The Practice of 'Middle Leading' in Mathematics Education

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While principals and systemic leaders have a significant role to play in leading, supporting and structuring mathematics education, their influence tends to be indirect and general. However, middle leaders such as curriculum leaders, senior teachers, and faculty heads, exercise their leadership much closer to the classroom, and as such they can have a more direct influence on the quality of teaching and learning in schools. To improve mathematics learning outcomes of student, it is crucial that educational leading is practiced by those with the greatest capacity to bring about positive practical and sustainable change – middle leaders. These school-based curriculum leaders can promote this development by engaging in forms of *Critical Participatory Action Research* that allows them to improve the quality of teaching and learning through an evidence-driven, site-based, collaborative approach.

It has been well known for a long time that leadership is critical for educational reform and this is no less the case in promoting educational development in mathematics education (Sexton & Downtown, 2014). In general, the literature related to leadership focuses on the role and practices of principals and school heads, and indeed their participation is crucial, but it is always at some distance from the classroom. These leaders have the capacity to open a space for pedagogical development and to support innovation, but they are often limited in their capacity to actually make a difference in the classroom. Lingard, Hayes, Mills and Christie (2003) found that the "principal effects on student outcomes were small and indirect" (p. 51), and, "teachers have the greatest impact upon student learning of all 'educational variables'. The effect of principals' practices on student learning are, in contrast, heavily mediated and limited" (p. 148). However, unlike principals, middle leaders are positioned much "closer" to the classroom and the practices that "happen" there and so their potential for impacting student learning is apparent.

While learning occurs in a range of sites within and outside the school, formal education through schooling is primarily focussed on the classroom. The classroom is where all the intentions and requirements of the curriculum meet learners through the practices of the teachers (Edwards-Groves, 2003). It is also the place where the effects of decisions made by principals, and educational managers and bureaucrats, have to be interpreted and enacted to promote learning (Grootenboer & Marshman, in press). It is not surprising then, that a number of studies have highlighted significant role of the teacher in the effectiveness of education (e.g., Lingard et al., 2003). In general, it is the teacher that has to interpret and put into practice the educational policies, programs and procedures in the classroom to facilitate rich student learning. It is the teacher that is the interface between the mathematics curriculum and learners, and so all the educational decisions made 'before or above' to the classroom site, they are always mediated through the teacher (Edwards-Groves, 2003; Grootenboer & Edwards-Groves, 2014).

With this in mind, it is clear that middle leaders are critical in the development of quality educational outcomes because they exercise their leading in and around classrooms. Middle leaders are those who have an acknowledged position of leadership in

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their school, but also have a significant teaching role (e.g., senior teacher, Head of Mathematics Department) (Grootenboer, Edwards-Groves & Rönnerman, 2014). In general, they can be viewed as those whose leading practices operate between the Principal or the Head, and the teaching staff – in the middle! It is these people - the middle leaders, who can have the greatest impact on teacher learning and development (Edwards-Groves & Rönnerman, 2013) and more directly impact classroom practices. As such they can be 'instructional' and 'curriculum' leaders who can focus on the core business of schooling – learning and teaching.

The concept of *middle leading* has significance in three ways:

1. ***Positionally*** – middle leading is structurally and relationally practised 'between' the school senior management and the teaching staff. They are not in a peculiar space of their own, but rather than are practising members of both groups.
2. ***Philosophically*** – middle leading is practised from the centre or alongside colleagues. In this sense, middle leaders are not the 'heroic crusader' leading from the front, but rather alongside and in collaboration with their colleagues.
3. ***In practice*** – middle leading is understood and developed as a practice. To this end, the focus is on the sayings, doings, and relatings of leading rather than the characteristics and qualities of middle leadership. (Grootenboer, Edwards-Groves & Rönnerman, 2014, p. 18)

Thus, we see middle leaders as critical educators in the improvement of mathematics learning and teaching.

Leading Mathematics Learning and Teaching

To improve the mathematical learning outcomes for students, the main focus is usually on improving pedagogy. While there are a number of important factors that impact on the mathematical achievement of students, the most amenable to influence and development from a school perspective is the teaching. And, as was noted previously, the teacher is the single most significant player in influencing student learning (Lingard, et al, 2003). Therefore, given the critical role of quality teaching, the focus for improved student learning in mathematics has to be on professional development for teachers. Here we want to argue that to be both effective and sustainable, teacher learning has to be fundamentally site-based (Grootenboer & Edwards-Groves, 2014). While there is a place for externally run and organised courses and programs, primarily professional development needs to be undertaken at a local level. Indeed, the effectiveness of teacher development courses run outside of the school site is determined by the capacity of those involved to take the learning back and apply it in their particular school. Also, pedagogical development needs to be responsive to the particular learning needs of the school site (Edwards-Groves & Grootenboer, under review). Student identities and learning contexts vary greatly from site to site, and so notion of 'best practice' can only have meaning at a very general level (Kemmis, McTaggart & Nixon, 2014) and might therefore, be talked about as 'good enough practice' in the meaning of letting context and site matter (Groundwater-Smith, Smith, Mockler, Ponte & Rönnerman, 2012).

For example, the mathematical pedagogy that might be needed with students in the Torres Strait Islands would be quite different from students in an urban school which would be different again from Aboriginal learners in schools in central Australia. Finally,

professional development should be collaborative and critically reflective. Lingard, et al. (2003) commented:

> … productive leadership encourages intellectual debates and discussions about the purposes, nature and content of a quality education; promotes critical reflection on practices; sponsors action research within the school; and seeks to ensure that this intellectual work connects with the concerns of teachers, students, parents and the broader educational community. Such leadership also ensures that teachers, and others working within schools, are provided with the support structures necessary to engage in intellectual discussions about their work, to reflect on the reform processes within their schools, as well as their pedagogical and assessment practices. (p. 20)

Considering these points, it seemed appropriate to focus on developing pedagogical capacity within schools and mathematics classrooms that would be localised and sustainable. To this end, equipping and supporting middle leaders to be curriculum leaders within their own school sites is an important and effective way to improve pedagogy, which in turn facilitates better learning outcomes in mathematics. Furthermore, *critical participatory action research* processes are an effective way to structure pedagogical development that was responsive to the needs and conditions of the school and classroom.

Critical Participatory Action Research (CPAR)

In educational contexts, we believe that there is an imperative to actively pursue the re-emphasis of *educational research* that places the interests of students, teachers and societies at the centre of the research process/project. CPAR is one way to promote this agenda. In this vein, mathematics education research is about transforming and developing mathematics learning practices in schools and classrooms.

Action research in a variety of forms has been employed for many years to facilitate and structure school development. Most commonly action research has been associated with, and seen as synonymous with, the 'action research cycle' (see Figure 1).

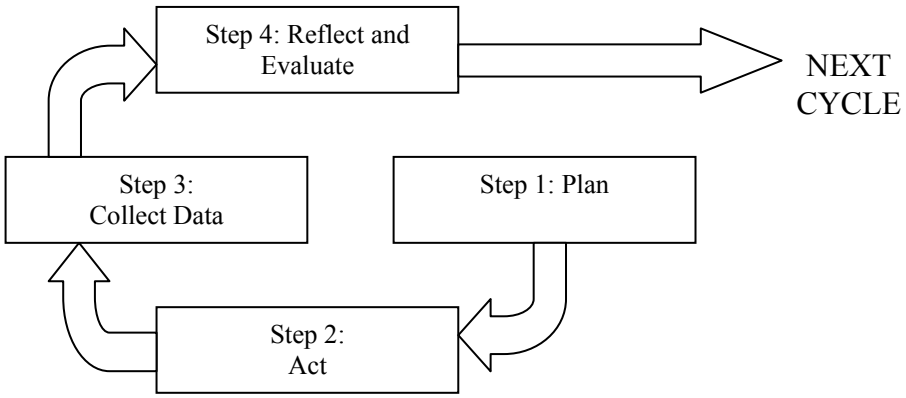

Figure 1: The Action Research Cycle

While the 'cycles' are useful, we see CPAR as more than just a cyclic process. CPAR fundamentally involves participants changing a social practice (e.g., mathematics teaching), and, changing what people *think* and *say*, what they *do*, and how they *relate* to others in that practice. To allow this to happen it is of importance that teachers get time and resources to meet in democratic dialogues where they can share knowledge and experiences related to their mathematics teaching practices in that site (Rönnerman & Salo, 2014).

The Critical Dimension

The *critical* nature of CPAR stems from its essential drive to question the moral and ethical nature of our practices. Specifically, this involves asking whether current educational practices and our educational institutions are:

- **Rational –** or are the practices irrational, unreasonable, incomprehensible, incoherent;
- **Sustainable –** or are the practices unsustainable, ineffective, unproductive, non-renewable; and,
- **Just –** or are the practices unjust, adversely affecting relationships, serving the interests of some at the expense of others, causing unreasonable conflict or suffering? (adapted from Kemmis, McTaggart & Nixon, 2014)

These are not just theoretical or esoteric questions, but rather they provide thoughtful prompts for evaluating whether educational practices are viable and responsive to the needs and circumstances of those involved at the time. For example, in mathematics education we should ask whether our current practices are irrational. Is it rational, reasonable and coherent to have many students completing their mathematics education seeing mathematics as irrelevant, boring and useless? We should also ask whether our current practices are unsustainable. Is it sustainable for the nation to, each year, produce many less mathematics graduates than is needed? And finally, we should ask whether our current mathematics education practices are unjust? Is it just that particular groups of students (e.g., students in remote schools) have lower mathematical outcomes than their urban peers? As these examples illustrate, the critical questions are relevant at a broad level, but also at a local site-based level where mathematics learning and teaching actually occurs.

Participation

Participation in CPAR is about developing a "communicative space" (Habermas, 1987) and requires consideration of who is involved, affected and included. Creating conditions for members to participate freely in this space - within what is described as a public sphere – makes communicative action possible. People who come together around issues of genuine concern about their circumstances and strive for intersubjective agreement about the language and ideas they use, mutual understanding of one another's perspectives, and unforced consensus about what to do (Kemmis, McTaggart & Nixon, 2014). In a school-based CPAR project this would obviously include the mathematics teachers and the school leadership, but fundamentally it also involves the students and often they are not considered as participants. We are not suggesting that all are participants in the same way or to the same degree, but nevertheless the students should be included because they are the prime focus of the mathematics education programs. Indeed, it would be irrational, ineffective and unjust to ignore the students in a mathematics education development project.

Action Research

As is clear from the preceding sections, action research is concerned with the development of social practices – in this case, practices of mathematics teaching and learning. To this end, the *purpose*, the *site* and the *focus* of CPAR are the practices of

learners and teachers, and, the associated practice architectures (practice arrangements or conditions which enable or constrain practices). This is consistent with the premise stated earlier that sees the interests of students, teachers and their communities at the centre of the research process. Here, in the context of discussing mathematics curriculum leadership in schools, we are also concerned with the practices of middle leaders, and how their leading practices enable and constrain mathematics education practices in their particular sites.

This is a form of critical hermeneutic research that aims at *understanding* (rather than simply describing and explaining) and *transforming* a situation (so that it is not irrational, unsustainable or unjust). It tends to be interpretive and qualitative in nature with a practical intent (educating practitioners so they can act rightly – *as a form of praxis*).

Mathematics Leading Through Site-based CPAR

As has been noted previously, effective professional development is grounded in the particular arrangements of the site, and the people who are learning and teaching in the school. Therefore, programs and activities that focus on development need to begin with an understanding of the site, and this involves data gathering. Teaching and learning practices are enabled and constrained by the practice architectures, and so any mathematics education development will have to be cognisant of these local arrangements as well as the practices themselves. Evidence-informed site-based pedagogical development will lead to teaching that is responsive to the actualities of the learner's mathematical education and the conditions within which they undertake their learning. To this end, CPAR is useful.

> In CPAR we do not aim to produce generalisations about the 'one best way' to do things. In fact, we don't want to find the best way to do things anywhere *except* here – where we are, in our situation. (Kemmis, McTaggart & Nixon, 2014, p. 69)

> "… productive leadership encourages intellectual debates and discussions about the purposes, nature and content of a quality education; promotes critical reflection on practices; sponsors action research within the school; and seeks to ensure that this intellectual work connects with the concerns of teachers, students, parents and the broader educational community. Such leadership also ensures that teachers, and others working within schools, are provided with the support structures necessary to engage in intellectual discussions about their work, to reflect on the reform processes within their schools, as well as their pedagogical and assessment practices." (Lingard, et al., 2003, p. 20)

To illustrate, below we recount how mathematics middle leaders in one secondary school used a form of CPAR to promote deeper learning and engagement with their students in Years 8 to 10[1]. The middle leader's role was to participate, facilitate, support and resource the action research-based development.

Case Study[2]: Urban Secondary College[3] Mathematics Department

Urban Secondary College (USC) is a large metropolitan high school and broadly their goal was to improve students' mathematical learning outcomes by improving mathematical pedagogy. The mathematics department teachers worked in three smaller groups that focussed respectively on the Year 8, Year 9 and Year 10 classes, and each group was led

[1] At this time, these were the first 3 years of secondary school.

2 The first named author worked with these middle leaders as a 'critical friend'. Therefore, what is reported here is not so much a research report, but an account of what occurred.

3 Pseudonyms have been used throughout this paper

by one of the mathematics faculty middle leaders. Generally, the mathematics classes at USC had been fairly traditional in nature involving teacher exposition and textbook work, and through this project the goal was to engage in different forms of pedagogy in order to promote deeper mathematical thinking and conceptual understanding.

The middle leaders in the mathematics department (the three middle leaders noted above and the Head of Department) had been successful mathematics teachers for a number of years, but their challenge was to facilitate engaging mathematical pedagogy across all the mathematics classrooms, including those that were taught by non-mathematics specialists (e.g., a physical education teacher who may have just one mathematics class). Indeed, the middle leaders realised that bringing about pedagogical change in mathematics required a cultural change in the department and this was accepted as being a long-term and on-going project. The consensus of the middle leaders and the department, after engaging in some focussed professional learning on engaging mathematical pedagogies, was that 'hands-on' discovery learning activities were appropriate. The middle leader's first response was to change the focus of their fortnightly department meetings from management and administration to pedagogy[4], hence providing curriculum leadership.

The three Year level groups met fortnightly and developed one 'discovery' type activity for the ensuing unit of work, and each teacher committed to using it and collected some evidence from their students related to the activity. Furthermore, they agreed to visit and observe in each other's class when this activity was being employed. Although these 2 developments may seem fairly small, they were not insignificant for those involved, and they marked a beginning to some cultural changes in the department (i.e., opening up their classrooms to colleagues) and some pedagogical reform (i.e., investigative approaches to learning mathematics). As curriculum leaders, the middle leaders engaged in the same pedagogical and cultural change as the staff, they usually invited others into their classroom first in order to build a climate of trust and collegiality.

To illustrate, in the Year 8 classes the students initially investigated the sum of interior angles in a polygon. In this lesson the students were involved in drawing polygons, marking and cutting off the 'corners', and rearranging the pieces to uncover the relationship between the number of sides of the polygon and the sum of the interior angles. During the lesson, visiting teachers observed students using a range of methods to investigate the relationship and generalise a rule. Historically, the students would simply have had the rule presented to them, however, it was noted that because students were given the time to develop their own conceptual understandings, they became confident in investigating more complex shapes, and in the process they developed more robust problem solving skills and dispositions.

It is important to note that when the teachers visited one another's classrooms, the observations were not so much of the teacher per se, but rather of the students' learning and their engagement with the particular activity. They paid particular attention to the nature of student participation, the learning behaviours they employed, and the questions or comments that they offered. These notes, along with the work samples of these students, provided useful evidence regarding what actually happened in the classroom, and the teachers used this to reflect on the activity, the pedagogical approach, and the mathematical learning practices of the students. Each teacher would reflect on their own practice in the light of the data collected, and then they met as a group and through

[4] Administrative matters were then largely managed through email and the school intranet

dialogue they reflected collaboratively. After these reflections, the teachers then went on to plan their next common lesson, incorporating their understandings from the previous cycle, and thus the next action research cycle began.

Towards the end of the year the teachers again met in their groups, and as a whole department. At this time they looked back over their development throughout the year, using their data and meeting notes as references for what they undertaken. At this time they were able to identify significant changes in their mathematical pedagogy, and although this looked different for each of the individual teachers (i.e. individual praxis), there was clearly a shared approach to teaching that was more responsive to the students' needs (i.e., collective praxis), and a different *department culture*. Furthermore, they were able to specifically identify pedagogies that were more successful in engaging the students and facilitating their learning in mathematics.

Discussion, Conclusions and Implications

Throughout this paper we have highlight two key aspects of leading in mathematics education and pedagogical reform for improved learning outcomes in mathematics – middle leading and CPAR. We believe that these are both important because learning and teaching occurs in actual sites, and therefore, it must be responsive to the particularities of that site. This is no less the case in mathematics education, where generalised notions of 'best practice' are seemingly well established and difficult to change, and yet we know that for many they complete their mathematics education with debilitating and restrictive mathematical identities. To this end, we argue that there is not a single *best practice* per se for mathematics education that can be successfully implemented across all school sites, but rather what is needed is pedagogical leadership and development that is responsive to the specific mathematical learning needs within each school and classroom site.

In the case recounted above, the initial impetus for the change emerged from a critical evaluation of their current practices and students' learning outcomes in mathematics. While not overtly addressing the questions noted previously about their practices being irrational, unsustainable and unjust (although these could have been productively employed to structure their department discussions), they did want to address issues related to the reasonableness and effectiveness of their mathematics education. Specifically, they were concerned that the students' were becoming disengaged and disenfranchised with mathematics, and this was occurring in the very place they wanted to promote engagement and appreciation of the subject – their mathematics classrooms. Their practices in the past had been largely built on an unquestioning acceptance and use of traditional 'best practices' of mathematics teaching, and through their CPAR facilitated by the middle leaders, they brought about changes to their practices.

As we noted at the beginning of this paper, improved educational outcomes in mathematics requires the support, involvement and commitment of educational leaders (Sexton & Downtown, 2014). This leadership is needed at all levels from government and system 'down', and particularly includes school principals. However, if actual classroom practice is to be developed then the critical leadership that is required – curriculum leadership, needs to be exercised 'closer' to the site where teaching and learning is actioned. To this end, middle leaders, as in those who have formal leading positions but also have a teaching role, are the leaders with the capacity and position to most directly influence pedagogy and in turn learning among both teachers and students. They can focus

on the key educational site – the classroom where teachers, students and mathematical ideas meet.

Effective middle leading is not simple, and it involves a range of roles including administrator, manager, and teacher, but the critical one is curriculum leader. As a curriculum leader the middle leader is focussed on improving the learning outcomes of the students, and this primarily is done through staff and pedagogical development (Sexton & Downtown, 2014). Furthermore, the middle leader has to nurture a sense of understanding of the students including their educational needs and their broader life worlds, and to facilitate connection with the community. This becomes particularly important when students don't come with the cultural capital necessary for success in school mathematics, and disproportionately these students come from disadvantaged communities.

Pedagogical leadership provided by senior teachers, faculty heads and the like, can ensure that teaching is responsive to the learners needs, thus avoiding the homogenizing effect of a standard approach. While the mathematics curriculum may be standardised across Australia, the way that curriculum is taken-up and presented in the classroom can and should vary through a diverse range of teaching approaches appropriate for the learners in that site. In this way mathematics education may become more rational, sustainable and just.

References

Groundwater-Smith, S., Smith, J., Mockler, N., Ponte, P., & Rönnerman, K. (2012). *Facilitating practitioner research: Developing transformational partnerships*. London: Routledge.

Edwards-Groves, C. (2003). *On task: Focused literacy learning*. Sydney: Primary English Teachers Association (PETA).

Edwards-Groves, C., & Grootenboer, P. (under review). Praxis and the theory of practice architectures: Resources for re-envisioning English Education. *Australian Journal of Language and Literacy*.

Edwards-Groves, C., & Rönnerman, K. (2013). Generating leading practices through professional learning. *Professional Development in Education, 39*(1), 122-140.

Grootenboer, P., & Marshman, M. (in press). *Mathematics, affect and learning: Middle years students' beliefs and attitudes about mathematics education*. Singapore: Springer

Grootenboer, P., & Edwards-Groves, C. (2014). Mathematics teaching as praxis. In J. Anderson, M. Cavanagh & A. Prescott (Eds.), *Curriculum in focus: Research guided practice* (Proceedings of the 37th annual conference of the Mathematics education Research Group of Australasia, pp. 271-278). Sydney: MERGA.

Grootenboer, P., Edwards-Groves, & Rönnerman, K. (2014). Leading practice development: Voices from the middle. *Professional Development in Education*. doi: 10.1080/19415257.2014.924985

Habermas, J. (1987). *The theory of communicative action, (Volume two): Lifeworld and system: A critique of functionalist reason* (trans: McCarthy, T.). Cambridge, Mass: MIT Press.

Hayes, D., Mills, M. Christie, P., & Lingard, B. (2006). *Teachers and schooling: Making a difference*. Crows Nest, NSW: Allen and Unwin.

Kemmis, S., McTaggart, R., & Nixon, R. (2014). *The action research planner: Doing critical participatory action research*. Singapore: Springer

Lingard, B., Hayes, D., Mills, M., & Christie, P., (2003). *Leading learning: Making hope practical in schools*. Maidenhead, UK: Open University Press.

Rönnerman, K., & Salo, P. (Eds.) (2014). *Lost in practice: Transforming Nordic educational action research*. Rotterdam: Sense.

Sexton, M., & Downtown, A. (2014). School mathematics leaders' perceptions of successes and challenges of their leadership role within a mathematics improvement project. In J. Anderson, M. Cavanagh & A. Prescott (Eds.), *Curriculum in focus: Research guided practice* (Proceedings of the 37th annual conference of the Mathematics education Research Group of Australasia, pp. 581-588). Sydney: MERGA.