Goals and Challenges of School Mathematics Leaders

Ann Downton
Monash University

Jill Cheeseman
Monash University

Anne Roche
Monash University

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School mathematics leaders have an important role supporting teachers to improve student-learning outcomes, yet little is known about their professional goals or the challenges they face. The study reported in this paper examined school mathematics leaders' views by analysing the qualitative responses of 193 primary and secondary leaders to two online questionnaire items. Participants described the goals they held and challenges they perceived when improving mathematics teaching and learning in their schools. Data were coded to categorise responses and examine patterns in the findings. Leaders had clearly defined goals focused on improving teaching and learning, which described their visions, their aspirations for teacher collaboration, and practical actions they intended to implement. Leaders recognised the importance of teachers' knowledge, teachers' mathematical dispositions, and teachers' preparedness to change, in the achievement of their goals. Other goals concerned conditions in schools including the need to: prioritise mathematics improvement; provide time for mathematics leadership; and manage school structures to support teachers' collaborative learning.

Keywords · teacher professional development · school mathematics leaders' goals· Leaders' challenges · school improvement · mathematics

Introduction

Developing school leadership has been a policy focus of educational sectors in Australia since 2008. A review commissioned by the Australian Federal government stated that:

> [s]chool leaders are called upon to play a variety of roles, including leaders of learning, business administrators, and culture setters. Participation in ongoing quality professional learning is essential to help school leaders to continue to develop across each of these dimensions, with a particular focus on their role as leaders of learning (Gonski et al., 2018, p. xvi).

The authors of the Gonski Review acknowledged the work undertaken since 2011, the role played by school leaders, and the importance of leaders' professional knowledge in educational improvement. The report acknowledged that these leaders need to be supported to develop their expertise as leaders of learning and empowered to become effective instructional leaders. Earlier work of Masters (2010) produced a framework for improvement of teaching and learning in schools that specified eight domains—the first of which was an explicit improvement agenda, where "the school principal and other school leaders are united, passionate and explicit about their core objective—to improve learning outcomes for all students in the school" (p. 1).

Both the Gonski Review (2018) and the work of Masters (2010) highlighted the need for distributed leadership (Gronn, 2010) in schools, which includes middle leaders (Grootenboer et al., 2020) with specific skills and expertise who work directly with teachers with a focus on student learning. The current paper is concerned with the goals of these middle leaders, referred to as School Mathematics Leaders (SMLs), and the results reported here have commonalities with Masters' improvement framework. These include: an explicit improvement agenda; the use, analysis and discussion of data; a culture that promotes learning; targeted use of school resources; an expert teaching team; systematic curriculum development; differentiated classroom learning; and effective teaching practices.

A good deal is written about school improvement goals (e.g., Gaffney & Faragher, 2010), yet there is less research about the aspirations of SMLs to improve the teaching and learning of mathematics in their schools. Leaders play a pivotal role in mathematics education as teacher-leaders with responsibilities for developing and improving mathematics teaching and learning in their schools. However, research findings concerning SMLs' aspirations for mathematical improvement and the obstacles they face in achieving their goals appear to be a gap in the literature. Knowing the goals and challenges they experience will provide educators, educational authorities, and researchers with further insights into both the nature of their work, and the professional learning or leadership support leaders require to enact their role.

The purpose of the study reported here was to document the goals and challenges of primary and secondary SMLs. The research questions we sought to answer were:

- What are the goals of school mathematics leaders?
- What are the challenges school mathematics leaders face?

Background

In the past, leaders in Australian schools who supported teachers to improve the teaching and learning of mathematics had various titles (see Cheeseman & Clarke, 2005; Department of Education and Training [DET], 2020; Sexton, 2019). The current study uses the title, School Mathematics Leader (Driscoll, 2017, 2021; Sexton & Downton, 2014), to describe school-based leaders of mathematics. These leaders are teachers who have a formal responsibility for improving mathematics learning and teaching in their school by providing professional learning for their colleagues, both within the classroom and in planning and assessment and moderation meetings. We examined the research literature for leaders' personal professional goals and the challenges faced when improving learning outcomes in mathematics, in the Australian context and internationally.

Goals for Improvement

A search of the literature related to educational goals revealed that a great deal has been written about system goals (see e.g., DET, 2022) and advice for leaders of mathematics teachers (e.g., Borko et al., 2021) but very little about SMLs' personal professional goals for school improvement. Insights into these personal goals would provide evidence of the aspirations and ideals these leaders hold regarding improved mathematics learning in their schools.

Gaffney and Faragher (2010) recommended two goals for sustainable improvement in mathematics outcomes: effective teaching of mathematics and high-level school leadership. Indeed, there is consensus that the greatest impact on student achievement is likely to occur when the leaders' role is focused on improving teacher practice (e.g., Hattie, 2002; Robinson et al., 2008; York-Barr & Duke, 2004). The same argument is reflected in more recent international research (Cobb et al., 2018; Fairman & Mackenzie, 2015; Lipscombe et al., 2020; Martinovic & ElKord, 2018), that school mathematics leaders play a role in improving the quality of teaching and learning in their schools.

Australasian research about mathematics leadership goals

Given the importance of the role these leaders play in their schools, our search of the literature showed little evidence of documentation of SMLs' personal professional goals in primary school contexts. In relation to leadership practices more broadly, a study by Higgins and Bonne (2011) examined the instructional leadership in a primary school in New Zealand. In particular, the ways in which the school leaders (principal, deputy and assistant principals), and numeracy lead teachers engaged in reforming the teaching and learning of mathematics. Higgins and Bonne found that mathematics reform was more effective when one of the numeracy lead teachers also held a designated leadership position such as assistant principal. The authors also identified key strategies that supported the implementation of their reform agenda. These included: strong support from the principal; consistent on-going professional

learning for staff; regular classroom observations; and sufficient time to embed new instructional practices.

Set within an Australian context, Vale et al.'s (2010) study focused on the leadership practices and approaches to developing leadership skills to improve mathematics learning of students in 43 primary and secondary low socio-economic status schools and networks in a rural region of the state of Victoria. Vale and colleagues found that leaders had a clear vision of school and classroom practice and set directions for improved student learning. A more recent study by Wilkie and Tan (2019) reported seven Australian secondary mathematics teacher leaders' personal goals for students' learning and achievement in mathematics. The authors found that in some contexts there was a mismatch between the leaders' goals and actions, due to teachers' beliefs, particularly related to student streaming, and parents' attitudes towards mathematics. In addition, although these leaders had specific goals, school policy constraints may have impacted the extent to which they achieved the desired outcomes.

Common to these studies were findings that mathematics leaders have clearly stated goals and targets for student learning; and play a crucial role in bringing about change to improve students' learning outcomes. Both of these findings are relevant to our study in that they highlight there is still more to know about the nature of these leaders' goals and the challenges they face to achieve these goals.

Researching leaders' goals

In their meta-analysis of the literature, Hallinger and Heck (2002) noted that researchers often made little distinction between educational visions, missions and goals. These authors considered a "vision, by its nature is a source of inspiration for one's life work" (p. 10). Whereas a "mission reaches into the hearts of people and engages them to act on behalf of something beyond their own immediate self-interest" (p. 13). A goal for these authors represents the difference between the current situation and a desired future state. A goal is something someone would like to accomplish; by contrast, often a functional, and more narrowly drawn target. The strength of a goal is its ability to focus the attention of people on a limited frame of activity. As Hallinger and Heck suggested, "Goal-setting can be seen as an avenue for school improvement" (p. 19). For the purposes of the present study, we chose to ask respondents to state their goals over a defined time frame to focus on practical and achievable improvements they would wish to see. In our subsequent analysis of the data, we returned to Hallinger and Heck's exhortation to define the types of goals more distinctly and used an adaptation of their definitions to discuss the findings of our study.

Challenges Faced by Mathematics Leaders

Studies in Australia and New Zealand have built an understanding of the challenges school mathematics leaders face in performing their roles and achieving improved outcomes in their school (Driscoll, 2017, 2021; Sexton & Downton, 2014; Thomas & Ward, 2006). The most common challenge reported by SMLs was a lack of formally allocated time to fulfil their leadership responsibilities. Time for planning, mentoring teachers in classrooms, reflecting on insights or discussing concerns, are important factors in improving the teaching and learning of mathematics in schools (Cheeseman & Clarke, 2005; Driscoll, 2017, 2021; Millet et al., 2004; Sexton & Downton, 2014). Other challenges included limited budgets for resources, inadequate support for teachers new to the school, and resistance of teachers towards adopting changed approaches to mathematics teaching.

Thomas and Ward (2006) surveyed 937 lead mathematics teachers in New Zealand. Their findings ranked factors perceived as barriers to sustaining and developing numeracy in their school. These barriers included:

- lack of teacher time to plan, teach and assess;
- training of new staff;
- teacher resistance;
- lack of budget for resources and release time;
- lack of appropriate resources;

- lack of focus on numeracy;
- lack of ongoing professional development; and
- lack of principal support for numeracy.

Driscoll (2021) found that some leaders felt they lacked support from their principals. Lamb (2010) argued that principals who chose not to prioritise mathematics improvement "lost opportunities" when they failed to provide for collaborative planning of mathematics programs. In addition, Farchi and Tubin (2019) found that more effective schools provided leaders with "an environment of clear rules, … [and] appropriate resources of time, space and authority" (p. 379). In those schools, the principals were important in providing the necessary resources for SMLs to perform their role. Furthermore, Gasston-Holmes (2019) referred to similar actions by principals as "culture building and enabling processes" (p. 25) that were necessary for building capacity of both teachers and leaders of learning.

Several studies have found a statistically significant relationship between teacher knowledge and student achievement (Ball et al., 2008; Baumert et al., 2010; Beswick, 2007; Campbell et al., 2014). Of concern is the evidence that SMLs sometimes struggle with their personal mathematics content knowledge and pedagogical content knowledge (e.g., Driscoll, 2017, 2021). Additionally, leaders may lack the self-efficacy to lead (Corbin et al., 2003). In fact, Driscoll (2017) reported that SMLs who expressed a lack of confidence in leading often had been in the role for less than three years and had little leadership training. This relative inexperience and lack of formal leadership preparation appeared to make their support of teacher development a challenge.

Leaders may also face challenges related to teachers' resistance to change their classroom practices or at least a lack motivation to engage with new teaching approaches (Gaffney et al., 2014; Thomas & Ward, 2006). In addition, teachers may hold negative attitudes about mathematics (Wilson & Thornton, 2007/2008), which reduces their confidence to take risks and engage fully in new teaching approaches. Teachers' views of students may be influenced by a "fixed mindset" (Dweck, 2006) whereby they believe that students are as smart as they are going to get and that not all students can learn mathematics. Wilkins (2008) found that teacher' beliefs about mathematics teaching and learning together with teachers' awareness of their students' mathematical dispositions are thought to influence teaching practices.

Research Approach

This study is anchored on an interpretivist paradigm (Creswell, 2007). Interpretivist methods and their application to mathematics education research date back to the 1980s (e.g., Eisenhart, 1988) and have been used in mathematics education research when striving to construct meaning from experiences shared or witnessed (e.g., Cobb, 2007). Interpretivism holds that reality is in some sense constructed by the mind, human knowledge is radically interpretive and there are no perspective-independent facts (van der Walt, 2020). There are multiple interpretations of single events and situations; hence knowledge is multi-layered and complex (Cobb, 2007). As this current research requires interpretation of the perspectives of the SMLs, an interpretivist lens is an appropriate frame.

The purpose of the current research was to document SMLs' view of the goals and challenges in their professional lives and then to interpret and summarise the findings. We brought to the task an understanding that "the world is essentially a construct; human knowledge is radically interpretive; there are no perspective-independent facts" (van der Walt, 2020, p. 66). Our role in the research was to interpret the unique views of each participant carefully, to consider similarities and differences in the responses of participants, and to search for patterns in the data that would allow us to construct a picture of the goals and challenges of school mathematics leadership more broadly.

Context of the Study

This study was part of larger study that involved primary and secondary school mathematics leaders (SMLs) from public schools in the state of Victoria, Australia, who were invited to complete an online questionnaire titled *Numeracy Leaders' Needs Analysis* (Vale et al., 2020). The survey was distributed

electronically to principals of all primary and secondary public schools in Victoria who were asked to pass on the link to the questionnaire to their SMLs. SMLs could also access the online questionnaire through the state government Department of Education website. The purpose of collecting these data was to identify the activities, knowledge, wishes, goals, challenges and professional learning needs of SMLs in Victorian primary and secondary schools and to seek their preferences for professional learning. In this article we report findings with respect to the aspirational goals and challenges of these leaders.

Participants

One hundred and ninety-three participants (149 Primary and 45 Secondary) responded to the questionnaire. This breakdown corresponds to the proportion of public primary and secondary schools in Victoria (69% and 31% respectively). Most participants (85%) indicated they had teaching responsibilities in addition to the school mathematics leadership role, and 67% had been teaching for more than nine years. In contrast, just over 60% had three years, or fewer experience as a SML and almost 15% were not mathematics leaders. Participants who were not designated mathematics leaders, held another leadership position such as Learning Specialist or Lead Teacher and were acting as SML under the banner of another position.

Data Collection

The questionnaire gathered responses online using Qualtrics™ Online Survey Platform. The questionnaire comprised 24 items—a mix of Likert ranking (7 items), closed responses (11 items), multiple choice (3 items) and open response (3 items) that focused on topics including: information about mathematics leaders' wishes, goals and challenges; mathematics leaders' perceptions of their knowledge of mathematics, pedagogies, curriculum, and resources; current leadership practices; professional learning preferences; and demographic information. Participants were not required to record their names as part of demographic data, only the region, whether primary or secondary, and years of experience. In this paper we report responses to two consecutive open response items that focused specifically on SML goals and challenges to answer the research questions:

- *As a leader of mathematics, your three key goals over the next three years are …*
- *Challenges that you may face in achieving these goals are ….*

Data Analysis

Analysing the qualitative data collected from open responses to the online questionnaire items, we noted the views of Bazeley (2009) whose advice was to strive to produce a deep analysis and to use divergent views to challenge generalisations by returning to substantive literature. It is important to note that our initial examination of the data revealed similarities in the goals leaders listed and the perceived challenges they faced. Therefore, we decided to treat the responses of the primary and secondary SMLs as one representative group. The data were analysed in two main ways:

1. Goals and challenges were categorised, coded and quantified.
2. Types of goals were defined and used to classify the data.

Goals and challenges were categorised, coded and quantified

Participant responses to each of the items were entered into an excel spreadsheet and the research assistant (Author 3) initially colour coded each response according to the main focus of each response (e.g., teacher practice, student learning). From this initial coding, the three researchers (Authors) independently sorted the data into categories that emerged. These categories were compared, discussed, and refined until a consensus was reached (Creswell, 2007; Miles & Huberman, 1994). The six categories agreed upon included: Teaching and Learning, Students, Leadership, Teachers, Resources, Community Involvement. Key differences in our independent classification related mainly to terminology such as modes of learning, school settings, and whether resources was a category or a

subcategory. Subcategories were then defined to examine the data in greater depth. Where respondents had written multiple ideas in one response, each separate idea was categorised and coded. We created tables to summarise the data, then compared participants' responses and sought patterns in the analysis to relate categories to the types of goals in the findings (Gibbs, 2018). We conducted a further analysis of the data to identify whether there was a direct match or relationship between a SML's goals and the perceived challenges.

Types of goals were defined and used to classify the data

In the second step of the analysis we examined the data deeply from a different perspective. The theoretical framework of goals proposed by Hallinger and Heck (2002) was adapted to investigate different types of goals in the data as: vision goals, consensus-forming goals, or practical goals. We considered vision goals a source of inspiration for the work of SMLs incorporating their values and beliefs about mathematics teaching and learning. We adapted the "mission" goal originally defined by Hallinger and Heck (2002), by adopting the phrase "consensus forming" as this reflected more clearly the nature of the second category of responses. This phrase was informed by the framework of leadership created by Fullan (2001) who noted the importance of consensus making, and leadership that developed shared understanding. We categorised goals that reflected building cohesive, collaborative teams of teaching colleagues with aligned ideals and purposes. The third type of goal we defined was practical goals, those actions needed to achieve measurable specific changes in a limited time. The types of goals are described and exemplified in Table 1. The goals data were then coded according to the three types of goals as defined, and a 20% sample was double coded by two independent researchers with an inter-rater reliability of 85%. The category descriptions were refined, and the data were recoded to produce the results reported here.

Table 1
Types of goals described and exemplified

Types of goals	Description	Example (# Respondent ID)
Vision goals	Goals expressed as ideals to which School Mathematics Leaders aspire. These goals do not imply any action on their part. They represent values and beliefs, which the leaders hope to realise.	Increase pedagogical knowledge for all (#13)
Consensus-forming goals	Goals that are ambitions to be achieved by all. In this case we took goals to represent consensus building and creating a shared understanding of mathematics educational ambitions. Alignment of purpose.	Build consistency across the school in the areas of assessment, reporting, support and extension (#21).
Practical goals	Goals for implementation. Actions towards a goal. Some steps to achieving a goal – doing something.	Work with teachers to ensure that challenging tasks are actually challenging (#19).

Results

The results are presented in two sections: the perceived goals and challenges of the SMLs reported as frequencies and percentages; and described as patterns in responses through the analysis of goals categorises as either vision, consensus forming, or practical goals. Finally, we describe the relationship between SMLs' goals and challenges.

Goals and Challenges of the SMLs

SMLs responded with, on average, three ideas each as the questionnaire item requested. The content foci of the goals were coded to six major categories: Teaching and Learning, Students, Leadership, Teachers, Resources, Community Involvement (see Table 2). To examine the data in greater depth, further analysis of the goals in each category resulted in the following subcategories:

Teaching and Learning: Pedagogy; Assessment/data analysis; Collaboration; Lesson/task type; Planning

Students: Learning outcomes; Dispositions/agency; Extension/support/ intervention

Leadership: Whole school approach; Leaders' capacity to lead

Teachers: Knowledge of mathematics; Knowledge/use of curriculum; Disposition/mindset; Beliefs/capabilities

Resources: Physical and online teaching materials; Professional learning (human resource); Time, Budget

Community involvement: Parents; Wider community

A similar analysis of the challenges was conducted to identify SMLs perceived hindrances to achieving their goals. Our analysis revealed that most of the obstacles aligned with the same broad categories as the goals, with the exception of those relating to school structure, so a further category was added (see Table 2). Subcategories of School structure include: Mathematics not a priority; Timetabling/organisation; Staff turnover; School size; and Networking with other school mathematics leaders.

In Table 2 the results of the coding of goals and challenges into the seven main categories are shown. Almost half of the goals focused on teaching and learning (45%). This finding makes sense because to improve students' mathematical outcomes, teaching and the learning goals need to be considered. The next most frequent responses focused on goals related to students (20%); leadership (17%); teachers (14%); resources (2%) and community involvement (2%). In contrast, the main sources of challenge are resources (32%) teachers (30%) and to a lesser extent, school structures (17%).

Table 2

Goals and challenges: Frequency of leaders categorised responses

Categories	Goals (*n* = 637) Frequency (%)	Challenges (*n* = 487) Frequency (%)
Teaching and learning	290 (45%)	28 (6%)
Students	124 (20%)	22 (4%)
Leadership	111 (17%)	40 (8%)
Teachers	88 (14%)	146 (30%)
Resources	13 (2%)	155 (32%)
Community involvement	11 (2%)	14 (3%)
School structures	0 (0%)	82 (17%)

Viewing the same data graphically (Figure 1), contrasts can be seen in the nature of SMLs' goals and challenges. A key point of difference is that the frequency of responses in the goals relates to teaching and learning, students and leadership are greatest, whereas resources and teachers are the greatest factors inhibiting improvement.

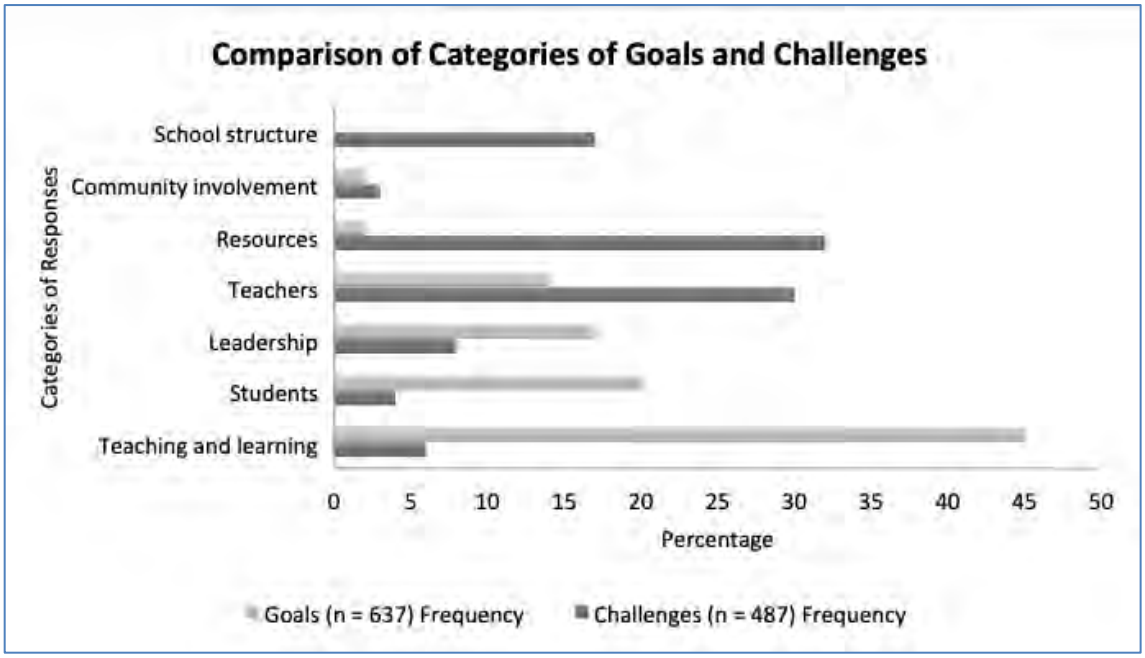

Figure 1. Goals and challenges: Frequencies of leaders' categorised responses

Our analysis of the data suggested that teacher knowledge and disposition towards mathematics create challenges for leaders. Further, the SMLs prioritised teaching and learning and recognised this as a core to improving students' mathematical outcomes. In addition, leaders stated that in order to achieve improvements sufficient resources, in particular time and budget, are necessary. Following is a deeper examination of the nature of the goals and challenges is presented and discussed for each of the seven categories and subcategories. Data are presented in tables or graphs; and examples of responses are included.

Teaching and learning

Examination of the subcategories (Table 3) revealed that just over half of these goals related principally to teachers' pedagogical practices (35%) and assessment and data analysis (32%). Examples of the goals pertaining to each subcategory show clear purpose and intent.

Table 3
Frequency of teaching and learning goals in subcategories

Teaching and Learning Subcategory	Goals (*n* = 290) Frequency (%)	Examples of response (# Respondent ID)
Pedagogy	103 (35%)	Promote problem-solving skills and encourage reasoning (#23)
Assessment/data analysis	91 (31%)	To embed formative assessment practices (#126)
Collaboration	41 (14%)	Co-teaching and planning opportunities and ongoing reflections (#48)
Lesson/task types	33 (11%)	Facilitate engaging lessons with real-life connections (#19)
Planning	22 (8%)	Overhaul how maths planning is done at the school (#106)

As discussed earlier, only a small percentage of challenges (6%) related to teaching and learning. Examples of these include:

> Shifting the practice of teachers who feel comfortable in their own practice (#50 pedagogy)
>
> Teachers not willing to team-teach ((#67 collaboration)
>
> Teachers providing different tasks as differentiation rather than designing low floor, high ceiling tasks for engaging all learners (#30 lessons/task types; pedagogy)
>
> Staff rely on summative assessment and not savvy with formative assessment (#172 assessment /data analysis)
>
> Hard to effect change when you don't see what people are planning or doing in their classroom (#51 planning)

Overall, the SMLs recognised that improving teachers' pedagogies and assessment practices were key to achieving improved learning outcomes for students.

Students

The most common foci of the goals relating to students were: student learning outcomes (n = 62, 50%), and disposition or agency (n = 47, 38%). Of a lesser note were goals relating intervention/support/or extension programs (n = 15, 12%). Goals relating to student learning outcomes largely focused on growth, or improvement (n = 32). Some of these goals were general such as "to improve student learning outcomes" (#19) or "for all students to experience significant growth" (#141). Other goals (n = 14) related to the national testing results, student goal setting, and problem solving capabilities. Goals pertaining to disposition/agency focused on self-belief, confidence, positive mindset, and student voice in mathematics lessons. Examples of respondents' specific goals for students include:

> Improve numeracy outcomes85% of students making 12 months growth in 12 months (#10)
>
> All students from Year 7-10 learning at their appropriate level whether it be above or below their current year level standard (#38)
>
> To continue to build students engagement with learning mathematics, including risk taking and enjoyment of the subject (#63)
>
> Increase student agency during numeracy sessions (#184)
>
> Foster a change in mindset of students in mathematics (#102)
>
> Build student excitement of maths learning and an appreciation of the diversity/richness in this subject (#29)
>
> Improve Problem Solving capabilities of students (#95)
>
> For students to be engaged in challenging maths tasks that enable them to grow and develop resilience (#91)
>
> For students to set their own goals and monitor their learning (#43)

Some of these aspirational goals relate specifically to student learning (#63, #184, #29, #91, #43), and are goals that can be implemented immediately, whereas others are more long-term goals (e.g., #10, #38).

A minority (5%) of respondents saw the students as an obstacle to achieving their goals. In particular, student disposition; ability; and behaviour were components that some SMLs considered in relation to achieving their goals. For example:

> Massive spread of ability levels in maths when they come to us is Year 7 - virtually impossible to cater for everyone (#67)
>
> Students can be two or three years above their curriculum areas so need to be further challenged (#11)
>
> Changing students from fixed to growth mindset (#108)

> Leadership and teachers not understanding the importance of student disposition in relation to understanding (#89)

Fewer challenges relating to students were identified by SMLs as compared to most other challenges. It could be argued that some of these identified challenges would not be overcome in the short term as they were contingent upon improved teaching and learning. In particular, the data highlight the need for all staff to have a shared understanding of the role student disposition plays in learning.

Leadership

Although only 17% (n = 111) of respondents' goals related to leadership, of these, 9% pertained to improving their own capacity as a leader. In contrast, only 8% of the challenges related to leadership. A closer analysis of these found that the majority of goals in this category (91%) focused on the need for a whole school approach, that is, having a consistent approach and shared philosophy towards the teaching and learning of mathematics. A closer analysis of the challenges revealed that just over half related to their capacity to lead others, and just under half to a lack of support and role clarity. Examples of respondents' specific goals and challenges include:

> Implementing a whole school approach to the way mathematics is delivered to our students (#31 goal)
>
> Continue to work towards having a consistency of approach in the teaching of mathematics (# 103 goal)
>
> To continue developing a learning culture of the importance of mathematics (#60 goal)
>
> Develop my own capacity to lead effective change school wide (# 135 goal)
>
> Personal knowledge, and skill to implement [change] confidently (#136 challenge)
>
> Lack of direction and role clarity (#115 challenge)
>
> Lack of support from middle leadership (#18 challenge)
>
> Unsupportive leadership - not really clear on what their expectations are of myself nor their staff which means it is hard to promote those values in teaching staff (# 51 challenge)

Overall, some of goals relating to their leadership and views of the impediments to achieving them were beyond their control.

Teachers

Teachers are the subject of both SMLs goals and challenges—teachers' knowledge of mathematics in particular features prominently (see Table 4). To identify any relationships between goals and challenges, responses in the same categories are aligned.

Leading teachers to develop knowledge is a priority goal (60%) but a lack of existing teacher knowledge is also considered a major challenge (45%). In addition to SMLs' responses about knowledge, teachers' attitudes were also considered. Challenges concerning teachers' mathematical dispositions, confidence and commitment, and beliefs were reported.

Table 4
Teachers: Subcategories of goals and challenges with examples

Teachers: Subcategories	Goals (*n* = 88) Freq (%) example (#ID)	Challenges (*n* = 146) Freq (%) example (# Respondent ID)
Knowledge of mathematics	53 (60%) To build capacity and knowledge in all areas of mathematics (#48)	65 (45%) Teacher knowledge of developing rich learning tasks (#40)
Knowledge/use of curriculum	17 (19%) To improve teacher knowledge of the learning continuum (#12)	5 (3%) Teachers with a lack of understanding of the curriculum (#178)
Disposition/mindset	13 (14%) For staff to feel confident and passionate about teaching maths (#91)	32 (22%) The low level of confidence and perceived competence across the board of generalist primary teachers (#188)
Beliefs/capabilities	5 (6%) Develop efficacy and self-belief in staff as to their capabilities of teaching maths (#100)	2 (1%) Teacher belief that worksheets are the best way to teach as they haven't seen results to suggest otherwise (#107)
Staff buy in/reluctance	0 (0%)	32 (22%) Some transmissive teachers don't see any need or urgency for change (#97)
Feeling overwhelmed	0 (0%)	10 (7%) Overwhelming teachers with too much change as there are also changes made to literacy (#143)

Viewing the same data graphically (Figure 2), similarities and differences can be seen in the nature of SMLs' goals and challenges. A noticeable similarity is the high frequency of responses for knowledge of mathematics both as a goal and a challenge. The data suggests there was a priority given to goals and challenges associated with this category possibly because SMLs recognise that improved teacher knowledge of mathematics is a key factor to improving student learning outcomes. Further, to achieve improved knowledge requires teacher commitment, a "growth mindset" (Dweck, 2015) and a positive disposition towards mathematics, which also suggests a change in culture. Hence, disposition/mindset was the third highest goal, and the second highest perceived challenge, along with reluctance to embrace change. Dimensions of staff buy in/reluctance, and feeling overwhelmed are noticeable differences in these data, as there are no goals associated with these perceived challenges.

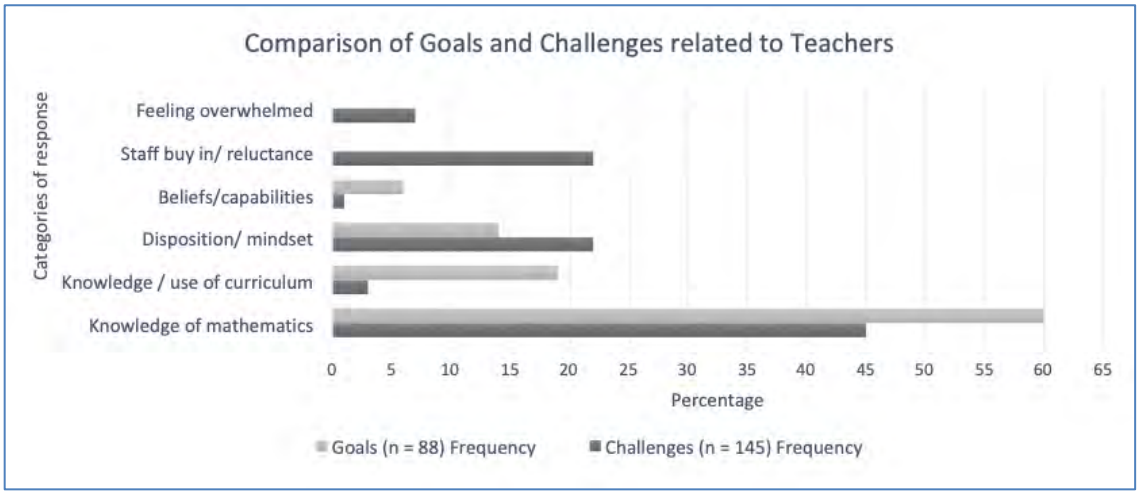

Figure 2. Comparison of categories of goals and challenges related to teachers.

Resources

A very small proportion (2%) of respondents' goals related to physical resources and professional learning resources (see Table 2). In contrast, 32% of the challenges related to resources being the most cited obstacle to achieving their goals. As seen in Table 5, lack of time is the largest contributing factor, followed by resources and funding to enact some of the goals and provide the necessary professional development and support required. Professional learning referred to time for mathematics professional development generally, for SMLs and for non-specialist mathematics teachers (sometimes called out-of-field mathematics teachers, in secondary schools).

Table 5
Resources: Frequency and percentage of challenges by category

Subcategory	Challenges (n = 155) Frequency (%)	Examples (# Respondent ID)
Time	94 (61%)	Time to work with teachers in the planning aspect (#9) Time release for both my own professional learning and planning time (#120)
Resources (physical, human)	30 (19%)	Lack of teaching resources (#60) Having the resources to support projects and apply skills in varied ways (#109)
Budget	24 (15%)	Resourcing the needs to the school within a tight budget (#183) Budget constraints when implementing professional development (#31)
Professional learning	7 (5%)	Support staff with timely professional learning instead of going ahead when we are not ready (#109) Professional learning needs for the non-mathematics teachers (#108)

The frustration of not having enough time or resources is evident in the following SMLs' responses.

> Time allocation as I am two days out of the class and monitoring and implementing my goals may be time consuming, maintaining 'teacher buy in' as they can often see the introduction of something as 'just another thing to do.' (#189)

> Lack of resources to allow me to focus on doing that job well. That is, I will be in a classroom and doing other work that means I cannot solely focus on mathematics, not enough money in the mathematics budget. (#63)

Community involvement

A small proportion of goals (2%) and challenges (3%) related to Community involvement. Examples include:

> Increase community involvement in school mathematics program (#28 goal)

> To engage families and our community in maths (#56 goal)

> Build community awareness in mathematics by having events introducing them to Numeracy portals, explaining involvement with programs such as Maths Talent Quests and Maths Games Days (#81 goal)

> Current perception of mathematics in the wider school community (#68 challenge)

> Parent community unaware of mathematical mindset and hence placing emphasis on performing and not learning (#69 challenge)

> Oppositional views on what good maths learning is within the school and school community (#170 challenge)

These goals and challenges suggest that SMLs are aspiring to involve the wider community and, by doing so, may dispel some current misconceptions about mathematics learning and teaching.

School structure

School structure was an additional theme related only to challenges. Results are presented in Table 6 with some illustrative quotations.

Table 6
School structure: Frequency and percentage of challenges by subcategory

Subcategory	Challenges (n = 82) Frequency (%)	Examples
Mathematics not a priority	41(50%)	Schools current focus is literacy, so it is difficult to implement numeracy across the curriculum (#4)
Timetabling/organisation	19 (23%)	Programming (#33) /timetable restraints (#16)/ insufficient time devoted to our work in maths (#44)
Staff turnover	12 (15%)	Difficulty employing qualified maths teachers (#80)
School size	6 (7%)	Being a Prep-12 school has some challenges of consistency across both areas (#73)
Networking or collaboration	4 (5%)	Lack of opportunities to network with other middle leaders (#80)

School structures created impediments to SMLs achieving their goals. The most common one being that mathematics was not seen as a priority in their school improvement plans, which has several implications for SMLs trying to achieve their goals. In addition, timetabling and organisational structures can obstruct mathematics improvement. These issues are encapsulated in respondent #110's responses:

> Lack of support from the principal
>
> Budget constraints
>
> Lack of time with other staff to plan and discuss maths lessons and assessments
>
> Competing with other subject areas

Related to the lack of support, one respondent (#176) highlighted the lack of school leadership commitment.

> Leadership not willing to accept that there is a need to improve mathematics despite data showing that students are achieving significantly below expected levels. Leadership not invested in the improvement of mathematics. Leadership is not willing to provide time to coach staff, whether at PLC or within the classroom.

SMLs need the support of the school leadership team to enact their role and strive to achieve their goals.

Discussion of the Focus of SMLs' Goals and Challenges

The results showed that the main focus of SMLs' goals was teaching and learning, students, leadership, and teachers. In contrast, resources, teachers' knowledge of mathematics, and school structures, were the focus of the challenges. The SML leaders recognised that prioritising teachers' pedagogical practice and assessment practices was key to achieving improved learning outcomes of students. To achieve this improvement required adequate resources, specifically time, materials and funding. Teacher knowledge, disposition and teacher resistance were also identified as obstacles to achieving overarching goals of improved teaching and learning across the school. Sexton and Downton (2014) found that improvement of mathematics learning was attributed to a changed school culture with a positive mindset and collaborative planning. Only a small percentage of SMLs reported planning as a goal (Table 3), whereas dispositions, in particular mindsets (Dweck, 2006) were both a goal and one of the major challenges (Table 4).

A key finding from the results is that SMLs recognised the importance of building teachers' pedagogical content knowledge and mathematical content knowledge to improve student outcomes. This finding resonates with those of earlier studies that described relationships among teacher

knowledge and student achievement (Ball et al., 2008; Baumert et al., 2010; Beswick, 2007; Campbell et al., 2014).

Time was a common challenge identified in the research literature, in particular time to carry out the mathematics leaders' role (Cheeseman & Clarke, 2005; Driscoll, 2021; Sexton & Downton, 2014), skill new staff (Thomas & Ward, 2006), and sustain staff collegiality (Vale et al., 2010). Time for planning, working with teachers in classrooms, reflecting on practice or discussing concerns, is important when improving the teaching and learning of mathematics in schools. Yet, almost two decades after Millet et al.'s (2004) original finding, time allocation for SML is still a problem identified by leaders of mathematics.

Teacher resistance (staff buy in) was also identified as a barrier to change (Sexton & Downton, 2014; Thomas & Ward, 2006). Aligned with teacher resistance are teachers' beliefs, which some respondents identified as barriers to achieving their goals (#12, #25, #107). Wilkins (2008) also found that teacher' beliefs about mathematics teaching and learning together with teachers' awareness of their students' mathematical dispositions are thought to influence teaching practices.

Related to staff buy in was the subcategory of feeling overwhelmed, as indicated by one respondent's comment (#143) that teachers were overwhelmed by all the changes in literacy. Sexton and Downton (2014), referred to such demands on teachers as competing agenda, and that SMLs need to be mindful of these pressures on teachers when leading improvement in mathematics teaching and learning.

In addition to the three main challenges to achieving their goals some SMLs identified their own limited leadership skills and self-efficacy as challenges for them. These SMLs doubted their ability to deal with teachers' negative dispositions, teachers' reluctance to explore new and different pedagogical approaches, or with teachers' feelings of being overwhelmed. Other studies have reported that SMLs' lack of mathematics knowledge and confidence can impact on their ability to enact their role (Clarke et al., 2005; Gaffney & Faragher, 2010), or lack of self-efficacy to lead (Corbin et al., 2003; Driscoll, 2017).

This first analysis of the SMLs' goals was to count the frequency of the foci of leaders' goals - the "what" of what leaders aimed to improve. Three findings were evident from these results.

1. SMLs had clearly defined goals focused on improving teaching and learning and subsequently student learning outcomes. The SMLs recognised that improving teachers' pedagogical practice and assessment practices were keys to achieving improved learning outcomes for students. Moreover, domains of the Masters' (2010) improvement framework were reflected in some of the SMLs' goals, including: the analysis and discussion of data, building a school culture that promotes mathematics, targeted use of resources, striving for expert teaching teams, and effective teaching practices.
2. **T**he challenges SMLs identified related to resources, teachers and to a lesser extent, school structures. This finding suggests SMLs recognise that to improve student learning outcomes and teacher practice, sufficient resources are required, in particular formal allocated leadership time and budget.
3. SMLs have a leadership role in their schools, yet they often have to contend with: conflicting priorities, limited decision-making responsibilities, and leadership support to enact their role to achieve their goals.

Categorising the Types of Goals

Standing back and thinking about whether the picture we gained from our first analysis reflected the complexity of the data set us thinking about Hallinger and Heck's (2002) research that said researchers were not rigorous in their definition of goals. We took the distinction these authors made between vision, mission, and goals to create categories for the types of goals as shown in Table 1. Applying our definitions (Table 1) we re-examined the data to consider which type of goal each response represented: a vision goal, a consensus-forming goal, or a practical goal. Table 7 provides a summary of these results.

Table 7
Frequency and percentage of type of goal by categories (n = 122)

Categories	Vision Goals (*n* = 58)	Consensus forming Goals (*n* = 31)	Practical Goals (*n* = 33)
Teaching and Learning	18 (31%)	20 (65%)	22 (67%)
Students	23 (40%)	2 (6%)	3 (9%)
Teachers	12 (21%)	3 (10%)	2 (6%)
Leadership	5 (8%)	6 (19%)	3 (9%)
Resources			1 (3%)
Community involvement			2 (6%)

There were almost twice as many vision goals as either consensus-forming goals or practical goals. This demonstrates the idealistic and inspirational nature of the goals of many SMLs. Their vision goals largely related to improved mathematical opportunities and outcomes for students (40%) and visions of the ways that school mathematics teaching and learning could be changed for the better (31%).

Consensus-making goals concentrated on teaching and learning (65%). This result reflected the SMLs views that, for lasting improvements in mathematics teaching and learning to be achieved, teachers need to be supported to build their knowledge for teaching and a positive disposition towards teaching mathematics. The goals in this category were closely aligned to those described by Hallinger and Heck (2002) as developing a "mission". The importance of a shared philosophy was acknowledged and the need for support from school leadership was mentioned. In the subcategory of leadership, 19% of SMLs specified their goals to develop their personal leadership knowledge and skills, as they recognised that leading teams of teachers would require experience and skill.

Practical goals mainly focused on teaching and learning of mathematics (67%). Very practical matters were mentioned as ways of initiating improvements in learning outcomes. There were stated intentions to develop scope and sequence documents to align teachers' expectations. Others had plans to examine assessment protocols to moderate teachers' knowledge of students' mathematical misconceptions. Ideas and goals for working alongside colleagues in classrooms to build opportunities to share expertise were also noted and planning mathematics programs with teams of teachers were included in practical goals. The following examples of SMLs responses highlight the depth of their goals relating to teaching and learning.

> Increase pedagogical content knowledge for all (#14 vision)
>
> Develop teachers' understandings of problem solving and the other mathematical capabilities to incorporate them more into their teaching practice (#63 consensus forming)
>
> Get teachers to the point where differentiation is evident in most lessons, lessening the need for intervention (#61 consensus forming)
>
> Work with teachers to ensure our challenging tasks are actually that ... challenging (#176 practical)

It became clear that these SMLs have ideals for "ambitious mathematics teaching and learning" in their schools (Lampert et al., 2010). They also know that a key to the improvement of mathematics for the students is the knowledge and enthusiasm of their teachers. SMLs understand that teachers need support of an "expert other" to achieve and maintain good results in mathematics. Several SMLs mentioned staff resistance to change and "push-back" due to the seemingly constant demands being placed on teachers. These leaders expressed their need for support from the principal and the need for time to undertake the complex work of improving mathematics in schools. They have the ambition, but many feel they do not have the opportunity to achieve success. Yet, as their practical goals show, they have constructive ways to begin the process of change for improvement. A further analysis revealed that a quarter of SMLs directly matched at least one of their goals to the challenge they perceived in achieving it (see Table 8).

Table 8
Individual SML's goals matched to challenges

SML	Goals	Challenges
#11	Improve student growth, particularly from Years 3-6 (vision)	Students can be two or three years above their curriculum areas so need to be further challenged
#12	To improve teacher knowledge of the learning continuum in maths so that they can differentiate for a student's' needs (consensus forming)	Teacher knowledge in maths Not willing to put in the effort in their learning or taking responsibility
#13	To develop teacher capacity to challenge students at all levels in particular at the higher levels (consensus forming)	Staff buy in - implementing changes within a dual stream school
#26	1. Encourage risk taking by teachers & leaders (vision) 2. Encourage all students to believe that they can learn maths to high levels (vision)	Gaining buy in from teachers Chipping at already established culture of 'I was no good at maths Uncovering beliefs held by teachers, students, leaders, parents/carers
#29	1. Develop teacher capacity/confidence to develop their pedagogy to support active learning through rich tasks (vision) 2. Build student excitement of maths learning and an appreciation of the diversity/richness in this subject (vision) 3. Develop planning and documentation that supports teachers in the above (vision)	Teacher capacity in terms of time, willingness Organisational restrictions
#56	1. To build my capacity to lead (vision) 2. To improve consistency within the maths block, across my school (consensus forming) 3. To engage families and our community in maths (vision)	My own inexperience - I still have a lot to learn in my role and I need time to develop my numeracy knowledge as well as my capacity to lead Lack of engagement - our families find it difficult to get involved due to their language backgrounds
#117	1. To set school goals for mathematics teaching improvement (consensus forming) 2. To collate and analyse assessment data (consensus forming) 3. To assist teachers as needed (practical)	No time, no experience, no knowledge

Many of the matched goals related to their vision and the corresponding challenges reflected the need to have teachers "on-board", willing to be part of the journey, and to improving their own mathematics content knowledge and pedagogical content knowledge. The last two respondents identified the need to build their leadership skills, with a sense of frustration evident in Respondent 117's response.

Discussion of the Types of SMLs' Goals

In the second analysis, the SMLs' goals were defined in terms of vision, consensus-forming, and practical goals. Identifying the type of goals in this manner revealed the nature and depth of the SMLs ambitions. Doing so highlighted the complexities of their role and the specific skills and expertise required of a SML.

SMLs vision goals largely focused on improving student outcomes. These leaders recognised that to improve student-learning outcomes they needed to focus on teachers' mathematical knowledge. The specialist forms of knowledge teachers' use are sophisticated and complex (Hill et al., 2008). Building improved content knowledge and pedagogical content knowledge takes time but the SMLs were aware that achieving their practical goals was an initial step towards achieving their long-term vision goals.

These SMLs have the ambition, but many felt they did not have the opportunity to achieve success. To achieve their goals, SMLs need to have the support and commitment of the principal and teachers. Schools in which both leadership and staff were united and committed to an improvement agenda were effective in improving student learning outcomes in mathematics (Muir et al., 2018).

Four findings were evident from the analysis of the types of goals reported.

1. SMLs have a range of goals to which they aspire, many of which involve a vision of the way they would like to see mathematics teaching and learning to improve student learning outcomes in mathematics.
2. The types of goals are complementary in that a vision goal needs to be enacted as a practical goal to translate the ideal into a reality in practice.
3. A practical goal needs to be achieved through the collaboration of teachers who have a shared understanding of their purpose and direction.
4. School leadership and teachers need to be committed participants in an improvement plan.

Conclusion

The aim of this study was to document the goals and challenges of SMLs. We found that SMLs' main goals focus on the improvement of mathematics teaching and learning. Leaders recognised the importance of teachers' knowledge, teachers' mathematical dispositions, and teachers' preparedness to change, in the achievement of their goals. Aligned with these teacher-centred goals, are goals related to conditions in schools that facilitate mathematics improvement. These conditions include: recognition of the need to prioritise mathematics improvement; time allocated for mathematics leadership; and school structures that support teachers' collaborative learning.

The goals and challenges of SMLs revealed the complexity of their leadership role by highlighting the long-term nature of improving mathematics teaching and learning, to achieve a vision. Supporting SMLs in their quest for change is critical and it is clear from the challenges identified that some SMLs do not feel they have the support of their school leadership. As highlighted in the research literature, leadership support and endorsement are critical for sustained improvement of mathematics teaching and learning (e.g., Driscoll, 2017; Gasston-Holmes, 2019; Lamb, 2010; Thomas & Ward, 2006).

We acknowledge some constraints of this study, in particular, specifying a time frame associated with the goals. The intention of having a time frame of three years was to focus the responses, yet it may have also influenced some responses. Removing the time frame may have enhanced the results further, which is an opportunity for further study.

There is little research relating to the aspirational goals of SMLs. Our findings, particularly those in relation to the nature of their aspirational goals, make a new contribution to the mathematics research literature related to school-based mathematics leaders in primary and secondary schools. A further contribution to the literature is the adaptation of Hallinger and Heck's (2012) theoretical framework, and application in the context of school-based mathematics leaders' goals for improving student learning outcomes. Further research might explore whether there is a relationship between vision and consensus-forming goals and changed teacher practice that lead to improved student learning outcomes in mathematics.

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Authors

Ann Downton
Monash University
email: ann.downton@monash.edu

Jill Cheeseman
Monash University
email: jill.cheeseman@monash.edu

Anne Roche
Monash University
email: anne.roche@monash.edu