REFORM IN MATHEMATICS: THE PRINCIPAL'S ZONE OF PROMOTED ACTION

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This study draws on Valsiner's (1997) extension of Vygotsky's (1978) theory on Zone of Proximal Development that had been further extended by those interested in teacher professional development (e.g., Blanton, Westbrook & Carter, 2005; Millett & Bibby, 2004). These theories were used to guide the constant comparative analysis of interview data collected during a case study involving all teachers and leadership in one primary state school in Queensland. Through this analysis it became apparent that the principal created a Zone of Free Movement and a Zone of Promoted Action that limited teachers' meaning making of reform in mathematics. Being alert to these actions is important if we are to truly understand how change in mathematics reform may be being implemented in schools.

Literature review

Concerns for the implementation of mandated curriculum reform has been consistently identified in the research literature (Fullan, 2001), with reform in mathematics no exception (e.g., Smylie & Perry, 2005). Handal and Herrington (2003) highlight this argument by specifically listing research on mathematics reforms where findings indicate that the implementation of innovations have failed. Researchers explain the high failure rate of reform in mathematics by pointing to the teacher, noting a number of inhibitors e.g., the majority of primary teachers are women who may not have pursued higher mathematics study and that teachers do not have the depth and breadth of content knowledge to successfully implement curriculum reform in mathematics (Ball & Bass, 2003; Ma, 1999; White, Mitchelmore, Branca, & Maxon, 2005). Furthermore, it is argued that teachers' beliefs and attitudes about teaching mathematics are often formed from their own school experience that reflected a traditional style of teaching (Brosnan, Edwards, & Erickson, 1996). Emulating this traditional style of teaching is said to give the teacher a sense of security and control. It provides the insecure teacher with a comfortable teaching environment; they are, therefore, reluctant to relinquish control of the lesson to their students as is expected with the current belief in co-constructive pedagogy in mathematics (Davis, 1990; Schoenfeld, 2000). Recognising these inhibitors to curriculum change in mathematics, there is a call in the literature for teachers to 'unlearn' their own school experiences in order to be open to change (Ball & Bass, 2003).

Considering how this unlearning would be achieved, literature encompassing educational change, teacher professionalism and professional development were reviewed (Lamb, 2010). Here it was found that emergent theories in each of these areas

coalesced around the concept of the professional learning community (PLC) described in terms of collaborative relationships, shared vision and values, and the active promotion of learning. As a consequence, the literature presents strong support for situating curriculum reform within the context of a professional learning community (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006). Moreover, this literature also alerts us to the impediments in developing a professional learning community: inappropriate structures, inadequate social capital and sustainability, as well as inhibitors to successful professional learning (Smeed, Kinmber, Millwater, & Ehrich, 2009).

As a way to interpret how the PLC engages with reform in mathematics, researchers (e.g., Millett & Bibby, 2004) have utilised Valsiner's (1987) extension of Vygotsky's (1978) theory on Zone of Proximal Development (ZPD). In his theory, Valsiner locates a further two zones, which he called the Zone of Free Movement (ZFM) and Zone of Promoted Action (ZPA). The ZFM is set by the adult and defines what action the child is allowed to undertake and the thinking to which the child is exposed. The ZPA is the tangible range of actions that the adult promotes in an effort to influence the child's behaviour. The interaction of these zones is such that the action that is promoted must be allowed and therefore the ZPA is within the ZFM. However, the ZPD can only be stimulated if it lies within the ZPA, while greater potential for development may exist outside the promoted action. This theory is represented in Figure 1.

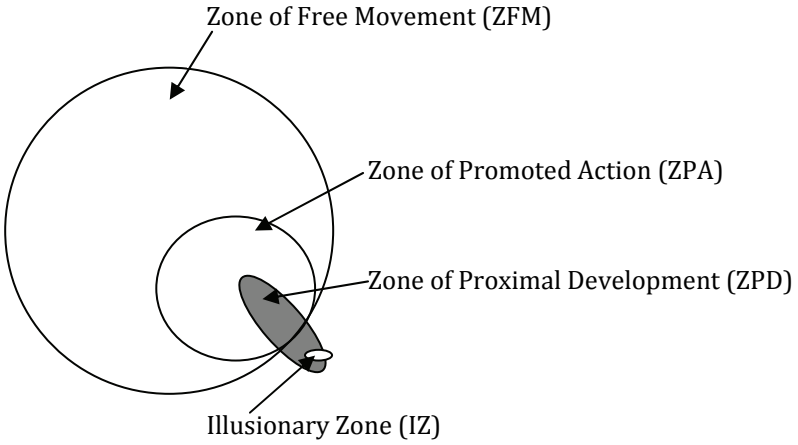

Figure 1. Model of interaction of the ZFM, ZPA, IZ and ZPD (adapted from Blanton, Westbrook and Carter, 2005, p. 8).

Blanton, Berenson and Norwood (2001) used this theory to analyse experienced teachers' responses to professional development arguing that the "ZPD is affected by the intellectual quality and developmental appropriateness of interactions with a more knowing other" (p. 5). Further developing this theory, Blanton, Westbrook and Carter, (2005) identified an Illusionary Zone (IZ) of promoted action as a zone of permissibility that the teacher appears to establish through behaviours and routines used in instruction but in reality does not allow. IZ was distinct from the ZPA in that ZPA should be contained within the ZFM (one can only promote that which is at least allowed) while IZ was that which appeared to be promoted but in fact was not allowed.

This theory is also utilised by Millett and Bibby (2004) where they argue that the "situation" (p. 3) in each school PLC will be different depending on the ZFM, ZPA, and the possibility of IZ, leading to different responses and therefore different outcomes for mathematics reform. They provide a model (see Figure 2) for analysing the local context of reform in mathematics.

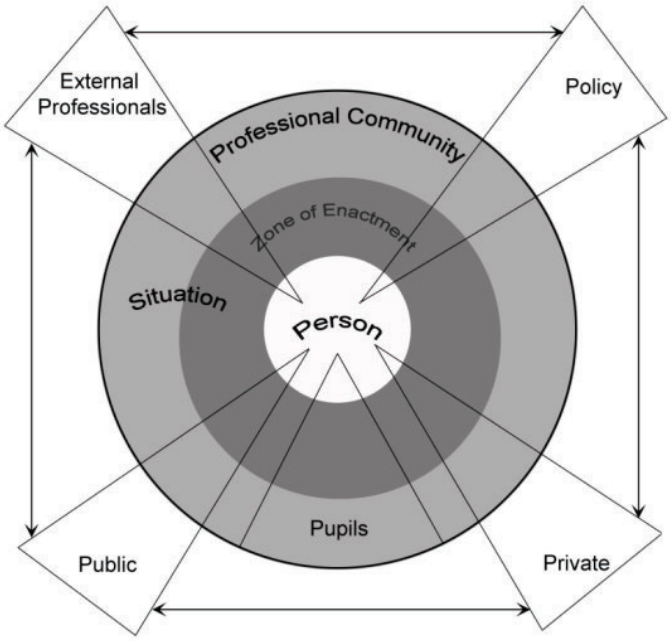

Figure 2. Theoretical model for analysing the context of reform in mathematics (Millett & Bibby, 2004, p. 3)

Here, Millet and Bibby (2004) focus on developing an understanding of a teacher's response to sources of support in the reform in mathematics by placing the teacher at the centre of the model. To be considered here is the teacher's "personal agency beliefs" and "beliefs about self-efficacy … and academic self esteem" (p. 5). In short, this theory seeks to understand the teachers' capacity to change by examining the context and culture of the teachers' working environment which includes the school's professional learning community and pupils. They term this environment the "situation" (p. 3).

Discussing their model in this way, Millett and Bibby then draw attention to the the *zone of enactment* (p. 4) for each teacher within the overall situation. This is an "an area of potential for professional development, the space in which the individual makes sense of reform or change initiatives in essentially a social process" (p. 1). In their view, the process of implementing curriculum change begins with one or more external factors (e.g. external professionals, policy, public and private). In the first instance, the personal and professional characteristics of the teacher will influence this decision whether to accept or reject this demand. However Millet and Bibby also argue that the zone of enactment is a "social construct" (p. 4) and, as such, will be influenced by interactions within the situation. If these interactions include "rich deliberations" that were "grounded in practice and supported by resources, curriculum change [is] more likely to be operationalised" (p. 4). Millett and Bibby (2004) argue that this interpretation of the actions within the school environment respects the position that each school's response can be different even though external factors remain the same.

Each of these external factors directly impacts the teacher's professional development as indicated by the arrows coming through to the 'person' in Figure 2. "External professionals" encompass all those professionals from outside the school who can support teacher change through professional development. This is often backed by what they term the "public" and includes commercial sources of support that are not a part of the government support system. For Millett and Bibby (2004), external "policy" refers to what they call an "avalanche" (p. 9) of policies while "public" refers to those who are outside the school but are none the less interested in education such as parents and the media.

In short, this model assumes that the various sources of support that operate within the situation will either stimulate a teacher's "zone of enactment" and lead to reform in mathematics or permit inaction and the ultimate failure of the intended reform. Developing this thought, Millett, Brown, and Askew (2004) later identify four conditions necessary for the development of the PLC and the realisation of the teachers' zones of enactment: time, talk, expertise, and motivation. They argued that it was essential for teachers to be given time to talk, to engage with the expertise of others for the motivation of teaching mathematics to develop.

This paper considers the role of the principal in providing these essential elements for successful reform in mathematics by further adapting Blanton et al (2005) adaptation of Valsiner's (1997) lens of the ZFM, ZPA and IZ from looking at teacher actions with students and considering Millett and Bibby's (2004) model by looking at the principal's actions within a PLC. The research question asks, can these models provide insights into how principals' actions impact teacher efforts at reform in mathematics?

Research methodology

Consistent with the research question, this case study focussed on the perspectives of key personnel involved in the implementation of the reform mathematics syllabus at Riverview Primary School (pseudonym), a state school in South East Queensland. The leadership team led by the Principal and all 26 classroom teachers (Years 1-7) participated in this case study.

This study was informed by symbolic interactionism (Blumer, 1998). As methodology, symbolic interactionism requires the adoption of two distinct stages within the study: "exploration" and "inspection" (Blumer, 1998, p. 40). The exploration stage allows the researcher to construct meaning about "what's going on around here" (Charon, 2007, p. 194), as well as to identify issues for further investigation during the inspection stage. Reported here is the qualitative data collected that included individual and group semi-structured interviews during both stages of the study. In the first stage the school's Principal and Head of Curriculum (HOC) were interviewed. From the analysis of this interview data a number of issues then led the investigation into the inspection stage of the study. Here, focus group interviews were conducted with each year level of teachers. This was followed by further clarification of the issues with individual interviews involving each members of the leadership team.

This two-stage data collection process was supported by a three step iterative process of data analysis termed as first, second and third order interpretation (Neuman, 2007). The first-order interpretation is from the perspective of the participants being studied. The second-order interpretation stems from the perspective of the researcher, and

involves eliciting the underlying coherence or sense of meaning in the data. Third-order interpretation involves the researcher assigning general theoretical significance to the data.

Results

First order interpretation

During the exploration stage of the study the Principal was interviewed to get a sense of 'What's going on around here. He outlined that the teachers had been given time to talk, were provided with PD and resources, and he believed that the teachers were motivated about reform, stating that the school PLC had committed to a shared vision of implementing reform across all curriculum areas and as a consequence the teachers are encouraged to embrace reform in mathematics. He described supports that had been provided to achieve this vision.

> I have built structures in the school, having year level coordinators who ... have had things explained to them, not just about maths but about all curriculum areas … Every other week is the year level specific curriculum meetings … We have now established another set of release times for teachers with advanced organisers for moderation. …This is not just for the purpose of having results clarified …We have them all annotated and they can see them on the web as samples. So that is part of the planning processes across the whole school, and obviously those planning processes will be even more developed with the mathematics as well.

When the principal was asked about PD he stated:

> ... what we've done with outside consultants is say, right, we know what we are going to do in this school, we have our curriculum journey mapped out, if we're looking sensibly at mathematics at the moment; we have to acknowledge that's what we're doing... We're looking at mathematics, what do we need? … I have PD money, the amount of that PD money is determined by us and our School Council, based upon our identifications of immediate needs and projections for planning.

These comments raised questions about how effective the teachers believe these structures and PD are for actually supporting planning in mathematics at the year level? Do these structures dovetail with whole school planning structures to support the school vision? The analysis of these data led the investigation into the inspection stage of the study where focus group interviews were conducted with all 26 classroom teachers.

When the teachers were asked about the supports provided for reform in mathematics at the year level and the whole school level a completely different perspective on the actions of the principal was presented.

> [At year level meetings] We normally sort of just keep track of what everyone's doing. Then we see if anyone needs assistance with their teaching, and what problems they've had with any students.

and

> When we have these moderation days or we have planning days, we go through all the writing tasks and the science etc.; it's really supposed to be the units we've already been planning with the HOC [Head of Curriculum], we really don't give maths much thought.

During the discussion with the teachers, it became apparent that a reform textbook had been introduced to the school, with no further professional support provided as one teacher explains:

> It was just kind of, you know, as we introduced [the textbook] and all the rest of it – investigations were kind of encouraged, but there wasn't any guide as far as kind of training and how to do it.

The teachers explained that following a bad year on state testing the decision was made to move away from the reform textbook and instead, adopt a school program from another school. This program was a list of content to be taught each year, semester and term.

> So we were told, you have to submit to the new program… this is our program, follow it. It's not as prescriptive as [the textbook] but I think I'm getting a bit lost.

Moreover, the teachers expressed frustration at having to implement the investigative pedagogy of the new syllabus with little guidance. The perception being that the lack of PD prevented them from appropriately implementing the new mathematics syllabus.

> I think one of the problems right across the board is there hasn't been any attention given to developing skills for teachers to do investigations and develop investigative thinking.

As a consequence the teachers expressed doubt that they were engaging in mathematics reform with one teacher saying:

> I think you still keep failing, even though you try and take on board a lot of the new stuff. You still fall back on your strengths and what you know how to teach well, and you do try to incorporate the new things or the styles of teaching or content as well, but, you know it's hard to shake 12 years of teaching a particular way - maths in a particular way - you can't just all of a sudden change.

When these views were presented to the Principal he denied that there was a problem with change, or that there was conflict between his views of support for the teachers reform efforts and the teachers' perception of support. He said:

> The teachers here are very, very good. We go to a lot of trouble here pulling units together …We hear them saying, 'Oh, there is too much to do'… I have no drama with what we are doing. If we left it to the laissez-faire system we would have anarchy.

The Principal goes on to explain that for mathematics, the teachers were given the school program to support them with implementing the *Essential Learnings* (Queensland Studies Authority, 2007) that superseded the Mathematics Year 1-10 Syllabus (Queensland Studies Authority, 2004):

> The program must be followed. It is getting tighter and tighter. The Essential Learnings makes that quite clear ...There's nowhere to deviate ... This is what you have got to do boys and girls so just do it. How you do it, is up to you. We can sit and whinge and carry on but the reality is you've got to do it.

Second order interpretation

This principal like most principals is under pressure to implement a range of reforms and to demonstrate that the students in the school can achieve at state/national averages or better. In attempting to achieve these goals, priorities must be set. The priorities for this school PLC was to have year level and whole school planning in literacy and science as well as professional development in these key learning areas. In this way, the

principal had provided opportunities for reform. However, reform in mathematics was initially limited to the provision of a textbook that was later removed and replaced with a school program that contained a list of content to be covered.

Third order interpretation

It is useful to interpret the principal's actions through the lens of the ZFM, ZPA and the IZ to consider the impacts on the PLC. It is clear from the principal and the teachers that a range of new structures within the school had been established to support curriculum reform. In this way, the ZFM for reform had been set. However, the topics for discussion at these meetings did not include mathematics reform, instead English and science were the focus at these meetings. Therefore, the ZPA did not include mathematics reform. The principal would argue that he had indeed promoted reform in mathematics by providing the textbook and then the school program. Yet for the teachers, the school program was merely a list of content that permitted the teachers to teach in the way they had traditionally taught. It can be argued that the principal's actions for reform were occurring in the IZ where he was not attuned to the teachers calls for support with reform in mathematics and as a result continued to convince himself that the teachers were implementing reform. These actions had indeed prevented reform in mathematics.

Conclusions

This research suggests that Valsiner's (1997) zone theory can be used to interpret the Principal's actions in constraining or promoting teacher action and thinking. The ZFM in this case study represents constraints and affordances as directed by the principal in relation to reform in mathematics and could be considered to include opportunities for whole school and year level planning as well as PD. The ZPA represents the actual opportunities that the Principal provided for teachers to engage with mathematics reform in the form of time to talk and to access expertise through PD so as to promote motivation about the reform within the school's PLC. In this case study the distinction needs to be made about generalised reform across the key learning areas in this primary school and reform in mathematics specifically. Here the IZ includes mathematics reform as it was not actually promoted by the principal, unlike English and science reform. For the interplay of the ZFM and the ZPA to impact on the ZPD, and lead to enhance content and pedagogy knowledge of the reform, teachers must perceive that the reform is being promoted by the principal i.e., within his ZPA. For this to be achieved the teachers would need to perceive that the principal is providing sufficient support for them to engage with the reform, and that, once these zones have aligned, the reform does in fact respect teachers' knowledge and beliefs about the teaching and learning of mathematics. In this case study, the concerns of the teachers remained unheard by the principal as he believed opportunities for reform had been provided. This study concludes that by developing a greater understanding of the principal's ZPA, and the possible existence of the IZ, better opportunities to align the ZFM and the ZPA will see enhanced potential for teacher ZPD.

The findings from this study suggest that Valsiner's (1997) zone theory can be applied to leadership contexts as a way to support understanding why some reform measures are successful while others are not. It is also recommended that this theory can

be used by school leaders for self-reflection and critique about the level of effectiveness in supporting teachers through reform in mathematics.

References

Ball, D. L., & Bass, H. (2003, June). *Towards a practice-based theory of mathematical knowledge for teaching.* Paper presented at the the 2002 annual meeting of the Canadian Mathematics Education Study Group, Edmonton, Canada.

Blanton, M., Berenson, S., & Norwood, K. (2001). Using classroom discourse to understand a prospective mathematics teacher's developing practice. *Teaching and Teacher Education, 17*(2), 227–242.

Blanton, M. L., Westbrook, S., & Carter, G. (2005). Using Valsiner's zone theory to interpret teaching practices in mathematics and science classrooms. Journal of Mathematics Teacher Education, 8, 5–33.

Blumer, H. (1998). *Symbolic interactionism: Perspective and method*. Berkeley, CA: University of California Press.

Brosnan, P., Edwards, T., & Erickson, D. (1996). An exploration of change in teachers' beliefs and practices during implementation of mathematics standards. *Focus on Learning Problems in Mathematics, 18*(4), 35–53.

Charon, J. M. (2007). *Symbolic interactionism: An introduction, an interpretation, and integration* (9th ed.). New Jersey: Pearson Prentice Hall.

Davis, R. B. (1990). Discovering learning and constructivism. In R. B. Davis, C. A. Maher & N. Noddings (Eds.), *Constructivist views on the teaching and learning of mathematics*. USA: National Council of Teachers of Mathematics.

Fullan, M. (2001). *The new meaning of educational change* (3rd ed.). New York: Teachers College Press.

Handal, B., & Herrington, A. (2003). Mathematics teachers' beliefs and curriculum reform. *Mathematics Education Research Journal, 15*, 59–69.

Lamb, J. (2010). *Implementing mandated curriculum reform: Sources of support for teacher meaning making.* Unpublished PhD Thesis. Australian Catholic University, Fitzroy, Victoria.

Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States*. Mahwah, NJ: Erlbaum.

Millett, A., & Bibby, T. (2004). The context for change. In A. Millett, M. Brown & M. Askew (Eds.), *Primary mathematics and the developing professional* (pp. 1–17). Netherlands: Kluwer Academic.

Millett, A., Brown, M., & Askew, M. (2004). Drawing conclusions. In A. Millett, M. Brown & M. Askew (Eds.), *Primary mathematics and the developing professional* (pp. 245–255). Netherlands: Kluwer Academic.

Neuman, W. L. (2007). *Basics of social research: Qualitative and quantitative approaches* (2nd ed.). Boston: Pearson Education.

Queensland Studies Authority. (2004). Mathematics Year 1–10 Syllabus Retrieved 13 June, 2006, from www.qsa.qld.edu.au/qsa/pd/workshops/1to10/math_opt_1.html

Queensland Studies Authority. (2007). Mathematics Essential Learnings by the end of Year 3, 5, 7 9 Retrieved 12 February, 2009, from http://www.qsa.qld.edu.au/downloads/p-9/qcar_el_maths_yr3.pdf

Schoenfeld, A. H. (2000). Models of the teaching process. *Journal of Mathematical Behavior, 18*, 243–261.

Smeed, J., Kinmber, M., Millwater, J., & Ehrich, L. (2009). Power over, with and through: Another look at micropolitics. *Leading and Managing, 15*(1), 26–41.

Smylie, M., & Perry, G. (2005). Restructuring schools for improving teaching. In M. Fullan (Ed.), *Fundamental change* (pp. 306–335). Netherlands: Springer.

Stoll, L., Bolam, R., McMahon, A., Wallace, M., & Thomas, S. (2006). Professional learning communities: A review of the literature. *Journal of Educational Change, 7*, 221–258.

Valsiner, J. (1987). *Culture and the development of children's action: a cultural-historical theory of developmental psychology*. Chichester: John Wiley & Sons.

Valsiner, J. (1997). *Culture and the development of children's actions: A theory of human development* (2nd Edition ed.). New York: John Wiley & Sons.

Vygotsky, L. S. (1978/1934). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press (Original work published in 1934).

White, P., Mitchelmore, M., Branca, N., & Maxon, M. (2005). Professional development: Mathematical content verses pedagogy. *Mathematics Teacher Education & Development, 6*, 49–60.