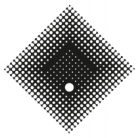

Leadership to Improve Mathematics Outcomes in Low SES Schools and School Networks

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Leadership to Improve Mathematics Outcomes in Low SES Schools and School Networks

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Instructional and transformational leadership is reportedly required to improve the mathematics outcomes of students in low socio-economic status school communities. This study of 43 schools in two networks of schools in rural Victoria explored leadership practices and found evidence to support both these leadership approaches along with distributed leadership practice. School leaders established network and school structures and relationships at various levels of the network and school organisation to enable and support ongoing improvement in teachers' pedagogical content knowledge and teaching practice and to build the leadership capacity of teachers within their schools. The leaders' knowledge of effective mathematics teaching practice enabled them to mentor teachers in their school or team and to support the practices of professional learning teams within their school.

In this article leadership practices and approaches to developing leadership capacity to improve mathematics outcomes for students in low socio-economic status (SES) schools and networks of schools are described and theorised. Previous studies, for example Cobb, McClain, de Silva Lamberg and Dean (2003) and Quiroz and Secada (2003) have shown that attempts to upscale district reforms to improve outcomes for disadvantaged students have stalled because of the complexity of educational disadvantage and an absence of instructional leadership. The quality of teaching is recognised as the most powerful factor for student learning but effective school leadership is needed to support the transformation of teaching practice and school culture in underperforming schools (Leithwood, Mascall, Strauss, Sacks, Memon, & Yashkina, 2006; Organisation for Economic Co-operation and Development [OECD], 2008; Sammons, Hillman, & Mortimore, 1995).

An Australian Government funded project to improve the literacy and numeracy[1] outcomes for students in low socio-economic status school communities (Department of Employment Education and Workplace Relations [DEEWR], 2009) that we had the privilege of evaluating provided us with the opportunity to explore the nature of effective leadership for improved student learning generally and for mathematics in particular. This study is part of a larger

1 The Australian Government and the Department of Education and Early Childhood use numeracy to mean mathematics in many publications, projects and policies. In this article we take numeracy to mean mathematics rather than specific definitions afforded numeracy in the literature. We use numeracy where this is the term used in the title of a position of an educator, curriculum or publication, or when referring to the objectives of the funded project, otherwise we use the term mathematics.

study of the DEEWR Literacy and Numeracy Pilot for Low SES School Communities that was implemented in Victoria named *Implementing a Cohesive, Multifaceted Approach to Improving Literacy and Numeracy Outcomes in Schools and Networks Pilot* (Victoria, 2009).

The Australian Government funded five school reform activities in low SES school communities in Pilot projects throughout Australia: building leadership capacity and whole school change, building teacher capacity, using student assessment data, student-centred approaches and interventions, and engaging parents and the community (DEEWR, 2009).

In Victoria, as a means of up-scaling improvement and decreasing inequities in school outcomes, the Department of Education and Early Childhood [DEECD] is developing and implementing a network strategy for distributing responsibility for educating young people to groups of schools rather than investing it in individual schools:

> There is a growing recognition, however, that to avoid very mixed levels of school performance, a devolved system needs to have a way of spreading best practice. This can be done through school networks overseen and advised by expert practitioners, who can intervene, where necessary, to help get schools back on track. (Dawkins, 2009)

In each education region of Victoria networks of up to 25 primary and secondary schools in geographic proximity have been formed. These networks are managed through the regional offices of DEECD and each network is supported by a Regional Network Leader. In Victoria the Australian Government's initiative for improving literacy and numeracy outcomes for students in low SES school communities was implemented using networks of schools. Recognising the complexity of improving outcomes for students, the project (hereafter referred to as the Pilot) that was implemented in Victorian government schools incorporated the five areas of school reform mentioned above (Victoria, 2009).

The forty-three (43) schools in this study belong to two networks of primary and secondary schools in one region of the DEECD located in country Victoria. These networks of schools are two of four school networks in Victoria that were selected by the DEECD for participation in the Pilot (Victoria, 2009). The Pilot began in 2009 with funding for two years[2].

The larger study collected data about practices occurring at the region, network, school and classroom level regarding the five areas of reform. We also collected and analysed student achievement data for literacy and mathematics (Vale, Davies, Hooley, Weaven, Davidson, & Swann, 2010). In this article we focus on building leadership capacity for mathematics teaching and we consider

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2 The Pilot schools received funding from both the Australian and Victorian Governments for the Pilot. This Pilot was implemented alongside other initiatives already operating in the region of these two networks. During the course of the Pilot, the schools continued to seek and receive funding for activities either directly or indirectly related to mathematics achievement from a range of government sources.

the following questions: How was leadership structured and practiced in the network and schools to enable improved mathematics learning? What leadership practices were promoted? How was leadership of mathematics teaching and learning supported and developed? The findings reported in this paper identify aspects of leadership and approaches to building leadership capacity that contributed to improvements in students' mathematics outcomes in the first year of the Pilot (Vale, et al., 2010).

Background

Leadership and Whole School Change

In the contemporary context of more autonomous schools, increased attention on accountability, as well as the belatedly renewed interest in closing the equity gap, education systems have drawn upon theories of effective leadership for effective schools (Elmore, 2007; OECD, 2008; Sammons, et al., 1995). Theories of transactional leadership, which focus on managerial activities, have given way to theories of transformational leadership and distributed leadership with attention paid to enhancing the school climate and environment and motivating and enhancing the instructional capacities of teachers (Spillane, Halverson, & Diamond, 2003).

According to transformational leadership theory, organisational change and leader vision draw followers to an agreed preferred future (Leithwood 1999). Leithwood's model includes four categories of transformational leadership: setting directions, developing people, redesigning the organisation and managing instructional programs. Developing and articulating a shared vision through collaborative practices for goal setting that includes high expectations describes the first category of practices of transformational leaders. Stimulating, supporting and modelling professional practices and values that underpin the development of people's teaching and leadership capacities describes the second category; and strengthening the school culture through structures for collaborative decision-making and involvement of the community describe practices for the third category of transformational leadership practice.

More recently, Leithwood's fourth category 'managing instructional programs' has been incorporated within the construct of instructional leadership. Instructional leadership is about the promotion of growth in student learning that occurs from actions of the principal and other school leaders (Hopkins, nd). It fits within the theory of transformational leadership since it is a move away from principal as administrator towards principal as learner and leader of learning. The term 'instructional' has been used recently by researchers to mean reform oriented approaches to teaching, for example, ambitious instruction (Cobb, 2008) or enquiry learning (Hopkins, nd). The focus of instructional leaders is the implementation of "strategies for effective teaching and learning [and] conditions that support implementation, in particular staff development and planning" (Hopkins, nd, p. 3). This meaning of instructional

leadership overlaps with Leithwood's second category about developing people, their skills, knowledge and practices. Hopkins argues that the purpose of instructional leadership is to facilitate and support teachers to "create powerful cognitive and social tasks to (sic) their students, and teach the students how to make productive use of them" (p. 4). In addition, instructional leaders have knowledge of the range of pedagogical practices that promote learning, and display a "commitment to promoting enquiry, particularly into the 'how' rather than the 'what'" (Hopkins, nd, p. 5).

Using Leithwood's framework of transformational leadership Goodnow and Wayman (2010) showed how schools and leaders make use of data about student achievement to set directions, develop people and redesign the organisation. However, they did not explore how teachers could use data to improve their practice. Gambino (2010) and Doolittle (2010) also focussed on how leaders may use data to facilitate change but they also addressed the need for leaders to understand how to facilitate professional learning communities in their schools. They did this by setting up networks of principals to provide a structure and forum for leaders to learn together. However, Hargreaves (2009) and Harris (2008) caution that the emphasis on accountability and 'turnaround' policies (currently being implemented in the United States and the United Kingdom) places pressure on leaders and teachers to improve learning outcomes, especially in literacy and mathematics that are likely to lead to a focus on short-term outcomes, instability in schools and a rapid turnover of leaders and principals.

Duignan (2006) believes that authentic educational leaders transform the lives of those they touch in the wider school community – teachers, students, parents and others – and that such leaders bring a higher purpose and meaning to educational practice by creating conditions that enable teachers and students to take a high degree of responsibility for their own teaching and learning. He argues that educational leaders must develop a sharing culture within the school community and that this requires more than simply a distribution of tasks and responsibilities to others and more of a shift of mindset on the part of the principal (Duignan, 2006, p. 107). Such authentic leaders will be secure about their own identity, thus not find it difficult to "freely share and distribute what were previously 'their' responsibilities". They build trusting relationships to support open communication and collaboration (Parsley, 2009).

Harris (2008) agrees with this idea of dispersed or distributed leadership in which leadership is seen as present in many more people in the organisation than just those with formal positions and titles:

> … effective school leadership equates with capacity-building … [since] capacity-building approaches are most likely to generate the foundation for improved performance in schools and school systems, and that this is best secured through broad-based, distributed leadership. (Harris, 2008, p. 24)

Cunningham and Cordeiro (2009) write that distributed leadership "stresses spreading involvement including things like decision making, teamwork, and work reallocation" (p. 212) and that such leadership is no longer that of an

individual but responsibilities are shifted to others, rather than shared with others as in participative or shared leadership. Arising from a study of cases of leadership reform within and between schools in the United Kingdom, Harris (2008) identified the following common principles of distributed leadership:

- it is broad-based leadership;
- it requires multiple levels of involvement in decision-making;
- it focuses primarily on improving classroom practice or instruction;
- it encompasses both formal and informal leaders;
- it links vertical and lateral leadership structures;
- it extends to students and encourages student voice;
- it is flexible and versatile (non-permanent groupings);
- it is fluid and interchangeable;
- it is ultimately concerned with improving leadership practice in order to influence teaching and learning. (Harris, 2008, pp. 71-72)

She developed a model to describe distributed leadership within, between and outside schools, where distributed leadership between schools involved collaboration and network activity and distributed leadership outside schools included partnerships and community engagement.

Hargreaves (2009) predicts an extension of distributed leadership, more in concert with the ideas of authentic leadership in what he has termed a "fourth way of educational reform" through the development of innovative professional communities involving networks of schools:

> Sustainable leaders will be allowed and encouraged to develop inspiring visions and even dreams with their teachers, students and communities. They will know how to build dynamic communities of distributed leadership while still being clearly in charge. They will work with and support other struggling schools and will 'let go' of their own schools, building new leadership capacity behind them. (Hargreaves, 2009, p. 31)

Leadership, Networks and Mathematics Learning

According to Cobb (2008), district or network level programs to improve the mathematics learning outcomes of students from socially disadvantaged groups have a tendency to be reactive rather than proactive. They almost exclusively focus on teacher professional development but fail to adequately anticipate obstacles arising from the demands on teachers and organizational practices or plan for effective support structures.

From a study of six schools in a district Cobb, et al., (2003) identified the need to improve instructional leadership in mathematics. In particular they recommended that:

- professional development for leading teachers focus on teaching approaches for disadvantaged students;
- network leaders attend professional development on leadership and act as brokers between the district and principals to support curriculum, teaching and leadership alignment;

- principals gain access to mathematics teaching expertise and act as brokers between school and district;
- district leaders provide clear guidance on what it means to be an instructional leader; and
- principals participate in professional development on mathematics teaching practice that is school-based.

With respect to effective support structures Loader (1997) gives good examples of how he tried to leverage the scarce resource of time – time for staff to think, dialogue and plan so that the rhetoric of "learners and teachers together" becomes real (p. 59). Support structures are also identified in Cobb and colleagues' ongoing research. They include high-quality professional development, access to expert instructors such as coaches, use of networks and the Principal (Colby, 2010). Yet these structural elements seem insufficient without understanding how they contribute to teachers' learning and improved practice. Such understanding is part of the wisdom of authentic leadership.

Communities of Practice

Much of the theory about school culture, reform and leadership can be related to Wenger's (1998) theory of communities of practice. Joint enterprise, mutual engagement and well-defined ways of thinking and working define communities of practice. In a school, or network of schools, these attributes include a shared understanding of curriculum and learning objectives, norms regarding teaching practice, and normative ways of planning for teaching (Cobb et al., 2003). Norms do not guarantee effective schools and effective learning for students, indeed the task of reforming schools and practice involves understanding these norms in order that they may be critiqued and challenged to generate new, shared understandings and practices for improved student learning.

Within a district or network of schools there is potential for the formation of a number of communities, for example networks of teachers and/or leaders with common responsibilities or interests, such as leadership, mathematics teaching and learning, student well-being, and teacher professional learning. Yet relationships between schools or staff in a network of schools may not generate communities of practice with a shared vision and norms of practice. Rather a network of schools may act as a constellation of practices or interact through a set of boundary encounters (Wenger, 1998). Wenger defined 'boundary encounters' as activities on which two communities of practice work together, 'brokers' as professionals who move between two or more communities of practice, and 'boundary objects' as products of the encounters between these communities.

The Leadership Context for the Study

The DEECD Effective Schools Model, based on the 1995 work of Sammons, Hillman and Mortimore, recognises the critical nature of school leadership

(Elmore, 2007). This model requires leaders to be highly influential in the teaching and learning process and to involve teachers in decision-making about curriculum, professional learning, resource management and policy directions. They must ensure that staff share in the vision and are aware of how to support students from low socio-economic backgrounds by providing suitable professional development, leading a whole-school approach to support these students, and allowing teachers the time to collaborate and share good practice ideas.

The Study

Schools in the Study

The forty-three (43) schools in these two networks ranged in size from 6 students to 542 students. Each of the communities for these two networks of schools was among the poorest of the school communities in rural Victoria, as measured by the School Family Occupation Index (SFO). The mean SFO for each network in the study is approximately 0.5 and the mean SFO for individual schools range between 0.147 and 0.855, where the higher values represent lower economic status. One of these networks also had high numbers of enrolments of Koori[3] students (6.8% of enrolment), newly arrived students to Australia (3.6%) and refugees (2.1%) and relatively high proportions of ELL/LBOTE[4] students (5.4%). Literacy and mathematics outcomes for students attending schools in these two networks were generally below expected levels when compared with other school networks in Victoria.

Methods

We designed the inquiry to include the participants in the research as fully as possible in all stages: data collection, analysis and generation of findings. We achieved this by using recognised qualitative processes such as document collection and informal interviews with regional staff of the DEECD, and collaborative practitioner research methodologies involving the collection of personal accounts and collaborative analysis of these accounts through roundtable meetings involving school and regional staff (Cherednichenko, Davies, Kruger, & O'Rourke, 2001).

Documents and Interviews

We gathered annual strategic plans designed by each of the schools in the networks as well as the strategic plan for each of the networks. We also collected documentation of the region's curriculum frameworks for leadership and mathematics and professional learning program documentation relating to them.

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3 Koori is the name indigenous people from south-eastern Australia use to identify as belonging to the language groups or tribes of the Kulin nation.

4 ELL – English Language Learners; LBOTE – Language background other than English.

These included the *Hume Common Curriculum* (DEECD, nd) and the *Numeracy Strategy: Hume Region 2008–2009* (DEECD, 2008), which pre-dated the Pilot, and the *Hume Region Intervention Program for Numeracy* (DEECD, 2009) which was trialled in the first year of the Pilot.

We conducted informal interviews through meetings with key network and regional staff including the Regional Network Leaders, Regional Numeracy Co-ordinator and other regional staff involved in developing curriculum frameworks and programs and managing the Pilot. These informal interviews provided information about the structure of the networks and the people involved in implementing the Pilot at the region, network and school levels. We attended a forum conducted by DEECD about the *Number Fluency Framework* (Montgomery & Waters, 2008) and *Hume Region Intervention Program for Numeracy*. We also met with program managers of an intervention program designed for Koori learners of literacy and mathematics (YALP, n.d.) that was operating in some schools in the study.

Collecting Personal Accounts

We collected personal accounts as electronic interviews conducted by email from teachers, coaches, literacy and numeracy leaders, principals and Regional Network Leaders. Firstly we invited principals in each Pilot school to provide the names of people in their school who were willing to participate. We received lists of names of teachers and their roles in relation to the Pilot objectives. We forwarded invitations by email to these participants inviting them to provide personal accounts by return email along with documentation of their agreement to participate in the research. The personal accounts included two sections.

The first section was used as a means to verify our analysis of each school's annual strategic plan. School Annual Implementation Plans set out the school's goals and targets for student learning, especially improvements in literacy and numeracy achievement, student engagement, student well-being and student pathways and transitions. The Plans also document key improvement strategies and significant projects to be conducted to pursue these goals. We analysed these plans and the main points regarding strategies for improving literacy and numeracy outcomes were tabulated and sent to participants who were asked whether the contents of that table was an accurate statement of their literacy and numeracy plan. If it was not, they were asked to add or delete as appropriate.

The second section posed questions about their experience of improving literacy and numeracy outcomes. The questions concerning numeracy were:

1. Can you please provide an account of what you have been doing to improve numeracy outcomes for your school/network?
2. Why did you adopt this action, approach or strategy?
3. What observations have you made about the success or otherwise of your approach?

Sixty-nine (69) personal accounts were collected from participants in the two networks, about half of which concerned numeracy.

Roundtables

Altogether four roundtable meetings were conducted for participants from the two networks. At each of these meetings the participants worked in groups through a process to analyse their personal account and then worked collaboratively in roundtables to conceptualise their work on improving literacy and numeracy outcomes by designing concept maps. The 43 participants constructed eight concept maps altogether.

The Roundtable meetings ran for about three hours and involved an introduction to the project and two data analysis activities (Davies, 2005). The first activity was sketching, threading, theorising and conceptualising and involved participants working with their own personal account, reading it, looking for keywords, then writing their theories (or beliefs) about their own comments. The second activity involved participants in small groups of five to eight analysing their responses collaboratively and emerging with a shared view about improving literacy and numeracy outcomes. This was developed following a concept mapping process that involved the individuals firstly recording the personal theories on notes, and then taking it in turn to paste their note onto the map and make a statement to explain the contribution. The participants were encouraged to explain why their theory/belief is important and how it relates to other concepts already on the map. The process continues until all of the participants' theories and beliefs are included. Links are made to complete the concept map and align or realign and organise the ideas.

Findings

The findings reported here concern each of the research questions and are organised into the following sections: leadership structure and expectations, developing leadership capacity and leadership practice. The final section reports findings regarding connections between leadership practice and changes in teaching and learning.

Leadership Structure and Expectations

As stated above the schools in this study are a member of two networks, of about 20 schools each, in one region of government schools in Victoria. There are seven networks altogether in this region. The networks in this region are organised geographically so that each network serves the community in a geographic area. To promote and enable sharing of practice, schools in each network are further divided into clusters of seven or eight schools. Because of the relatively large distances between schools in one of the networks in this study, these clusters are geographically based and include both primary and secondary schools. In the other network that is located in and around a provincial city, schools with like needs were clustered together: small rural primary schools, primary and secondary schools with high proportions of Koori, refugee and/or ESL students, and primary schools with higher SES school communities.

From the data collected we learned that across the region, and within these two networks, there is an intricate network of people with clearly articulated leadership roles connected to the Pilot. Figure 1 illustrates the leadership positions with a role related to leadership of mathematics education at the region, network and school level. At the regional level there are positions for leading school improvement and improvement in mathematics teaching and learning covering all schools as well as leadership of the Pilot. Each network of schools is supported by a network leader and a school principal takes a leadership role with the smaller cluster of schools within the network. For the Pilot, coaches were appointed by the region to work in one or more schools with individual teachers to improve their teaching capacity, whereas a numeracy leader is a staff member of the school who is assigned the responsibility of leading mathematics teaching in the school. As will be described in the following section, the role of numeracy coaches developed during the implementation of the Pilot and for some coaches this role shifted to mentoring school numeracy leaders as well as supporting collaboration between leaders across the schools. Community leaders[5], who are not part of the education system, have been included in Figure 1 as these leaders may be engaged with school communities and potentially may play a significant role in school improvement (Hargreaves, 2009). Likewise parent and student leaders at the school level may play significant roles in reforming schools.

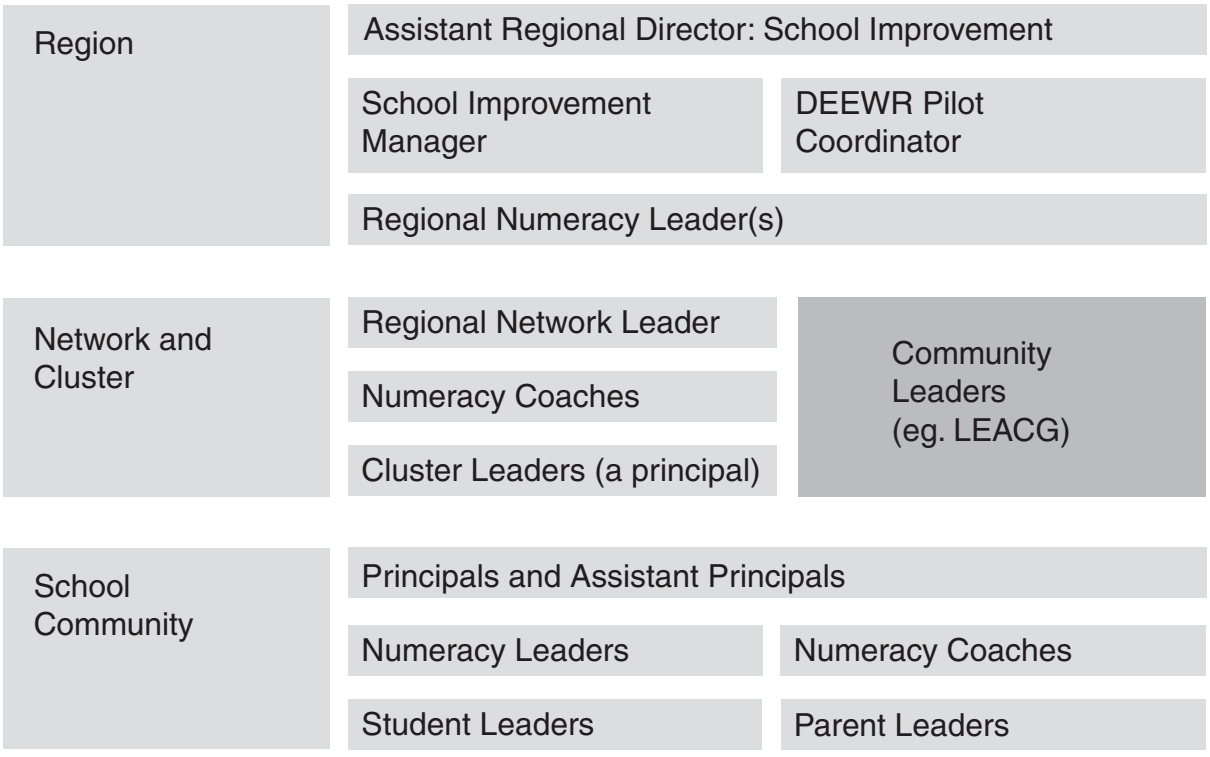

Figure 1. Mathematics Leadership Roles in the Region, Network and School

5 For example, the LEACG is the Local Education Aboriginal Consultative Group.

In each of the strategic plans of each network in this study the beliefs, actions and measures of success for each level of participant, from the student/child to the region, are documented. The belief statements articulate high expectations for students, teachers, principals and regional leaders with respect to learning and school improvement. Examples of these beliefs include:

> all children can learn given time and support;
> all teachers have the capacity to improve the learning outcomes of all students;
> effective leaders lead effective schools;
> clusters have a collective responsibility for the learning of all young people;
> School improvement efforts [are] enhanced through greater collaborative planning;
> network structures align to regional and system planning to ensure a strategic but differential targeted approach to school improvement;
> a culture of learning and improvement at all levels of the system. (Network A, Strategic Plan, 2009)

The responsibilities of leaders, teachers and students are specified as "theories of action" in the Network Strategic Plans, where the regional leaders (including the Regional Numeracy Leader) set the directions for school improvement and for improving numeracy (that is, mathematics) outcomes. According to the Network Strategic Plans the regional leaders identify, model and promote best practice, develop and provide professional learning opportunities and programs in educational leadership and effective practice for mathematics teaching.

At the network level, Regional Network Leaders (RNL) and numeracy coaches are expected to provide leadership for principals, school numeracy leaders and classroom teachers. In particular the RNL is expected to "know each of their schools thoroughly; … build the capacity of Instructional Leaders; … identify, share and promote best practice and resources and aligning these around identified needs; … develop a professional learning strategy" and mentor and coach principals and leaders (Network A Strategic Plan, 2009).

The belief that principals are educational (or instructional) leaders is recorded in the Network Strategic Plan. Principals are expected to demonstrate this leadership capacity by developing "the knowledge to identify and articulate to teachers what is good practice," placing "strong emphasis on developing purposeful teaching and learning in classrooms" and ensuring that "teaching is informed by multiple sources of feedback." Principals are also expected to be transformational leaders by "building leadership capacity within the school" and developing "systems to ensure focused professional learning."

Normally school numeracy leaders are half-time positions and these teachers are classroom teachers or deliver student intervention programs for the other half of their workload. Each school numeracy leader works with the teachers of mathematics in their school who are organised into professional learning teams. The number and structure of these teams depends on the size and type of school, as well as the strategies implemented by the school to build leadership capacity and provide professional learning for teachers. For example,

some primary schools in one of the networks decided to distribute mathematics leadership to classroom teachers working with their peers in sections of the school as illustrated in Figure 2. The principals call these teachers middle level leaders. These middle level leaders are full-time classroom teachers. The professional learning teams in these schools consist of the teachers in each section, where one of them is the middle level numeracy leader. The school numeracy leader also participates.

The regional numeracy coaches provide assistance and support the school and middle level numeracy leaders, coach individual teachers in the teams and attend professional learning team (PLT) meetings. The contribution of the numeracy coach to building leadership capacity is discussed in the next section.

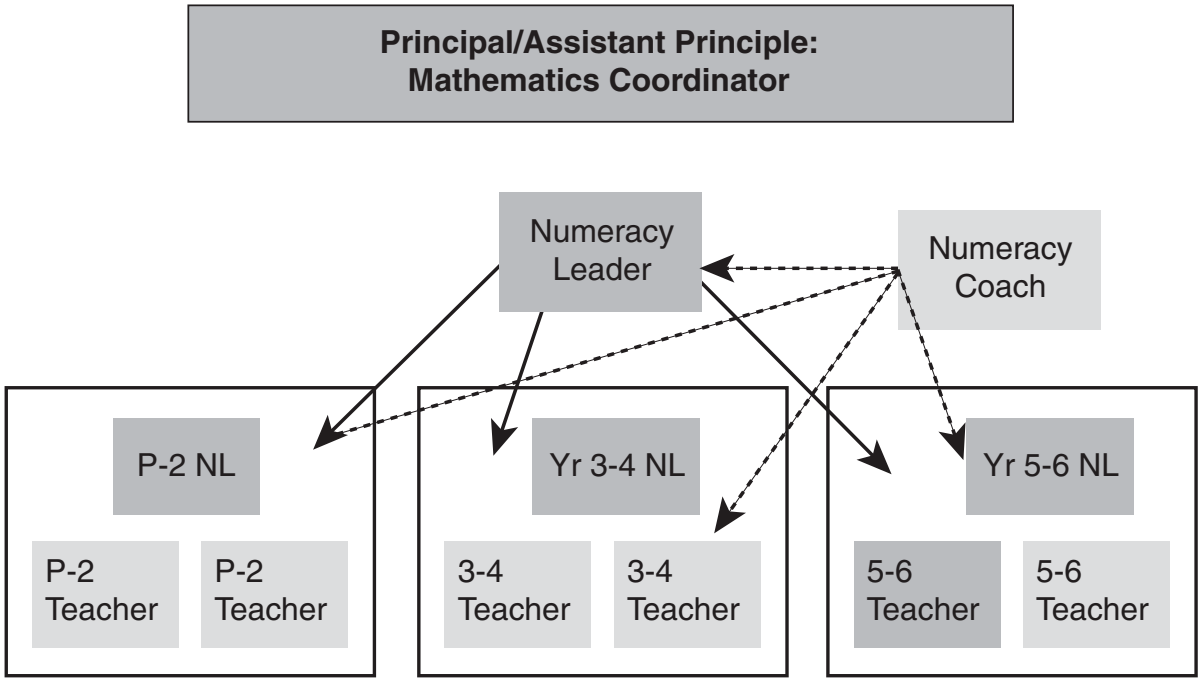

Figure 2. Leadership of professional learning teams in schools

Developing Leadership Capacity

The region's professional learning program for principals and other leaders specifies two aims:

> First, to reinforce the idea that school leaders are instructional leaders in their schools by providing explicit and current professional learning about the circumstances under which students learn best. The second area is to provide specific skills that will assist school leaders in transforming their school and sustaining improvements. (DEECD, nd, Foreward)

The program is designed to promote cultural change and support a whole school approach to improving literacy and mathematics; one that is aligned from region to network to school to professional learning teams to teachers in classrooms.

School leaders are encouraged to transform by "changing perceptions, confronting reality, looking at the real picture and real work, creating new vision, persistence in realisation" (DEECD, nd). Included in the program are modules concerning analysis and strategic use of data, leading professional conversations and leading "the school community in promoting a vision of the future, underpinned by common purposes and values" (DEECD, nd).

The program seeks to establish a common language that leaders and teachers may use to align understandings and practices. Based on research evidence the program documents and delivers professional learning regarding effective practice in mathematics teaching. It uses cases of students from the region to "confront reality" and to investigate effective practices of teachers and improved learning of students. The modules concerned with instructional leadership include: "Leading numeracy: the learner; Leading numeracy: the classroom; Neurodevelopment and the learner; Leading effective learning; Leading equity; Leading curriculum and assessment design" (DEECD, nd). As stated in the following account of one the Regional Network Leaders the professional learning programs have enabled alignment of language and practice across schools in each network and across networks of schools in the region:

> The Region's Common Curriculum training for principals, literacy and numeracy leaders and teachers is the key platform for improvement in this pilot…this has most definitely created alignment of purpose and approach across the schools. This is evidenced in professional conversations I have on a regular basis with every principal. (RNL)

Participants in the study described structures and practices that facilitated and developed leadership capacity. Schools working together in neighbourhoods and clusters within each network and supported by either the RNL, or the numeracy coach, used between school collaborative groups to develop leadership capacity for school and middle level numeracy leaders as described by a primary school principal:

> I believe instruction[al] leadership is a vital link in the literacy and numeracy improvement agenda. Within our Neighbourhood Network we have a developed professional learning culture that is designed to build capacity at all levels of the Neighbourhood Network. For example, Principals and RNL plan strategically for key improvement strategies… I believe that working collaboratively within the school and beyond (neighbourhood) builds collective capacity, consistency and responsibility. This work needs to be privileged by time and resources to facilitate professional learning and effective classroom practice. (Principal)

The principals of three primary schools established the Primary Neighbourhood Network. They meet weekly. They share knowledge, practices and experiences and also collaborate to develop programs and projects that run in each of their schools. An example of these collaborative projects and shared responsibility for improving learning in each other's schools is a joint program that they designed

to employ three family liaison officers to work with, and engage, families from three different cultural groups (Koori, Iraqi and Afghani) whose children attend each of their schools. Attendance and participation in this Neighbourhood Network by the RNL illustrates differentiated and targeted support for school improvement.

These school leaders also explained the importance of building leadership capacity by distributing leadership within their schools as depicted in Figure 2 above:

> Many of the strategies involve building leadership capacity and teacher effectiveness – to achieve a sustainable model for ongoing improvement. Further to this is a distributed model of leadership – with teachers across all levels of the school responsible for either literacy or numeracy … [N]umeracy leaders identified across the school work with colleagues to build capacity of consistent and informed teacher practice. (Principal)

> I believe that having numeracy leaders across each section of the school has supported the idea of 'shared accountability' and has a positive (and strategic) influence on the commitment to numeracy across the school. (Assistant Principal)

Numeracy coaches are normally expert teachers of mathematics. Their role is to coach individual teachers of mathematics to improve their mathematics pedagogical content knowledge and teaching practice. This involves assisting teachers to review their practice and student outcomes, teaching them effective strategies, introducing them to appropriate mathematics tasks and assisting them to construct effective lessons and learning sequences (DEECD, 2010). In Victoria these teachers receive training to develop their skills in mentoring and coaching and participate in regular professional learning conducted by the Regional Numeracy Leaders, covering effective mathematics teaching practices, mathematics curriculum and learning frameworks or trajectories, analysis of data for strategic planning and classroom planning, and resources for teaching and assessment. A coach may be a teacher in a school who is given this responsibility or employed by the Region to work with teachers in more than one school in one network. For the Pilot, regional numeracy coaches were appointed to work with particular schools as a means of differentiating and targeting support for schools. In the networks in the Pilot, in addition to their role of coaching classroom teachers, the numeracy coach also works collaboratively with numeracy leaders in schools that have been targeted for the Pilot to develop numeracy leadership capacity in schools.

An illustration of the way in which numeracy coaches provide instructional leadership and contribute to building leadership capacity is the Primary Neighbourhood Network that operates in Network A. The three principals identified the need for building leadership capacity within their schools and the benefits of working collaboratively beyond the school so they established a neighbourhood cluster for their school numeracy leaders and middle level numeracy leaders. The following account describes the practices of the numeracy

coach in this neighbourhood of primary schools. Figure 3 is a model of the Neighbourhood Numeracy Professional Learning Team (Numeracy DEEWR Focus Group referred to in the coach's personal account). She highlights the importance of strategic planning based on the analysis of assessment data, collaborative decision-making through the mutual engagement of the leaders and the provision of ongoing support through modelling effective practices, engaging in reflection and review, and the provision of resources.

> In the primary setting, I have worked primarily with the [school] numeracy leaders to work on the numeracy instruction of their schools, using coaching and supporting them in their Professional Learning Team meetings. The three [school] numeracy leaders work closely with me on a regular basis and have determined the needs of their schools, which have formed the basis of agendas for our twice a term meeting with the Numeracy DEEWR Focus Group. Each school also sends a representative from their P-2, 3/4 & 5/6 sections. In all, we are a group of 13 with me and a new Teaching & Learning Coach, who coaches individual teachers in one of those priority schools. Our agendas revolve around data collection and unpacking, student centred approaches to teaching numeracy, appropriate DEECD resources and their uses and implementing the Hume Common Curriculum in Numeracy. As the facilitator of the group, I make sure the group has their agendas, resources and that we set action plans from our discussions and then I follow up on those plans helping the leaders implement them. Our group has become quite cohesive and each has taken a turn to host our day long meetings and provide morning tea and lunch. After our focus group meeting, I am able to schedule a school visit to the three main numeracy leaders, who feed forward to the others. This happens on the average once a week. During that time, I coach them in how they can implement the ideas within their schools in both whole school approaches and with their Professional Learning Teams. If I am able to attend their PLT's, I am often there to observe, support or to gather data for them in a particular area. To the group, I provide relevant research that we unpack and put in context, ways to do in depth data analysis and Professional Development. I have also for example, modelled intervention strategies for a staff with the numeracy leader. I have on occasion had numeracy leaders shadow me as I coach classroom teachers, to help those leaders coach others. (Numeracy Coach)

This mathematics coach acknowledged that coaching the school mathematics leaders was challenging and "improved my own coaching skills." School numeracy leaders value the support provided to develop their knowledge of effective practice and their leadership skills and knowledge. For example:

> The Maths Coach … has also been a valuable support for me as I have been coming to grips with my new role as Maths Co-ordinator and the work I am doing trialling the Regional Numeracy Intervention Program at [school name]; regularly debriefing after Regional P.D. sessions and working together to plan strategically and to design learning activities to target specific needs. (Numeracy Leader)

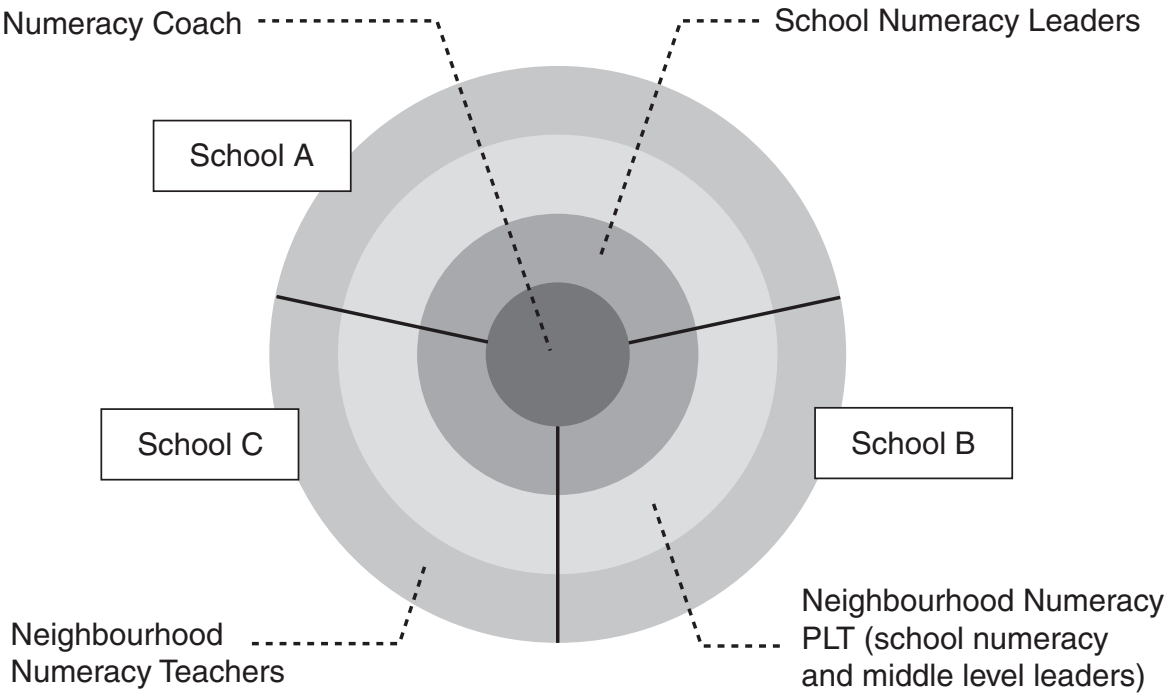

Figure 3. Structure of the Primary Numeracy Neighbourhood

Leadership Practice

An understanding of their role as transformational leaders is illustrated in the following personal accounts of School Leaders. These leaders identify the need to set a direction with specific goals, using a language that is shared within the school and across the network at various levels.

> I believe that a clearly articulated vision and a relentless and consistent message is delivered regularly throughout the neighbourhood networks and school – at leadership, classroom and community levels. (Principal)

> [I] work in collaboration with coaches and school based numeracy leaders at a neighbourhood PLT to develop a common language and understanding of numeracy across the network schools, along with planning a strategic approach and strategies for implementation at a school level; …[I] work in collaboration with school based numeracy leaders and numeracy coordinator to plan and implement a strategic approach at a school level. (Assistant Principal)

> Whole school alignment through processes and professional learning improve student outcomes… Accountability is important for all staff and the system. (Principal)

> This year our school has undertaken a whole school approach to teaching Mathematics. To achieve this all teachers have participated in individual testing of all children – Prep-2 using the Mathematics Online Interview and 3-6 using Hume Fluency Assessment. The data from this testing then was to be used to plan for individual needs and explicitly teach the skills and strategies at each child point of need. (Numeracy Coach)

As instructional leaders, principals, assistant principals and school numeracy leaders provide professional learning that is based on their knowledge of teachers' practices and achievements and connects teachers' professional learning needs with agreed pedagogical directions and practice. They promote and model effective practices and introduce teachers to teaching and learning resources.

> Numeracy is my passion as well as my responsibility at this school. It is my job to promote and support excellent Maths teaching across the school. Our staff have had a lot of PD in Maths for many years but some teachers especially in the Middle and Senior teams have had difficulty changing their teaching styles. There was a real need to increase the opportunities students had to complete hands on numeracy tasks. Common Curriculum Numeracy reinforced the need to have appropriate scaffolding opportunities for all students at all times. (Numeracy Leader)

> As the School Principal I have been involved in whole staff numeracy training, information sharing via email and discussion groups with coach and groups of teachers, class observations, individual feedback sessions, numeracy walks, provided time (if necessary) to release teachers for lesson feedback, organised the timetable to allow coaching debriefing to occur and, supported the Mathematics TPL team in their application and research. (Principal)

> I was fortunate to attend all four days of the Common Curriculum Numeracy modules. This was an excellent program which we (small team from our school) were able to share with the staff during professional development sessions … We ran sessions on differentiated lessons and spent some planning sessions, collectively planning a differentiated lesson to match an area of need. (Numeracy Leader)

> [I] regularly promote the use of concrete materials to allow students to develop the ability to visualise models; … Promote the use of ICT tools in numeracy lessons; Promote Maths 300 as a resource and encourage staff to explore and implement lessons. (Assistant Principal)

> I designed a grid to match the NFA which I encouraged staff to use. This gave a quick overview of a class, so teachers could quickly see what skills were required by whom … I also wrote an explicit teaching plan for the school, with reference to EYN and Common Curriculum Numeracy. This teaching plan outlines the format of a lesson and the features of the parts. Teachers have been encouraged to use this plan when designing their lessons. (Numeracy Leader)

In order to improve teaching practice and learning outcomes leaders need to know their teacher colleagues and their practices and they achieve this by observing them and working alongside them when assessing, reviewing and planning student learning:

> In my role as numeracy leader … I regularly undertake numeracy walks to see what is occurring in classrooms and to gauge the levels of support required. (Numeracy Leader)

> [I] create grade level profiles from Early Years Numeracy Data to develop shared accountability; Undertake formal assessments, Eg: Number Fluency Assessment, On Demand, EYN online interview; Discuss with staff student progress, align progress to developmental pathways and support staff to develop differentiated lessons; [Discuss] the features of an effective numeracy classroom and differentiation tools with staff. (Assistant Principal)

> In my role as Numeracy leader I have assisted staff to identify their groups, a common thread of need and plan differentiated lessons. (Numeracy Leader)

Providing time and forums for teachers to participate in professional learning teams (PLTs) is a task that school numeracy leaders prioritise to improve student learning. In the larger primary schools and secondary schools these professional learning teams are organised around year level sections (see Figure 2). Leaders also believe that establishing and refining the work of professional learning teams in schools so that they are collegial and collaborative, support teachers' learning and practice, contribute to a sharing school culture and enable a focus on improving student learning:

> [I have been] setting up structures that provide opportunities for staff to meet in PLTs, be coached with review time allocated … Planned school structures support professional learning. (Principal)

> Teachers need time to plan together to target needs – preferably with a maths leader who can provide more depth to learning pathways and add suggestions and help differentiate tasks to meet different children's needs. (Numeracy Leader)

> Professional learning teams are used to align teachers through professional reading, training and planning. (Numeracy Leader)

> Collegiality is important to driving teaching and learning. This starts with Principal, literacy/numeracy leaders and staff … Collegiality promotes collective wisdom. (Principal)

> I reckon educational leadership is about having rich conversations about individual students. This, and the data, changes the culture. (Principal)

> PLT meetings, which were not running regularly or with much of a focus are becoming value adding experiences for many of the teachers with the student at the centre of the conversation. This has not been an easy task and continues to need focused work and much support, but the three schools have begun the journey. Activities like looking at student data to determine the teaching needs of a student or sharing students' pieces of work are beginning to happen. (Numeracy coach)

Many personal accounts described the activities of professional learning teams (PLTs) and the way in which the school numeracy leader or numeracy coach supports the learning of teachers in professional learning teams. During professional learning team meetings teachers interpret assessment data and samples of student work, identify and discuss the learning needs of their

students, plan lessons, and investigate and trial student learning tasks. Some schools in the study have also implemented lesson study (Sanders, 2009), a practice where teachers collaboratively plan a lesson, observe their colleagues teaching this lesson, in real-time or from a video recording, and then collaboratively review and critique the lesson and its implementation.

> I believe that although there is a lot more work for me to do in PLTs, teachers are seeing their value. The Prep and grade 1 teachers have asked for changes to the timetable so that they could access my assistance for their PLTs. With them I have been looking at elements of the VELS Maths Continuum, discussing the implications of them, helping to design learning paths and making teachers aware of the hands on materials and their application to different learning activities. We have also looked at some of the difficulties in administering the Early Years Online Interview because several teachers keyed in invalid responses earlier in the year. (Numeracy Leader)

> With the assistance of our Mathematics Coach, using assessment data and planning individual lessons became a focus for several teachers in the 3-4 unit. The structure of a lesson was analysed and each section then modelled and practised during class lessons, and later discussed during unit meetings. (Numeracy Coach)

> I believe that we need to improve our outcomes based upon a common curriculum and common practice using our pre-existing assessments to raise our results. (P-2 Numeracy Leader)

> … This led to Lesson Study. Two units each planned a lesson in detail. Two teachers shared the teaching role while the others observed the lesson. The team then debriefed and modified the lesson according [to need] then the other teachers taught the second lesson while the others observed. Each unit videoed their lesson. One unit then used the video to analyse each section of a lesson and discuss ways the lesson might be improved. All teachers found this to be valuable. This video will be used in future PD. (Numeracy Coach)

As the following extract from a personal account suggests, developing trust is an important ingredient for successful collaboration and collegial reflection and review.

> The model of having a link between the Maths Coach and the rest of the staff through a team of Maths leaders who are given extra training that can be tailored to the needs of their target area of the school and shared with their colleagues is an effective model that will gain strength over time as teachers who are feeling inundated are starting to see it as support rather than an imposition … [It] must be given the time it requires to allow it to work in a non-threatening, and focused way to build skills and teacher effectiveness in a regular and long term in what the class teacher sees as profitable and practical. (Numeracy Leader)

Effective Leaders Lead Effective Schools

The concept maps that were constructed by groups of teachers and leaders from the two networks in roundtables made it clear that improving numeracy (and literacy) teaching and learning is complex. The content and connections depicted in each concept map were shaped by the central idea or ideas that were the starting points for each group. Roundtable participants from the two networks in this study put consensus, shared vision, student learning or teacher practice at the centre of their maps. These concept maps gave a great sense of engagement and collaboration and indicated a culture of agency for improvement. There was a sense of striving for a shared view and common practices through consensus processes and the emergence of a common language for discussion and dialogue about improving student learning. Teachers and schools seemed to be empowered by the alignment of language, common practices, network-wide activities, a focus on student learning, assessment practices, and analysing data and planning for student learning at the school and classroom level.

In the concept maps that placed student learning at the centre there is an assumption that improved student learning outcomes are linked to building teacher capacity, which is conceptual and practice-based; identifying and implementing common and consistent practices; and finally collaborative, collegial and open interactions couched within an awareness of the network.

Leadership was explicitly identified in some concept maps. In others it was assumed in the structure and connections of concepts. Where leadership was explicitly included it was associated with effective teams, good communication, commitment to improvement, planning for the future and shared learning, practice and accountability. Some concept maps depicted leadership as an over-arching framework which influences school culture or enables alignment and group responsibility. In another there was a bottom up perspective of leadership. In this concept map leadership promotes inquiry into effective practice that informs whole school planning. In yet another concept map, the participants argued that leadership was the “glue” that holds teacher learning and student learning together. These conceptions of leadership are compatible with the sense of engagement and collaboration present in the concept maps overall and with notions of transformational and instructional leadership.

According to the following personal accounts of school leaders the approach and structure of educational leadership and collegial professional learning within the school, neighbourhood and network is beginning to change school culture and practices to implement whole school approaches to mathematics teaching.

> Positive relationships have developed between Numeracy Coordinator & Regional coaching staff along with staff members in order to influence commitment to numeracy across the school … [There are] regular, focused PLT's centring on the 'right' work; [There are] increased conversations about student learning; numeracy leaders in each section have developed greater expertise and willing to share this back with staff; … All staff are building confidence and capacity to develop a targeted approach to teaching numeracy … (Assistant Principal)

Observable successes ...

- Greater use of data in lesson planning, differentiating and reviewing
- Increased level of conversation about student learning in literacy and numeracy
- Younger teachers more prepared to engage in and lead the improvement agenda
- Greater confidence and skills in coordinators
- Teachers moving from compliance to more active engagement
- Coaches relentless, resilient and hard working and provide high level of expertise
- Collaborative neighbourhood networking is building lateral capacity and collegiality (Principal)

Changes in practice are beginning to impact positively on student learning in the schools in this study (Vale, et al., 2010). Analysis of mathematics achievement data found growth in number achievement for students in years 3 through 6 was greater than expected growth for primary students in a six-month period. Growth in number achievement for students in years Prep to 2 in a six-month period was greater than growth achieved by students in the Early Years Numeracy Research Project in a nine-month period (Clarke, et al, 2001). However, this was not the case for secondary students; growth in number achievement was at, or below, expected growth for students in years 7 to 9. Growth in number achievement for primary and secondary Koori, newly arrived, refugee, ELL and the lowest SFO students was at, or greater than, the expected growth in a six-month period.

Despite these reported successes, many leaders and teachers recognise that they are still at the beginning of the process for effecting school change and changes in teaching practices and that they need to continue to build on their work or to finetune their approach.

Discussion and Conclusion

The experiences and beliefs of leaders in this study emphasise the importance of developing both instructional and transformational leadership capacity within the school and network in order to improve teaching practices and student learning. In the two networks in this study leaders at the network and school level practice both instructional and transformational leadership as promoted by the Region. Leaders demonstrate their knowledge of mathematics teaching and assessment practices that are promoted by the Region and reported in the literature to be effective for student learning and work collaboratively with their colleagues to develop their knowledge and practice. Findings suggest that leaders in this study:

- set directions for improved student learning consistent with high expectations for students and teachers;
- articulate a clear vision of school and classroom practice; and
- provide for the development of people and strengthening of school culture.

A number of factors appear to be important in building leadership capacity across the networks at different levels. These include the network structure itself, which brings together leaders and teachers from a common geographic location with common school community characteristics for professional learning, and provides the potential for further mutual engagement and joint enterprise. Principals have taken advantage of this structure to privilege time for themselves and their school numeracy leaders to meet in a small neighbourhood of schools or a cluster of seven or eight schools, or in the Regional Network. The knowledge and skills of school leaders, at all levels, is enhanced by the professional relationship formed with other leaders from schools with similar demographic and student achievement characteristics. Communities of practice are evident at the network level, whole school level and the professional learning team level since teachers in these various teams or networks:

- use a shared language;
- engage in activities that matter for improving student learning;
- focus on improving their knowledge and practice; and
- develop and use common teaching strategies, assessment processes and tools.

Second the findings suggest that leadership capability has been achieved through the deliberate strategy of distributing leadership responsibility throughout the school and providing time for groups of leaders to meet within schools and beyond in neighbourhoods or networks to share knowledge and practice and participate in structured professional learning programs delivered by experts with knowledge of effective practice and instructional leadership. The numeracy coaches performed an important role in facilitating these meetings and supporting school numeracy leaders. Collaborative professional learning teams, as envisioned by Fullan, Hill and Crevola (2006), are enacted in these schools, where school level numeracy leaders work on developing trusting relationships among teachers and facilitate, promote and support enquiry into their practice in a team context.

Third, while the concept maps designed by participants in this study suggest a sense of agency, with leaders and teachers working together in schools and networks to analyse practice and implement reforms in their schools, the work on reforming mathematics teaching, in the Pilot to date, is underpinned by the curriculum and practice promoted by the Region. The 'vision' for school reform for improved mathematics learning is provided by the Region in a language that is accessible for leaders and teachers. Leaders at all levels, and teachers, benefited from the support that numeracy coaches, Regional Network Leaders, Regional Numeracy Leaders and regional teaching and assessment materials and resources provided. The school numeracy leaders' knowledge of effective mathematics teaching practice enabled them to mentor and coach teachers in their school or team and to develop collegial practices of professional learning teams within their school.

Some school leaders who are working in smaller neighbourhoods of schools with similar demographic and achievement characteristics are beginning to set

their own agenda for reform and share this vision with others in the larger network of schools in their locality. To realise sustainable leadership as envisioned by Hargreaves (2009), principals and school numeracy leaders will need to continue to strengthen collaboration between their schools and persist with their inquiry into effective practice, so that what drives teachers' practice is what they come to know to be effective for improving the mathematics learning of their students.

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