

Perceived Professional Learning Needs of Numeracy Coaches

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This paper describes part of research conducted with fifteen Numeracy Coaches as they carried out their work supporting teachers in Victorian government schools. There was great variation in the mathematical background of coaches, and this area of the research investigated the changing perception of professional learning priorities to support their work in schools, using questionnaire and interview data. The data indicated that the coaches' priority for mathematics content knowledge and pedagogical content knowledge strengthened over the year of the study.

The *Teaching and Learning Coaches Initiative* was intended to provide assistance to schools to improve student outcomes in mathematics and, in the case of a small number of schools, in science. The initiative was underpinned by the key findings that student achievement is determined to a significant extent by the knowledge and skills of teachers in individual classrooms. (Darling-Hammond, 2000; Wenglinsky, 2000)

In 2007, the DEECD worked extensively with Professor Richard Elmore on evaluating the School Improvement Practices in Victorian Government schools. Elmore (2007) noted that human investment was the strength of the Education System in Victoria and suggested that teachers:

should be given opportunities to develop a cosmopolitan view of their practice, one in which new and powerful ideas about teaching practice are public goods, rather than private practice. They should be exposed to coaching and mentoring others as early as possible in their careers. (p.7)

In the later part of 2007, the Teaching and Learning Coach Initiative (TaLC) was announced to begin in February 2008. The purpose and intention was to provide intensive assistance to identified schools to bring about changes in classroom practices that are necessary to improve student outcomes and build teacher capacity. In particular, the focus was on teacher capacity to establish priorities, analyse student results, measure student progress and improve the quality of learning and teaching. This represented a change in focus for school improvement policy to more direct support of teachers in the classroom and accountability of each of the regions. The data reported in this paper forms part of research conducted with fifteen Numeracy Coaches based in regional Victoria. The specific research question that was explored is: How do mathematics coaches' priorities for professional learning needs grow or change during a one-year period?

The Role of Coaches

Coaches work collaboratively with teachers to build their capacity to improve student learning outcomes. Victorian schools are divided into nine geographical regions and Teaching and Learning Coaches form part of regional school improvement teams. They are allocated to identified schools based on school data and mathematical performance for specified periods of time as determined by regional leaders. The impetus for teacher coaching was based on research that increasing teacher capacity had the most direct impact on improving student achievement (Hattie, 2003).

Coaching is a form of professional development in increasing use by school systems. In Victoria, both the Catholic and Government systems have large scale coaching initiatives. It is argued that it has the potential to have a high impact on classroom practice. Feger, Woleck, and Hickman, (2004, pp. 2-5) found that:

- effective coaching encourages collaborative, reflective practice;
- effective embedded professional learning promotes positive cultural change;
- a focus on content encourages the use of data analysis to inform practice;
- coaching promotes the implementation of learning and reciprocal accountability; and
- coaching supports collective, interconnected leadership across a school.

The literature points to three broad categories of skills that an effective coach should possess: pedagogical knowledge, content expertise and interpersonal skills (Steiner & Kowal, 2007).

Teachers in primary schools require a deep understanding of mathematics for teaching and this is a key component in improving student learning outcomes (Hill, Rowan & Ball, 2005). Shulman (1986) discussed the combination of content and pedagogical content knowledge for teaching.

Mere content knowledge is likely to be as useless pedagogically as content-free skill. But to blend properly the two aspects of a teacher's capacities requires that we pay as much attention to the content aspects of teaching as we have recently devoted to the elements of teaching process (p.6)

It is widely accepted that teachers of mathematics require appropriate strength in both content and pedagogical content knowledge. Much of the literature is general, focusing on leadership and relational aspects, with an implicit assumption that the pedagogical content and content knowledge and skills of coaches will be sufficient for the role.

Table 1 presents five categories of learning needs for coaches. These categories emerge from the literature. Examples of relevant authors are given for each category.

Table 1:

Aspects of Coaches' Professional Learning Needs and Related Literature

Categories of learning needs	Literature basis for the selection of the categories including the intended interpretation
Content Knowledge of Mathematics.	“...deep understanding of the content area of the subject for which they are working.” (Feger, Woleck & Hickman, 2004, p.4) Teachers' mathematical knowledge was significantly related to student achievement (Hill, Rowan & Ball, 2005)
Instructional Skills of Teaching and Learning	Sound pedagogical practices based on Principles of Learning and Teaching (PoLT) enable coaches to discuss instructional practices and models for explicit teaching and learning. (DEECD, 2006)
Interpersonal Relationship Development	Requires understanding the human states of mind, including verbal and non-verbal references to lead and pace teacher learning. (Costa & Garmston, 2002; Steiner & Kowal, 2007)
Instructional Knowledge as a Coach	Identify and plan for change through focussed inquiry to broaden the basis for work with teachers. “...given the vast amount of information teachers need to assimilate coaches will continually make decisions about whether to introduce something new or support further refinement of a previously explored concept or strategy”. (Burkins, 2007, p.107)
Leadership Skills	“Coaches require many approaches to change and need to adapt their methods to be aligned with the goals of the school/teacher/and educational system”. (Toll, 2004, p.18)

Methodology

To support the development of skills, knowledge and capacity in mathematics, coaches were invited to take part in monthly mathematics pedagogical content forums, addressing topic areas of fractions and algebra. The basis used was formative data collection and analysis to identify “big ideas” for student learning. Of the 15 coaches, 13 attended these sessions on a regular basis. In addition, coaches attended 16 days of professional development provided at the state level, focusing on both mathematics-specific and general coaching techniques and theory.

The level of mathematics background and experience for the coaches varied considerably from secondary mathematics trained (3 coaches), primary trained (10 coaches) and secondary English (2 coaches). All coaches were asked to complete a survey in March and again in November 2009. From the initial survey results, four coaches were identified for case study analysis and were interviewed in April and October 2009. The selected coaches provided a balance between perceived coaching ability and confidence in mathematics and represented different networks within the region. Two of the selected coaches had a high degree of experience in teacher action research within their school. They were both actively involved in the Project for Enhancing Effective Learning (PEEL) conferences, workgroups and discussion groups. The third coach had experiences across a range of schools including Adult Education and listed primary mathematics as an initial strength. The fourth coach had a strong focus on data analysis and school improvement, working as both the Line Manager for a number of coaches, coaching in one school and regional school accountability.

The data presented in this paper focus on the perceived learning needs of the coaches. At the beginning (March) and end of the research (November) as part of the survey completed by all coaches they were asked to rank the five aspects for their learning or development from the first column in Table 1 in order of personal importance with the following instructions.

Please rank the following aspects for your **own development** as a Teaching and Learning Coach. Rank order the following of 1 as **most important** aspect and 5 being the **least important** aspect of your learning.

Results

Table 2 presents the ranked perceived professional learning needs of the coaches from the survey in March and November, respectively. (The ranking of 1 being their highest professional learning need and 5 being their lowest need).

While the perceived professional learning needs varied considerably across the coaches involved in the study, it can be noted that there was a substantial increase in the learning need for *Content Knowledge of Mathematics*, as evidenced by the lower score. While the focus for their learning through the regional meetings was on content knowledge of mathematics (presented within the context of student learning and pedagogical content knowledge) this seems to have actually increased their awareness of their needs. It could be argued that the more we learn, the more we realise we have to learn.

The variation between coaches in each category was large with all possible ranks represented for each aspect in both collection periods except for *Instructional Knowledge as a Coach* for which only four ranks were represented. This validated the need for more in-depth data collection to help to understand the individual responses.

Table 2:

Rankings of Professional Development Needs (March and November)

	Content Knowledge of Mathematics		Leadership Skills		Interpersonal Relationship Development		Instructional Knowledge as a Coach		Instructional Skills for Teaching and Learning	
	Mar	Nov	Mar	Nov	Mar	Nov	Mar	Nov	Mar	Nov
A	1	2	4	1	5	5	2	3	3	4
B	1	2	3	3	5	5	2	4	4	1
C	1	3	4	5	5	1	2	2	3	4
D	3	1	2	5	5	3	4	2	1	4
E	5	1	4	5	2	4	1	2	3	3
F	5	1	4	4	3	5	1	2	2	3
G	2	1	4	4	5	5	1	2	3	3
H	2	2	1	1	3	3	4	4	5	5
I	2	2	5	5	2	4	3	1	1	3
J	5	2	3	5	1	1	4	3	2	4
K	4	3	5	5	1	4	3	2	2	1
L	5	5	4	2	1	4	2	1	3	3
M	5	5	1	3	2	1	3	2	4	4
N	5	5	4	1	3	3	1	2	2	4
P	5	5	1	3	2	4	4	2	3	1
Q	5	5	3	3	4	4	2	2	1	1

From the initial interviews, it appeared that coaches were interpreting the categories of *Instructional Skills for Teaching and Learning* in two different ways: as generalised teaching skills and behaviours, or as specific content knowledge of mathematics. To further investigate this task, coaches were asked in the second survey to explain their first and last professional learning need. The coaches that highlighted *Instructional Skills for Teaching and Learning* as their first priority supported their choice with the following statements:

Coach Q: I need to develop the continua of learning in mathematics to be established for level 4, 5 and 6 (Victorian Essential Learning Standards, yr 5-10) and how it extends to finding a problem of practice is a personal learning goal.

Coach P: I believe Professional Development in understanding the pedagogy for teaching mathematics is the most important. As Teaching and Learning Coaches we need to have a clear understanding of the horizontal knowledge of an outcome so we can ask probing questions in our coaching conversations.

These comments would seem to refer to knowledge for teaching mathematics, with elements of both content and pedagogical content, rather than more general instructional skills that were the intention of the category. While we may argue that teachers do not need to understand the nuances of defining their own knowledge and skills, it would seem that for a teaching and learning coach who is required to support the professional learning of others, these distinctions might be better understood. The following example was an explanation for choosing *Instructional Knowledge as a Coach* that also focused on mathematics teaching knowledge:

Coach L: I need to become more confident in sharing with the teachers the "horizontal" knowledge or the steps/gaps which have been identified in the student learning. Being able to identify and lead these for various mathematical concepts to be understood.

When the case study coaches discussed *Content Knowledge of Mathematics* as their professional learning need in October and were asked to elaborate on what aspects of

mathematics teaching they found particularly difficult, three out of four specifically reported fractions, percentages, decimals and ratio questions as their most challenging.

Coach D: ...Teaching and Learning approaches that are specific to core ideas in mathematics are a focus for me. My area of focus is Fractions, decimal, ratio. I have started to understand the big ideas of these, however I have a long way to go, especially in answering questions in context.

These comments by coaches have been somewhat surprising given that coaches were involved in substantial professional learning sessions both at the regional and state level specifically targeting Fractions, Decimals and Ratio. To explore these results further and focus on individual responses, brief summaries of three of the case study teachers synthesised from the interview transcripts are now presented.

Case Studies

The overall results for the case studies are shown in Table 3. The rankings in April and October were based on the card sort.

Table 3:

Case Study Ranking of Professional Development Needs (survey and card sort)

	Content Knowledge of Mathematics				Leadership skills				Interpersonal Relationship Development				Instructional Knowledge as a Coach				Instructional skills for Teaching and Learning.			
	M	A	O	N	M	A	O	N	M	A	O	N	M	A	O	N	M	A	O	N
Kay	2	1	1	2	5	3	2	5	2	4	4	4	3	2	1	1	1	*	3	3
Amy	1	1	2	2	4	1	4	1	5	5	5	5	2	3	3	3	3	2	4	4
Claire	3	1	2	1	2	5	5	5	5	4	4	3	4	3	3	2	1	2	1	4

*Placed along side all

Kay was first appointed as a coach in June 2008, six months into the coach initiative beginning in Victoria. She appeared to hold a strong belief and commitment for teacher action research and she was involved in a number of PEEL projects as a classroom teacher. When Kay first completed the survey in March, she identified development of her strength in *Instructional skills for Teaching and Learning* as the highest rank. A further six weeks into the study saw a shift for Kay. She still ranked the *Instructional Skills for Teaching and Learning* highly, although her greatest need to be a more effective coach was now identified as *Content Knowledge of Mathematics*. She discussed specifically the need to be able to identify confidently what students were doing in mathematics classrooms as an area for her development. She was unable to describe or predict a sequence of mathematics skills that students could display during a mathematics lesson or specific learning task.

Early in the year, Kay started to use demonstration lessons from the professional learning program to illustrate to the teachers she was coaching how mathematics tasks can be scaffolded to allow all students to learn. This form of professional learning gave her opportunity to unpack the mathematics within the learning tasks herself before working with teachers in classrooms. This gave her confidence to predict the mathematics skills that students displayed by what they were able to do, say and write. As the year progressed and Kay further developed her pedagogical content knowledge through using a variety of models and specific learning tasks to meet the learning needs of the teachers and students. She explained that the rich learning tasks she chose to demonstrate were selected to further the teachers' understanding of mathematics. The start of her shift in coaching confidence was to identify and discuss evidence of student learning for some of the "big ideas" in

mathematics. She also identified the use of analogies and a range of models for similar mathematical situations in the demonstration lessons, strengthened and enhanced her coaching conversations with teachers.

The end of the study saw a further shift for Kay in terms of the *Instructional Skills for Teaching and Learning*. Kay explained that her general pedagogy skills could be drawn upon easily, however to be a more effective mathematics coach, this is no longer a priority. An understanding of how all students learn mathematics particularly as the content requirements, learning tasks and mathematical models become more advanced (in Kay's words, above Grade 6 level) limits her ability to coach teachers effectively. Throughout the research, it was questioned if Kay saw herself as the teacher of the children or the coach of teachers. This is one of the many challenges for coaches as they transition from being a classroom teacher to a role as a mathematics coach.

Case study coaches were sent a draft of their summaries and Kay's response supports this coaching challenge:

It was so interesting that you identified the very issue that I think is the biggest challenge to me- that is totally stepping away from the teacher role into the coach role. I think it is because I am so passionate about teachers reflecting on and building good teacher practice, and students really engaging in their learning, that sometime I slip into a teacher role, rather than really meeting the teachers I am coaching where they are at. It is something I am aware of and am working on- a work in progress! I think I am growing into the role of a coach, and that was another reason to push myself a bit more and will take me out of my comfort zone, and hopefully improve my skills as a coach.

Amy was appointed as a teaching and learning coach in June 2008. Her background included teaching across a number of primary schools and also the adult learning sector. She saw her strength as general pedagogy, and in the first interview discussed the limitation of her mathematics: "In literacy, you can get away with pedagogy; in maths you need the content for credibility. I know I have a lot to learn in mathematics. I need to develop the content first before I can develop the effective pedagogies." She saw herself as having teaching skills, but needed to know how to tell teachers what to do without offending them. By the end of the research, Amy discussed the use of data collection and evidence of student learning in mathematics as the basis for coaching teachers.

Amy identified the regional mathematics professional learning programs as an excellent vehicle to develop both her content and pedagogical content knowledge. Amy elaborates that while she was able to solve mathematical problems, she was unable to describe how students could learn mathematical concepts in a variety of ways. The Professional Learning provided her with the models and contexts to open the learning for teachers and students. She perceived her knowledge of lower secondary mathematics as her future goal. "I need to develop my horizontal knowledge at the secondary level. The area of focus for my learning is Fractions, and in particular ratio questions in context." To extend her "horizontal knowledge", Amy enrolled in a Grad Cert of Secondary Mathematics in 2010. She appears to be referring to *knowledge at the mathematical horizon* (Hill, Ball & Schilling, 2008), a concept shared at the regional professional learning sessions.

In the first interview, Amy was unable to describe any coaching structures other than telling teachers what they needed to do. By the end of the research, she had adopted a range of conversation structures, based on the Cognitive Coaching Frameworks (Costa & Carmston, 2004). It would seem that the professional learning program was able to meet Amy's needs in terms of coaching structures and conversations, however her identification of her learning needs for content and pedagogical content knowledge have strengthened.

Claire started in the initiative in a support role to the Student Learning Manager and became the Teaching and Learning Coach manager in January 2009. In March 2009, she began coaching at one of the schools where a coach was unable to continue due to personal reasons. In April, she identified clearly development of *Content Knowledge of Mathematics* as her highest need, though it had been ranked lower in the survey. She answered most questions in her interview in terms of her need to develop her understanding of mathematics content. When asked to elaborate or clarify her focus area, she was unable to do so. “I really need to develop all these. I don’t know what I don’t know.” In the final interview, Claire still considered *Content Knowledge of Mathematics* as a high priority, however she then incorporated content and pedagogical content into the one area. She was also able to identify her next level of learning in Mathematics.

A strong knowledge of mathematics is essential for engaging in debate and rigour to inform the next level of my learning. For me this is around fractions and division. Content knowledge development where I needed and enjoyed the greatest impact on change and challenge that has led to growth. Mathematics subject and pedagogical content continues to be my priority.

At the beginning of the research, when asked to discuss her choice of *Instructional Skills for Teaching and Learning*, she only referred to how to teach mathematics. A shift in November was noted, with Claire discussing teaching and learning models of how students learn “We need to be aware of what will get students, teachers and teams onto the ‘ramp’ (Vygotsky’s Zone of Proximal Development) as the instructional skills for teaching and learning.”

Claire did not see the role as a coach as one of Leadership. She saw her role as using collaboration and shared learning but not leading: “I have deliberately positioned myself as a learner of mathematics. I have used content knowledge building as the basis for my connection to colleagues.”

Conclusion

Many coaches are faced with challenges related to their own content knowledge of mathematics. To lead conceptually-driven conversations with the teachers with whom they are working, they need to be supported to develop their own content and pedagogy skills. Many coaches continued to raise concerns related to their own understanding of content and pedagogical content knowledge of mathematics. As coaches were exposed to classroom coaching experiences and focused professional learning throughout the research period, this seemed to strengthen their goals to further develop their content knowledge in mathematics. It seemed to be a case of “knowing what they didn’t know.”

During the research period, there were changes in the language used by the coaches including pedagogical content knowledge of mathematics, and reference to specific aspects of this, demonstrating an emergence of new understanding of how students learn mathematics. However, most coaches continued to discuss pedagogical content knowledge in isolation from subject content knowledge and were unable to make links between the two.

The finding of this study support the need for coaching initiatives to include a focus on developing knowledge for teaching mathematics, including content and pedagogical content knowledge (Ball, Thames & Phelps, 2008). It is important that coaches have strong mathematics content and pedagogical content knowledge to support teacher development and ultimately achieve the policy imperatives of improving student learning.

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