Numeracy Suite, four online courses were designed in 2020 to support the professional learning of mathematics leaders. The courses were implemented and evaluated across 2020-2021. The evaluation showed that each online course was effective in meeting the professional learning needs of primary and secondary mathematics leaders.

As part of a five-year initiative to improve the mathematics learning of students in the State of Victoria, the former Institute of Educational Leadership launched the *Numeracy Suite* (https://www.academy.vic.gov.au/initiatives/numeracy-suite) to build the capacity of mathematics leaders in primary and secondary schools. Monash University academics were awarded the contract to design and deliver four 15-week online courses as part of the *Numeracy Suite*. This paper provides an overview of the four courses and insights from the course evaluations about their effectiveness.

Development and Overview of the Online Courses

Prior to developing the online courses, the Monash University team conducted a Needs Analysis survey of Victorian mathematics leaders in 2019 to inform the design and focus of the online courses (Vale et al., 2020, 2021). Two items addressed leaders' professional learning needs. Question 7 invited leaders to select four priorities for their *mathematics leadership professional learning* from a list of nine topics. Five topics were selected by approximately half of all participants (n = 196). These were:

1. Facilitating effective mathematics planning (60%).
2. Leading teacher professional learning in mathematics/numeracy teaching (56%).
3. Encouraging staff to take risks and trial different teaching strategies and tasks (53%).
4. Supporting, mentoring and coaching colleagues (50%).
5. Enhancing positive dispositions of students and teachers (49%).

These five topics were selected by leaders in both primary and secondary schools, regardless of their location or region, and were consistent with previous research about the challenges middle leaders face in leading change (Grootenboer, 2018).

The mathematics leaders were also invited to select four priorities for their professional learning in mathematics teaching practice from a list of ten topics (Question 8). Five professional learning topics were selected by about half of all leaders. These were:

1. Effective assessment of content, proficiencies, and dispositions (54%).
2. Differentiating instruction to cater for the needs of all students (53%).
3. Using strategies to improve student proficiency in understanding, fluency, problem solving, or reasoning (53%).

2022. N. Fitzallen, C. Murphy, V. Hatisaru, & N. Maher (Eds.), *Mathematical confluences and journeys* (Proceedings of the 44th Annual Conference of the Mathematics Education Research Group of Australasia, July 3–7), pp. 29–32. Launceston: MERGA.

4. Using data, including artefacts and work samples, to measure learning growth over time (49%); and
5. Including student voice and providing opportunities for students to negotiate their learning (47%).

Informed by these identified priority areas and the current mathematics and leadership literature, four online courses for mathematics leaders were developed. Each 15-week course was organised into four inquiry cycles so that content and leadership approaches could be adequately explored, trialled, and critiqued. Each inquiry cycle included a virtual workshop, optional online synchronous discussion groups, asynchronous learning activities and professional readings via the Bastow 307 learning management system (LMS), a weekly school-based investigation, and a weekly online discussion post to share insights about the school-based investigation. In learning cycle four, participants undertook a project relevant to their leadership context. Participants were invited to complete mid and end-of-course evaluations that inform course improvement. Outlines of the four online courses (OCs) follow.

Online Course 1: Leading Differentiated Teaching in Mathematics

Effectively differentiating learning for students with diverse abilities, backgrounds, and performance levels is a challenging aspect of teaching mathematics. This course enables school mathematics leaders to explore and critique several inclusive pedagogical approaches that cater for diverse students. Leaders focus on how attending to specific learning design characteristics when developing (or sourcing) tasks enables the whole class to undertake the same core mathematical activity, at a level of challenge, appropriate for each student.

Online Course 2: Leading Mathematics Planning

Collaborative planning is a critical part of the learning and teaching cycle. In this course, leaders explore key features of planning that underpin and enhance student-centred learning. Course content explores planning documentation that focuses on student-centred learning, embedding professional reading to support teachers' mathematical knowledge for teaching, and a model that guides leaders through the complexities of mathematics planning. Participants examine their school's planning approaches and develop a plan to lead teachers towards placing student-centred learning at the forefront of mathematics planning decisions.

Online Course 3: Leading Student-centred Assessment in Mathematics

Assessment is often viewed and practiced as a periodic externally imposed event or as an individual teacher-conducted activity that interrupts instruction—both practices treat assessment as something completed by students. The course aims to assist mathematics leaders to understand assessment practices and ensure that assessment is an integral part of instruction. Overall, the content focus of the course is to investigate how collaborative assessment practices can provide new "eyes" for understanding learners' mathematical thinking and dispositions, thereby guiding more effective teaching responses. A range of assessment strategies are explored and analysed across both cognitive and affective domains.

Online Course 4: Leading Improvement in Mathematics Teaching

Improving mathematics teachers' knowledge, confidence, attitudes, dispositions, and mindsets are important goals for professional learning. This course enables mathematics leaders to explore and critique approaches to leading professional learning in mathematics/numeracy teaching, and for supporting teachers to take risks and trial different teaching strategies and tasks. Participants use protocols and approaches to collect and analyse

data with their teachers in order to trial and enact evidence-based teaching practice in classrooms.

Model for School-Based Professional Learning/Improvement Cycles

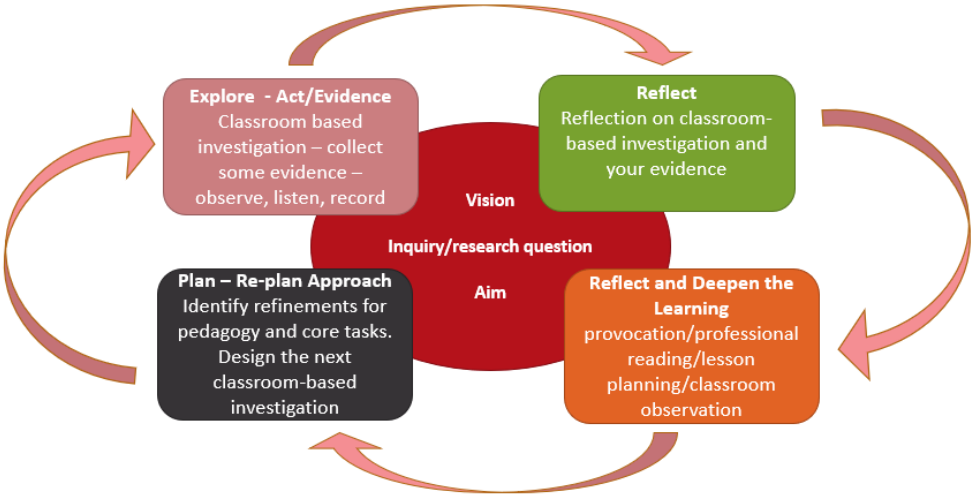

Figure 1. Model for school-based professional learning/improvement cycles.

The overarching goal of the Numeracy Suite is building leadership capacity to create and shape the conditions for whole school improvement in mathematics and numeracy learning and teaching. Thus, the online courses need to prepare leaders to enact school-based professional learning cycles/improvement cycles in partnership with colleagues (e.g., see Grootenboer, 2018). Figure 1 shows the model for school-based professional learning/ improvement cycles developed for the online courses to guide leaders in this endeavour. This model is informed by critical participatory action research (Kemmis et al., 2014). Course activities and LMS content support the model and provide material for leaders to use when leading school teams.

Effectiveness of the Online Courses

Participants in each of the Numeracy Suite online courses were invited to complete online mid-course and end-of-course evaluations that consider the knowledge and skills gained, the effectiveness of the course design, learning environments, facilitation, structure, and discussion groups, and participants' views of their overall experience of the course, including the most positive aspects, and aspects that could be improved. The evaluation included a mix of 5-point Likert-scale items, and open response questions. Mean-responses were calculated for each Likert-scale item, and the open responses were examined to identify key themes, using a grounded theory approach (Charmaz, 2008). Analysis of data from Semester 2 2021 end-of-course evaluation was used to provide illustrative examples of the course evaluation findings. Of interest for this paper was whether courses were viewed by mathematics leaders as effective, aspects of courses that were viewed positively, and aspects that might be improved. These findings can inform the design and content of other online courses.

Overall, the evaluation findings for Semester 2 2021 provide strong endorsement of the relevance and quality of the online courses. The mean responses (n = 62) for the 5-point Likert-scale items for the 6 evaluation categories, averaged across the four courses, were: knowledge gained (4.5); skills developed (4.4); online learning environment (4.1); virtual workshop facilitation (4.7); course design (4.6); and course structure (4.0). These positive results were

amplified by nearly 100% of respondents across all courses indicating that they would recommend their course to colleagues and were satisfied with the quality of the course.

Positive aspects of the courses identified by participants in the two open-response questions included course content, opportunities for discussions and collaborations with other mathematics leaders, course design, facilitators, and the readings and resources. For example, one participant in OC2 commented, "*I found the structure of the course great, it built on skills and knowledge each week and prepared you well for the final project."*

Participants also indicated that they valued the practical nature of the *tasks* and being able to put into practice many of the leadership strategies about which they were learning. For example, "*I have adapted our assessment schedule to fit the new learning"* (OC3) and "*The Planning Model allowed me to lead my team through improving our current planning practices. I really valued the Enabling and Planning prompts to support learning success for all students*" (OC2). Participants also highlighted the opportunities to work with and learn from other leaders as one of the most positive aspects of the course. For example, "*talking with other Numeracy Leaders"* (OC4) and *"also enjoyed the numerous opportunities to interact with staff from other schools to gain new perspective and ideas"* (OC1). Participants valued the facilitators' expertise as one of the most effective aspects of the course, consistent with literature indicating that access to experts is important for leading and sustaining change in mathematics (Clarke, 1997; Goos et al., 2018). For example, *"[The facilitators] were able to provide us with on-the-spot resources based on the discussions we were involved in"* (OC4), and *"Facilitators were engaging and extremely knowledgeable"* (OC2).

Suggestions for course improvements varied across the four courses. Common themes related to difficulties with workshops being scheduled after school hours and competing workload expectations, clarity of course requirements, challenges with using the Bastow 307 LMS, and one request for more specific secondary content.

Conclusion

Overall, the findings provide confidence about the quality and positive benefits of the Numeracy Suite online courses for leaders of mathematics. It was clear that participation in the courses was having positive impact and assisting mathematics leaders to create conditions for effective teacher professional learning and strategic planning for whole-school improvement in mathematics teaching and learning. However, many of the mathematics leaders had little time during school hours to support their professional learning, or to implement their initiatives. (Vale et al., 2020). These time constraints limit the potential impact of leaders' work.

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Teaching Sprints: Action Research Led by School Mathematics Teacher Leaders

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Action research is a means for teachers and researchers to develop evidence-based practices. This paper reports the process and outcomes of *teaching sprints*, an approach to action research, conducted by secondary school mathematics leaders as part of a professional learning program. Mathematics leaders consistently reported the value of developing collaborative practices throughout the planning, enacting and reflection of the teaching sprint.

The roles of school mathematics leaders are varied and depend on the school and individual context (Driscoll, 2017; Grootenboer et al., 2015). Kemmis et al. (2014) described mathematics leaders as middle leaders, whose responsibilities sit between the classroom and the school principal. They are often engaged in complex interactions with students, teachers, and the school leadership team. Middle leaders are likely to have the greatest impact on student achievement when they focus their role on improving teacher practice (Robinson et al., 2008; York-Barr & Duke 2004). Grootenboer et al. (2020) reported action-orientated professional learning where middle leaders worked collegially with small teams of colleagues in an "… ongoing and sustainable way to develop educational practice collaboratively in response to local needs and conditions based on evidence. It is a way of developing pedagogy and curriculum *from the classroom out*" (p. 39). They did not, however, provide examples of mathematics leaders' action-oriented projects. In this paper, we report on a qualitative study of *teaching sprints* (Breakspear & Jones, 2020), that is, short, targeted action research projects conducted by secondary school mathematics leaders as part of an online professional learning course entitled, *Leading Mathematics for Improvement in Teaching and Learning*.

Action research is a form of practitioner research. Kemmis and McTaggert (1988) described it as both a process and practice used by teachers, often collaborating with other teachers that involves a cycle of planning, observing, reflecting, revising the plan, and continuing the spiral of investigation. More recently, Kemmis (2008) defined action research as "a practice that … transforms the sayings, doings and relating that compose those other practices" (p. 463). The sayings (what is said), doings (activities and work) and relating (ways of relating or interacting) of mathematics leaders are part of the framework of "practice architectures" of middle leadership (Kemmis et al., 2014, p. 31).

Investigating teaching practices to improve student learning is promoted by the Department of Education and Training in Victoria (2010); however, there is no specific advice for leading action research within schools. Breakspear and Jones (2020) proposed three phases for action research: prepare, teaching sprint, and review. In the prepare phase, they emphasised collaborating with the teaching team to identify the focus of practice for improvement. McNiff (2010) recommended this phase should identify a question for investigation, and the gathering and collaborative analysis of data. Findings and implications of the data analysis are used to identify a goal for changing practice that they then enact as a "teaching sprint." The teaching sprint is enacted in a short period of time, such as 2–3 weeks. Further data, including observations, are collected and used in the final phase of review to reflect on the effectiveness of the teaching sprint and determine the implications for future practice. In this paper, we report on a qualitative study of teaching sprints conducted by secondary mathematics leaders (MLs) to identify the influence of these teaching sprints on the sayings, doings and relating of the MLs and their understanding of evidence-based practice.

2022. N. Fitzallen, C. Murphy, V. Hatisaru, & N. Maher (Eds.), *Mathematical confluences and journeys* (Proceedings of the 44th Annual Conference of the Mathematics Education Research Group of Australasia, July 3–7), pp. 33–36. Launceston: MERGA.

The Study

The *Leading Mathematics for Improvement in Teaching and Learning* course was designed for primary and secondary mathematics leaders (MLs). It was conducted over 15 weeks and involved five cycles, including an online virtual workshop and school investigations for each cycle. The themes for each cycle were: (1) The role of mathematics leaders; (2) Developing trusting relationships; (3) Effective practices in mathematics professional learning; (4) Enacting an action research cycle–Teaching Sprint. Having conducted other school-based activities to learn about their teachers and students and to trial leading various professional learning activities in their school, the final cycle involved the leaders completing a co-constructed action research project over 4 weeks with the teacher(s). This involved: choosing an aspect of teaching mathematics (Week 10); formulating a question and collecting data about their question (Week 11); co-constructing implication statements from the data analysis (Week 12); designing and conducting a teaching sprint around one implication statement (Weeks 13 & 14); sharing the teaching sprint with the group and critiquing a colleague's teaching sprint (Week 14).

Both primary and secondary mathematics leaders participated in the Leading Improvement in Mathematics Teaching course in 2020 or 2021. Fifteen secondary MLs and 45 primary MLs completed the reports for their teaching sprint. For this paper we collected the written reports of the teaching sprints that the secondary MLs shared with other participants in Week 14 and conducted a qualitative analysis of these teaching sprint reports. These secondary MLs were from metropolitan, regional, and rural schools. Thematic analysis (Bryman, 2016) of these reports was organised according to the sayings, doings, and relating (Kemmis et al., 2014) that occurred during each stage of their Teaching Sprint. Pseudonyms are used when quoting from the teaching sprint reports of the secondary MLs.

Findings

Focus of the Action Research

Sayings. There were a range of foci, or areas of practice to make sense of and improve identified in the initial step. These included: student engagement, student achievement, teachers' pedagogical content knowledge, problem solving, reasoning, student disposition, and differentiated learning.

> I had noticed in my year 10 students were eager to learn ... but really struggled to explain their thinking ... I had also ... heard other staff's frustrations at student's poor results on our tiered ALTS (Assessed Learning Tasks) [with] three exit points … (Bec)
>
> … Can we improve our students' disposition to Maths? (Chris)
>
> The class teacher is primary trained and finding it difficult to manage the Year 8 class and to explain mathematical concepts to the students … Year 8 students ... were disengaged and behaviour was poor. (Faye)
>
> How do we assess student understanding throughout a lesson? (Indira)
>
> … recent data suggests that many of our students are "cruising" .... How can we change our practice to enhance every student's opportunities to achieve at least one year's worth of growth in a year? (Narelle)

Relating. When analysing their reports, we found that all but four of the secondary MLs identified the focus for the teaching sprint without consulting their staff. These four MLs used a team meeting or meeting with one other teacher to identify the focus.

Data Analysis and Planning the Teaching Sprint

Doings. MLs reported using a range of data to analyse, identify, and set the goal for their teaching sprint. The data that the MLs collected and analysed included NAPLAN (https://www.nap.edu.au/) and other assessment data, formal and informal surveys of students or teachers, feedback from students, interviews of teachers, observation of lessons and teacher team meetings, which were used to discuss the focus issue.

> We conducted a Learning Design walk. Whilst the teacher explained .... We observed when the students talked to peers, looked around the room, or opened games on their laptops and calculated an approximate time that they were engaged. (Andy)

> In one of my PLCs, I placed the word "mathematical thinking" onto a Padlet and asked staff to write down their thoughts on how we were currently approaching teaching this and how they thought our students were at doing it. (Bec)

> Staff Opinion Survey shows that 47% of staff are not confident in using data to inform practice. (Jackie)

> I grabbed these [NAPLAN] questions [with low scores] and presented these to a small team of Year 8 teachers. We discussed the features of these questions to see if there were any commonalities. (Narelle)

At each school the teachers gathered, and analysed data collected during the teaching sprint.

> Throughout the sprint teachers collected anecdotal evidence from their classes and I observed some classes. (Bec)

> We surveyed students before and after the 'teaching sprint' to determine the students' dispositions to Maths. (Chris)

> Students were given the same survey post the mathematics experience as a means of assessing their "soft skill" development. Teacher observation of the development of student's team working skills also formed part of this assessment. (Faye)

> We developed a range of tasks that involved some form of reasoning …. Finally, the process of moderation would be used to develop our ability to make consistent judgements on progress and growth. (Narelle)

Relating. In the majority of the cases, the MLs collected and analysed the data. They then held a team meeting to analyse or discuss the findings of the data analysis. In almost all cases the teaching sprint was co-planned by the MLs with the other teacher(s) at that the year level(s) to be involved.

Reflecting on the Teaching Sprint

Sayings. The MLs reported on the mathematics teachers' new understandings of their students, pedagogical practices such as strategies for developing a growth mindset or student responsibility and engagement, planning to address student learning needs and teacher questioning.

> … with us continually modelling mathematical thinking but by the end of the two weeks cycle, we had most students being able to explain why they thought something didn't belong .... Mathematical thinking is something that the team is now seeing as important and something that we need to explicitly teach. (Bec)

> … both the teacher and the Learning Specialist noted that students were more willing to work in their teams and were more willing to persist when challenges arose .... The classroom teacher was challenged … with the questioning needed to direct student thinking .... (Faye)

> All staff have access to PAT-M Data and know how to interpret Group reports …. Maths teachers can identify misconceptions and address these. (Jackie)

> The moderation process allowed us to share ideas as to what we were looking for in the work to represent each level on the rubric. This … also gave us the opportunity to think about what specific skills, ideas, and concepts we should focus on with our students. (Narelle)

Relating. Following the teaching sprint, the MLs reflected on their relationship with colleagues and their collaborative practices:

> Collection of data and sharing of data was super important at getting the team on board to change practice. It is important that I value all of the team's opinions and that I listen and reflect on their opinions. (Bec)
>
> … I need to encourage and remind teachers to develop these skills in students. (Chris)
>
> Year 8 Mathematics team meetings will focus on developing the teacher's capacity to plan and deliver rich tasks. (Faye)
>
> We wanted to celebrate the growth that had been achieved in this area. (Narelle)

When reflecting on the teaching sprint, some of the MLs explicitly identified the value of continuing to promote and provide opportunity to collaborate, collect and analyse various data, plan lessons, and reflect on student students' proficiencies and engagement. Other leaders commented that they need to lead the professional learning of their colleagues.

Conclusion

The teaching sprints provided MLs with a collaboration and consultation process that supported them to relate with teams of teachers to explore teaching practices to improve student learning, engagement, and dispositions. Whilst MLs attempted to keep the focus small, their reports showed that they tackled significant curriculum and pedagogical challenges. Similar to that noted by Grootenboer et al. (2020), the small-scale action research projects (teaching sprints) reported in this paper provided the MLs with evidence of practices that were effective for their students and worthy of both celebrating and continuing.

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Ways in Which a Workshop Stimulated Leaders' Thinking

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Leading mathematics teaching and learning in schools is a complex job that requires the development of specialised knowledge and skills. Opportunities to learn in professional workshops can help to build leadership knowledge and skills. The results presented here describe 262 leaders' prompted reflections at the end of a professional development workshop. Leaders thought deeply about their role in transforming school mathematics. They considered the context of their schools, what was important, and what they valued in mathematics. Leaders thought about the tasks and pedagogies teachers select and the impact teachers' choices have on students' learning. Most of all, leaders reflected on ways that they could act to inspire changes that would lead to improved mathematical outcomes for students. In addition to the reflections of leaders, we present features of the workshop that stimulated leaders' thinking.

There is an increasing appreciation by leaders in educational sectors that the role of mathematics leaders in schools is important in improving student learning outcomes (Department of Education and Training [DET], 2022). To maximise gains by students, leaders of mathematics teachers need to develop both their capacity to lead their colleagues, and their pedagogical content knowledge (Driscoll, 2021). One model of professional learning designed with this purpose in mind is reported here. The professional development program was structured as a single whole day format. A single one-off professional development is usually not recommended (DET, 2005). Yet, in reality, one day of replacement of senior staff is all that is available and feasible in many schools. The challenge was to design a workshop that had the potential to act as a valuable stimulus for thinking for school mathematics leaders and require them to carefully consider ways to improve mathematics teaching and learning in their schools.

The Numeracy/Mathematics Leader Area Workshop 2021 was delivered to 386 participants as 14 single day professional development events. It was designed as part of the Numeracy Suite to lead a cultural shift in thinking about mathematics, develop shared values and passion for mathematics, build confidence of teachers, and positive dispositions for all learners (DET, 2021). It was delivered as an online workshop as the COVID-19 pandemic at the time prevented teachers meeting face-to-face. Every attempt was made to deliver the workshop with Clarke's (1994) inspiring principles of effective professional development in mind. The features of the workshop included:

- pre-workshop tasks to collect interview data from teachers and students to be used in discussions about positive dispositions towards mathematics,
- collaborative small "breakout" groups,
- information sessions connecting research-based theoretical perspectives to the lived classroom experience of the participants, and
- reflection by participants on their thinking at the end of the day.

The participants were all leaders of mathematics in their schools. Each workshop was designed to focus on a specific geographical area of the state to enable participants to network and to build knowledge of their local schools. Participants were allocated to either primary or secondary school groups when collaborating in small groups to enable them to share their expert knowledge about leading the improvement of mathematics learning.

2022. N. Fitzallen, C. Murphy, V. Hatisaru, & N. Maher (Eds.), *Mathematical confluences and journeys* (Proceedings of the 44th Annual Conference of the Mathematics Education Research Group of Australasia, July 3–7), pp. 37–40. Launceston: MERGA.

Method

The data reported here are the participants' (n = 262) end-of-day reflections in response to the prompt: "Today I thought quite deeply about …." Although the responses were written in the online chat box and were visible to others, there was little evidence of repetition of ideas in the data. We contend that the responses provided insights into the meaning the participants made of the workshop.

Findings

Data collected from the online chat were uploaded and coded in NVivo software. As a first pass of the text a word cloud (Figure 1) was produced to look at an overview of the participants' thinking. As can be seen from the central words in the largest font size, students' learning of mathematics together with tasks and teachers in schools were the main foci of the reflections. These words accurately described the main emphases of the workshop which centred on improving students' learning of mathematics, the importance of teachers' productive pedagogies and the student engagement generated by well-selected tasks. The next "ring" of words reflects the content of the workshop day—specifically including dispositions towards mathematics, and staff and student collaboration around mathematics to build engagement and improve thinking and reasoning. Although this representation was affirming in terms of the purpose of the workshop, it offered limited insight into participants' thinking.

Figure 1. Word frequency in the data represented as a Word Cloud in NVivo.

Each written response was then coded using decisions made in the context of this study (Elliot, 2018). Where a leader mentioned more than one thing they had been thinking deeply about, a second categorisation of the response was recorded. For example, "how to develop mathematical thinking in the students at school and how to engender a positive attitude to mathematics at my school". This response was coded *improving mathematical thinking* and *creating positive dispositions.* Therefore, as can be seen in Table 1, there were 371 ideas from 262 respondents. The categories of response revealed the leaders were thinking deeply about; querying their personal leadership, creating positive dispositions and motivating aspirational thinking of their teachers, improving the selection of tasks for better teaching of mathematics, focussing on effective mathematics pedagogies, especially those eliciting students' thinking, reasoning and learning, working as a team with resources for teaching and professional learning, and prioritising mathematics and thinking about the future.

Table 1
Frequency of categories of response

Category	Frequency (%) (n =371)
Querying personal leadership	89 (24%)
Creating positive dispositions and motivation aspirations of teachers	76 (20%)
Task for better teaching of mathematics	43 (12%)
Teaching pedagogy	42 (11%)
Working as a team with resources for teaching and learning	40 (11%)
Teachers discussing students' thinking and learning	36 (10%)
Developing students' mathematical reasoning	23 (6%)
Prioritising mathematics and thinking about the future	22 (6%)

The reflections of the leaders are illustrated by several quotes. Many leaders (n = 89) queried how they could implement ideas, for example, "How I can best support my teachers to try something new in mathematics—try a challenging, open-ended task and to enjoy teaching mathematics?" Leaders (n = 40) reflected on their teams saying, for example, "Today I thought quite deeply about how we are working as individuals and not as a team—and how we should share student thinking [and take] the next step of learning with each other." Many leaders reported their deep consideration of the importance of positive dispositions (n = 76) writing comments such as,

> Today I thought deeply about how our school can come together more regularly to foster a more positive disposition. To provide opportunities as a team of mathematics teachers to encourage one another and support one another. To take risks in the classroom.

Table 2
Personal Leadership Sub-categories of Response to "Today I thought quite deeply about…"

Sub-category	Frequency (%)	Illustrative examples
Questioning action needed by them	33 (37%)	How to deliver learning for peers that drives forward their appreciation for mathematics.
Intended actions described	17 (19%)	Working with teachers to start more discussions around students' mindsets.
Personal behaviours required	15 (17%)	Listening more to both teachers and students to understand their perceptions and dispositions and to act upon that information.
What is important/valued	12 (13%)	What success in mathematics looks like, skills and dispositions we value.
Reflecting of school issues	12 (13%)	How we can make changes at our school to encourage teachers to grow their content knowledge, trust their judgements and explore other avenues of assessment. Also, how we can change teachers' mindsets away from 'hating mathematics' themselves and passing those feelings onto students.

The most frequent category of responses termed, Querying Personal Leadership (24%) dealt with applying workshop ideas to the leader's personal setting. The finding echoes Jackson and her colleagues' statement (2015) that leaders needed to apply professional learning to the reorganisation of school practices (Table 1).

Sub-categories of personal leadership considerations were defined (Patton, 2002) to determine what leaders considered important (see Table 2). Almost one quarter of responses (24%) involved participants questioning how to act on ideas raised in the workshop. However, a further 19% of leaders had made up their minds about how to act and stated their intentions as mathematics leaders in their schools. Some leaders (17%) reflected on the personal behaviours they would adopt. Other leaders (13%) thought deeply about what was important in their schools. A further 13 percent of leaders considered broad school issues of leadership. Examples of each sub-category are found in Table 2.

Conclusion

We found that mathematics leaders were stimulated to think deeply about their role in transforming school mathematics during one day of professional development. Leaders considered the context of their schools, what was important and what they valued in mathematics. Further, leaders thought about the tasks and pedagogies teachers use and their impact on students' learning. Most of all, they reflected on ways that they could act to inspire changes that would lead to improved mathematical outcomes.

While there is explicit advice that one day professional development workshops are ineffective (e.g., Campbell, 1997), we argue that it is not the duration of a professional development workshop that is critical (Adey, 2004). It appeared that the participants came to the workshop as producers of knowledge, not as consumers of knowledge. Setting participants' expectations by asking them to collect interview data from teachers and students to use in discussions about positive dispositions towards mathematics sends a strong message about valuing and using their knowledge. By encouraging collaborative small "breakout" groups the learning is personalised and shared and opportunities are made for future networking. Also, providing research-based information connects theoretical perspectives to participants' lived experience affirms their knowledge. Finally, requiring reflection by participants on their thinking at the end of the day gives participants time to consider how to use their learning to initiate changes in mathematics teaching and learning.

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