Developing a Culture of Collaboration

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This paper explores the role of professional learning community and collegial discussion as important supports for developing teacher expertise in the teaching and learning of mathematics in rural and remote regions of Queensland, Australia. The research reported in this paper is from the first year of a longitudinal research and development project. Findings suggest that teachers in rural and remote schools with a small number of mathematics teachers may benefit from access to the mathematics professional learning community of a larger rural school.

It is well recognised that many teachers in rural and remote regions of central Queensland are new graduates. They teach for three years in these regions and then return to the city centres along the coast of Queensland. This practice results in high teacher turnover, insuring a constant flow of new, inexperienced teachers to these regions (Heslop, 2003). Making this situation more complex for the teaching of mathematics in years 8, 9 and 10 is the usual practice that this teaching is often delegated to novice teachers without a mathematics background.

This paper reports on one aspect of a larger project. The larger project aims to develop a set of guiding principles (diSessa & Cobb, 2004) for an effective, longitudinal and collaborative approach to increasing the quality of mathematics teaching and learning in remote regions in Queensland. The vehicle used to enhance year 8, 9 and 10 teachers' understanding of mathematics teaching and learning is through the development of a professional learning community among the rural and remote teachers participating in this project. This approach recognises the problems associated with the tyranny of distance often experienced by teachers in remote regions as it prevents access to a mathematics professional learning community and as a consequence collegial discussion that could guide their developing understanding of the teaching and learning of mathematics. In an effort to meet this aim the research investigates ways of developing and sustaining local teaching capacity for mathematics in years 8, 9 and 10 through the promotion of a professional learning community. The argument presented in this paper is from the theoretical perspective that professional learning communities provide spaces for teacher discussion, and are therefore fundamental to the support provided to recent graduates as they develop expertise through their early teaching experiences.

Literature Review

Professional learning communities, also known as professional teaching communities are well recognised in the literature as providing collegial support for teachers (Cobb, McClain, Lamberg, & Dean, 2003; Gamoran et al., 2003; Grossman, Wineburg, & Woolworth, 2001; Lave & Wenger, 1991; Little, 2004; Stein, Silver, & Smith, 1998; Wenger, 1998). In addition, research literature suggests that effective professional development for teaching mathematics has been identified in both qualitative and quantitative studies as needing the following characteristics; extended duration, collective participation, active learning opportunities, a focus on problems and issues that are close to practice, and attention to the use of tools that are integral to that practice (Borko, 2004; Cohen & Hill, 2000; Garet, Porter, Desimone, Birman, & Yoon, 2001). Moreover it seems

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important to introduce two strands of support that are particularly relevant in the initial collaboration with groups of mathematics teachers: building teacher community, and building teachers' mathematical competence.

Building Teacher Community

Teachers' learning in professional development settings is often conceptualised in terms of changes in teachers' participation in a community of practice that the group of participants constitute (Wenger, 1998). The value of this analytical approach is in shifting researchers' attention from individual teacher attributes to the norms, routines, and discourses of the profession that both shape and are shaped by the participating teachers. However, the process of *community genesis* (Gueudet & Trouche, 2012) where the professional learning community grows and develops over a period of time is an accomplishment that requires considerable proactive support (Visnovska, Cobb, & Dean, 2012). It involves development of a joint enterprise, norms of mutual engagement, and a shared technical repertoire (Cobb et al., 2003; Wenger, 1998) that would be conducive to reorganisation of mathematics teachers' practices. Dean (2005) reported that in her collaboration with a group of middle school mathematics teachers in the US, the means of supporting the transformation of the teacher group into a community of practice were not part of the initial program design but the need for them became obvious during the initial professional development sessions. Explicit support for the emergence of a professional community is at the forefront of a number of recent professional development programs (e.g., Borko et al., 2010).

Building Teachers' Mathematical Competence

Strong grounding in mathematical content is a well-established characteristic of effective professional development for mathematics teachers (e.g., Carpenter et al., 2004; Smith, 2001). This is because the forms of envisioned teaching practice require that teachers develop deep understandings of mathematics (Ball & Cohen, 1999) and, more specifically, *mathematical knowledge for teaching* (Ball & Bass, 2003).

Research on teaching mathematics for understanding (Carpenter et al., 2004) indicates that teachers need to build on their students' current reasoning while, at the same time, keep in mind significant mathematical ideas that are the goal of instruction (Ball, 1993). Effective instructional practices emphasise students' opportunities to engage in mathematically challenging tasks, where students are presented with opportunities to communicate their mathematical thinking in classroom discussions (Hiebert & Grouws, 2007).

For teachers who do not typically include classroom discussions in their teaching, leading discussions might seem unpredictable and uncertain (Visnovska, Cobb & Dean, 2012). Their concern may rest with how to give students opportunities to contribute to discussion with pre-prepared data that also led students in a way that promoted the intended mathematical ideas. Elsewhere (Visnovska & Lamb, accepted) we have reported that while some of teachers we collaborate with were not accustomed to detailed planning in advance of their classroom interactions, preferring instead to think on their feet, other teachers in the group engaged in deep pedagogical conversations as they planned the delivery of the lesson. In an effort to build on the existing research literature we investigate in this paper what might have contributed to differences in these teachers' participation in group planning discussions. Using data from teacher interviews at the end of the first year of the project, we pay particular attention to teachers' opportunities for collegial interactions at their school sites.

Theoretical Perspective

This research draws on Millett and Bibby's (2004) model (Figure 1) of teacher change within the context of curriculum change to theorise teacher interactions when participating in detailed planning discussions. Their model illustrates the local context of curriculum change and, in so doing, suggests that the role played by a teacher's professional learning community is vital to effective change. They theorise that the role of the teacher is central to the implementation of curriculum change and so a teacher's "personal agency beliefs" and "beliefs about self-efficacy…and academic self esteem" (p. 5) play a part in determining the success or otherwise of the implementation process. The influence of a teacher's personal and professional identity on curriculum change is also supported elsewhere in the literature where efficacy issues in respect to mathematics teaching are identified as critical factors (Ball & Bass, 2003; Gresalfi & Cobb, 2011; Ma, 1999). The importance of time, talk, expertise, and motivation in providing the sources of support necessary for positive self-efficacy has been identified by Millett, Brown and Askew (2004). It seemed that time, talk, and expertise complement internal motivation, resulting in "deep change" (p. 245).

Millett and Bibby (2004) conceptualise teachers' work as being situated within a specific school culture, or *professional community*, called school culture, that shapes the teachers' capacity to change. They explain that the teacher and the *situation* are located within a wider context that includes influences such as: *policy* developed by governments and various authorities; *professionals* external to education; the *private* or commercial sector; and the general *public* or those who are outside the school but are none-the-less interested in education such as parents and the media.

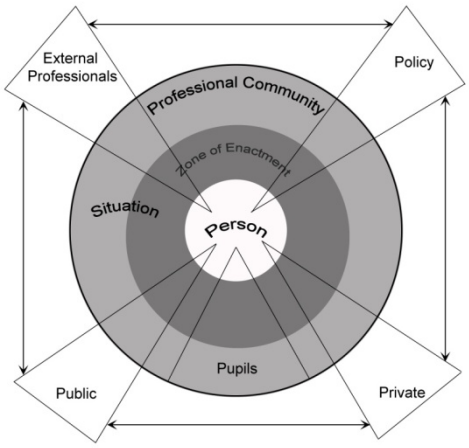

Figure 1. Theoretical model for analysing the context of curriculum change. (Millett & Bibby, 2004, p.3)

Millett and Biby (2004) draw on Spillane's (1999) earlier work, noting that the impetus for curriculum change often comes from a wider context beyond the school environment that is supported by the professional community stimulating a "zone of enactment" (Millett and Bibby, 2004 p. 4) to which the teacher will respond. Critical to a teacher's response within their *zone of enactment* is the type of support found within their institutional context and whether sharing and critical interrogation of their practice takes place. Positive support includes "rich deliberations" that, when "grounded in practice and supported by resources, [make] curriculum change more likely to be operationalised" (p. 4).

They also noted that external expertise was deemed to be essential to support teachers' learning with respect to new content knowledge and content specific pedagogical knowledge. Heirdsfield, Lamb, & Spry, 2010 found that another factor critical to developing the motivation that leads to deep change is length of time. Individual PD sessions do not

support change but rather sustained engagement with PD providers over extended periods is needed.

Method

There are eleven teachers from six schools and one regional mathematics advisor participating in the project. The group of teachers met for the first time in March 2011 and then on two subsequent occasions during 2011 for a day of professional development. Two teachers, Tom and Jodie are the focus of this paper. Pseudonyms have been used. They are not qualified mathematics teachers and as a result teach across years 8, 9 and 10. Tom's largest class has 16 students and the smallest 6 students. Across years 8-12 there are 5 other teachers teaching mathematics at Tom's school including new graduates qualified in the teaching of mathematics to year 12. Jodie teaches years 9 and 10 mathematics in a smaller school with 8 and 5 children in her two mathematics classes. There is one other mathematics teacher at her school. The second mathematics teacher is a recent graduate qualified to teach mathematics to year 12. The distance between Tom and Jodie's schools is approximately 5 hours drive.

The data reported in this paper are drawn from interviews conducted with these two experienced teachers at the conclusion of the first year of the project. These interviews were audio recorded, transcribed and analysed for evidence of how the school *situation* supports each teacher's *zone of enactment* regarding detailed planning conversations.

The selection of these teachers reported on in this paper was purposive as their cases were chosen for the capacity to illuminate rather than for representativeness (Stake, 2005). In particular, the cases reported in this paper were selected because of the way these teachers are influenced by their school situation and as a consequence the *zones of enactment* that operate in their schools.

Results and Discussion

In both schools there are formal and informal meetings opportunities for the teachers to discuss their teaching and learning of mathematics. Both experienced teachers were asked the same questions. The question regarding informal meeting opportunities that could stimulate the teachers' zone of enactment was, In the last month have you gone to anyone for advise, a question or a concern or just to talk about something that has to do with your teaching of mathematics?

> Tom: I am actually located in a room where the majority of the maths teachers are... So I'm in a kind of in a staff room that shares four of the teachers, so all the time, like there's a lot of collegial support about. Lots of questions, is something working or not working in class, and sharing of ideas... If we find something that is working well in one of our classes it is guaranteed to probably do alright in the same age group in the other class so we touch base quite a bit... I guess we informally do it more than several times daily.

Jodie's response to this question was in complete contrast to Tom's response.

> Jodie: No, not really because although we do have another mathematics trained teacher in the school, he is only first year. So he doesn't, you cannot say he is experienced. He has never taught high school maths so I cannot really ask him anything. So no, I don't really get to ask anyone. I feel a bit isolated in that aspect.
>
> Researcher: OK. So were there any issues or questions that you wanted to ask someone but because of the situation it just did not seem like an option?

> Jodie: No, it is very rarely I need to. I think as I have become more experienced I do not need to ask you know as many questions anymore sort of thing. Actually in my first year when I first started I had a fellow senior math teacher here. So, no, I don't really have many questions or issues anymore.

Tom and Jodie were also asked about informal opportunities to observe other mathematics lessons in their school. Michael explained that this is possible but he does formal observations/collaborative teaching on a regular basis. When Jodie was asked about informal observation of the other mathematics teacher in the school she explained that she observes, "Just what I see when I walk past the classroom." Worthy of note is that the other mathematics teacher does come in to observe Jodie's class from time to time. When asked if she talked about the lesson or the things that she did and why with her colleague she replied: "No, not really. No, I would not say that."

The different situations in these two schools regarding informal opportunities to interact would suggest that the zone of enactment for both teachers and their colleagues is very different. As an experienced teacher Tom is able to induct new teachers into the school culture or situation that promotes collaborative discussion. However it would seem that experience of such collaborative culture has not been part of Jodie's school situation and therefore she does not have the same level of appreciation for discussions as Tom.

Both teachers have formal opportunities to interact with colleagues.

> Tom: ...our HOD for Science, Math, IT and Business is the person that shares that meeting. We present the planning that we have, any assessment items, check the assessment calendar and how that fits in with what we are doing with our kids at the moment. We are doing a lot of analysis of students and building up class profiles with those students and where they sit within the group, how their academic results are and our response to that as teachers so one of the documents that we will be developing for the next meeting is each class doing a brief to the HOD on our students.

In addition to these formal monthly meetings Tom is also able to work with another mathematics teachers during tutorial sessions that are formally timetabled by the school and are designed to work with targeted groups of students. He explained that there were tutorials for students needing extension, support and motivation. Tom worked with the students needing support and he often joined with the tutorial group organised to provide motivation for learning of mathematics.

> Tom: There are a couple of ways with these tutor support groups. There is an opportunity for me to get in and actually work with other teachers in these tutorial groups ... I guess lots of ideas, lots of how did you go, how did you do this in your group or I have tried this, what did you try, how did that work. So I do lots of reflective conversations about what I am doing and what they are doing to try to see, you know, benchmark in what they are doing. And some of the "I can do it differently to how they did it". Dealing with the one on one when I am in the same class at the same time and one of us dominates the teaching ...and the other one is supporting. So we get an opportunity to be in the driving seat and the others are watching and then when the other person is in the driving seat you watch so you kind of analyse on the spot what they are doing differently and how it is working and watching the students. How they are doing that, how they are engaging differently, whether they are seeing similar things or different things when I am in control of the class. So that has been a really good experience to be able to do that with this group.

Tom's descriptions are typical of those reported in the research literature where teacher collaboration within a school situation promotes thinking about the different ways that children engage with mathematical thinking (Borko, 2004; Cohen & Hill, 2000; Garet et al., 2001).

In contrast, Jodie, in the smaller school, does not seem to have the same opportunities for collaboration. Jodie described one avenue for teachers to seek advice.

> [At staff meetings] we regularly do demonstrations or talk to each other about what is going on... Like, they [other teachers] come up in conversations in staff rooms or at our staff meeting. If someone wants some advice they can easily go and see the other teachers.

For Jodie it seems that the only time she would engage in a discussion is when she needs advice. Being an experienced teacher, she does not feel she needs to seek advice. Her perspective is very different from Tom's. Tom considers collegial discussions as valuable learning for the group of mathematics teachers. The depth of discussions indicates that teachers in Tom's school are constantly stimulating each other's zone of enactment.

The size of the school and therefore the number of mathematics teachers may be making a difference to the situation. For Jodie and her colleague, it would seem that they are unable to have the same detailed discussions about their teaching that are possible in a slightly larger rural school where Tom teaches. In addition, it seems that the general discussions that Jodie has with her colleagues do not lend themselves to enhancing the teachers' zone of enactment regarding their teaching of mathematics in the same way that Tom's discussions with his colleagues do. When asked about observations Jodie explained that a formal process operates in the school where each semester she observes one of the other maths teacher's lessons and he observes one of her lessons. She explained:

> Yes, I had a lesson observation in one of [other maths teacher] classes at the start of the year and he has been into one of my maths classes too. As an official observation... Yeah, it comes from admin so all teachers need to do it. We are going and observing another teacher and then just give them feedback on their teaching practices. So you know, their behaviour management, their planning for the day, for the lesson. You know. Are they catering for all students? We've actually got a sheet that we fill out.

These different situations provide very different opportunities for teacher observation, feedback and reflection. In Jodie's case the school situation provides opportunities to discuss broad topics but unfortunately it does not provide opportunities that can promote detailed discussion about the planning for teaching and learning of mathematics. It would seem that the teachers do not know how to interact at this level. Therefore the zone of enactment is not stimulated by her or her colleague. The situation at Tom's school provides ample opportunities for these vital conversations to occur. For example Michael said:

> We are looking at the tasks for those students with tutorial support twice a week... So there is a bit of a discussion around different ways to come up with a solution to a particular problem... So we do that assessment. We do that with a regular assessment. We look at an assessment after it has been marked to see how they performed and whether we need to take it or change it for next year.

Mathematics specific discussions like the ones described above can stimulate each teacher's zone of enactment and in so doing promote ongoing development of the school situation as well as curriculum leadership among the teachers.

When Jodie was asked about her interactions with her colleagues and whether these interactions have influenced her thinking or planning she responded by saying: "No, not really, I think at this stage in my teaching career I think I have sort of seen it all before." This comment suggests that without opportunities for robust discussions it is easier to become satisfied with a specific teaching approach. While this teaching approach may be the most appropriate for the students in Jodie's class, the situation is not conducive to ongoing improvement of teaching and learning of mathematics within her school.

Conclusion

The results reported in this paper would suggest that because bigger rural and remote towns have a larger number of mathematics teachers they may well support greater collegial collaboration. Certainly in Tom's case he feels very well supported by the situation that is

promoted in his school. He has both formal and informal opportunities to meet with his colleagues and discuss his teaching and to learn from his colleagues. It seems that the informal opportunities are supported by the sharing of a staff room with other mathematics teachers. It would also seem that detailed discussions on the planning for and reflecting on teaching is a feature of this school mathematics team. It is reasonable to argue that this situation is leading to supporting and enhancing Tom's zone of enactment and contributes to his participation patterns in PD sessions. These results certainly support the literature more generally and specifically Millett and Bibby's (2004) theory on stimulating the teachers' zone of enactment.

While large schools might not always have a culture that supports mathematics teachers, very small schools such as Jodie's would almost always provide fewer collaborative learning opportunities. It is thus to be expected that some teachers attending ongoing regional PD sessions would need to be initially supported to engage in collaborative conversations within the PD sessions. The differences in teachers' readiness to collaboratively plan and discuss teaching and learning of mathematics have certainly been present in this project, where only the teachers from some of the larger schools fully engaged (Visnovska & Lamb, 2012 accepted).

Researchers and PD providers in rural and remote regions need to consider that some teachers have opportunities to engage in detailed discussion and are very practiced at this process while other teachers, both new and experienced, may have not had exposure to this level of interaction. It would seem prudent for researchers and PD providers to make an effort to promote professional learning communities beyond the school setting in rural communities and to build a professional learning community of subject area teachers across schools. This may be achieved through the use of resources such as Skype Professional, a low-cost software application that allows for group videoconferencing from different sites.

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