Do Teachers Change Their Practices While Participating in a Lesson Study?

Jo Clay Olson
University of Colorado at Denver and Health Sciences Centre
<jo olson@cudenver edu>

Lesson study describes a process that supports teacher collaboration and the implementation of reform pedagogy This study investigated whether teachers' practices changed while participating in a lesson study and sought to identify aspects of a lesson study that advanced this growth Analysis indicated that the discourse patterns of teachers who participated in a lesson study changed when they personalised an insight, suggesting that critical reflection is a catalyst for teachers' professional growth

Japanese teachers crafted research lessons to help them shift their teaching practices from telling to teaching for understanding (Lewis, 2000) Their process of creating, enacting, analysing, and refining a research lesson is described as a lesson study Lewis suggests that lesson study has the potential to support teachers' professional growth worldwide by creating a learning environment that encourages teachers to collaborate, engage in self- reflection, and analyse student learning According to Lokan, Ford, and Greenwood (1996), before student learning can increase, teachers need support and opportunities to create and develop more effective teaching practices

Research on lesson study indicates that as teachers collaborate, set goals, observe, and discuss lessons, they assume responsibility for their own learning and student achievement increased (Riggs & Barrett, 2004; Southwell & White, 2004; White, 2004) Zilliox and Fernandez (2004) found that most classroom teaching was an isolated practice where content and pedagogical decisions resided in the curriculum Lesson study was a mechanism that exposed teachers' beliefs and encouraged prospective elementary and secondary teachers to examine the effectiveness of their pedagogy As these teachers took turns teaching the lesson, they became more focused on allowing students space and time to investigate mathematical ideas and create justifications

Zilliox and Fernandex (2004) found that the cycles of revision created opportunities for teachers to gain insights about teaching and learning But, do teachers integrate these insights into their daily practices? Specifically, this study investigated whether changes occurred in teachers' practices while participating in a lesson study and sought to identify aspects of a lesson study that promoted sustained change

Theoretical Framework

Symbolic interactionism is a perspective from which researchers can interpret how interactions between people create meaning through observations, experiences, and words (Denzin, 1992) Knowledge grows out of interactions between people and it is the interplay between personal and social meanings that creates new ideas (Ernest, 1991) This knowledge is dynamic and changes as individuals create and reconstruct it When teachers change their pedagogy, their conception of mathematics and teaching also changes (Thompson, 1992) Boden (1990) found that changes in classroom discourse indicated a shift in a teacher's interpretation of reform mathematics Based on the perspective of symbolic interactionism, I created a methodology to investigate whether changes in teachers' pedagogy could be linked to the lesson study process The discourse between

teachers and between teachers and their students was analysed for new patterns of interaction

Methods

Ten elementary teachers joined a leadership institute to gain skills and knowledge to support mathematics reforms while participating in a three-year systemic change initiative These ten teachers unanimously selected lesson study as a form of professional development to support their own professional growth Three lesson-study groups formed along grade level bands during the fall (2001) to design lessons that exposed students' problem solving approaches for place value (first and second-grade teachers), money (third-grade teachers), and regrouping (fourth-grade teachers) problems

I believed that these areas were problematic for students because the teachers were unaware of how students intuitively made sense of problems If students' approaches were revealed, then teachers could plan instruction to build on their ideas Thus, I directed the lesson study groups to focus their attention on crafting a lesson that provided them with an opportunity to ask students questions to identify the point when a problem solving strategy led students to an erroneous solution Two frameworks, tasks' cognitive demand (Stein & Smith, 2000) and question types (Driscoll, 1999), were used to create problems and questions for a lesson that would allow students to articulate of their mathematical ideas

Participants

Five teachers volunteered to participate as case studies to investigate whether their teaching practices changed while participating in a lesson study The case-study teachers taught 1st through 4th grade and were experienced with 7 to 25 years of classroom teaching I assumed the role of a participant-researcher by organizing the leadership institute, assuming the role of a consultant during the lesson study, and observing the teachers in action

Data sources and Analysis

To investigate the interactions of teachers while participating in their lesson study group, three major data sources were collected over 6-months and continued after concluding the lesson study for 12 months These data sources included (a) field notes from monthly observations, (b) audio and videotape recordings, (c) teachers' reflections The data were collected to identify changes in teachers' practices These multiple data sources were used to provide triangulation (Miles & Huberman, 1994) to develop a holistic understanding of the five teachers' interpretation of reform mathematics portrayed through their actions

The interactions between teachers while they participated in the lesson study were examined for the moments when a new insight about teaching and learning emerged Each observed lesson was analysed using constant comparative methods (Miles & Huberman, 1994) for the use of questions and the enacted cognitive demand of the task In addition, teachers' reflections about their teaching practices were analysed for changes in their focus Five time-ordered matrices were constructed to coordinate each teacher's interactions during the lesson study with classroom practices These matrices were then analysed using a cross-case time-ordered matrix for patterns that linked interactions during the lesson study activities with changes in teachers' practices

Results and Discussion

The first, second, and third-grade teachers fully participated in a lesson study which comprised of creating a task, examining its cognitive demand, creating probing questions to ask while conducting the lesson, and analysing students' problem solving approaches The fourth-grade teachers abandoned their lesson study after two months because "it was not a good use of [their] time fourth-grade teachers need an integrated curriculum outline" (meeting, November 2001) The fourth-grade teachers spent the remaining four months selecting activities from the reform mathematics materials and a traditional textbook to meet the school district's curriculum guide I encouraged them to analyse each activity for its cognitive demand, but they bypassed my request stating, "We have too much to cover and there isn't time " (meeting, January 2002)

The five case-study teachers' initial teaching practices were similar (see Table 1) They asked questions that led students to expected responses The five teachers followed a traditional discourse pattern in which they initiated a question, listened to a response, and evaluated the response (Cazden, 2001) The cognitive demand of a task was relatively low with the teachers suggesting a procedure for students to use based on prior instruction (Stein & Smith, 1998) They also posed a few tasks of slightly higher cognitive demand by showing how manipulatives could model a procedure to deepen students' understanding (procedure with connections)

Table 1
Initial Classroom Practices of the Case-Study Teachers

Teacher	Grade Level	Classroom Questioning	Discourse Pattern	Task's Cognitive Demand	Lesson Study Participation
Ms Lavender	1	Leading [1]	Traditional IRE	Procedures with and without connections	Fully
Ms Trillium	2	Leading	Traditional IRE	Procedures with and without connections	Fully
Ms Edelweiss	3	Leading	Traditional IRE	Procedures with connections	Fully
Ms Marigold	4	Leading	Traditional IRE	Procedures with and without connections	Withdrew
Ms Jonquil	4	Leading	Traditional IRE	Procedures with and without connections	Withdrew

[1] Questions led students to an expected response

The first-grade and one fourth-grade teachers' classroom practices are portrayed as illustrative examples of the five case-study teachers Then, their teaching practices are described after finishing the lesson study in February Finally, changes in teachers' practices are linked with activities in the lesson study to identify critical aspects of the lesson study experience which supported the teachers' professional growth

Initial Practices

Ms Lavender and Ms Jonquil had many similar teaching practices They designed lessons to help students investigate fundamental mathematical ideas embedded in procedures Both teachers were confident and espoused similar beliefs about teaching and

learning Ms Lavender stated, “I present situations to students, question them, and let them explore ” Ms Jonquil, a fourth-grade teacher, pushed her students “beyond finding an answer and stopping We try to find if there are other possible answers, why or why not ”

Ms Lavender’s first-grade mathematics instruction was divided into two segments, calendar math and problem solving (observations, September and October 2001) Ms Lavender’s pedagogy was characterised by the following three qualities: (a) questions were asked to teach students procedures, (b) questions during class instruction helped students understand a procedure, and (c) students were given time to respond to questions

During calendar math, the first grade students added one straw to a jar to represent each school day When ten straws were collected in the jar marked ONES, they were bundled with a rubber band and placed in a container marked TENS On October 16, 2001 school had been in session for 39 days The following excerpt was typical of Ms Lavender=s calendar math and provides an illustrative example of her questioning

3: Ms Lavender	How many days have we been in school?
4: Jeffrey	Thirty-nine
5: Ms Lavender	Thirty-nine, very good How many ones do we have?
6: Ellen	Nine
7: Ms Lavender	How many ones are in 39?
8: Brandon	Nine
9: Ms Lavender	Nine How many tens do we have? Chris
10: Chris	Ten
11: Ms Lavender	What was my question?
12: Chris	Three
13: Ms Lavender	What was my question?
14: Chris	(Pause 4 seconds) How many tens is there?
15: Ms Lavender	Yes, how many tens do we have?
16: Chris	Three

Ms Lavender began mathematics lessons with calendar math and she asked the same set of questions (lines 3, 5, 7, 9) The cognitive demand was low as students were focused on reproducing an expected response Ms Lavender elevated the task to procedures with connections when she asked Chris to restate the question (line 13) before she accepted his response (line 16) Throughout this episode and other interactions, Ms Lavender maintained control of the classroom discourse using the traditional IRE discourse pattern

Ms Jonquil’s fourth-grade mathematics instruction was divided into two segments, warm up and problem solving (observations, September and October 2001) Ms Jonquil=s pedagogy was characterised by the following three qualities: (a) questions were asked to make connections between representations and mathematical symbols, (b) questions during class instruction helped students create and practice definitions, and (c) students were given time to respond and correct themselves

Ms Jonquil typically presented a task to elicit students’ prior knowledge to begin each mathematics lesson This excerpt illustrates both her introduction and her classroom discourse (observation, October 3, 2001) Ms Jonquil held up several rectangles that represented halves of a square Students taped the rectangles together to form two squares to represent two wholes As they taped the rectangles together, Ms Jonquil asked a series of questions that led the students to a correct symbolic representation

8: Ms Jonquil	How many halves are here (pointing at one rectangle)?
9: Marie	One

10: Ms Jonquil	And here (pointing a rectangle next to the first rectangle)?
11: Marie	One
12: Ms Jonquil	How many altogether?
13: Marie	Two
14: Ms Jonquil	Can you write 2 halves? (Pause 5 seconds) The whole is divided into how many parts? (Pause 4 seconds) Who can help?
15: Steven	Two
16: Ms Jonquil	Two, that's the denominator And what is the numerator?
17: Chris	Two?
18: Ms Jonquil	That's right Can you write that (to student 1) That's right, put a 2 for the denominator and a 2 for the numerator

Ms Jonquil selected an activity that provided an opportunity for her to assess students' knowledge and review definitions or procedures The cognitive demand was low as students were focused on reproducing an expected response (lines 9, 11, 13) When Marie was unable to write a symbolic representation of halves, Ms Jonquil asked another student to answer her question (lines 14 and 16) Ms Jonquil then led Marie to a correct symbolic representation of 2 halves (line 18) Like Ms Lavender, Ms Jonquil maintained control of the classroom discourse using a traditional IRE discourse pattern

Teaching Practices after Completing the Lesson Study

Each case-study teacher who participated in the lesson study changed unique aspects of their pedagogy These changes were revealed in their interactions with students and colleagues (see Table 2) Ms Lavender wrote the full problem on the board instead of an abbreviated form She posed tasks with higher cognitive demand, which required students to explore the nature of mathematical ideas (Stein & Smith, 1998) She also established a new discourse pattern by encouraging students to lead a classroom discussion (Cazden, 2001) Cazden characterised two other reform discourse patterns as accepting alternative strategies and community of inquiry where students initiated topics for investigations Ms Trillium speculated about her students' responses as an indication of their mathematical thinking Ms Edelweiss asked students questions to uncover their intuitive approach and then used leading questions to help them solve the problem using their own strategy In contrast, I did not identify changes in pedagogy of the two fourth-grade teachers who chose to work on the fourth-grade curriculum guide Ms Lavender and Ms Jonquil's teaching practices are described to serve as illustrative examples of teachers' evolving pedagogy

Ms Lavender drew a tic-tack-toe grid on the board and placed a 23 in the centre box (February 2002) She gave the marker to Jasmine Jasmine wrote the number 24 in the square to the right of the 23 She then turned and faced the class

24: Jasmine	Do you have a question? Raise your hand
25: Student 1	How do you know that?
26: Jasmine	I counted, after 23 comes 24
32: Student 3	How much tens is there in 20?
33: Jasmine	Uhm, the amount (pause 14 sec)
34: Ms Lavender	Did you understand her question? She asked you how many tens there were in 20

Table 2
Classroom Practices in February 2002

Teacher	Grade Level	Classroom Questioning	Discourse Pattern	Task's Cognitive Demand
Ms Lavender	1	Elicit mathematical thinking [1]	Reform: Student Led Discussions	Procedures with connections and doing math
Ms Trillium	2	Prompt reflection [1]	Reform: Accept Alternative Strategies	Procedures with connections
Ms Edelweiss	3	Elicit mathematical thinking	Reform: Community of Inquiry	Procedures with connections and doing math
Ms Marigold	4	Leading	Traditional	Procedures with and without connections
Ms Jonquil	4	Leading	Traditional	Procedures with and without connections

[1] Questions that *elicit mathematical thinking* encourage students to make observations about patterns and create conjectures Questions that *prompt reflection* encourage student to reflect, justify and extend their thinking (Driscoll, 1999)

Jasmine assumed responsibility for the classroom discourse and asked the class if they had any questions (line 24) One student asked her to justify the placement of 24 (line 25) and another child asked her to think about the meaning of twenty (line 32) During the interaction between students, Ms Lavender assisted her students as they developed their questioning skills (lines 34) This classroom discourse pattern was a departure from the traditional pattern with the teacher maintaining control Ms Lavender shared authority with students by allowing them to lead the discussion and pose questions to each other

Ms Jonquil's practice did not change She continued to introduce the lesson by asking students to recall previously learned information and to suggest procedures to follow The suggested procedures were further explored in a task which utilised manipulatives designed to deepen students' understanding of a mathematical idea The classroom discourse remained traditional in which Ms Jonquil asked questions that led students to expected responses and reinforced their explanations by repeating students' responses

Process of Learning during the Lesson Study

Ms Lavender and Ms Trillium joined a lesson study group that focused on the development of children's understanding of place value Ms Edelweiss joined a lesson study group with two other teachers that investigated the ways that students make change The lesson study groups met monthly During the first phase of the lesson study, the teachers defined learning goals and selected a task that would reveal students' misconceptions

In September, the primary teachers theorised that students who understood place value would break a multi-digit number into groups of tens and ones and utilise the structure of the hundreds chart to solve problems They indicated that most of their students did not break multi-digit numbers apart and relied on the inefficient method of counting by ones to solve problems In October, they discussed how pictures could be incorporated with the hundreds chart to develop place value understanding They created two problems to

connect a picture with the place value "There are 36 cupcakes We want to put 10 cupcakes in each box How many boxes would we need to fill? How many extra cupcakes?" and "We have three boxes of cupcakes and 6 extra on a plate Each box has 10 cupcakes How many cupcakes do we have?"

The second phase of the learning process began when the teachers related theory to their work Both lesson study groups discussed how teachers maintain or reduce the cognitive demand of tasks by the types of questions asked Together, they created a set of probing questions that would not reduce the cognitive demand of the problems

The final phase of learning for the primary teachers occurred as they finalised their lesson study plans The group decided to state the problem to the students and then Ms Lavender would write the important information on the board, "36 cupcakes" and "10 in a box " I asked, "Does that change the cognitive demand of the task when you write an abbreviated form on the board?" After a lengthy discussion, Ms Lavender concluded, "I think I inadvertently lower[ed] the cognitive demand " The group discussed how their classroom routines and assumptions change the cognitive demand of a task during instruction The teachers shared aspects of their own teaching practices that influenced the enacted cognitive demand of tasks which then influences students' opportunities to learn

The intermediate teachers gained a new insight during the lesson analysis I asked them why a student added a dime to 95¢ to make a dollar There was a pause, and them Ms Edelweiss said, "I don't know I never asked " With this realization, the intermediate teachers had a rich conversation about their own practices I characterised this phase as personalizing the experience from a new perspective

Summary and Implications

Cross-case analysis of the three case-study teachers indicated that changes in their practices manifested themselves when they reflected on their own practices from a new perspective Like other teachers, lesson study provided a context for this reflection (e g , Riggs & Barrett 2004; Southwell & White 2004) The changes of pedagogy occurred within a short time period (January to February) and the only explanation for these changes to have occurred during this time frame was that a common phenomenon influenced the three teachers The three case-study teachers who participated in the lesson study gained a new insight after personalizing how their own actions impacted classroom discourse and led them to re-examine their beliefs about teaching and learning This discussion was a catalyst for their professional growth and manifested itself in changes in their teaching practices In contrast, the fourth-grade teachers did not participate in a lesson study I saw no evidence that they considered how their own actions might influence students' opportunities to learn or that their pedagogy changed

These findings indicate that lesson study may encourage teachers to critically reflect on their own pedagogy The teachers who participated in a lesson study transformed their teaching practices after discussing a new insight with colleagues Continued observation over 12 months indicated that the three case-study teachers maintained these changes and continued observation will indicate whether these changes become ingrained into their practices This study supports other research findings (e g , Ellerton, Clements & Skehan, 1989) that pedagogical changes require a social group to personalise shared experiences through critical reflection and to create new meanings Additional research is needed to identify other aspects of lesson study that promote teachers' professional growth

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