Lesson Study: An Effective School-Based Teacher Professional Learning Model for Teachers of Mathematics

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This paper reports on ongoing research in a cluster of schools in the outer south-eastern suburbs of Melbourne which is utilising Lesson Study as a peer observation model for mathematics teaching. The findings from nine initial Lesson Study sessions undertaken by cluster teachers to develop a Fractions Teaching Program are presented. The results indicate the success of the fractions tasks created. The potential of Lesson Study as an effective model of school-based professional learning for teachers of mathematics became apparent.

Recognition of the importance of school-based professional learning is gathering pace in Victorian schools. At the 2006 Victorian Principal's Big Day Out, Darrell Fraser, Deputy Secretary, Office of School Education, State of Victoria Department of Education and Early Childhood Development (DEECD), "remarked that the time of school leaders sending teachers to three-day PD seminars were over and that critical reflection and sharing with colleagues were now vital" (Corben, 2006, p. 10). This view has been given greater authority in the Parliament of Victoria's recent inquiry into teacher professional learning where a key recommendation states that, "the Victorian Government and individual schools prioritise school-based modes of delivery for teacher professional learning" (Parliament of Victoria, 2009, p 89).

This inquiry (Parliament of Victoria, 2009) identifies four modes of delivery; action research, peer observation, mentoring, and professional learning teams. In the section of the inquiry concerning peer observation, the committee notes that Lesson Study, "has received widespread acclaim" (p. 69) and whilst acknowledging that, "this type of professional learning has not yet attained the coverage and coordination evident in Japan" (p. 69) advocates the model as, "consistent with the current trend towards school-based professional development, and reflective, collaborative learning in Victorian schools" (p. 69). The importance of school-based professional learning therefore provides part of the rationale behind this research on Lesson Study. However, there are other contextual reasons for this study and these are explored in the next section.

Background

Lesson Study in this cluster of schools (one secondary and five primaries) in the outer south-eastern suburbs of Melbourne, is part of a broader action research project entitled, 'Improving Numeracy Teaching Through Data Analysis.' This project is based on improving student outcomes through enhancing the teaching program in the cluster. It is an assessment for learning project, concerned with using school data to analyse weaknesses in our teaching programs, and then, improve those programs. An analysis of cluster data determined our initial focus on fractions. A further initiative in the cluster is peer coaching. Peer coaching links clearly with reflective, collaborative learning, a key feature of the ideas behind the promotion of school-based professional learning. Indeed Showers (1985, p. 43), states one purpose of coaching as building, "communities-of-teachers who continuously engage in the study of their craft." My review of the literature on peer

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coaching led me to Lesson Study (Hollingsworth & Oliver, 2005; Olson, 2005; Stepanek, 2001; White & Southwell, 2003).

Lesson Study has its origins in the peer observation based Japanese professional learning model, *jugyokenkyu*. White and Southwell (2003) describe Lesson Study as, "a small group of teachers … who meet regularly to plan, design, implement, evaluate and refine lessons for a unit of work they had selected" (p. 744). Stepanek (2001) provides an excellent overview of Lesson Study, describing the Lesson Study process as flowing through the following phases; focusing the lesson, planning the lesson, teaching the lesson, reflecting and evaluating, revising the lesson, teaching the revised lesson, reflecting and evaluating, and sharing results.

The more I read, the more I became convinced about Lesson Study as a useful vehicle for teacher professional learning in mathematics. What struck me particularly was its similarity to action research with its cycle of planning, action and reflection stages (Stepanek, 2001). It also involves all teachers in the cluster team working as co-researchers and co-subjects in, "co-operative inquiry cycles of reflection and action" (Heron and Reason, 2001, p. 180).[1] Kuhne and Quigley (1997) describe action research in a similar cyclical fashion of planning, action and reflection. Lesson Study, therefore, seems to be action research in microcosm, and as such seemed highly appropriate as the main form of teacher professional learning for the project.

Lesson Study is also a common theme in recent numeracy research. Olson (2005) conducted a small-scale case study investigating changes in the mathematics teaching practice of five primary teachers, two of whom dropped out of the Lesson Study process. Olson (2005) describes how the three case study teachers who participated gained new insights after personalising how their actions impacted classroom discourse and led them to re-examine their beliefs about teaching and learning. In contrast the teachers who dropped out did not consider how their actions might influence students' opportunities to learn or change their pedagogy.

Hollingsworth and Oliver (2005) also offer a positive account of Lesson Study at a Ballarat secondary college. White and Southwell (2003) in the context of their study of mathematics teaching in a range of secondary schools in New South Wales concluded that, "the Lesson Study program was experienced by teachers as a powerful process for guiding them towards new practices and dispositions" (p. 750).

Methodology

Our focus as a Cluster Numeracy Team over the past eighteen months has been in developing fractions tasks and implementing the tasks in cluster classrooms using Lesson Study as a professional learning model. Implementation began with a professional learning day for teachers from each of the cluster schools. The professional learning day culminated in the creation of fifteen tasks/lessons on an agreed planning format. The results presented are from nine Lesson Study sessions conducted between late 2007 and 2008. Table 1 indicates the title of each of these nine sessions with acknowledgement of the sources of the activities and the sample sizes for the teacher and student feedback.

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[1] In 2007 this researcher was a practising teacher in one of the cluster primary schools. Since moving to La Trobe University at the beginning of 2008 he has retained the role of cluster coordinator.

Table 1
Lesson Study Sessions, Acknowledgements, Teachers and Student Survey Sample Sizes

Lesson Study	Lesson Title and Acknowledgements	Teacher Sample	Student Sample
1	Using Number Sense When Adding Fractions (Vale, 2007)	2	24
2	Fraction, Decimal and Percentage Match (self-designed)	4	24
3	Folding Paper Strips. (DEECD, Maths Continuum, 2004)	3	24
4	One-on-One (Burnett & Tickle, 2007)	4	23
5	Using Number Sense When Adding Fractions (Vale, 2007)	3	21
6	Number Card Sorting (Marr, Helme & Tout, 2003)	3	25
7	Chocolate Bars (Clarke, 2006)	4	25
8	Everything about my Fraction (Downton, Knight, Clarke & Lewis, 2006)	4	20
9	Two Equal Parts (self-designed)	4	20

For the Lesson Study sessions the members of the team were divided into groups so that each group consisted of teachers from different schools. I, as coordinator of the team was involved in each session as co-researcher, co-practitioner. All the Lesson Study sessions followed a similar format with planning the lesson occurring at the start of the day until recess, a teaching session of similar time span after recess, with reflection straight after the teaching session. Detailed Lesson Study protocol documentation (preliminary discussion, observation, reflection) was kept for all three distinct components.

Survey data was obtained from the teachers and students involved using eight items concerned with the success or otherwise of the lesson.[2] Specifically, the student survey explored mathematical features of the lesson, items related to the task completed, and two attitudinal items (Table 2).

Table 2
Questions in Rating Section of Student Survey

Item number	Question	Question Type
1	I talked about the mathematics using mathematical words	Mathematical
2	I learnt some mathematics I didn't know	Mathematical
3	I was thinking about mathematics for most of the lesson	Mathematical
4	I got started without any help	Task
5	I saw more than one way of doing the tasks	Task
6	I tried my hardest	Attitudinal
7	I was challenged	Attitudinal
8	I could now use this mathematics on other problems	Mathematical

[2] The teacher and student surveys were already in use in cluster schools for a separate project, Task Types and Mathematics Learning (2008) and due to the familiarity of the students with these surveys they were adopted for Lesson Study sessions with the permission of the TTML project's Chief Investigator.

A question prompt asked, 'please indicate how strongly you agree or disagree with these statements,' with a four point rating scale (strongly agree: 4; agree: 3; disagree: 2; strongly disagree: 1).

Feedback from teachers was obtained in three ways. The survey focused on student learning, with items measuring from the teachers' perspectives the relative proportion of students who engaged in particular processes during the lesson. These related to mathematical features of the lesson, items related to the task completed, and attitudinal items. The survey used a five point scale (none: 1; some: 2; half: 3; most: 4; all: 5) with the prompt, 'please describe the proportion of the class who…' (Table 3).

Table 3
Questions in Rating Section of Teacher Survey

Item number	Question	Question Type
1	Talked mathematically to each other	Mathematical
2	Learnt some new mathematics	Mathematical
3	Were on task for most of the lesson	Task
4	Got started without additional help	Task
5	Saw more than one way of doing the main task	Task
6	Tried their hardest	Attitudinal
7	Engaged in higher order thinking	Attitudinal
8	Asked meaningful questions	Attitudinal

During the Lesson Study sessions a reflection session was written up as part of the Lesson Study protocol. Part of this evaluation session was a discussion of possible lesson revisions in line with the Lesson Study process, and which of the teachers would try out these revisions with their grade. Feedback from these trials was incorporated into the lesson plan for future use. This highlights a weakness in this project's development of Lesson Study. The process should involve the same group in revising and re-teaching the lesson with a final reflection session. This is not possible with the constraints of organisation across a cluster of schools. I will return to this point in the conclusion.

A final source of teacher feedback was a formal evaluation in the form of a Plus, Minus, Interesting (PMI) evaluation tool. This was undertaken on a separate professional learning day by fourteen teachers. All teachers had been involved in at least one Lesson Study session.

Results and Discussion

Teacher Feedback

Whilst data for the teacher survey is based on a very small sample, average scores were generally high. The following analysis principles were adopted. The five point scale leads to scores greater than 4 classified as 'high,' scores greater than 3 classified as 'good,' and scores lower than 3 classified as 'low' (Table 4). See Table 3 for the questions related to each item number in the table.

Table 4
Teacher Survey: Perspectives on Student Responses to the Lesson Study Session

Item Number	Lesson Study 1	Lesson Study 2	Lesson Study 3	Lesson Study 4	Lesson Study 5	Lesson Study 6	Lesson Study 7	Lesson Study 8	Lesson Study 9	Mean
1	4.50	4.50	4.00	4.00	3.00	4.00	4.00	3.75	4.50	4.03
2	4.00	4.00	4.33	4.25	2.40	4.00	3.50	2.75	4.50	3.75
3	5.00	4.25	4.33	4.00	2.60	4.33	4.25	5.00	5.00	4.31
4	4.50	4.25	4.00	4.00	2.60	4.00	4.25	4.00	4.25	3.98
5	4.00	4.25	3.66	3.00	2.20	3.33	4.25	4.00	3.50	3.58
6	4.50	5.00	4.33	4.25	2.80	4.00	4.25	4.50	5.00	4.29
7	3.50	4.75	3.66	3.50	2.20	4.00	3.50	4.00	4.00	3.68
8	1.50	4.00	3.66	3.00	3.00	3.33	4.00	4.00	4.00	3.39
Mean	3.94	4.38	4.00	3.75	2.60	3.87	4.00	4.00	4.34	3.88

Scores are very positive with ‘high’ means for five of the nine sessions (Sessions 2, 3, 7, 8 and 9), and scores at the higher end of the ‘good’ category in three of the other four (Sessions 1, 4 and 6). Only Lesson Study 5 recorded a ‘low’ score and scores were ‘low’ for this lesson across all eight items. High scores were recorded for three of the eight items; ‘talking mathematically,’ on task for the lesson,’ and ‘tried their hardest’ (Items 1, 3 and 6). A further three recorded scores at the upper end of the ‘good’ category; ‘learnt some new mathematics,’ got started without help,’ and engaged in higher order thinking’ (Items 2, 4 and 7). Lower scores were recorded for ‘asking meaningful questions’ and ‘seeing more than one way of doing the tasks’ (Items 5 and 8) The former refers to a more advanced aspect of student thinking and so it is not surprising that lower scores were recorded. Given the importance, however, of advanced thinking in student understanding of the complexity of fractions, this data highlights an issue that needs to be addressed by the cluster teachers. As far as the ‘seeing more than one way of doing the task’ item is concerned the lower response is not that surprising given that some students are constrained by their lack of familiarity with alternative strategies in mathematics. Whilst this was a focus of the teaching approach in many of the Lesson Study sessions, it is an aspect of improved student thinking that we can usefully explore further in our planning.

The discussions that ensued in the subsequent evaluation sessions reflected this generally positive perspective. All teachers involved were enthusiastic about Lesson Study, enjoying the opportunity to work with teachers in other schools, to observe a lesson with a specific aim, and focusing on the sometimes intricate nature of teaching fractions. All were keen to complete and circulate protocol documentation, including extremely detailed observation notes in two cases. The teachers’ positive views about Lesson Study were also reflected in my conversations with them, and with Principal Class staff in their schools.

The final source of teacher feedback was responses to the PMI evaluation tool which was also affirming of the Lesson Study approach. On a simple level the responses in the ‘Plus’ section far outweighed that of the other two sections. There were 59 separate comments in the ‘Plus’ section compared to 10 in the ‘Minus’ section and 22 in the ‘Interesting’ column. This in itself indicates how positive teachers feel about Lesson Study. A number of teachers commented to me on the day that they found it difficult to think of

comments for the Minus section. Of greater interest is the nature and quality of teachers' comments. Two comments follow that are indicative of typical responses;

> I thought that allocating a whole day to this experience was a fantastic idea. It meant that we could complete the structure of the lesson study in its entirety and make it a really worthwhile experience. The set-up of the day also worked really well. It was great to get together with teachers from another school to plan a 'perfect' lesson on a particular concept with a set focus. This emphasised different planning and teaching techniques and also gave us an opportunity to discuss the difference between our groups of children.

> Working with teachers from other schools is invaluable. We get so familiar with the processes and habits of our own school, it is fantastic to share ideas and strategies across schools and get a different perspective. It is also extremely useful to watch another teacher teach (especially when they are teaching your grade).

A number of thoughtful comments were provided in the Interesting section. Some of these provided fascinating ideas for the further development of this Lesson Study research and I will return to these in the conclusion.

Student Feedback

The following analysis principles were adopted for the student survey. The four point scale leads to scores greater than 3.5 classified as 'high,' scores greater than 3 classified as 'good,' and scores lower than 3 as 'low' (Table 5). See Table 2 for the questions related to each item number in the table.

Table 5
Student Survey

Item Number	Lesson Study 1	Lesson Study 2	Lesson Study 3	Lesson Study 4	Lesson Study 5	Lesson Study 6	Lesson Study 7	Lesson Study 8	Lesson Study 9	Mean
1	3.00	3.42	2.88	3.30	2.62	3.20	2.84	3.65	3.37	3.14
2	3.50	3.13	2.96	3.09	3.14	3.12	2.64	3.30	3.50	3.15
3	3.04	3.33	3.13	3.35	2.67	3.20	3.36	3.65	3.85	3.29
4	2.50	3.33	2.92	2.64	2.48	3.40	2.84	3.10	3.55	2.97
5	3.29	2.96	3.33	3.26	2.95	3.36	3.28	3.15	3.63	3.25
6	3.42	3.63	3.33	3.52	2.95	3.80	3.04	3.55	3.90	3.46
7	3.04	3.52	2.83	2.91	2.95	2.72	2.44	3.35	2.65	2.93
8	3.42	2.96	3.42	3.48	2.95	3.32	3.08	3.74	3.18	3.28
Mean	3.15	3.29	3.10	3.19	2.84	3.27	2.94	3.44	3.45	3.18

While there are no overall means in the 'high' category there are a number of individual 'high' scores e.g. three for Lesson Study 8 and five for Lesson Study 9. Clearly the lack of overall 'high' means indicates that teachers rated these lessons better than the students did, though not by a great margin. This is not surprising. As teachers had been involved in planning each lesson for an hour and a half they had a stake in the success of the lesson. It is harder to remain objective in such circumstances. However, there are trends in the data that support a correlation between the students' and teachers' reflections. Lessons that scored high on the teacher data tended to score high on the student data. The

same was true for lessons with lower scores. This was most obvious in the case of Lesson Study 5 which received the lowest overall score in both student and teacher surveys.

Lesson Study 5 provides interesting data. This lesson was a repeat of Lesson Study 1 but with older students, Year 8 as opposed to Year 6. It was far less successful with the older students, indeed student responses during the lesson, discussed in detail during the evaluation session, were in many ways less advanced. The grade was clearly unfamiliar with the type of mathematics involved which included lengthy discussion of concepts. The grade's usual way of working was textbook based with limited whole class verbal interaction. On reflection, this should have been more apparent during the planning session, and has certainly encouraged me to ensure that in future, the aspects of the preliminary discussion related to the class concerned are thoroughly discussed.

Particularly encouraging is the item on using the mathematics on other problems, where five of the sessions had scores of 3.32 or above. This item clearly links to ideas of students making connections between different areas of mathematics, an important feature of effective teaching of numeracy. However, in the context of Lesson Study where lessons relate to the cluster numeracy team's focus and not necessarily the focus in the classroom at the time, we had expected students to find it hard to make connections as the lessons were out of context to other class work in mathematics. The fact that in many lessons they didn't find it hard is very encouraging. A further positive note is the high scores recorded for students trying their hardest (Item 6; highest mean 3.46), indicating that they were motivated by the tasks.

Conclusion

This analysis of Lesson Study mirrors previous findings in that results are very positive. All teachers involved not only enjoyed the sessions, but found them very powerful as a professional learning tool. The sessions have confirmed that fractions tasks were created by the team which work in cluster classrooms. This success of Lesson Study from the teachers' perspectives indicates that it should continue in some form with adjustments made with respect to the feedback obtained. Student feedback is also positive and supports continuation. Further Lesson Study sessions looking at the new cluster focus on structure have happened and a recent meeting of the cluster numeracy team expressed the view that it should continue in 2009. How the process can be adapted, in light of the reported feedback, within the current cluster context and in other contexts will be a feature of this continuing research.

Teacher comments in the 'Interesting' section of the PMI evaluation also give insight to future directions. The first comment concerns the data we collect during the process.

> Gathering more quantitative data on student learning to increase targeted data use would potentially be another powerful data source. Is our sense of what we're achieving realistic?

This last point on the realism of our achievements is extremely important. Whilst it is undoubtedly the case that educational change takes a number of years, nevertheless there is pressure within cluster schools to provide evidence that what we are doing is impacting upon student achievement. Indeed, improving the numeracy outcomes of all our students is a key aim of the cluster numeracy team. Clearly collecting richer quantitative and qualitative data on our students' understanding of the conceptual focus of Lesson Study needs to be developed.

Another teacher highlighted the theme of developing the benefits of Lesson Study with teachers in her school;

> I would love to sit in on a lesson taught by a teacher in my own school. I think the depth of discussion would be greater and would give each school within the cluster a better idea of the skills and resources in our own school. I know this is not the idea of the cluster, but just a thought.

Developing Lesson Study within cluster schools could clearly benefit individual schools and is an issue which warrants further consideration. An interesting aspect of this development is the opportunity to apply the Lesson Study methodology more fully. I commented earlier regarding the fact that the process as applied in the cluster did not provide the opportunity to reteach a revised lesson and complete the cycle in full. The mathematics team at the cluster secondary college are planning to develop Lesson Study within the college in 2009 and this could also be an interesting avenue for further research.

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