Teacher Learning in Lesson Study: Affordances, Disturbances, Contradictions, and Implications

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Abstract

Lesson Study is a form of professional development where teachers collaboratively design research lessons and improve instruction using the evidence they have gathered on student learning and development. This article reports on a professional learning team's enactment of Lesson Study in an elementary school. A methodological approach informed by Cultural-Historical Activity Theory was adopted to study teacher learning practices that provided affordances to teacher learning, practices that produced disturbances to teacher learning, and underlying systemic contradictions revealed by the disturbances. The findings suggest implications for enhancing school-based professional development through Lesson Study.

Keywords: teacher learning practices, professional learning community, lesson study, cultural-historical activity theory

1. Introduction

In this article, we explore professional learning practices in Lesson Study contexts and discuss implications for enhancing teacher learning. In a Lesson Study (Lewis & Hurd, 2011; Murata, 2011), teachers go through cycles of instructional improvement in which they collaboratively formulate goals for student learning and long-term development, examine research and curriculum related to pressing issues in student learning, and plan a research lesson that is then conducted in a classroom with one of the team members teaching the lesson and the rest observing and gathering data on student learning and development. The teachers would then meet for a debrief session or colloquium to reflect upon and discuss the data gathered, use the evidence to improve the lesson and instruction in general, and if desired, teach the improved lesson in another class and gather evidence for further discussion (Lewis & Hurd, 2011; Murata, 2011).

The distinctive characteristics that set Lesson Study apart from other similar professional development approaches are the research lesson and the colloquium following it (Groth, 2011; Murata, 2011). The collaborative planning and debriefing of research lessons provide teachers with learning opportunities through shared classroom experiences in which certain aspects of teaching and student learning may be highlighted and reflected upon as a group. The planning and debriefing of research lessons allow teachers to sharpen skills use for observing evidence of students' learning, and to collectively gain access to pedagogical content knowledge that would otherwise remain tacit (Dudley, 2013). However, much can still be done to understand what and how teachers learn in such collaborative settings (Borko, 2004). Despite the popularity of Lesson Study and the belief that it supports the professional learning of teachers, there is limited research on the processes and mechanisms of teacher learning in Lesson Study contexts, and on how Lesson Study provides opportunities for teacher learning that advances pedagogical practices and beliefs related to student learning

(Ni Shuilleabhain & Seery, 2018; Widjaja, Vale, Groves, & Doig, 2017; Willems & Van den Bossche, 2019). Interaction processes within Lesson Study groups that lead to sustained teacher learning have also remained largely unstudied and under-theorized (Lewis, Perry, & Friedkin, 2009).

This article reports a research study on the learning practices of a professional learning team (PLT) comprising teachers who taught students in Grade Four and who enacted Lesson Study in an elementary school that had organized itself as a professional learning community (PLC). The notion of a PLC does not have a singular, universally accepted definition (Hord, 1997; Stoll, Bolam, McMahon, Wallace, & Thomas, 2006). PLC practitioners and researchers had described a PLC as a group of educators engaged in ongoing collaborative inquiry on their practices, so that they learn better approaches and act on what they learn to benefit their students (DuFour, DuFour, Eaker, & Many, 2006; Hord, 1997; Stoll, Bolam, McMahon, Wallace, & Thomas, 2006). The absence of a universally accepted definition of PLC may be explained by the lack of theorization of the multi-dimensional construct of PLC (Hairon, Goh, Chua, & Wang, 2017). In addition, the actual development of authentic and sustainable PLCs have also been extremely challenging and rare (Aubusson, Steele, Dinham, & Brady, 2007; Mullen, 2009; Stoll & Louis, 2007). These gaps in the PLC research base suggest a lack of a nuanced understanding of the nature of professional learning practices that operate at the heart of PLCs and how they affect teacher learning.

Practices refer to doing, not "in and of itself" (Wenger, 1998, p. 15) but to doing in a cultural-historical context that frames and accords meaning to what is being done. Practices, being habitual social ways of doing that unfold over time and space (Reckwitz, 2002; Schatzki, 1996), are created and sustained through discursive interactions (Rex, Steadman, & Graciano, 2006). Hence, a study of teachers' discursive interactions and sense-making can

shed light on the nature of professional learning practices. The purpose of this research was to study (1) teacher learning practices that provided affordances to teacher learning, (2) teacher learning practices that produced disturbances to teacher learning, and (3) underlying systemic contradictions revealed by the disturbances.

2. Literature Review

Teacher learning practices may be studied by examining the nature of teachers' conversations because discourse can afford or limit professional learning (Nelson, Deuel, Slavit, & Kennedy, 2010). The quality of teachers' interactions shapes the nature of professional learning accomplished. For example, learning outcomes depend on whether teachers engage in "congenial conversations" which focus on the superficial sharing of classroom practice or in "collegial dialogue" which emphasizes substantive and specific probing into teaching and learning (Nelson et al., 2010, p. 175).

Studies have been conducted to examine features of teachers' talk and interactions during Lesson Study and whether they support teachers' professional development. Features of dialogic interactions that have been found to support teachers' professional development include dialogic interactions that request for information, interactions that challenge ideas in teachers' use of information about students' learning or difficulties in learning certain aspects, and discursive moves that pertain to problem-solving discourse or to problem-setting discourse (Suzuki, 2012; Warwick, Vrikki, Vermunt, Mercer, & Halem, 2016). With regard to the quality of conversations during debriefing sessions, it has been found that the less beneficial conversations tended to be those that focus on play-by-play descriptions of what students were doing during the lesson, while the more beneficial conversations tended to be those in which teachers related student actions and misunderstandings with the lesson or to

teaching in more conceptual ways (Clevenger, Kuhnley, O'Rourke, & Umland, 2009). These findings underscore the important roles played by teachers in facilitating debriefing discussions. Amador and Carter (2018) reported that the verbalization of professional noticing by all team members was afforded by moves such as facilitator-initiated prompts and turn-taking following prompts, but constrained by content shifts in the conversation or when there were lengthy exchanges between just the facilitator and the teacher of the research lesson. Taken together, these studies on teachers' talk and interactions illustrate the importance of the quality of discourse in shaping teacher learning in Lesson Study, and of the facilitation of the discourse.

The study of teachers' professional learning practices may be further illumined by considering the context within which teachers work. Cultural-Historical Activity Theory (Cole & Engeström, 1993; Engeström, 1987), or CHAT for short, is a perspective that guides the study of human activity in a collective context. Based on the work by cultural-historical psychologists such as Vygotsky and Leontyev, CHAT views a work activity system as a whole, comprising individual workers and their co-workers, the different roles they play, the rules that regulate how they work together, the conceptual models and instruments they use in their work, and the purpose to which the work community directs its activity (Engeström, 1987). Hence, CHAT uses methods that take a systematic and systemic approach to analyze interactions in complex environments to help researchers understand "individual activity in relation to its context and how the individual, his/her activities, and the context affect one another" (Yamagata-Lynch, 2010, p. 1). As such, CHAT offers a way to explain the relationships between individual human activity and the broader cultural, institutional, and historical situations in which the activity occurs (Wertsch, Rio, & Alvarez, 1995).

CHAT has been used as a means for understanding the challenges faced by teachers when undergoing changes in practices, such as those arising from the use of innovative

pedagogy (Beatty & Feldman, 2012), historically different modes of teamwork (Engeström, 2008), and reform in teaching (Stouraitis, Potari, & Skott, 2017). The appeal of CHAT lies in its heuristic power in studying human activity that is multi-faceted and taking place in a dynamic context, and for understanding the problems and potentials of the activity against the local history of the activity (Engeström, 2001; Yamagata-Lynch, 2010).

3. Methodology and Methods

This research adopted a methodological approach informed by CHAT to examine the professional learning activity of Lesson Study enacted by a PLT in an elementary school. In providing the means for viewing an activity as a unit of analysis, CHAT allows researchers to maintain a broader macro-perspective and take into account the multifaceted nature of the complex environment that people work and develop in, while allowing the examination of interrelationships among different factors without having to sacrifice insights that sometimes can only be revealed through micro-level analyses (Engeström & Middleton, 1998; Holt & Morris, 1993; Yamagata-Lynch, 2010). A number of analysis methods, which will be elaborated upon in the data analysis section, were employed to carry out both macro-level analyses of key processes in the PLT and school, and micro-level analyses that reveal teacher agency in interactions and negotiations (Engeström & Middleton, 1998).

The study of practices that afforded teacher learning was guided by the work of Greeno and Gresalfi (2008). According to these researchers, the affordances for actors in an activity system include the resources and practices of the system, the actors' access to those resources and practices, and the dispositions and abilities of the actors to participate in ways that support their activity and professional learning in some way. The teachers' learning practices were also studied to understand what practices led to disturbances, which refer to deviations that interrupt the flow of the professional learning activity (Engeström, 2008;

Helle, 2000). Disturbances were studied as they reveal underlying contradictions or tensions that can lead to attempts to change the activity itself (Engeström, 2001), hence providing clues to how the professional learning activity may be transformed. Table 1 shows the research framework summarizing the phenomenon studied, the methodological approach, and the methods used to generate and analyze data.

Table 1
The Research Framework

Phenomenon Studied: Teacher learning practices during Lesson Study		
Methodological Approach: Cultural-Historical Activity theory		
Data Collection: • Naturalistic inquiry of teachers in a PLT participating in Lesson Study • Collection of video data, interview data, and artifacts	Data Preparation: • Video content logging • Interim analysis • Identification of excerpts for detailed transcription and analysis	Data Analysis: Leontyev's (2009) three planes of abstraction through the examination of • Discourse • Learning practices • Activity systems

3.1 Data Collection

Since the examination of interactions among teachers forms an integral part of the research, ethnographic tools such as participant observation in a naturalistic setting, immersion in the field, and the collection of a range of data (Gordon, Holland, & Lahelma, 2001) were employed. Data were collected over one academic year in a co-educational elementary school that embarked on organizing itself as a PLC. The school comprised about 90 teachers, and 2000 students in Grade One through Six. The teachers were grouped into PLTs according to the grade level(s) they taught and they were provided with weekly one-hour PLT meeting slots within curriculum time that they used for joint professional learning activities. The research participants were nine teachers working together in a PLT of teachers teaching students in Grade Four (see Table 2). The weekly PLT meetings were video-recorded and field notes were taken during the meetings as a record of observations. The

data were supplemented with interviews with the teachers, and artifacts they generated for PLT meetings (e.g., notes of meetings, lesson plans, written reflections).

Table 2
Profile of Teachers in the PLT that was Studied

Teacher (Pseudonym)	Teaching experience (At time of interview)	Main role in PLT
Zain	8 years	PLT leader
Jane	2 years	Lesson study facilitator
Ying	15 years	Member
Faye	12 years	Book study facilitator (Semester 1)
Miss Hu	28 years	Book study facilitator (Semester 2)
Luke	5 years	Lesson study facilitator
Siti	2 years	Member
Alice	9 years	Member
Nora	18 years	Member

3.2 Data Preparation

Data preparation was carried out to convert the video and audio data collected into textual data to facilitate interim analysis (Miles & Huberman, 1994). The first stage of data preparation involved the viewing of video recordings of the PLT meetings from beginning to end in a continuous sitting whenever possible to generate video logs, which were then cross-referenced to the field notes. The second stage involved summarizing the key content of all PLT meetings related to the activity of Lesson Study during the academic year, to provide an overview of the teachers' enactment of Lesson Study. The third stage involved the detailed transcription and the identification of discourse excerpts for further in-depth analysis. The discourse excerpts were chosen because they contained interactional hot spots (Jordan & Henderson, 1995) marked by contextualisation cues (Gumperz, 1982) in the form of shifts in intonation and speech volume (e.g., raising one's voice, speaking in an excited manner), which signal the unfolding of a "more intense (and probably more important) part of the interaction" (Konzett, 2012, p. 33).

3.3 Data Analysis

The approach taken for data analysis was based on Leontyev's (2009) three planes of abstraction – operation, action, and activity. According to Leontyev, an activity exists as a combination of actions oriented towards specific goals, and each action is accomplished by automatic operations which depend on the conditions. The planes of abstraction could be characterized according to timescale because an activity is a long-term formation composed of short-term processes in the form of actions which in turn consist of operations (Kuutti, 1996). In this research, the operation plane of abstraction was used to characterize fleeting moments of discursive interaction among teachers, the action plane of abstraction was used to characterize teachers' learning practices which are habitual social ways of doing that link two or more moments of interaction over time, and the activity plane of abstraction was used to characterize the Lesson Study activity as a whole which the PLT collaboratively planned for and carried out over the period of the academic year (Table 3).

Table 3
The Data Analysis Approach According to Leontyev's Planes of Abstraction

Plane of abstraction	Focus	Method	Guiding principles or schemes
Operation	Teachers' discursive interactions	Analysis of discursive interactions in each discourse excerpt	• Discourse surrounding use of student-learning data (Nelson, Slavit, & Deuel, 2012) • Discursive disturbances (Engeström, 2008)
Action	Teachers' learning practices	Analysis of patterns across discourse excerpts	• Principles of commonality, differences, relationship (Gibson & Brown, 2009)
Activity	Professional learning activity	Analysis of the activity system as a whole	• Activity systems analysis (Engeström & Sannino, 2010; Mwanza, 2001; Yamagata-Lynch, 2010)

The aim of carrying out the data analysis at three planes of abstraction is to reveal interrelationships among discourse, learning practices, and the activity of Lesson Study as a whole. Firstly, separate discursive interactions can be brought into relation to reveal practices. Secondly, separate practices can be brought into relation to reveal practices in Lesson Study that afforded teacher learning, and seemingly separate disturbances can be brought into relation to reveal underlying systemic contradictions in the activity as a whole.

3.3.1 Data Analysis at the Plane of Operation

Data analysis at the plane of operation focused on a study of teachers' discursive interactions, guided by the framework developed by Nelson and Slavit (2010) for studying teachers' interactions when working with student learning data. This framework was chosen because, in Lesson Study, the collection and analysis of concrete evidence of student learning are essential to generating questions about classroom practices, and designing lessons that address the questions (Fernandez, Cannon, & Chokshi, 2003). The framework describes the overall nature of teachers' dialogic interactions revolving around student learning data as a continuum that is based on the level of negotiation that takes place when cognitive conflicts arise. Negotiation involves the building upon of others' verbal contributions and actions, making explicit or implicit efforts to elicit and understand each other's ideas and values.

Dialogic interactions may be categorized as *inquiry-based talk* (sustained negotiation), *exploratory talk* (emergent negotiation), *connected talk* (weak negotiation), and *disconnected talk* (no negotiation). The strongest kind of negotiative talk is inquiry-based talk: talk characterized by expressions of wonder or uncertainty that motivate sustained efforts in the questioning of practices, beliefs, and knowledge in order to achieve shared understanding and generation of knowledge. The conversations are analytic in nature as the posing of probing, clarifying and critical questions are common-place, thus inviting the

making of inferences, predictions, and challenges. The next category of negotiative talk is exploratory talk that shows both collegiality and congeniality. Collegiality refers to a culture in which teachers feel comfortable publicly and critically examining their practices and underlying values. Congeniality refers to a culture in which teachers avoid cognitive conflict to preserve interpersonal relationships. Exploratory talk has both descriptive and analytic elements; while the questions posed tend to be more probing or clarifying than of being procedural and logistical, the questions are not pursued as deeply as they are in inquiry-based talk. Connected talk is the weakest kind of negotiative talk. It tends to be descriptive and task-oriented and involves the presentation of ideas that are authoritative in nature, or questions that elicit details that are logistical, procedural, or technical in nature. The conversation turns are related to one another but the content of the talk tends to comprise short sequences related to the completion of a task or reporting on activity. Connected talk often features a wide range of topics as ideas and questions are seldom pursued, and student learning data are seldom critically examined. Finally, non-negotiative talk or disconnected talk is characterized by interactions where teachers do not build on others' statements resulting in talk that is disconnected across conversational turns. Conversations may be superficially connected through the sharing of related aspects but there is a lack of substantive building-on of one another's contributions. Questions that occur tend to be technical or procedural, rather than serve to probe or clarify perspectives, interpretations or assertions expressed in previous turns of talk. In this research, teacher learning in a PLT is viewed as the process by which teachers participate in shared meaning-making about interrelationships between learning and teaching, as teachers engage in teacher learning activities with the purpose of enhancing their teaching practices to better facilitate students' learning. Hence, the presence of negotiative talk is an indicator of teacher learning practices that afford professional learning.

The discourse data were also analyzed for discursive disturbances indicated by deviations from the normal course of events in the work process defined by plans, explicit rules, and instructions, or tacitly assumed traditions (Engeström, 2008), and by non-negotiative or disconnected talk as described by Nelson and Slavit (2010).

3.3.2 Data Analysis at the Plane of Action

Data analysis at the plane of action examined practices that the teachers enacted, shown in repeated patterns in actions and interactions over time while carrying out Lesson Study. Since practices are habitual social ways of doing that unfold over time and space and are created and sustained through discursive interactions (Reckwitz, 2002; Rex et al., 2006; Schatzki, 1996), the discourse excerpts were examined across time to identify practices that brought about affordances or disturbances to teacher learning. This was done by reading and re-reading the discourse excerpts and their associated analyses to collate the essence of each discourse excerpt in two time-ordered matrices (Miles & Huberman, 1994), one for learning practices that afforded teacher learning, and the other for learning practices that led to disturbances. The process involved the identification of commonality, differences, and relationships through the use of thematic analysis (Gibson & Brown, 2009). Examining commonality involved looking for similarities across interactions over time that suggest the presence of practices. Examining differences involved looking for features to distinguish among practices. Examining relationships involved examining the relationships among the practices.

Thematic analysis (Gibson & Brown, 2009) of the disturbances was carried out to identify underlying systemic contradictions, which refer to "historically accumulating structural tensions within and between activity systems" (Engeström, 2001, p. 137) that provide clues to how an activity system as a whole may be changed and further developed

(Engeström, 1999). The disturbances observed were then organized into a time-ordered matrix (Miles & Huberman, 1994).

3.3.3 Data Analysis at the Plane of Activity

At the plane of activity, activity systems analysis (Yamagata-Lynch, 2010) was used to analyze the Lesson Study activity as a whole. Pioneered by Engeström (1987), activity systems analysis examines the multifaceted nature of the activity and the interrelationships among the components (subject, object, instruments, outcome, community, division of labor, and rules) that constitute the activity. The components of the Lesson Study activity were identified and explicated with reference to the guiding questions summarized in Table 4. The use of activity systems analysis provides the means for extracting the essence of complex data sets from real-world settings and presenting them in triangle models that communicate interrelationships as well as reveal systemic implications (Yamagata-Lynch, 2010).

Table 4
Guiding Questions for Explicating the Components of the Human Activity Triangle

Component	Guiding questions adapted from Mwanza (2001, p. 345) and Engeström and Sannino (2010, p. 6)
Subject	Who is the individual or subgroup carrying out this activity?
Object	Why is this activity taking place?
Instruments	By what means (tools and signs) is the subject carrying out this activity?
Outcome	What is the desired outcome from carrying out this activity?
Community	What is the environment in which this activity is carried out? Who are the individuals and subgroups who share the same object?
Division of labor	Who is responsible for what, when carrying out this activity and how are the roles organized? What are the horizontal division of tasks and vertical division of power and status?
Rules	What are the explicit and implicit regulations, cultural norms, conventions, standards, rules or regulations that constrain actions within the activity or that govern the performance of this activity?

3.3.4 Trustworthiness

As this research was qualitative in nature, its trustworthiness was checked in terms of the criteria for credibility and dependability, which parallel notions of validity and reliability (Guba, 1981). Credibility has to do with how the researcher establishes confidence in the plausibility of the research findings based on how the research was designed. A strategy used to establish credibility is the *prolonged engagement at the research site* through the observation and video recording of weekly PLT meetings over the course of one academic year. The strategy of *referential adequacy materials* was also employed through the collection of artifacts (e.g., documents shared during PLT meetings and notes of meeting), which were referenced when certain observations from the video data need corroboration. *Member check*, another strategy for attaining credibility, was used. The teachers were invited to verify notes taken during individual interviews to check whether their views had been faithfully represented. The strategy of *peer debriefing* was also used where feedback and critique were sought from fellow researchers who were also engaged in research on teacher learning.

Dependability is concerned with the stability of data in the sense that similar results could be obtained through the use of different methods. One strategy used was the *overlap method*, a variation of triangulation (Denzin, 2009), carried out by collecting data from multiple sources (e.g., PLT meetings, individual interviews, documents). In addition, between-method triangulation was used in terms of using methods employed in activity systems analysis as well as methods employed in sociolinguistics in the study of discourse. The establishment of an *audit trail* was also employed by documenting and archiving field notes, video logs and interview notes annotated with reflections.

4. Results

To provide a broad context for the results, we start by presenting an overview of the PLT's enactment of Lesson Study. The PLT approached Lesson Study in line with the process described by Murata, Lewis, and Perry (2004): (1) consider goals for student learning and development, (2) study existing instructional materials, (3) plan a lesson in line with the goals, (4) have one team member teach the lesson while others observe, (5) hold a colloquium of the lesson, (6) revise the lesson for teaching by a different research teacher in another class, and (7) hold a second colloquium to discuss the research lesson.

The teachers enacted two Lesson Study Cycles, summarized in Table 5. The first cycle was carried out for a mathematics topic while the second cycle was carried out for a science topic. In the first cycle, the teachers carried out a Lesson Study on their students' understanding of the mathematical concept of fraction-of-a-set, and the drawing of bar models to solve word problems. The teachers chose these aspects as they had noticed that students often struggled with the use of bar models to represent the information in word problems involving fractions. In the second cycle, the focus was on students' conceptions of magnetism. During the research lesson, students were given a few unknown objects and were asked to identify which was a magnet, which was made of magnetic material, and which was made of non-magnetic material. The teachers chose this concept as they had noticed that students had difficulties differentiating between magnets and objects made of magnetic materials.

Table 5

Summary of Lesson Study Sessions

Lesson Study Cycle	Session, Date, Approximate Duration	Main content of discourse	Discourse excerpts
Cycle 1 (Mathematics)	1st Session 22 Mar 19 min	Planning for Cycle 1 Research Lesson: • Timing of the Lesson Study cycles • Objectives for the Lesson Study • Areas of student learning to observe (e.g., drawing of models)	DE1, DE11
	2nd Session 29 Mar 17 min	Planning for Cycle 1 Research Lesson: • Overview of the lesson plan • Overview of presentation slides to decide on the choice of illustrative exercises and practice exercises	DE4, DE14
	3rd Session 5 Apr 5 min	Planning for Cycle 1 Research Lesson: • Timing of the research lesson	-
	4th Session 19 Apr 42 min	Colloquium for Cycle 1 Research Lesson held on 14 Apr: • A reminder of colloquium ground rules • Sharing of observations and discussion of possible reasons for difficulties faced by the students	DE5, DE6, DE12, DE18
	5th Session 17 May 38 min	Colloquium for Cycle 1 Research Lesson held on 26 Apr: • A reminder of colloquium ground rules • Sharing of observations and discussion of possible reasons for difficulties faced by the students • Sharing of observations by the Principal	DE7, DE15
Cycle 2 (Science)	6th Session 19 July 4 min	Planning for Cycle 2 Research Lesson: • Clarification on who should help plan the Science lesson • Discussion on the timing of the research lesson	DE2
	7th Session 26 July 15 min	Planning for Cycle 2 Research Lesson: • Overview of the lesson plan idea and which misconception to address • Choice of class for the research lesson • Possible dates/times for research lesson and colloquium	DE13
	8th Session 25 Aug 51 min	Colloquium for Cycle 2 Research Lesson held on 16 Aug: • Sharing of how Lesson Study may be conducted • Discussion on how group work among students should be structured	DE3, DE8, DE19
	9th Session 13 Sep 51 min	Colloquium for Cycle 2 Research Lesson held on 30 Aug: • A reminder of colloquium ground rules • Sharing of observations by teachers and discussions	DE9, DE10, DE16, DE17

Of the total of 1285 minutes of video-data collected during the weekly PLT meetings that took place over the academic year, 242 minutes were spent on discussions related to Lesson Study. The amount of meeting time spent on Lesson Study ranged from 5 minutes to 51 minutes. On the whole, more time was spent on colloquia than on discussions pertaining

to the planning of research lessons. This could partly be due to "backstage work", referring to activities that took place between the formal stages of Lesson Study but were hidden from public view (Bruce & Ladky, 2011, p. 243). The backstage work was undertaken by team members who met outside the weekly time-tabled PLT meeting slots to discuss the research lessons before presenting them to the rest of the PLT during the meetings. Through the different levels of data analyses, a total of 19 discourse excerpts (DE1 to DE 19) emerged that illustrated teacher learning practices, which either provided affordances to teacher learning or produced disturbances to teacher learning.

4.1 Data Analysis at the Plane of Operation

This section presents two examples of how data analysis was carried out at the plane of operation to study teachers' discursive interactions for two of the 19 discourse excerpts. The first example is an analysis of DE8 (Interaction Sequence 1) from the colloquium of a Cycle 2 science research lesson on magnets and magnetic materials. In the excerpt, the teachers discussed students' talk surrounding a concept cartoon (Figure 1) used to elicit information about students' pre-conceptions about magnets magnetic materials.

Interaction Sequence 1

From DE8 during the Cycle 2 (Science) Colloquium Session Held on 25 Aug

482	Jane:	…she said, "discuss". But NOBODY DISCUSSED!
483	Olive:	Yah.
484	Luke:	You see, that's why I think they are afraid of making mistakes, you see, they don't want to talk.
485	Ying:	Or maybe they are not guided as to what to discuss. It's like, "What do you want me to say?" you know?
486	Siti:	But they are used to concept cartoons, the whole setting already.
487	Teachers:	((Brief overlapping talk as teachers excitedly joined in discussion))
488	Ying:	But I think, you know, you can always role play this concept.
489	Jane:	Yah.
490	Ying:	While flashing it, you can have someone- "You are this person"
491	Jane:	Call people to come (forward)
492	Ying:	Say, read out the thing, then after that, I think prompters need to be there, more prompters: "So what do you think? Do you think that Amelia is correct? Do you think what she said about magnets is correct?" So these are some of the prompters that help them to think further …
		[…]
500	Jane:	I don't know whether group work will excite this class or not, because sometimes I will challenge my class. Like, "Okay, is Amelia right or wrong? Okay, write in your whiteboard, then flash straight away", so there's competition.
501	Luke:	So actually you see, maybe whiteboard is a good thing, write down- "How many of you think that A is correct? Write down your answer."
502	Jane:	"True or false"
503	Luke:	Okay, "Write down then explain why".
504	Jane:	Okay, then give them one point.
505	Luke:	Maybe they have something to work on, why don't we just let them discuss, you know? You get what I mean? At least they have something to write down. They've no choice, they have to write down, and then they have to flash the answer. Because sometimes, it is very hard to discuss, you know? They don't talk, it's better to write down, so at least there's something to show. "Okay 1, 2, 3 everyone show" Okay then you can see, you see? Because when she tells them to discuss, then asks them for their answers, we cannot really see whether they know or not.
506	Ying:	So they can make their prediction on the task card.
507	Luke:	Yah
508	Ying:	Then put the task card aside, because, at the end, you have one ( )
509	Jane:	So, they can have the task card ((simulates writing on a task card)), A, B, Amelia, whoever, whoever. So, true or false? T? False, true, false. "So, okay, discuss with your friends, okay, each person has to decide", perhaps, then after that "flash" ((simulates showing answers written on a task card)). "Okay, now you keep your task card, then later, everyone will get to see whether they are correct or not."

The teachers noted that even though the research lesson teacher had asked the students to discuss the concept cartoon, the students remained quiet. Luke attributed the lack of discussion to the students' refusal to talk due to fear of making mistakes (turn 484). Ying, however, felt that it was because insufficient guidance was provided (turn 485) and wondered

whether asking the students to role-play the concept cartoon (turn 488) and providing more prompting questions (turn 492) would help. Jane and Luke felt that it would help to engage the students in discussion by letting them write their thoughts onto their mini-whiteboards or task cards and showing them to the teacher (turns 500 – 505). Their idea was further developed when Ying and Jane suggested that after the students have written their "predictions" on their mini-whiteboards (turn 506), they could discuss them with their group members, then put them aside and revisit them at the end of the lesson as a consolidation activity, to find out whether their evaluations of the utterances in the concept cartoon were right or wrong (turn 509). In turns 492, and 500 – 505, the teachers made use of teaching rehearsals (Horn, 2010) to simulate different verbal instructions that the research teacher could provide to the students.

There was an animated exchange among the teachers as they engaged in a collaborative discussion on how the activity could be improved upon. The research lesson that they had experienced provided them with a shared context in which to interpret their observations and to suggest improvements to the lesson.

DE8 shows features of exploratory talk where the teachers progressively built on one another's observations and ideas to improve the original concept-cartoon activity. It shows a nuanced stance among the teachers because the proposed changes were based on observations they made during the research lesson. This provided valuable opportunities for teacher learning as it made public the considerations that went into the decision-making process behind the design of classroom learning activities.

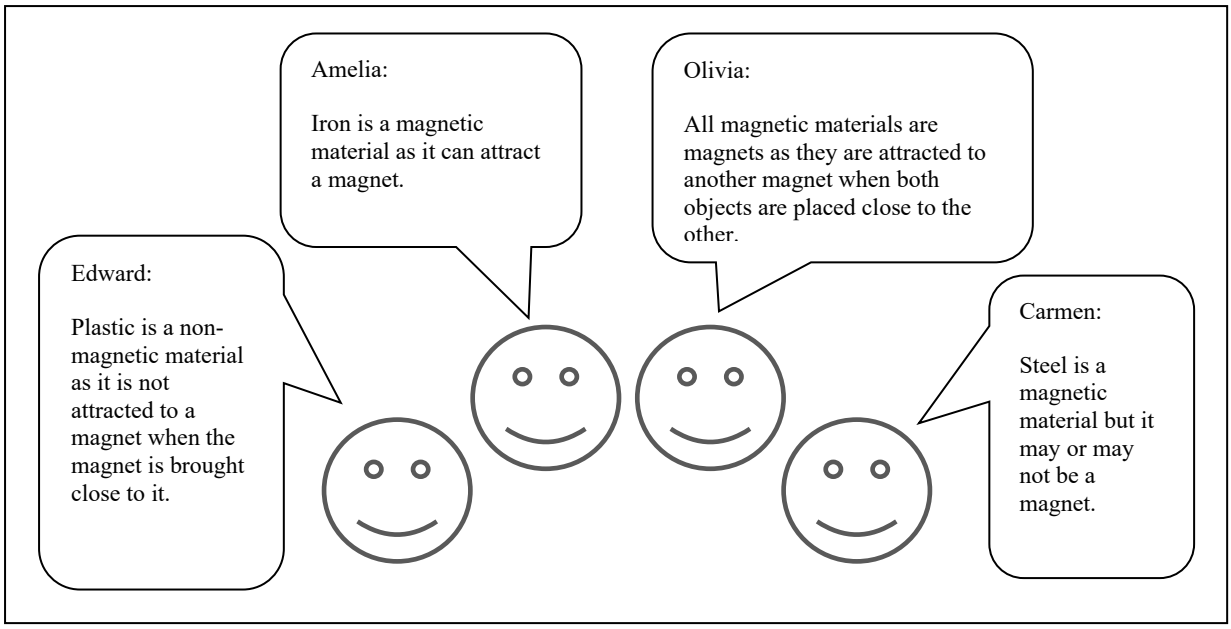

Figure 1. Concept cartoon used in the science research lesson.

The second example is an analysis of DE12 (Interaction Sequence 2) from Cycle 1 colloquium of a mathematics research lesson on fractions. At the beginning of the excerpt, Ms Hu shared that she noticed three types of problems presented during the research lesson. The group then went on to summarize the four types of fraction-of-a-set word problems presented to the students: (1) given the whole, find the parts; (2) given the parts, find the whole; (3) given a part, find another part; and (4) given numbers, pose a fraction-of-a-set word problem (turns 323 – 328). Luke pointed out that instead of identifying types of problems, it would be better to teach students the steps for solving the problems (turns 334 and 336). However, Ms Hu felt that teachers should know the types of word problems (turns 335 and 337) so that they could draw students' attention to certain features of the problems. However, instead of seeking to come to an agreement of the changes that would need to be made for the second research lesson to directly address the problems identified in the first research lesson, the teachers' attention quickly shifted to logistical matters related to the scheduling of the second research lesson (turns 338-345). The focus on logistical issues could be because the PLT meeting was the only time when all the teachers could be present

together to agree upon and to coordinate a myriad of details related to the choice of class, choice of research teacher, and timing of the research lesson.

Interaction Sequence 2

From DE12 during the Cycle 1 (Mathematics) Colloquium Session Held on 19 Apr

323	Ms Hu:	…Because we want to see the concept part. Looks like the Type 1, Type 2, Type 3, there are three different things. One is: they give you the whole, you find the parts. Another one is: they give you the part, you find the whole. The third one?
324	Zain:	Part, and then the other part.
325	Kee:	They pose the problem, using the numbers that are given
326	Luke:	Using those variables.
327	Ms Hu:	So, those are the main concepts, you see? Yah, your concepts are there. So the child must know. "Am I given whole or am I given part? Am I supposed to find whole or am I supposed to find part? What is it that I'm supposed to find?"
328	Kee	Yes.
329	Ms Hu:	So those are the concepts that the child must know. Then, your drawing will be=
330	Zain:	=That's just the basic, you know?
331	Ms Hu:	Yah.
332	Zain:	What (they test in) the exam is Type 3, Type 4.
333	Ms Hu:	Type 3, do they know? Are they supposed to know (Type 4 now)?
334	Luke:	It doesn't- They cannot memorize what is the type, whatever=
335	Ms Hu:	=Yah, I know. But the teacher must know=
336	Luke:	=They must learn to draw slowly, and interpret sentence by sentence and come up with a pictorial drawing. And then from the use of the pictorial drawing to help them in their working.
337	Ms Hu:	You see, the teacher must know. Because if the teacher knows, then the teacher may point out these things. Say, "350 is what? It's the whole thing", you know? So, as a teacher, I must know, what am I supposed to be teaching here. You know what I mean?
338	Luke:	So, we will use 4D. But where is- Who is 4D's Mother Tongue teacher?
339	Jane:	It's the, the-
340	Ms Hu:	Eh? Is it Mother Tongue (period)?
341	Jane:	Now, huh? Who has the timetable?
342	Ms Hu:	Yah, this time.
343	Kee:	Mine is PE lesson.
344	Ms Hu:	Yours. PE lesson?
345	Jane:	((Claps her hands)) No, they are having PE lesson cos I just came from that class. They had PE before that.

4.2 Data Analysis at the Plane of Action

A thematic analysis of the discourse excerpts revealed repeated patterns in interactions that can be associated with learning practices that afforded teacher learning. Learning practices in Lesson Study that provided affordances to teacher learning included *collegial questioning and critique*, *rehearsal of stimulus activities*, *multimodal representation and juxtaposition of students' work*, *collaborative improvement of lesson activities*, and *simultaneous attention to student learning and teacher learning*. Table 6 shows a summary

of the practices that afforded teacher learning and the excerpts that evidenced the presence of the practices.

That the teachers questioned assumptions and candidly shared concerns suggested the presence of *collegial questioning and critique* as opposed to an over-emphasis on the maintenance of harmony within a group (Hargreaves, 2003; Janis, 1972). Such a learning practice suggests a culture in which teachers feel comfortable enough to publicly and critically examine their practices and underlying values (Nelson, Slavit, & Deuel, 2012).

The teachers practiced *rehearsal of stimulus activities* when they needed to narrate and act out anticipated classroom interaction that could take place when presenting certain key tasks or problems to students during lessons. Such rehearsals enabled the teachers to conduct task analyses of stimulus activities to review the pre-requisite skills that students would need to successfully complete the activities, and to identify pitfalls that might prevent students from doing so.

Multimodal representation of students' work refers to teachers' use of verbal descriptions, writings, drawings, and photographs to represent students' written work, dialogue, and actions. It was observed that the multimodal representation of the students' work helped the teachers to identify recurrent patterns of problems faced by different students, as well as to converge on the crucial ideas that repeatedly presented difficulties to the students. An example of the *juxtaposition of students' work* is the comparison of how different students approached the solving of a particular problem. Through the use of multimodal representations and juxtaposition of students' work, the teachers identified various interpretations held by students and categorized different types of errors that students made when solving problems, which helped them to formulate follow-up strategies to help the students.

Table 6

Time-ordered Matrix Summarizing Affordances and Types of Talk Observed

Affordance	Planning of Cycle 1 Research Lesson (Mathematics)	Colloquia of Cycle 1 Research Lesson (Mathematics)	Planning of Cycle 2 Research Lesson (Science)	Colloquia of Cycle 2 Research Lesson (Science)
Affordance 1: Collegial questioning and critique	Questioning of assumptions in DE1 (Exploratory talk)		Candid sharing of concerns in DE2 (Connected talk)	
Affordance 2: Rehearsal of stimulus activities	Rehearsing stimulus activity planned in DE4 (Exploratory talk)			Rehearsing alternatives to planned activity in DE8 (Exploratory talk)
Affordance 3: Multimodal representation and juxtaposition of students' work		Looking at scripts showing students' work in DE5 (Exploratory talk) Looking at photographs of students' work in DE6 (Connected talk) Comparing different methods in students' solutions in DE7 (Connected talk)		
Affordance 4: Collaborative improvement of lesson activities				Building upon others' suggestions in DE8 (Exploratory talk) Sharing of alternative scaffolds in DE10 (Inquiry-based talk)
Affordance 5: Simultaneous attention to student learning and teacher learning				Differentiating students' learning outcomes from teachers' learning goals in DE3 (Exploratory talk) Comparing ways of recording observations of students' learning in DE9 (Exploratory talk)

Collaborative improvement of lesson activities refers to the teachers' progressive building-upon of one another's observations and ideas to improve a lesson while discussing observations and sharing possible speculations underlying the observations.

That the teachers were mindful of their professional learning goals, and not just the students' learning goals, during research lessons and the considerations they gave to the recording of their observations suggest the presence of the practice *simultaneous attention to student learning and teacher learning.* It refers to how the Lesson Study process allowed teachers to address the needs for student learning while enabling them to also address their own professional learning needs. This practice can help teachers to approach Lesson Study as a means of collaborative inquiry so that they are more explicit in identifying what they wish to *learn* about students' learning and inquire into during a research lesson, as opposed to simply thinking of what they wish to *teach* during the research lesson. Such a stance is possible because, in Lesson Study, the classroom is deemed to be simultaneously the site for students learning as well as for professional learning. Hence, Lesson Study provides opportunities for teachers to consider both their students' learning and their own professional learning.

What appeared to be particularly beneficial in Lesson Study to teacher learning is the use of student-learning data. The teachers generally felt that being able to closely observe a group of students and to listen in on their discussions during a research lesson provided them with valuable insights.

Taken as a whole, the overarching learning practice in Lesson Study that afforded teacher learning was the *evidence-based examination of pedagogy through collective inquiry of classroom practice*. By engaging in the collaborative planning of research lessons, the collection of student-learning data during the research lessons, and the discussion of the

student-learning data during the colloquia, the teachers partook in the collective inquiry of their classroom practices that contributed to their professional learning.

A thematic analysis of the discourse excerpts also revealed repeated patterns in interactions that can be associated with practices that led to disturbances in teacher learning. Learning practices that produced disturbances to teacher learning in the context of Lesson Study were *focus on logistical issues*, *rushed discussions*, and *struggles in note-taking*. Table 7 summarizes the disturbances and the segments in the excerpts that illustrated the disturbances observed in the Lesson Study activity system.

Table 7
Time-ordered Matrix Summarizing Disturbances Observed

Disturbance	Planning of Cycle 1 Research Lesson (Mathematics)	Colloquia of Cycle 1 Research Lesson (Mathematics)	Planning of Cycle 2 Research Lesson (Science)	Colloquia of Cycle 2 Research Lesson (Science)
Disturbance 1: Focus on logistical issues	Scheduling of research lesson in DE11	Choice of class for research lesson in DE12	Scheduling of colloquium in DE13	
Disturbance 2: Rushed discussions	Limited participation in collaborative planning in DE14	Brief sharing of students' work in DE15		Key distinguishing concepts identified but not discussed in DE16 Need to leave the meeting to attend to other responsibilities in DE17
Disturbance 3: Struggles in note-taking		Questioning whether certain comments should be recorded in DE18		Discussing how colloquia notes should be recorded in DE19

Focus on logistical issues refers to the attention paid by teachers to logistical arrangements such as the scheduling of research lessons that often required changes to the teachers' and students' timetables. Such focus often led to less time being spent on consolidating the team's professional learning, hence bringing about disturbances to teacher learning.

Rushed discussions were observed in situations such as when in-depth inquiry could not be pursued due to the need to proceed to other items in the meeting agenda, the need to provide everyone with the opportunity to share their observations during colloquia, and the need to end meetings early to attend to other responsibilities.

Rushed discussions were observed during the research lesson planning stage even though collaborative lesson planning is a crucial stage in Lesson Study. For Lesson Study to be effective and successful, sufficient time is needed to engage adequately in *kyozaikenkyu*, the intentional investigation of instructional materials to develop an in-depth understanding of the content to be taught, and the study of students' anticipated responses (Yoshida & Jackson, 2011). To work around the issue of time, the teachers worked in smaller groups outside PLT meeting times to prepare plans that they then presented during PLT meetings. However, such preliminary discussions resulted in some decisions being made prior to the PLT meetings, leading to fewer opportunities for other teachers to be involved in negotiative conversations during PLT meetings that could contribute further to the team's professional learning.

Rushed discussions were also observed during colloquia. For example, during a colloquium for the mathematics research lesson, students' worksheets brought to the meeting could only be shown cursorily even though the student learning data contained could potentially shed light on students' difficulties. At times, student-learning data were analyzed in terms of the students' abilities (e.g., whether they could or could not solve a problem), and the opportunity for examining nuances in students' mistakes was not taken up. Likewise, for the science research lesson, even though there were points in the conversations when teachers highlighted concepts that were central to the topic or pedagogical skill being discussed, the teachers were prevented from delving further into those aspects due to time constraints.

The recording of notes of meeting was one way that the school used to check how the school's strategic thrusts were cascaded and operationalized at all PLTs to maintain alignment between the school's overall strategic direction, and day-to-day decisions and actions by PLTs. To do this, a template was provided that required recorders of the notes of meeting to categorize discussion items according to the school's strategic thrusts. *Struggles in note-taking* were observed when the recorders taking notes expressed uncertainty about which strategic thrust a particular discussion topic should fall under, or about what should be recorded in the notes of meeting, leading to an interruption in the discussion.

4.3 Data Analysis at the Plane of Activity

The overall structure of the Lesson Study activity system enacted by the PLT, based on data collected through video recordings and field notes of the PLT meetings, and interviews with the teachers in the PLT with reference to the guiding questions in Table 4, is presented in Figure 2.

The teachers in the PLT are the *subject* of the Lesson Study activity system. The school had embarked on Lesson Study with the *object* of helping the teachers better understand how students learn and to build a culture of open classrooms where teachers would be comfortable experimenting with their teaching and observing one another's classroom teaching. The desired *outcome* of the teachers' professional learning was the improvement in teaching and learning in the classroom. The means (the *instruments*) for mediating the attainment of the object was the Lesson Study protocols together with resources such as lesson plans, and observation notes. The PLT's practices that afforded teacher learning during Lesson Study are also important aspects of the *instruments* as these goal-oriented actions are a means of helping the teachers attain the desired *outcome*. The *division of labor* is shown in how the different teachers worked together for the Lesson Study

activity. For example, two teachers designated as Lesson Study facilitators coordinated the team's efforts and worked with the Level Manager who oversaw administrative details pertaining to the organization and communication pertaining to all PLT meetings. *Rules* include guidelines and procedures, and implicit norms that shaped how the teachers communicated, interacted, and worked with one another in the functioning of the school (the *community*) as a whole. Examples of rules include PLT meeting norms related to the setting of agenda and recording of notes and the norms associated with how Lesson Study was carried out.

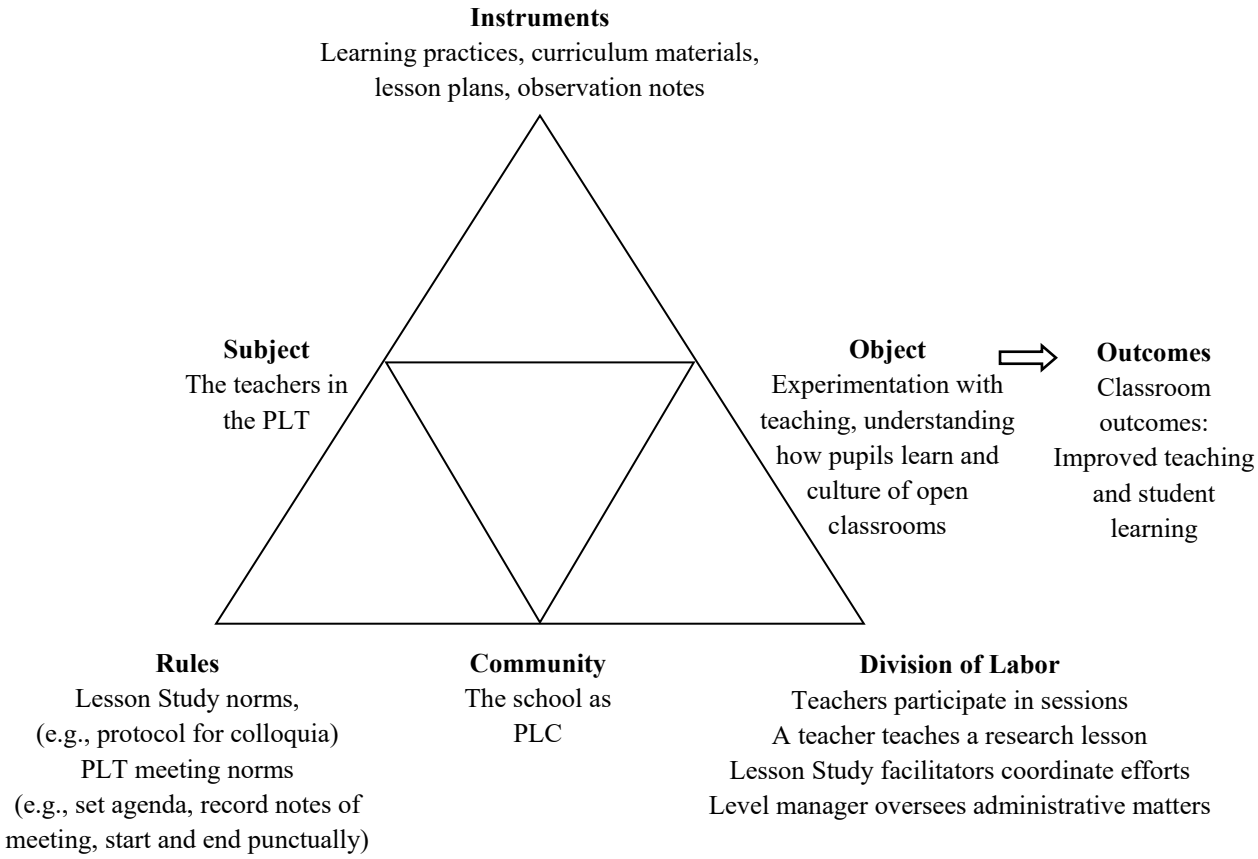

Figure 2. The structure of the Lesson Study activity system.

A study of the activity system as a whole reveals contradictions in the Lesson Study system that manifested as disturbances to teacher learning (see Figure 3). The disturbances may be traced to a quaternary contradiction and two secondary contradictions that affected the rules and object nodes of the Lesson Study activity system. A quaternary contradiction

refers to a tension between the Lesson Study activity system and neighboring activity systems that run in parallel with it, while a secondary contradiction refers to the tension arising between different nodes within the same activity system (Engeström; 1987).

Disturbances from the focus on logistical issues stemmed from the contradiction labeled "1" in Figure 3, a quaternary contradiction that indicates tensions between the Lesson Study activity system and neighboring activity systems such as co-curricular activities and remedial classes that take place after school hours. The Lesson Study activity system was closely intertwined with these neighboring activity systems because research lessons, an essential feature of Lesson Study, take place in the midst of the school's daily lessons and other activities. If research lessons were to be held during curriculum time, the PLT meeting slot would need to be used as it was the only common free time slot when the teachers in the PLT were released from teaching. In such a situation, swops in class periods for the chosen class would have to be made; the PLT would need to work with affected teachers, and they would also need to check the timings of school events to avoid conflicts in schedules. If research lessons were to be held outside curriculum time, the PLT would need to ensure that pupils' co-curricular activities and remedial lessons would not be affected. Moreover, the scheduling of research lessons needed to take into account the pace at which classes completed the learning of topics requisite to the research lessons. Hence, logistical issues related to the scheduling of research lessons and changes to time-tables often competed for the teachers' attention and took up much time during PLT meetings, often at the expense of discussions of pedagogical aspects.

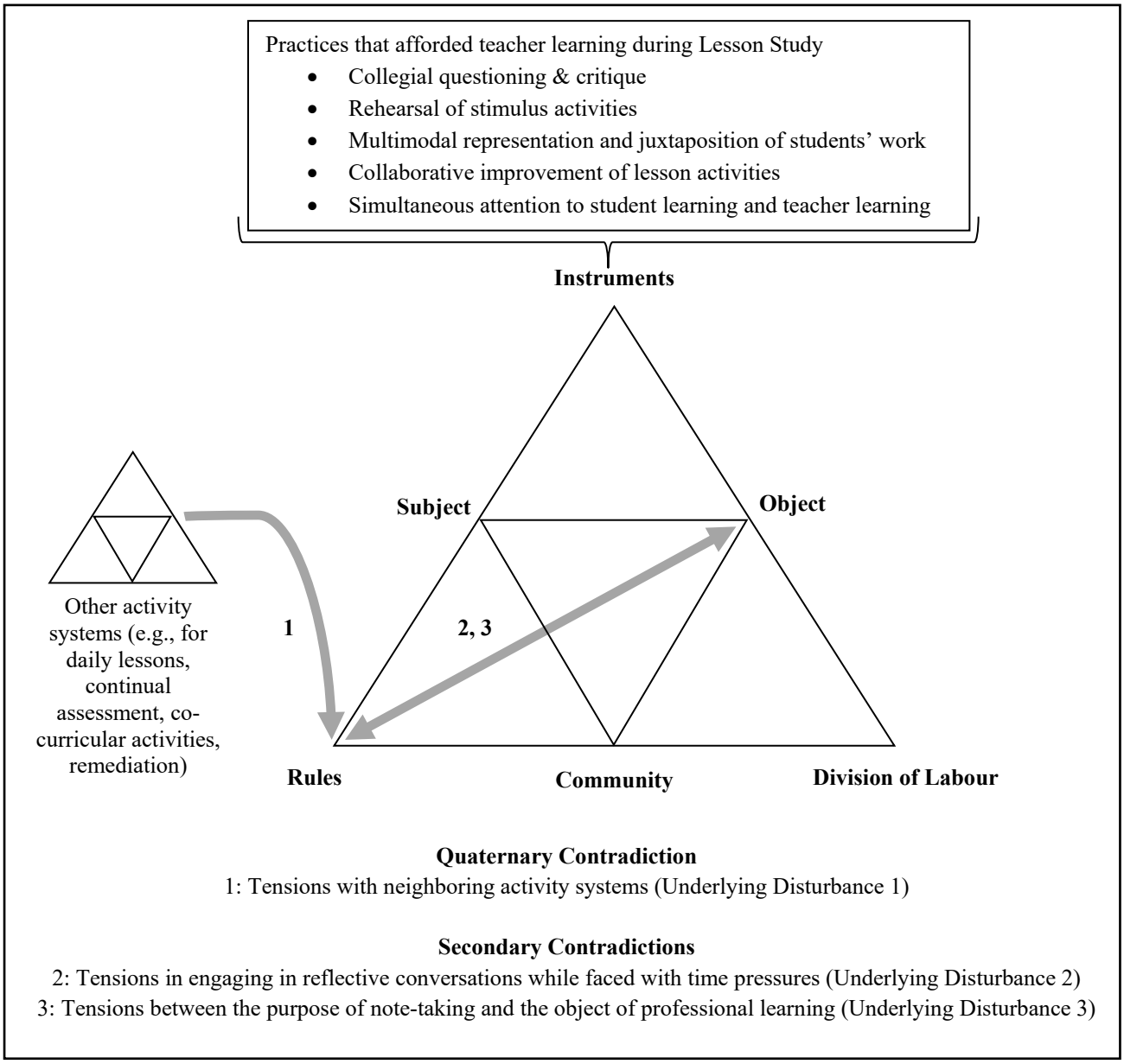

Figure 3. Affordances to teacher learning and contradictions underlying disturbances.

Disturbances from rushed discussions may be traced to the contradiction between the rules governing how the PLT works and the object of Lesson Study leading, labeled "2" (in Figure 3), which refers to tensions in engaging in reflective conversations while faced with time pressures. Time was a concern as there were only 60 minutes during a PLT meeting and teachers often needed to rush off to teach their respective classes or to attend to other responsibilities immediately after the meeting. Both the contradictions labelled "1" and "2"

are related to time issues. This finding is in line with interview data that show that the teachers felt that issues related to time often constrained their professional learning. Examples of time-related issues include time constraints, time spent on administrative or logistical details, the lack of time for focusing on professional learning, and the need to rush off after PLT meetings.

Disturbances related to *struggles in note-taking* may be traced to the contradiction labeled "3" (in Figure 3), which refers to tensions between the purpose of note-taking and the object of professional learning. This contradiction might have arisen because the way in which notes of meetings were taken was derived from organizational structures adopted by the school in the past. Prior to the year when the research was conducted when the school was yet to be organized as a PLC, the teachers were organized into administrative teams to enable the cascading of the school's strategic thrusts to daily school operations. The cascading of the school's strategic thrusts was monitored through the recording of meeting notes according to the school's strategic thrusts. Although the school was subsequently reorganized as a PLC and the teachers were grouped into PLTs, the approach of recording notes of meetings remained. The interview data indicate that the notes of meetings served as a means for the school to monitor whether time spent during PLT meetings focused more on professional development than on administrative matters.

5. Discussion of Implications

The contradictions inherent in the Lesson Study activity system provide clues to how professional learning of the PLT may be further enhanced because contradictions are "the precursors of development, as they put people in the position of having to change something in order to resolve the contradiction" (Engeström, 2001, p. 10). This section discusses the

implications of the contradictions identified in the Lesson Study activity system studied in this research.

The first contradiction related to the disturbances associated with a focus on logistical issues stemmed from tensions between the Lesson Study activity system and neighboring activity systems for the running of the school's programs (e.g., daily lessons, co-curricular activities, continual assessments, and staff meetings, etc.). The time-table sets the pace and timing for daily school activities for all school staff and students. Proposed changes to any teachers' or classes' timetables when scheduling a research lesson such that all PLT members may be present during the research lesson had to be carefully considered to avoid inconveniences to teachers outside the PLT. In addition, the scheduling of research lessons had to take into account the pace at which the students were progressing with regard to the school's scheme of work; Lesson study practitioners had noted that the scheduling of the teaching of research lessons are particularly challenging because a research lesson needs to be held in a class that has not yet gone past the particular place in the flow of the curriculum that is targeted (Stepanek, Appel, Leong, Mangan, & Mitchell, 2007). Hence, the teachers in the PLT spent much time going through logistical details pertaining to the scheduling of research lessons, and PLT meetings often ended with a discussion of logistics instead of consolidation of key professional learning points discussed. That Lesson Study research lessons could be scheduled and carried out despite all the constraints faced showed a commitment to the engagement in this form of school-based professional development by not just the PLT itself but by the entire school, as the other PLTs comprising teachers teaching at other grade levels in the school also engaged in Lesson Study. The teachers exercised autonomy when making tweaks to teachers' and classes' time-tables to make it possible for research lessons to take place.

The second contradiction related to the disturbances associated with rushed discussions is also related to time. It manifested in the dilemma between the need for engagement in thoughtful professional learning and having to quickly end discussions so that the teachers may move on to attending to other responsibilities. The contradiction shows competing demands on the teachers' time as they juggled their teaching responsibilities with their involvement in Lesson Study, which is an activity that requires substantial time and commitment (Rock & Wilson, 2005). The presence of these contradictions related to time echoes findings in Lesson Study literature; the key challenges found in the implementation of Lesson Study was the time needed for the iterative cycles, and constraints on time due to competing demands (Fang, Lee, & Syed Haron, 2009; Fang, Lee, Syed Haron, Wang, & Arasaratnam, 2009).

The third contradiction is a secondary contradiction related to tensions arising from possible mismatches between the purpose of note-taking and the object of professional learning in the Lesson Study activity system. The disturbances showed some teachers' discomfort when recording PLT meetings that centered on discussions about pedagogical challenges observed during Lesson Study using templates originally conceptualized to monitor the cascading of school strategic goals. The template used for the recording of notes was a vestige of organizational structures that existed prior to the school's re-organization of the teachers into PLTs. The presence of this contradiction suggests a need for the school to clarify the purpose of the recording of notes during PLT meetings, and how checking the alignment of PLT activities with the school's strategic thrusts helps the PLT attain the outcomes of improved teaching and student learning. These contradictions may be symptomatic of the challenges faced by the school in its journey of growing itself into a PLC committed to fostering teacher learning that in turn enhances student learning.

One possible means of resolving the contradictions is for the PLT to facilitate and document their discussions in ways that further strengthen their use of student learning data for Lesson Study. As talk plays a key role in the teacher-learning process, the PLT could adopt norms of principled discourse which refers to the articulation of teachers' beliefs and guiding principles behind their practices and curricular decisions to provide their peers with access to the teacher learning curriculum (Lieberman, 2009). Inquiring into student learning using classroom evidence and data, aspects that engaging in Lesson Study also involves, is an example of engaging in principled discourse. The teachers could focus on reflecting on student-learning data instead of merely reporting student-learning data during colloquia. For example, to focus and deepen conversations during colloquia, teachers could write their reflections immediately after research lessons as doing so would help them identify comments that would have the most impact on the team's professional learning and that hence should be shared during the colloquia, instead of reading off long lists of observations (Stepanek et al., 2007). To help teachers synthesize the observations and data shared to present a coherent picture of the students' learning experiences in each research lesson, the colloquium may be concluded through the provision of final comments that highlight the characteristics of the research lesson, and to put the observations in context of broader issues and big ideas related to teaching and learning (Murata, 2011). The provision of effective final commentary can help teachers to rise above the specific observations and data gathered to form habits of mind with regard to inquiring into the teaching and learning process. Such a focus on principled discourse could be accompanied by the documentation of colloquia discussions to reflect not just teachers' observations during research lessons, but also implications and decisions arising from the observations, and guiding principles for future practice. Note-taking done in this manner would go beyond reporting on discussions carried out during PLT meetings to articulating teacher learning points for future action.

Another possible means of resolving the contradictions is for teacher learning to be foregrounded for the teacher learning curriculum to be made more apparent. Teachers often view student learning as their key responsibility. However, with the advent of the PLC, teachers' responsibility in PLTs also encompasses teacher learning. The curriculum for student learning is often codified in documents such as the syllabus, the school's scheme of work, and lesson plans. In contrast, the curriculum for teacher learning is often emergent and less obvious compared to the curriculum for student learning (James, 2007). As a member of a PLT, a teacher needs to be cognizant of his/her own learning process as a learner of the disciplinary content, as well as the important role he or she plays in co-facilitating the professional learning of professional peers within the PLT. Every PLT member is simultaneously attending to both the goals pertaining to teacher learning as well as to student learning.

According to Alvesson (2013), organizational culture refers to a shared and learned system of common meanings, values, understandings, and symbols necessary for coordinated action such that the behavior, events, and processes in an organization are comprehensible and meaningful. In order for teachers to constantly keep the twin goals of student learning as well as teacher learning in view, there is a need to engage in school reculturing through the development of "values, norms, and attitudes that affect the core of the culture" (Huffman & Hipp, 2003, p. 15). School reculturing involves school leaders and teachers coming together to articulate a shared understanding of what professional learning is for them, what experiences foster teacher learning, and what the experiences look and sound like. Such a process of establishing a shared vision of teacher learning includes negotiation and articulation by the school community on the nature of professional learning activities, their purpose, and the epistemology underlying the design of the learning experiences offered to the teachers.

One key aspect of reculturing lies in the roles as perceived by teachers themselves. Teachers have traditionally seen themselves mainly as teachers in the classroom whose sole responsibility lies in facilitating the learning of their pupils. However, when a school establishes itself as a PLC, its teachers would need to take on the added responsibility of being a facilitator of their fellow teachers' learning. By being in a PLC, teachers are placed in positions where they need to be skilled not just in pedagogy to facilitate student learning, but in andragogy as well to facilitate teacher learning. Discussions about student learning will need to take on an educative dimension, which entails teachers reconceptualising their own professional learning as being engaged as "learners in the area that their students will learn in but at a level that is more suitable to their own learning" (Wilson & Berne, 1999, p. 194).

The adoption of Lesson Study involves reculturing that can be challenging. In order for teachers to assume the role of researcher to study their own practices, they need to "develop a disposition towards their practice that is grounded in a vision of teaching as a site for learning and of themselves as actively in charge of their ongoing learning process" (Fernandez et al., 2003, p. 182). Teachers need to know how to generate questions about classroom practices, design lessons that addressed their questions and collect and analyze concrete evidence to answer their questions.

Overall, a school that restructures itself as a PLC also needs to look into reculturing where core beliefs about the nature of teacher learning and student learning are examined. It involves helping teachers recognizing themselves as not just teachers of students but also as co-facilitators of their colleagues' learning and co-learners, as they approach teaching as a site for inquiry about student learning and for their own professional learning.

6. Conclusion

This research was undertaken with the purpose of contributing towards the body of knowledge with regard to the nature of learning practices enacted during professional learning activities, and how the practices shape teacher learning. Taking CHAT as the guiding methodological approach, the enactment of professional learning activities by a PLT during their weekly hour-long team meetings were examined to study learning practices that provided affordances to teacher learning, learning practices that produced disturbances to teacher learning, and what the disturbances reveal about underlying systemic contradictions. The scope of this research study has been limited to the study of the teachers in a PLT in a school that was in its beginning stages of establishing itself as a PLC. Researchers who wish to conduct future research of a similar nature could consider studying more than one PLT within the same school to uncover more nuanced insights that might have eluded the study of a single PLT.

In Lesson Study, the shared pedagogical context, use of student-learning data, and opportunities for teacher learning about student learning afforded the teachers' learning as a PLT. The evidence-based examination of pedagogy through collective inquiry of classroom practice through Lesson Study processes provided the teachers with opportunities to engage in a collaborative study of teaching materials, planning of research lessons, joint observation of research lessons, sharing of feedback during colloquia, and making further improvements. On the one hand, practices such (1) collegial questioning and critique, (2) rehearsal of stimulus activities, (3) multimodal representation and juxtaposition of students' work, (4) collaborative improvement of lesson activities, and (5) simultaneous attention to student learning and teacher learning provided affordances for teacher learning. On the other hand, practices such as (1) focus on logistical issues, (2) rushed discussions, and (3) struggles in note-taking led to disturbances in teacher learning. These disturbances were traced to

contradictions that impacted the object and rules nodes in the Lesson Study activity system. The contradictions suggest structural tensions arising from the complexity of conducting Lesson Study in parallel with closely related neighboring activities. They also suggest structural tensions from norms adopted in the past to monitor the cascading of school strategic thrusts and that may not be as well suited to the object of professional learning.

A discussion of the implications of the affordances, disturbances, and contradictions found revealed possible implications for the enhancement of professional learning. To help teachers recognize and take on the added responsibility of facilitating teacher learning, there is a need for the school community to articulate its vision of teacher learning. The foregrounding of teacher learning is essential so that the twin goals of teacher learning and student learning that are central to the work of a professional learning community, may be supported.

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