A THEORETICAL LENS ON LESSON STUDY: PROFESSIONAL LEARNING ACROSS BOUNDARIES

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Issues of developing lesson study practices as a model of professional learning across boundaries are explored in this paper from a Cultural and Historical Activity theoretic perspective. We consider the work of professional learning communities as teachers seek to expand the object of their classroom activity and in doing so identify systemic contradictions and personal conflicts that arise, leading to the potential for expansive learning. Further to this, we identify potential use for theory-in-action and directions for future research and development.

INTRODUCTION AND BACKGROUND

This paper explores, from a theoretical perspective, the professional learning of teachers who seek to develop their practice in relation to supporting students' problem solving in mathematics. Here we use the lens of third-generation Cultural Historical Activity Theory (CHAT) (see for example Engeström, 1987) to consider the development of lesson study groups as professional learning communities. This has been motivated by our work with several new lesson study groups in England aimed at motivating students' study of mathematics through inquiry-based teaching and learning, with a particular focus on problem-solving.

The focus of these lesson study groups on problem solving adds a complexity beyond the 'iconic' Japanese model of lesson study as practised and developed since the nineteenth century. In Japan lesson study is long-established, has high status and is central both to pre-service teacher education and to a teacher-led process of sustained professional development in an education system that 'discourages professional isolation' (Collinson & Ono 2001, p. 227). To this end, lesson study involves a community of teachers and 'knowledgeable other(s)' collaborating in a cyclical process that involves planning a 'research lesson', joint observation of the lesson and critical reflection in a detailed post-lesson discussion. This may lead to the collaborative development of a revised version of the lesson plan and progression once more around the cycle. An important member of the lesson study group is the *knowledgeable other*, a mathematics education 'expert' who aims to make a particularly significant contribution to the post-lesson discussion by providing insights informed by research and in-depth curriculum knowledge.

Lesson study based on the Japanese model has become increasingly widely known and adapted for use across geographical and cultural boundaries since the publication of the Stigler and Hiebert's book *The Teaching Gap* (1999). Perry and Lewis (2009), discussing implementation in the US, for example, describe how US teachers found it hard to elicit students' thinking and to keep that at the heart of post-lesson discussions. Likewise, Doig and Groves (2012), drawing on experiences in Australia, point out a

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number of factors that militate against direct transfer of what works in Japan to other cultures. For example, they highlight the high status and stable communities of teachers, stability of educational policy and the less individualistic quality of Japanese culture, and the more flexible approach they take to scheduling research lessons and their subsequent debriefings.

MATHEMATICS LESSONS: WHAT MATHEMATICS?

Central to professional learning through lesson study is understanding and development by the lesson study group of a shared vision of the nature of mathematics teaching. It appears from our survey of the literature in relation to lesson study, and comparative mathematics education more widely, that mathematics teaching is primarily considered as focused on 'content' as opposed to mathematical processes. This is noticeable in a number of international studies. For example, in seeking to uncover similarities and differences in patterns of teaching within and across national boundaries, analysis based on the TIMSS video studies (see for example, Givvin *et al*., 2005) focused on purpose in terms of content, classroom social interactions and content activity (measuring the time that students worked on problems). The 'Learners' Perspective Study' (Clarke, 2006), also gauged students' performance in terms of mathematical content learned. Similarly, in the United States, research exploring knowledge for teaching (Ball *et al.*, 2008) broadens our thinking in this area beyond subject knowledge to include areas such as knowledge of curriculum, students and general and subject-specific pedagogies but omits reference to underlying issues of mathematical processes.

More recently the OECD PISA series of international comparative studies that quantify student performance on a range of tests in mathematics, and also science and literacy, have raised the profile of problem solving. The framework used by these studies to define the mathematics domain (OECD, 2003), in addition to content, identifies competencies and context and how these blend together in the mathematics tasks which we give to students, thus recognising the mathematical practices in which students then engage. In seeking to ensure our students become better mathematical problem solvers our lesson study communities are therefore attempting to focus on important mathematical processes. In the most recent formulation of the English national curriculum in mathematics with which our schools are working, these are organised using a problem-solving cycle and are termed 'representing', 'analysing', 'interpreting' and 'evaluating', with over-arching competencies identified as 'communicating' and 'reflecting'. Our lesson study therefore focuses on research lessons in which students develop mathematical problem solving skills rather than build specific mathematical content knowledge.

THEORETICAL FRAMEWORK

Cultural Historical Activity Theory (CHAT) considers how the activity of a community viewed as an Activity System is mediated by a range of different influences. It builds on the fundamental thinking of Vygotsky about how the action of an individual (subject) in pursuit of a goal-directed outcome is mediated by artefacts,

tools and 'instruments' (upper triangles in Figure 1). Luria, Leont'ev and followers (for a summary of their work see Engeström & Cole, 1997), in considering the unit of analysis to be extended to a collective of individuals, identify the additional mediating influences of the community with its division of labour and rules and norms (lower triangles in Figure 1). Central to lesson study, and of course teaching in general, is the Activity System of the mathematics classroom (left-hand triangles in Figure 1). Here teacher and pupils work as a community, with the learning of mathematics as object and, for many, pursuit of certification/qualification as the eventual outcome. There is a clear division of labour in the classroom, with teacher and pupils drawing on a range of tools in their individual actions. In many instances these tools are selected by the teacher, for example the questions they ask, the ordering of conceptual development they choose, texts, manipulatives, technology and so on, but individual pupils may additionally select from their own set of aids and resources. The modus operandi of the classroom community, as is the case in all Activity Systems, is culturally and historically situated and develop over time As a result pupils, teachers and society more widely can be considered to operate within *le contrat didactique* (Brousseau, 1997) that encapsulates the current manifestation of culturally situated expectations of what constitutes a mathematics lesson.

Teachers in their professional lives are members of different communities in multiple Activity Systems determined by the structural organisation of their school and the educational system more widely. For example, mathematics teachers are frequently organised to work collectively in distinct departments in pursuit of the learning of mathematics, but in which individual teachers are involved in very different actions, from those that they carry out in classroom settings, such as developing schemes of work to organise their curriculum.

Lesson study brings into the shared experience of teachers and other educators a new Activity System with the object of professional learning (right-hand triangles, Figure1). The joint activity of the lesson study group includes developing the lesson

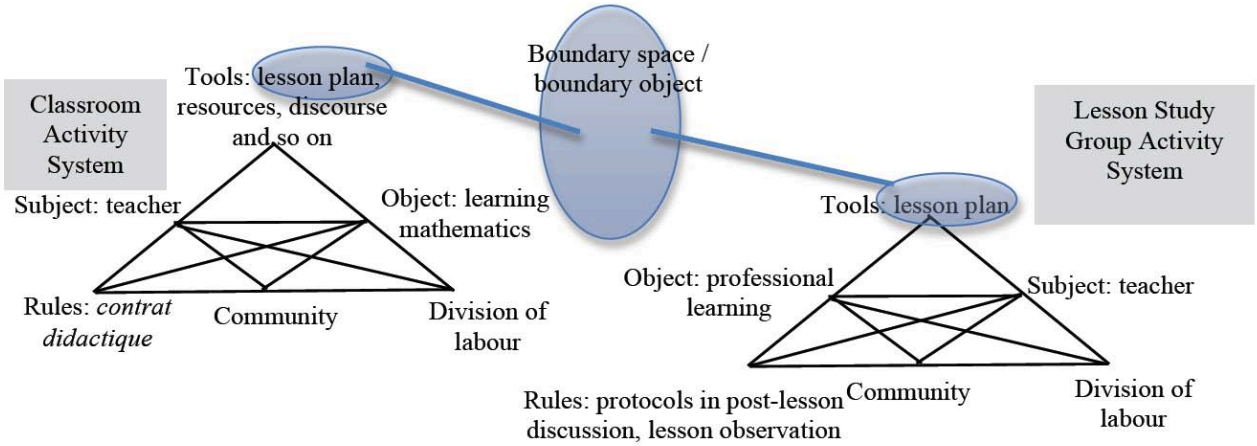

Figure 1: Interacting Activity Systems of classroom (student learning of mathematics) and lesson study group (professional learning)

plan, teaching and observing the research lesson, taking part in the post-lesson discussion and (optionally) refining the lesson plan. Here we are using the term lesson

plan in an inclusive sense to incorporate more than the written document that is developed as a communicative production, but also the shared understanding of teaching and learning intentions that its production-in-action facilitates amongst all participants in the process. We wish to be equally inclusive about professional learning, recognising that for teachers, as for other workers, it is an ongoing process that importantly includes reflection on action on a daily basis. Lesson study, like other forms of formalised professional development activities, however, attempts to make specific aspects of professional learning explicit and provides both time and space in which this can occur and be shared with colleagues, as opposed to day-to-day learning that is often individual, ad-hoc and tacit.

The focus of our reflections in the remainder of this paper is therefore on two Activity Systems of learning: one centred on the learning of pupils in classrooms and the other on teachers and educators and their professional learning in the lesson study community. Teachers are key actors in each of these systems and can be considered as boundary crossers. Here we draw on the notion of boundary as expressed by Akkerman and Bakker (2011, p. 133) "as a socio-cultural difference leading to a discontinuity in action or interaction". In their review of research into boundary crossing and boundary objects Akkerman and Bakker (2011) argue that from a socio-cultural perspective all learning involves boundaries although as they point out researchers use the term in different ways. Here we emphasise, as do Akkerman and Bakker, the importance of discontinuity as being essential at the boundary, whether it be within or between Activity Systems. In lesson study we consider that it is in the boundary between classroom and lesson study group Activity Systems that teachers, in their reflections on their actions and interactions in each, experience professional learning. The lesson plan, understood in its widest sense, plays an important role as a boundary object. Star and Griesemer (1989), in defining boundary objects, point to their having different meanings in different Activity Systems while retaining a common essence. We see the lesson plan as being at the nexus of understanding of teaching and learning intentions. In the classroom it acts as a mediating instrument as a script by which the teacher organizes the research lesson, but it has other roles to play beyond this at different times in the activity of the lesson study group. For example, in initial planning the lesson plan provides documentation of, and encapsulates, their values, understandings, beliefs and intentions, whereas in the post-lesson discussion it again acts as a mediating instrument, this time facilitating discussion of these and their enactment as pedagogical practices in the classroom.

We contend that the teachers' professional learning takes place at the boundary and is centred on the lesson plan that, as a boundary object, embodies the group's shared and emerging perspectives on practice. In this sense it facilitates reflection on action and perspective making and taking (Boland and Tenkasi, 1995) on issues in relation to teaching and learning. Crucially, in this space identity development is supported which, with Wenger (1998), we see as fundamental to learning. Further, we consider members of the lesson study group as undergoing, in Beach's terms (1999), a *consequential transition*, being in developmental change as they renegotiate their relationship with the social activities with which they are involved. We find ideas of

transition helpful in consideration of lesson study, which by design supports teachers in 'the construction of knowledge, identities, and skills, or transformation, rather than the application of something that has been acquired elsewhere' (Beach, 1999, p.119). We therefore view lesson study as supporting teachers in transition as they expand and enrich their mathematics educator identity.

At a system level, Engeström (2001) points to the central role of historically accumulating tensions within and between activity systems, which provide contradictions that are potential sources of change and development. These contradictions often give rise to conflict (Vasilyuk, 1988) for individual members of the community, who may experience destabilization of personal and interpersonal equilibrium. These conflicts often have a much shorter life-cycle than the contradictions (Sannino, 2008), that have their roots in systems that are much less open to change and quick resolution. As individuals reflect upon, question and adopt new actions, the community reconceptualizes the object and motive of the Activity System, giving rise to *expansive learning* that produces new patterns of activity. In relation to professional development, Engeström and Sannino (2010) advocate the term *expansion* to capture the key idea that "learners construct a new object and concept for their collective activity, and implement this new object and concept in practice". We find these concepts useful in understanding professional learning as more than training or even reflective participation but rather as professional exploration of the nature of current and proposed objects of activity.

THEORY IN ACTION, NOW AND FOR THE FUTURE

The theoretical ideas we have set out above provide a valuable lens which we have used to reflect on our work on professional learning using lesson study with networks of schools in England. In addition to our role as researchers, we also act as 'knowledgeable others' and our use of CHAT has provided us with some useful tools, including discourse, with which to consider the conflicts and contradictions that we have not only observed but also experienced.

Focusing lessons on students' learning of key problem solving processes has proven particularly problematic: from lesson planning, even though drawing on classroom tasks specifically designed to support this, through enactment in the 'research lesson' to the post-lesson discussion. Our analysis points to a fundamental contradiction we have introduced in the classroom Activity System, where we wish to expand the object of activity so that pupil learning is understood to include the processes of problem solving whilst continuing to draw on and develop pupils' facility with mathematical content. As suggested earlier this is not a commonly considered issue in mathematics classrooms and consequently should be central to the professional learning of teachers both as individuals and as collectives. It is apparent that in both the classroom and the lesson study group Activity Systems we are inadequately served in terms of 'tools' with which to support teaching and learning of problem solving; for example, well-developed and understood pedagogies and understanding of what constitutes learning, and progress in learning, in relation to the key processes. Questions that arise, for example, include, 'What are more sophisticated models of mathematical

representations that we might expect from pupils?', 'Which representations provide for useful mathematical insight?', and so on.

Our introduction of lesson study to support professional learning in relation to this expanded object of classroom activity provides a challenge for members of the lesson study group in addition to developing the new activity system. This on its own requires a negotiation of a division of labour and sense of community, a development of a shared understanding of new rules together with an importation of existing, and development of new tools that will mediate the activity of the collective and actions of individuals in pursuit of a common goal and outcome. The establishment of the lesson study group provides many opportunities for disturbance of personal equilibrium across aspects of each individual's professional life ('conflict', in CHAT terms), and we found this to be conflated with the personal dissonance that the contradiction of the expanded object of classroom activity provides. Together these provided a considerable challenge for individuals and the collective in their ongoing day-to-day professional learning.

We advocate CHAT as a powerful theoretical lens through which to view the introduction of lesson study across cultural boundaries, whether geo-spatial or temporal. Our reflections as outlined here lead us to conclude that the theoretical tools that CHAT provides for analysis of lesson study in action will be of use to lesson study groups in facilitating better conceptualisation and understanding of the professional learning with which they are involved. They can be employed to facilitate the development of a common understanding of goals and outcomes of the group, and a discourse with which they can articulate and discuss these. (This parallels the way in which Engeström has used CHAT in his Helsinki change laboratory in his work with Health workers.) In this regard the crucial role of the lesson plan as a boundary object requires careful consideration. The 'new' status of the lesson plan as more than a script for the lesson needs to be recognised. Its use as a tool in mediating teacher activity in the classroom is enriched to encapsulate a practitioner research agenda: the plan embodies the group's research question(s) and methodology. Beyond their use in a single lesson, the lesson plans provide a means by which developing professional knowledge and perspective making of the individual and lesson study group can be used to communicate, both internally and externally, their new and emerging shared understanding (perspective taking).

We additionally value the insights that CHAT provides in relation to systemic contradiction and individual conflict, such as those illustrated here, as potentially useful to 'knowledgeable others' as they seek to negotiate their role within the lesson study group. Beyond this, as lesson study attempts to become established in new cultural settings and mathematics educators act as brokers to facilitate new modes of professional learning, viewing lesson study through the lens of CHAT has the potential to provide insight to inform new research agendas, for example, designing programmes that seek to explore potential systemic change that will introduce contradictions and professional conflict. We see careful design with attention to boundary conditions as having the ability to inform new directions in professional learning and future practice.

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