

Working group report: lesson study in research and CPD in mathematics education

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The working group met at BSRLM to share experiences of using lesson study in various ways in various contexts in schools, higher education (HE), initial teacher education (ITE) and continuing professional development (CPD) in mathematics education. Lesson study was established in Japan as an important and effective enquiry based approach to professional development. The use of lesson study in CPD and ITE is described in this short paper.

Keywords: professional development, lesson study, initial teacher education

Introduction

Lesson study involves a group of teachers jointly planning and reviewing a lesson in a real classroom. Most of the lessons studies in Japan are designed to research a particular issue in mathematics or a vision of education. (Hart, Alston and Murata, 2011). The focus of the study can vary from helping learners to be active problem solvers to how to teach a difficult topic (Lewis & Tsuchida, 1998). The systematic collaborative approach to lesson design, planning, implementation and review has been found to promote student engagement and learning and cultures of professional development (Fernandez & Yoshida, 2004; Lewis & Tsuchida, 1998; Stigler & Hiebert, 1999). It is important to observe that teachers should not consider research lessons as finished products that they can take up and use with learners without alteration. The research lessons are examples of reflection in action (Schon, 1987).

Many countries are adopting and adapting lesson study as a means of professional development and enhancement in mathematics, and this has become a subfield for research (Hart et al., 2011). The questions we wish to raise are the following:

- How and why does the Japanese model evolve in different cultural contexts, and phases? Is there an 'essential, sine qua non' to lesson study?
- How is lesson study constituted as research, or synergised with research in mathematics education?

The University of Manchester, lesson study in the context of ITE/CPD in mathematics education

During 2011-12 a local teaching school (Altrincham Girls' Grammar School, 2012) led a successful Teaching Agency funded pilot project into lesson study. The project involved a number of partner schools and was primarily concerned with groups of established teachers, although student teachers placed in the schools contributed to the lesson study and found the experience beneficial. Consequently we decided to investigate the use of lesson study with the entire cohort as a means of supporting their development and enabling professional development for teachers in our partner schools.

During the academic year 2012-13, 50 PGCE mathematics students visited five different schools at regular intervals during the course and worked with experienced teachers on lesson study. The intention was for the student teachers and the more experienced teachers to work collaboratively and support each other's learning and to challenge beliefs about teaching and learning in a safe environment.

Initially we visited the schools for three consecutive Fridays at the beginning of the course, to give the trainee teachers an opportunity to get to know the school and to get used to the idea of working collaboratively. The main purpose of these first three days was not to work on lesson study but to get the student teachers used to the idea of working collaboratively and to introduce a critically reflective approach to teaching practice. We also took this opportunity to allow the inexperienced student teachers to work on lesson planning.

The groups returned to the same school in January after their first school placements had finished. This time we went with the purpose of working solely on lesson study having previously introduced the underpinning theory of lesson study in university. As in September/October all lesson study groups were facilitated by a colleague from the university. The university tutors had the dual role of tutors and researchers.

The student teachers knew that the focus of the research lesson was on dialogue but had not worked extensively on dialogue.

We wanted the classroom teachers and the student teachers to feel free to experiment outside their comfort zone. We did not want the teachers and student teachers to feel that lesson study was yet another performance management tool. We believe that the constant scrutinising of the teacher in our performative culture is not always helpful (Williams, Ryan & Morgan, 2013) and wanted instead to create a safe environment for enquiry based professional development to happen. For this reason we focused the observation on the learners' progress and not on the teacher's performance.

The focus of our research lessons was on how to improve classroom dialogue in mathematics (Williams & Ryan, 2007). For this reason our observation sheets had been designed to capture opportunities for dialogue.

This is a novel model adapted from the Japanese lesson study. There are examples of other successful studies with pre-service teachers (Potari, 2011). However our model has been adapted to our particular culture and needs. One particular aspect of the UoM model is the fact that re-teaching is essential for us. We have observed that the student teachers valued the opportunity to re-teach the lesson and to reflect in action (Schon 1987). The main aspects that were valued by the students teachers were: (i) the opportunity to reflect on and re-teach a lesson gave the groups a powerful opportunity to reflect in action. (ii) the importance of the ITE-peer group and its relations with more powerful others (mentors and tutors) in the process.

We encountered some challenges while trying to implement lesson study as part of the PGCE programme. In particular some classroom teachers found it difficult to move away from their usual role as the assessor of the lesson, to co-teacher with the ITE students. It has been observed in the literature that "this change of disposition may not be easy for many experienced teachers educators (mentors) who have been accustomed to directing professional learning as an exercise in imparting knowledge" (Hart et al., 2011, p. 289). Even if apparently a simple idea, lesson study is a complex process requiring commitment and time. Some of the teachers involved in the study found it difficult to make time to dedicate to the research lesson due to curriculum and budget constraints as also observed by Hart et al. (2011). Following this experience we concluded that lesson study may complement and even 'lead' the development of

student teachers' reflective professional practices, because it may provide a social structure and tools not normally available to the lone student on teaching practice.

Bowland Maths lesson study project 2012-2013

The roots of the Bowland Maths Lesson Study project go back to 2010 when a group of academics from Tokyo Gakugei University heard about Bowland Maths and were interested to find out more. The Japanese education system demonstrates a very high level of success in mathematical concepts, but they have less experience of mathematical processes and are keen to develop that area, hence their interest in Bowland Maths. A delegation came to UK in autumn 2010 to see Bowland Maths in action in English classrooms. The school visits were organised in London by Alice Onion and in the Midlands by Malcolm Swan (University of Nottingham), setting the seeds for the structure of our current project. Two years down the line, Bowland Japan had been set up and we in the UK had learnt about lesson study from our Japanese colleagues.

This one year project is funded by the Bowland Charitable Trust and it forms a logical progression for Bowland Maths from the production of CPD materials. The aim of Bowland Maths is to transform secondary mathematics by substantially increasing the role of mathematical processes. To do this, action is taken on three fronts: teacher development, curriculum and assessment. The work on curriculum materials is particularly well known. Thus far on teacher development, seven CPD modules have been developed by Malcolm's team at the University of Nottingham. The Lesson Study project complements this and provides deep learning for a small cadre of teachers. Invitations of expressions of interest to participate in a lesson study project were sent out in summer 2012. These were sifted and a small number, limited by funding, were selected to form the project's core participants. There are nine schools involved and there have been 27 research lessons in total with one being held at each school per term.

The Impuls project in Japan is the key partner in the project, working with the University of Nottingham and with Bowland Maths. Members of the Impuls team and other visitors from Japan, including a government minister and researchers from universities other than Tokyo Gakugei have visited UK for one week each term, participating in a dozen of the Bowland Maths lesson studies.

The mode of professional learning adapted from the Japanese model addresses the major issues identified by Joubert and colleagues (2009) in their review of the research literature that to be effective the learning of mathematics teachers needs to be sustained over substantial periods of time (Correnti, 2007; Guskey & Yoon, 2009). In relation to this they identify that one successful approach has involved the development of collaborative communities of practice within mathematics departments. Further, such communities are often kick-started and sustained by outside expertise. They also identify that the most successful professional development for mathematics teaching pays attention to the development of the mathematics itself and particularly student learning.

Fundamental to the Bowland Maths project's model of lesson study, therefore, is the expertise brought to partnerships by 'knowledgeable others' and the focus on the interaction of learning with materials and the mathematical experiences and learning they generate (Lewis et al., 2006). The importance of these in the Japanese model is perhaps signified by the fact that the words used to describe them (*koshi* and *kyozaiikenkyu* – Takahashi & Yoshida, 2004; Doig et al., 2012, respectively) are often

left in the original Japanese in the literature, as they embody meaning that is often not well-understood outside Japan. We share the view of our Impuls colleagues that the role of the *koshi* (expert other) is essential and primarily to 'raise the bar' of planning and post-lesson discussion by bringing research evidence to help probe the reflection of practice. Our experience thus far supports this and we have observed a development in the depth and quality of post-lesson discussions, and emerging findings from our research on this point to the critical nature of the role of the *koshi* in bringing to the discussion crucial issues that would have otherwise been unlikely to emerge.

Our work throughout has been informed by third generation Cultural Historical Activity Theory (CHAT) perspective (for a summary see Engeström, 1999). Thus we have considered how the activity of the different communities involved in our programme might be viewed as interacting and mediated by a range of different influences. In considering the activity system as our unit of analysis therefore the focus is on a collective of individuals in pursuit of a common objective and outcome resulting in the goal directed actions of the system's members. The actions of the individual are considered mediated by artefacts, tools and 'instruments' with the activity of the collective subject to the additional mediating influences of the community with its division of labour and rules and norms. Central to lesson study, and of course teaching in general, is the Activity System of the mathematics classroom. Here, we consider that our approach has been particularly challenging as our aim was to expand the object of activity to focus teaching and learning on problem solving. This has required introduction of a range of new mediating tools including the Bowland Maths materials, as well as a range of new ideas and discourse by both teachers and learners that focuses on how to represent problems, reason mathematically, interpret, evaluate and communicate mathematical results in terms of the situation that has been mathematised. Important in this regard has been what it means to engage in these key processes, seek quality and improve. These have been prominent in the *neriage* (planning) phase of the lessons in which teachers and students have discussed their learning of problem solving skills.

Teachers live their professional lives as members of multiple Activity Systems determined by the structural organisation of their school and the educational system more widely. Lesson study brings into the shared experience of teachers and other educators a new Activity System with object of professional learning and outcome improved knowledge of teaching. The joint activity of the lesson study group includes developing the lesson plan, teaching and observing the research lesson and taking part in the post-lesson discussion. Within both the Lesson Study group and classroom activity systems we consider the lesson plan having particular importance as a boundary object (Star 1989). The lesson plan facilitates boundary crossing between the activity systems acting as a script for teaching whilst encapsulating the research aims of the lesson study group for the lesson. The written document that is developed as a communicative production, incorporates the shared understanding of teaching and learning intentions that its production-in-action facilitates amongst all participants in the process. As such we consider it as providing both the catalyst for sharing of the group's intentions and image of these (Roth and Radford, 2011) for their later reflections. Thus we see lesson study making important aspects of professional learning of both individuals and professional community explicit and providing both time and space in which this can occur, as opposed to other forms of professional development that are often individual, ad-hoc and tacit.

Arrangements in the London cluster are complicated. Nonetheless it is worth explaining them as there may be lessons here for future projects. A number of factors influenced the judgements about who to involve and how to get things started, including geography, experience of working well with schools and of Bowland Maths, and links with higher education institutions. Each London school has an adviser who works with a team of two or three teachers to plan the research lessons. There is also a linked higher education expert who comes in just on research lesson days, to take the role of *koshi*, referred to earlier.

Brunel provides the HE link for two schools in the London Borough of Bromley and with a teacher who participated in a Bowland funded lesson study trip to Japan. King's College London is the HE link for two schools in Barking and Dagenham. The local authority's secondary mathematics consultants provide the advisory support for these two pairs of schools. These two local authorities were chosen because the people leading secondary mathematics were suitably experienced and also very enthusiastic.

The project has exceeded expectations for teacher development. A final project report, which is currently being written, will detail the outcomes of teacher questionnaires and interviews. Some teachers have volunteered that this is the best CPD they have ever had. The strength is in the rigour of the post lesson analysis and that this feeds directly into the practice of all teachers present. The lesson studies are also significant learning opportunities for all others involved, particularly when there are visitors from Japan joining the lesson study.

At this stage, as the academic year ends and the Bowland Maths lesson study project is due to finish, participants are discussing next steps. The project this year has generated a great deal of enthusiasm so there is real momentum. The limiting factors as ever are time and money; there is no shortage of ideas or imagination. At least three of the schools will continue with lesson study, Brunel University is planning to build on this year's project by involving partnership schools in lesson study, while in Barking and Dagenham the authority is looking to use mathematics lesson study to enhance transition between primary and secondary school.

This one year project has provided a very helpful pilot study that will inform our future research that will seek to understand how we might build sustainable communities of teachers involved in lesson study focussed on mathematical problem solving. This work will research and develop support tools for communities that wish to work together, in collaboration with expertise and knowledge of teaching and learning of HEI-based mathematics educators.

Conclusions

The most significant benefit emerging from the two very different experiences described here is the potential for lesson study to enhance critically reflective practice. The shared experience of planning, teaching/observing and evaluating provides an unrivalled opportunity for reflection on action (Schon, 1987).

Lesson study does allow teachers to move out of their comfort zone by giving them shared ownership of something that they may not have the confidence to do alone. The importance of re-teaching the lesson for beginning teachers also emerged as significant in contributing to professional learning. This was not a feature of the Bowland Maths lesson study project.

The working group hopes to continue and is open to all.

References

- Altrincham Girls' Grammar School (AGGS). (2012). *Lesson study conference*.
<http://www.aggs.trafford.sch.uk/index.php/teaching-school/teaching-school-news/991-lesson-study-conference-enhancing-dialogue-and-questioning-in-mathematics-classrooms>.
- Correnti, R. (2007). An Empirical Investigation of Professional Development Effects on Literacy Instruction Using Daily Logs. *Educational Evaluation and Policy Analysis*, 29 (4), 262–295.
- Doig, B., & Groves, S. (2012). Japanese lesson study: Teacher professional development through communities of inquiry. *Mathematics Teacher Education and Development*, 13 (1), 77-93.
- Engeström, Y. (1999). Innovative learning in work teams: analyzing cycles of knowledge creation in practice. In Y. Engeström, R. Miettinen & R. Punamäki (Eds.), *Perspectives on activity theory* (pp. 377-404), Cambridge: Cambridge University Press.
- Fernandez, C. & Yoshida, M. (2004). *Lesson Study: A Japanese Approach To Improving Mathematics Teaching and Learning*. Mahwah, New Jersey: Laurence Erlbaum Associates
- Guskey, T. R. & Yoon, K. S. (2009). What Works in Professional Development? *Phi Delta Kappan*, 90 (7), 495–500.
- Hart, L.C., Alston, A & Murata, A. (Eds.) (2011). *Lesson Study Research and Practice in Mathematics Education: Learning Together*, New York: Springer.
- Joubert, M., Back, J., DeGeest, E., Hirst, C., & Sutherland, R. (2009). *Final Report: Researching Effective CPD in Mathematics Education (RECME)*. Sheffield. Retrieved from <https://www.ncetm.org.uk/enquiry/9251>.
- Lewis, C. & Tsuchida, I. (1998). A lesson is like a swiftly flowing river: Research lessons and the improvement of Japanese education. *American Educator*, Winter: 14-17, 50-52.
- Potari, D. (2011). Response to part II: Emerging issues from lesson study approaches in prospective mathematics teacher education in Hart, L.C., Alston, A.S. & Murata, A. (Eds.) *Lesson study research and practice in mathematics education: Learning together* New York: Springer, 127-132.
- Roth, W-M., & Radford, L. (2011). *A cultural-historical perspective on mathematics teaching and learning*. Rotterdam: Sense publishers.
- Schon, D.A. (1987). *Educating the Reflective Practitioner* San Francisco: Jossey-Bass.
- Star, S. L. (1989). *Regions of the mind: Brain research and the quest for scientific certainty*, Stanford. CA: Stanford University Press.
- Stigler, J. & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York: Free Press.
- Takahashi, A., & Yoshida, M. (2004). Lesson-Study Communities. *Teaching Children Mathematics*, 10 (9), 436-443.
- Williams, J. & Ryan, J. (2007). *Children's Mathematics 4-15*. Maidenhead: Open University Press
- Williams, J., Ryan, J. & Morgan, C. (2013). *Lesson Study in a Performative Culture* (in preparation)