

# Leading Change in Mathematics: The Queensland Mathematics Syllabus

Janeen Lamb

*Australian Catholic University*  
<Janeen.Lamb@acu.edu.au>

Gayle Spry

*Australian Catholic University*  
<Gayle.Spry@acu.edu.au>

This paper provides an account of a recent research study that focused on the implementation of the Queensland, Year 1-10 Mathematics Syllabus (QSA, 2004), at Hillside Primary School in South East Queensland. A context analysis of curriculum change supported by a literature review is provided. This analysis and review enabled the development and validation of a questionnaire used to assess sources of support for curriculum change. The results of this study alerts policy makers, practitioners and researchers to the level of complexity of curriculum change in mathematics and the need to provided both internal and external sources of support during the implementation phase.

## Introduction

In 2004, the Queensland Studies Authority released the Year 1-10 Mathematics Syllabus (QSA, 2004) with the intention of implementing this syllabus by 2007. This new mathematics syllabus represents a significant shift in the teaching of mathematics from the previous syllabus published by the Department of Education (1987). In particular, this new syllabus required changes in pedagogy from one of teacher centred instruction built around a problem solving approach to an investigative approach that builds on theories of constructivism by “adopting a learner-centred approach to learning and teaching” (QSA, 2004, p. 39).

This paper provides an account of a recent research study that focused on the implementation of this new syllabus at Hillside Primary School in South East Queensland. In particular, this paper presents a “rich” picture of the context of curriculum change at Hillside Primary School and reviews relevant literature in respect to curriculum change. This context analysis and literature review generated one overarching research question that was to guide the various moments of data collection and analysis within this study.

*Research Question: What are the sources of support for meaning making in the context of the implementation of the Year 1-10 Mathematics Syllabus (QSA, 2004) at Hillside Primary School.*

Moreover, the review of the literature also enabled the development and validation of a questionnaire, School Professional Learning Community Questionnaire (SPLCQ), around the sources of support for the implementation of the new Queensland mathematics syllabus at Hillside Primary School. This questionnaire proved to be an effective method of collecting and analysing data during the initial exploration stage of this “mixed methods” study (Creswell & Plano Clark, 2007). The data collected using this questionnaire are included and discussed in terms of a way forward for policymakers and practitioners in this area as well as suggesting areas for further research.

## Context Analysis

Hillside Primary School is positioned within the institutional context of public education in Queensland, and is therefore directly impacted by the changes in policies and practices introduced by the Queensland Department of Education Training and the Arts (DETA). Moreover, it seems that policy developments within public education in Queensland represents a ‘push’ for curriculum change that, in turn, stems from global

pressure for economic efficiency within the wider socio-cultural context (Mundy, 2005). Fearful that 'poor' national and international test results in mathematics will impact upon the future workforce, there has been strong political support in Queensland for curriculum innovation in mathematics resulting in a new syllabus. Thus developments in the wider socio-cultural context and the institutional context of public education in Queensland impact on Hillside Primary School in the form of a mandated requirement to implement the new mathematics syllabus.

Given this understanding of the context, it is interesting to note the teachers' response to the implementation of the *Year 1-10 Mathematics Syllabus* (QSA, 2004) at Hillside Primary School. As discussed above this new syllabus represents a significant shift in the teaching of mathematics from the previous syllabus (Department of Education, 1987). By 2006, the new syllabus had begun to impact upon the teaching of mathematics at Hillside Primary School and teachers were voicing their concern about what was now being required: "Why are we expected to teach algebra in the primary school?"; "I don't understand algebra myself so where can I learn about it?"; "Is mental computation, mental arithmetic?"; "How do you plan investigations in maths?"; "If it is all investigations when do the kids learn their maths?"; "How do you assess group work investigations?" These questions suggest that when it came to the implementation of new mathematics syllabus, these teachers did not have a clear understanding of *what* should change, *why* it should change or *how* to go about making this change. This situation is problematic if we accept that the success and failure of new educational policies and practices, including the implementation of a new syllabus, depend on how teachers respond to the challenge (Handal & Herrington, 2003).

## Literature Review

To date, literature around the issue of curriculum change recommends a partnership approach that is both 'top-down' and 'bottom-up' and relies on "collaborative relationships between administrators, curriculum developers, professional associations, researchers, teacher educators, teachers, and parents" (MacDonald, 2003, p. 142). However, despite good intentions, more often than not, this partnership approach to curriculum reform represents "pseudo-participation and quasi-democracy" (Smyth & Shacklock, 1998, p. 23) as teachers' work is increasingly shaped by central policy makers. Here there are concerns that opportunities for teacher participation are limited to a few and "most [teachers] will not contribute to the construction of the institutional discourse" (Kirk & MacDonald, 2001, p. 565). Consequently, it is argued that the school as a professional learning community provides an 'ideal' environment for curriculum change (MacDonald, 2003).

Recognising the limits of the teacher's contribution in curriculum change, Kruse and Seashore Louis (2007) suggest that there is "an important place for *top-down initiatives* to create professional learning communities (p.116). Supporting this thought Proudfoot (2003) commenting on the implementation of curriculum change in Queensland state schools calls for "professional learning communities to generate organisational learning and organisational capacity" (p.2). Supporting the establishment and sustainment of the professional learning communities, in the context of curriculum change, is no easy task as this project requires "long and continuous redesign conversations" within the school community and beyond to the wider community (Wilson & Davis in Miller, 2005, p. 262). These conversations aid the development of a shared vision around student learning, support engagement in collaborative activity to enact this shared vision and taking collective responsibility for student learning. Such a conversation allows the teachers'

voice to be heard and for teachers to take ownership of the curriculum change (Kirk & McDonald, 2001). In this way, teachers “become partners in curriculum reform, derived from intimate knowledge of local contexts of implementation, in particular from their knowledge of their students, available resources, and the obdurate practicalities of their work” (p.564).

This understanding of the redesign conversations and the role of teachers is consistent with Spillanes’ (1999) conclusions in respect to “zones of enactment” and the implementation of mandated curriculum change in mathematics.

To summarize, zones of enactment are that space in which reform levers meet the world of practitioners and ‘practice’, involving the interplay of teachers’ personal resources with external incentives and learning opportunities mobilized by policy, professional, private and other sectors. I argue that teachers’ zones of enactment vary on a continuum from individualistic to social. My account suggests three important characteristics of the enactment zones of those teachers who changed the core of their practice. First, their enactment zones extended beyond their classrooms to include fellow teachers and local and external ‘experts’ on the reforms. Second, their enactment zones involved both deliberations on reform ideas and teachers’ efforts to put these ideas into practice. Third, their enactment zones included a variety of material resources that were used to support learning about the enactment of these reform ideas. (pp.171-172)

Developing this thought, Millett and Bibby (2004) provide a model for supporting curriculum change in mathematics. This model is of particular interest as these authors use this theory when analysing the British teachers’ response to implementing the British Numeracy Strategy. Figure 3.2 depicts their interpretation of the theory.

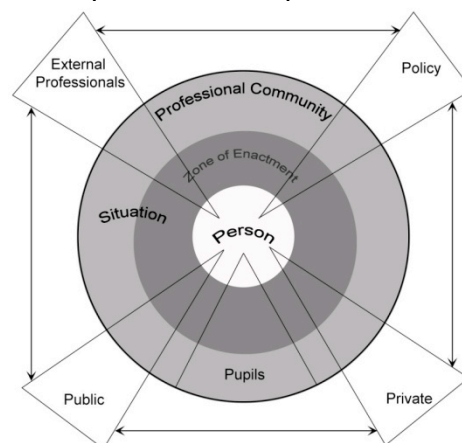


Figure 1. Theoretical model for analysing the context of curriculum change. (Millett & Bibby, 2004, p.3)

In this model, Millett and Bibby (2004) focus on developing an understanding of a teacher’s response to sources of support during episodes of curriculum change. In particular, this model identifies both the internal and external sources of support for curriculum change. Internal sources of support operate within a professional learning community. This “situation” (p. 6) stimulates a teacher’s “zone of enactment” leading to curriculum change. Here Millett and Bibby (2004) follow Spillane’s (1999) lead by defining the “zone of enactment” in terms of “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). External sources of support are identified at the periphery of Millett and Bibby’s model. These external sources of support include the support of external professionals (eg. professional development) and policy-makers (eg.

guideline documents) as well as support from the general public (eg. media, public opinion and parents) and the private commercial sector (eg. textbooks). Together these external sources of support promote the teacher's zone of enactment within the professional learning community.

In summary, this model situates the curriculum change within a culture of the professional learning community as well as providing appropriate external support including the support of external professionals, policy-makers, the general public and private commercial interests.

### Development and Validation of the Questionnaire

In developing the School Professional Learning Community Questionnaire (SPLCQ), the researcher was guided by the literature (e.g. Millet & Bidy, 2004), existing questionnaires from prior research on the professional learning community (Bolam et al., 2005; Huffman & Hipp, 2003; Mulford, Silins, & Leithwood, 2004) and interviews conducted with the Principal and Head of Curriculum at Hillside Primary School. The SPLCQ was designed to assess the sources of support evident in the school professional learning community for the implementation of the new mathematics syllabus. The development of the SPLCQ followed the intuitive-rational model for instrument development (Hase & Goldberg, 1967). In addition, the items on the SPLCQ employed a forced choice four point Likert with options of strongly disagree, disagree, agree and strongly agree. Typically, a Likert scale has a five-point response format with anchors ranging from strongly disagree to strongly agree. It is acknowledged that a four point scale does have limitations and therefore may yield less reliable results for the vast majority of psychometric instruments (Preston & Colman, 2000). However, it was decided that the neutral response category of unsure did not respect the teachers' knowledge of the school context and that they would have an opinion on the items on the SPLCQ (Burns, 1998). Consequently, a four point Likert response format was used. This is consistent with the forced choice four point Likert scale used with the Professional Learning Community Assessment (PLCA) from the USA (Huffman & Hipp, 2003). Once developed, three teachers holding administrative positions in local schools were asked to scrutinise the SPLCQ for appropriate use of context-based terms, readability of items and ease of interpretation. Minor changes were made as recommended to insure face validity.

The SPLCQ was then distributed to the 26 teachers at Hillside Primary. A total of 25 completed questionnaires were returned allowing convergent and discriminant validity to be assessed. Cronbach's coefficient alphas for the 10 scales ranged from .68 to .91 indicating very sound internal reliability consistency. These 10 scales then underwent discriminant validity testing. In each case the mean correlation of the scale with the remaining nine scales was sufficiently low to indicate that 10 generally distinct scales had been developed. Both the scales and the results of validation are identified in Table 1.

Table 1  
*Scales and Validation Results*

Scale Name	Cronbach Coefficient $\alpha$	Mean Correlation
Whole School Structured Planning (WSSP)	.72	.43
Whole School Collaboration (WSC)	.76	.41
Year Level Structured Planning (YLSP)	.73	.40
Year Level Collaboration (YLC)	.85	.27
Teacher Accountability (TA)	.68	.13
Material Resourcing (MR)	.91	.26
Internal Professional Resourcing (IPR)	.78	.08
External Professional Development (EPD)	.71	.03
Content Knowledge Efficacy (CKE)	.76	.39
Teaching Efficacy (TE)	.74	.33

## Results

Following this validation process the researchers applied categorised responses to the questionnaire in terms of demographic variables. In order to compare SPLCQ scores according to years of teaching, teacher respondents were assigned to one of three groups. The first group consisted of teachers who had been teaching 1 to 6 years (7 teachers). The second group were teachers who had been teaching between 7 and 20 years (9 teachers). The third group were teachers who had taught for more than 20 years (9 teachers). The results of this analysis are displayed in Figure 2.

Firstly, these results suggest that teachers were reasonably positive in respect to the sources of support for curriculum change in mathematics at Hillside Primary School. In particular four of the scales (WSC, YLSP, YLC, TA,) have a scale mean above 3.0 and four (WSSP, IPR, CKE, TE) have a scale mean above 2.6. However, in interpreting this positive response it is interesting to note the outlier cases that suggest issues for further investigation (Creswell, 2002). YLC represents a positive outlier with a mean score of 3.62 indicating the value the respondents place on year level collaboration. On the other hand, the negative outlier EPD has a mean score of 2.0 indicating dissatisfaction with the extent to which teachers can access professional development from external professionals. Together these results remind us of the importance placed on year level collaboration and external professional support within the context of curriculum change. These outlier cases also suggest that whilst teachers value the support of colleagues they also recognise that in the context of curriculum change, in-house expertise (e.g., Head of Curriculum) does not replace external professional expertise.

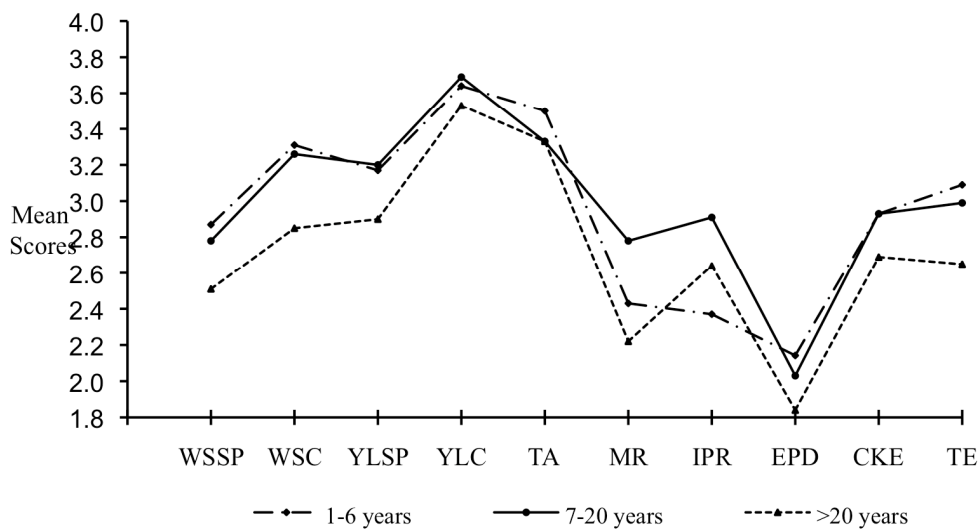


Figure 2. Mean scores for 10 SPLCQ scales according to years of teaching.

Secondly, these results suggest that ‘years of teaching’ influence the teacher’s perspective on sources of support in the context of curriculum change. Tukey’s HSD post hoc procedure revealed statistically significant differences in WSC for the comparison of teachers with 1 to 6 years of teaching with teachers with greater than 20 years experience and also for teachers with 7 to 20 years of teaching compared to teachers with greater than 20 years experience ( $p < .05$ ). For the TE scale, Tukey’s HSD post hoc procedure revealed similar statistically significant differences for the comparison of teachers with 1 to 6 years of teaching with teachers with greater than 20 years experience, and also for teachers with 7 to 20 years of teaching with teacher with greater than 20 years experience ( $p < .05$ ). Teachers who had taught for 1 to 6 years perceived significantly higher WSC and TE than did those teachers with greater than 20 years of teaching (effect sizes = 1.21 and 1.42 respectively). Similarly, teachers who had taught for 7 to 20 years perceived significantly higher WSC and TE than did those teachers with greater than 20 years of teaching (effect sizes = 1.08 and 1.10 respectively). All of these effect sizes are very large. This finding indicates that respondents teaching more than 20 years were less positive about the sources of support than the other two age groups.

## Conclusion

This paper discusses a recent study that focused on the implementation of this new Queensland mathematics syllabus at Hillside Primary School in South East Queensland. In particular, this paper focused on the development and validation of the School Professional Learning Community Questionnaire (SPLCQ) and discussed the results following the completion of this questionnaire by the teachers at Hillside Primary School.

In the first instance, the findings of this study reveal a positive response to the implementation of curriculum change in mathematics at Hillside Primary School. On a positive note, it seems that whilst teacher accountability requirements have provided a 'push' for curriculum change in mathematics, whole school and year level structured planning and collaboration have provided the necessary 'pull' for change. However, on a less positive note, this study has identified issues that need to be addressed. These issues include the need to provide external professional development to supplement internal professional expertise. In addition, it seems more experienced teachers are less positive in respect to sources of support for curriculum change. Both these issues invited further research at Hillside Primary School with the intention of tailoring the sources of support to the context.

Beyond shedding light on curriculum change at Hillside Primary School, the results of this study also confirms prior research that identifies the complexity of curriculum change and the need to provide both internal and external sources of support for curriculum change. Internally, professional learning community is advanced as the 'ideal' environment for such change. Externally, the literature has identified the role played by external professionals, policy makers, the general public and the private commercial sector in supporting curriculum change. In this study, ten scales were developed and validated. They signalled the role played by both internal and external sources of support for curriculum change at Hillside Primary School. These scales range from issues of whole school and year level structured planning and collaboration to the material resourcing, internal professional resourcing and external professional development as well as teacher accountability, content knowledge and teaching efficacy. As a way forward, this study once again alerts policy makers, practitioners and researchers to recognise the level of complexity of curriculum change in mathematics and the need to provide both internal and external sources of support during the implementation phase.

## References

- Bolam, R., McMahon, R., Stoll, L., Thomas, S., Wallace, M., Greenwood, A., et al. (2005). *Creating and sustaining effective professional learning communities*. Retrieved 12 April, 2007, from <http://www.dfes.gov.uk/research/data/uploadfiles/RR637.pdf>.
- Burns, R. B. (1998). *Introduction to research methods. Third Edition*. Melbourne: Longman.
- Creswell, J. W. (2002). *Educational research: Planning, conducting and evaluating quantitative and qualitative research*. Upper Saddle River, NJ Pearson Education Inc.
- Creswell, J. W., & Plano Clark, V. L. (2007). *Designing and conducting mixed methods research*. Thousand Oaks: Sage Publications.
- Department of Education, Q. (1987). *Years 1 to 10 mathematics syllabus*. Brisbane: Government Printer.
- Handal, B., & Herrington, A. (2003). Mathematics teachers' beliefs and curriculum reform. *Mathematics Education Research Journal*, 15(1), 59-69.
- Hase, H. D., & Goldberg, L. R. (1967). Comparative validity of different strategies of constructing personality inventory scales. *Psychological Bulletin*, 67(4), 231-248.
- Huffman, J., & Hipp, K. (2003). *Reculturing schools as professional learning communities*. Maryland, USA: Scarecrow Education.
- Kirk, D., & MacDonald, D. (2001). Teacher voice and ownership of curriculum change. *Journal of Curriculum Studies*, 33(5), 551-567. .
- Kruse, S., & Seashore Louis, K. (2007). Developing collective understanding over time: Reflections on building professional learning community. In L. Stoll & K. Seashore Louis (Eds.), *Professional learning communities: Divergence, detail and difficulties* (pp. 106-118). Buckingham: Open University Press.
- MacDonald, D. (2003). Curriculum change and the post-modern world: Is the school curriculum-reform movement an anachronism? *Journal of Curriculum Studies*, 35(2), 139-149.

- Miller, L. (2005). Redefining teachers, reculturing schools: Connections, commitments and challenges. In A. Hargreaves (Ed.), *International handbook of educational change: Extending educational change* (Vol. 2, pp. 249-263). Dordrecht, The Netherlands: Springer.
- 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 Publishers.
- Mulford, B., Silins, H., & Leithwood, K. (2004). *Educational leadership for organisational learning and improved student outcomes*. Dordrecht: Kluwer Academic Publishers.
- Mundy, K. (2005). Globalisation and educational change: New policy worlds. In N. Bascia, A. Cumming, A. Datnow, K. Leithwood & D. Livingstone (Eds.), *International handbook of educational policy* (Vol. 1, pp. 3-17). Great Britain: Springer.
- Preston, C., & Colman, A. (2000). Optimal number of response categories in rating scales: reliability, validity, discriminating power and respondent preferences. *Acta Psychologica*, 104(1), 1-15.
- Proudford, C. (2003). Building professional learning communities for curriculum change. *Curriculum Perspectives*, 23(3), 1-10.
- Queensland Studies Authority. (2004). Year 1-10 Mathematics Syllabus. Retrieved 13 June, 2006, from [www.qsa.qld.edu.au/qsa/pd/workshops/1to10/math\\_opt\\_1.html](http://www.qsa.qld.edu.au/qsa/pd/workshops/1to10/math_opt_1.html)
- Smyth, J., & Shacklock, G. (1998). *Re-making teaching: Ideology, policy and practice*. London: Routledge.
- Spillane, J. (1999). External reform initiatives and teachers' efforts to reconstruct their practice: The mediating role of teachers' zones of enactment. *Journal of Curriculum Studies*, 31(2), 143-175.