

## **The application of lesson study across mathematics and mathematics education departments in an Irish third-level institution**

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This presentation reports preliminary findings arising from a research project, which embodied cross-disciplinary collaboration into the teaching and learning of Mathematics. The project involved the use of a form of Japanese lesson study by colleagues from the Education Department and the Mathematics Department of a College of Education and Humanities in the Republic of Ireland. Five colleagues worked together to explore the goals of teaching two research lessons; the first of which was part of a module in the history of mathematics for BA students, and the second, a lesson in mathematics education for BEd (Primary) students. Following ethical clearance, the research lessons were videotaped using both a static camcorder focused on the teacher and a roving camera to record student participation. The research lessons were also observed in situ by the remaining participants of the lesson study group. Both research lessons were later transcribed. In this presentation we will report on our initial findings from the different perspectives of preparing, teaching, observing and reviewing the first research lesson. The potential for conducting lesson study in a cross-disciplinary fashion will be discussed.

**Keywords: lesson study, research mathematics lesson, collaborative inquiry**

### **Introduction**

A call for research proposals by the Irish National Academy for Integration of Research, Teaching and Learning was the catalyst for this research project (NAIRTL 2009). Initially, six colleagues collaborated in preparing a research proposal. All members of the team - Maurice and Sinéad from the Mathematics Department and Dolores, Thérèse and Ronan from the Education Department - were interested in mathematics education research and welcomed an opportunity to explore together their own and each other's practices using lesson study as a means for doing so. Both groups approached the project with enthusiasm, interest and respect while acknowledging that they were engaged in different practices as the former taught undergraduate mathematics courses to BA and BEd students and the latter taught mathematics education courses to pre-service and practising teachers. In 2010, Ronan moved away from mathematics education and was replaced by Miriam. The use of lesson study had already been researched and theorised in the institution as a means of learning to teach mathematics with preservice primary teachers (Corcoran 2008) and members of the research team from the Education Department had some experience of working as Knowledgeable Other (Watanabe and Wang-Iverson 2005) with student groups engaged in lesson study. The inter-departmental, cross-disciplinary research team proposed a new departure, to embrace the potential of lesson study as a means of investigating and developing their own mathematics teaching, and as a model of 'good practice' for student participants.

## **The spread of lesson study as a protocol and a process**

Engagement in the practice of lesson study has been integral to the Japanese educational system for over a hundred years (Isoda 2007). It first came to attention outside Japan from the publication of *The Teaching Gap* (Stigler and Hiebert 1999) and the work of Yoshida (1999). Since then, lesson study as a process for teacher professional development has grown in popularity in the USA, thanks to the work of two scholars in particular, Lewis (2002) and Fernandez (2005) and to their teacher colleagues. Superficially, the lesson study protocol appears to involve a group of teachers collaborating to prepare and plan a single 'research lesson' which one member of the group teaches while the others observe. The research lesson is then reviewed and possibly revised, most often with the aid of a Knowledgeable Other. Lesson study is seen as an iterative process and the preparatory and post-research lesson stages can be of varying length. Early research findings indicated that Japanese teachers brought much more than the three part protocol of prepare, teach/observe and review research lessons when engaged in lesson study. They appeared to adopt three essential lenses, namely the researcher lens, the curriculum development lens and the student lens to focus their engagement in lesson study (Fernandez, Cannon and Chokshi 2003). For groups of teachers engaged in lesson study in one school district the process was considered to lead to deep learning and teacher professional development (Perry and Lewis 2009). As the phenomenon of lesson study became more widespread in the US researchers began to ask why lesson study was so influential in improving teaching. Lewis, Perry and Murata (2006) conjectured that engagement in the lesson study process brought about an increase in teacher knowledge, built teacher community and contributed learning/teaching resources, although they also recognized its value in developing and refining mathematics lessons. Research corroborates that engagement in lesson study as collaboration between university lecturers and preservice teachers (Corcoran and Pepperell 2011) and with practicing teachers (Back and Joubert 2011) is successful in building mathematical knowledge in teaching. But the potential of lesson study is much greater than its contribution to developing mathematical knowledge in teachers, a potential recognized by Tall (2008), for example. As lesson study has become better known throughout the world, there has been a slew of research into many aspects of lesson study and its contribution to enhanced teaching of mathematics (A-PEC 2008; Hart, Alston and Murata 2011).

## **Establishing a community of inquiry**

Preliminary meetings to discuss the research project and familiarize ourselves with the lesson study cycle and relevant research were held in July and September 2009 and the group undertook to engage in two cycles of lesson study over the coming academic year. As a group, we decided to adopt lesson study protocols (Yoshida 2005), and proposed to use the four dimensions of the Knowledge Quartet as a common framework for discussing research lessons (Rowland, Huckstep and Thwaites 2005). The notion of a community of practice (Wenger 1998) was considered as a possible heuristic for thinking about the data being generated as we negotiated the research trajectory together. However, while valuing the depth and complementarity of our educational backgrounds and recognizing the disparity in our mathematical experiences we adopted 'inquiry' as a research stance (Jaworski, 2004; 2008). Our inquiry stance embraced inquiry into lesson study, into each other's

practices, into mathematics, into pedagogy and into (mathematics education) research. We set out to build shared understandings and to uncover the tacit in our practices. In consequence the research project was conceived as ‘developmental’ and the design as ‘emergent’.

### **Forging the research design**

As with all school based research, the college and timetable course outlines constrained decisions about when the research lessons could take place, and which topics could be addressed. It was agreed that the first research lesson, reported here, would be taught by Maurice. The actual preparation phase began in December 2009, with meetings of one/two hours’ duration taking place regularly in January and February leading the first research lesson on March 8<sup>th</sup> 2010. Group members kept field notes and all relevant material was stored on a dedicated Moodle site to which all members had access. There were 8 (out of 9) BA students present at the research lesson. A schedule for observation and data collection during the lesson was agreed beforehand. For example, observers were on the lookout for moments of insight, and opportunities for increasing agency. The research lesson was of the usual fifty minutes duration and was video-recorded using a static camcorder facing the lecturer and a roving camcorder focused on students at work. The video recordings were translated into DVDs and later transcribed. A focus group of students was interviewed after the research lesson and all student participants were invited to make entries in their learning journals relating to the lesson. A second research lesson, this time in mathematics education, and taught by Thérèse, took place on November 30<sup>th</sup> 2010.

### **The first research lesson**

The collaborative preparation phase involved planning the teaching of the research lesson and studying the course curriculum and materials to be used. The research lesson chosen was an introductory session on the history of calculus, exploring Leibniz’ conception of the calculus based on Bos’ study (1980) of Leibniz’ work of October 1675. This specialist area is one with which only the course lecturer, Maurice, was familiar. While his Mathematics Department colleague, Sinéad, could be expected to understand the underlying mathematical concepts, the material was new to the rest of us. In consequence, there was a lot of reading, questioning and explaining to be done as we grappled with building a shared understanding of the topic of the lesson, where GeoGebra would be used to explore Leibniz’ notion of the characteristic triangle. In a preliminary analysis of data of the lesson study cycle, the research team considered three perspectives: the process of preparing, of teaching while being observed and the process of reviewing a lesson collaboratively.

### ***Preparing***

As course lecturer Maurice was responsible for setting goals for teaching as he would in the normal way. However, the questions asked by lesson study team members caused him to articulate the goals for student learning during the research lesson in a more detailed and specific manner than he was accustomed to doing. His decision to have students use GeoGebra, which had been uploaded on their laptops was a new departure. Mindful of the possible effect that the presence of two video technicians and four observers would have on student participation, it was decided to prearrange the desks so that students were sitting in pairs in a U- shape. The list of nineteen

questions that he proposed to ask the students was posted on Moodle. These fell into two categories: questions concerning student engagement with the prescribed text and questions concerning student engagement with the technology and the affordances that electronic and hard copies of GeoGebra worksheets would offer for student learning. While recognizing Maurice's expertise, the group felt a degree of ownership of the research lesson.

### ***Teaching/observing***

Maurice was aware of contingency opportunities in a new way as he was teaching the lesson (Rowland et al 2005). When working to understand Leibniz' characteristic triangle, one student pointed to a perpendicular bisector in the supplied diagram. The term 'bisector' was inappropriate and Maurice was aware of his attempting to deflect her attention away from the error by emphasizing the term 'perpendicular'. He later regretted this handling of the situation as a missed opportunity for enhancing her personal agency. All the observers were struck by the immediacy of observing a live research lesson of adults engaged in teaching a learning mathematics, from a perspective which is different from that of teacher, student or evaluator, roles we have all held already. One student was aware of feeling constrained by the experience:

It kind of put pressure on you to kind of try and figure stuff out for yourself ... but then you didn't want to say it in case you sounded stupid in front of everyone else  
(post-lesson focus group)

Another student claimed she enjoyed it. "There is no doubt but that it was an exciting experience and I don't feel that they disrupted the lecture in anyway". Maurice expressed the affective dimension as:

It is new terrain working with colleagues like this! Any apprehension is more than compensated for by a deep sense of gratitude towards colleagues. My self-confidence varied significantly at different stages throughout the project – from being racked with doubt to being buoyed up with confident enthusiasm.

The remaining team members expressed respect and empathy for all the participants in the research lesson, a spirit which appeared to imbue the whole lesson study process. There are resonances here as elsewhere in the data with Wenger's notions of 'engagement', 'imagination' and 'alignment' which together with his construct of 'accountability to the enterprise' appear to indicate that engagement in the practice of lesson study for the teaching and learning of mathematics is a worthwhile endeavour (Corcoran, O'Reilly and Breen, 2010).

### ***Reviewing***

In this study, mathematicians and mathematics educators brought many different ideas and perspectives to bear on the research lesson plan. Teaching mathematics at third level can be normally considered quite an isolated activity yet on this occasion it was experienced as a collaborative one with ideas of good pedagogic practice being brought centre-stage and shared in a structured and effective way. In the review phase, the lesson study team members appeared to hone in on different aspects of the lesson, according to how they perceived moments of insight and opportunities for increasing student agency which lead to a rich and mutually rewarding post-lesson discussion session. Space prohibits reporting these here. The video recording allowed the possibility of revisiting and reliving the lesson, enabling us to take a deeper look at interesting incidents during the lesson and probe more deeply into our initial

observations. However, for the review phase to be most effective it should have been carried out without delay. Time constraints limited these possibilities.

### Concluding questions

Engagement with lesson study is inherently 'work in progress'. To date the research team has undertaken two lesson study cycles each hinging on a research lesson taught in a different department. We have reported only preliminary findings from the first research lesson here. The work is ongoing and our inquiry stance in relation to preliminary data analysis throws up many questions of a generic nature. These are adapted from those posed by Breen (2004) and relate to our growing understandings of the commonalities and differences in our practices. Arising from our inquiry stance into each other's practices, we ask ourselves, what do we learn from each other? Our questions into mathematics education research relate to power and its distribution among the group. How do we work with student agency? We strive to discern whose questions are privileged? And whose theories are foregrounded? As we inquire into the lesson study process we seek personal responses to the question, how do participants cope with different agendas? Who maintains the 'project'? Who is in control of the research? Is the process of lesson study the catalyst (and the glue) which sustains the research endeavour? These questions highlight that the existing research design and/or theoretical framework will need to be augmented in future. More in-depth data analysis is required at the level of participation as colleagues who choose to collaborate in the communal space of lesson study.

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