

EXPLORING “LESSON STUDY” IN TEACHER PREPARATION

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Prospective secondary mathematics teachers continue to lack images of “reformed” teaching. This investigation studied prospective teachers’ development of reform-oriented teaching through Micro-teaching Lesson Study [MLS], an experience based on Japanese lesson study (Stigler and Heibert, 1999). A qualitative analysis of various data sources (video-taped lessons, written lesson plans and reflections, observations, and surveys) for 18 participants working in groups of three was conducted. Findings include growth in understanding and implementing reform-oriented teaching and development of subject matter knowledge. Participants perceived the experience and its components as beneficial in their development as teachers.

INTRODUCTION AND RATIONALE

In many countries, dissatisfaction with teacher education is pressuring toward more field-based programs (Korthagen and Kessels, 1999). More school-based experiences, however, is not the panacea that some expect. Teachers’ learning based on their own observations of practices while being students and their individual observations of teachers in placement schools within their teacher education programs leads to teacher preparation that is idiosyncratic and particular (Ball and Cohen, 1999). Zeichner and Tabachnick (1981) and Lortie (1975) have revealed the socialization of teachers into the status quo through the participation in field experiences and personal observations of practice. Prospective secondary mathematics teachers continue to lack images of “reformed” teaching, teaching that engages students in experimenting, analyzing, conjecturing, justifying, and making connections. To better prepare secondary mathematics teachers and reduce the idiosyncratic nature of their development, it seems appropriate to engage them in more collaborative tasks, discourse and environments that will help them more systematically develop images of reformed mathematics teaching and the capabilities to reflect on, reason about and engage in change. As prospective teachers engage in these collaborative experiences, teacher educators should study their development in order to inform the pedagogy of teacher education. The National Academy of Education [NAE] (1999) in a research advisory report underscored as a priority the need for further research on the preparation of teachers.

Mathematics teacher educators need to seek and investigate activities, tasks and contexts that provide prospective teachers with common experiences that will help them more systematically develop images of reformed mathematics teaching. The purpose of this study was to investigate the professional development of prospective teachers engaged in one such experience, named Micro-teaching Lesson Study

[MLS]. The development of MLS is based on “lesson study,” a component of professional development that is highly valued by Japanese teachers and is considered one of the best ideas for improving teaching and education from the world’s teachers (Stigler and Heibert, 1999). MLS incorporates key features and phases of Japanese lesson study. The phases of MLS follow those of lesson study: collaborative planning, lesson observation by colleagues and other experts, analytic reflection, and ongoing revision (Curcio, 2002). MLS provides a context for prospective teachers to develop pedagogical content knowledge, knowledge of teaching, content and learning, and images of reform-oriented teaching. MLS may take on different formats. The present investigation studied the use of MLS within an initial course on teaching mathematics. The prospective teachers collaborated in groups of three through three cycles of planning, teaching, analysis and revision of one lesson. As with Japanese lesson study, an important feature of MLS is the focus on learning goals. During this study, the main learning goal for the lessons was to develop students’ reasoning and ability to study patterns in discovering relationships or constructing concepts. The following questions were under investigation:

- (1) To what extent does MLS help prospective mathematics teachers develop knowledge of teaching aligned with recent reforms in mathematics education?
- (2) What were prospective teachers’ perceptions of the MLS experience and its components?

RELEVANT LITERATURE

The National Commission on Teaching and America’s Future [NCTAF] (1996) identified uninspired methods of teaching prospective teachers as a barrier in the education of qualified teachers that make learning come alive. Prospective teachers are expected to excite and motivate students to learn; yet their own learning experiences are often uninspired and traditional. Methods courses are often taught through lectures and recitation. Prospective teachers complain that methods courses are not intellectually substantive or that discussions of theory and research are not sufficiently oriented toward practice (Commission on Behavioral and Social Sciences and Education [CBSSE], 2000). MLS provides prospective teachers with an intellectually challenging opportunity to explore the use of theory and research based instructional methods.

From a cognitive perspective, knowledge construction is assumed to be a dynamic and active process. Learners construct knowledge while attempting to make sense of their experience. The construction of knowledge involves the interaction of past knowledge with the experience of the moment (Resnick, 1987).

Current information about human learning suggests that learning environments should be learner centered, knowledge centered, assessment centered, and community centered (CBSSE, 2000). The MLS is a collaborative experience encompassing these four components. The MLS is learner centered with prospective teachers working in

small groups to develop, implement, and analyze the teaching of mathematics lessons. It is knowledge centered focusing on helping prospective teachers understand and develop images of reform-oriented teaching as envisioned by the National Council of Teachers of Mathematics [NCTM] (1991, 2000) through discussion, exploration, experimentation, and analysis. Knowledge is developed through cycles of planning, implementing, and reflecting on lessons. The opportunity for feedback and revision within the teaching cycles provides for the assessment centeredness of the task. The MLS is community centered in that it provided prospective teachers with opportunities to experiment, make mistakes, discuss, and negotiate among peers and an instructor their emerging understandings of teaching toward goals aligned with reform-oriented teaching.

METHODS, DATA COLLECTION AND ANALYSIS

The research design involved primarily qualitative data collection and analysis. Data collection included observations of planning, implementing, and analysis of lessons, group documentation of three cycles of planning, teaching, analysis and revisions, video-tapes of lessons, and surveys of feedback, analysis, and collaboration. The investigation was conducted in an initial course on learning to teach mathematics that included 18 prospective teachers. Prior to the MLS experience, the prospective teachers were engaged in discussing readings and analyzing videotaped lessons, focusing on reform-oriented teaching of mathematics. Additionally, they were engaged in mathematical tasks modeling the current vision of mathematics teaching proposed by NCTM (1991, 2000). The prospective teachers were given an initial survey to assess their knowledge of potential mathematics topics for lessons. Based on these surveys and instructor observations, the prospective teachers were grouped heterogeneously into six MLS groups each consisting of three prospective teachers.

Each group was involved in three cycles of planning, teaching, analyzing and revising a mathematics lesson with a goal of promoting reasoning and the study of patterns in discovering a relationship or constructing a concept. Mathematics topics for the lessons included fractals, traceable paths, Euler's formula, permutations, prisms and pyramids, and ellipses. The lessons were taught to small groups of peers in the same course; class members lacked understanding of the lesson topics as determined by the initial survey. Each group completed a written assignment consisting of 5 sections that guided them through the phases of the MLS based on Japanese lesson study: Section I included pre-lesson thoughts, materials explored and lesson plan; Section II included video of first teaching, analysis of the lesson (individual and group reflections) and revisions to lesson plan; Section III included video of second teaching analysis (individual and group reflections) and revisions; Section IV included video of the third teaching, analysis (individual and group reflections) and final revisions; Section V included the final revised lesson along with suggestions for teaching the lesson to be distributed to class members. Analysis of the lessons was conducted with respect to a video analysis framework based on the

vision of mathematics teaching promoted by NCTM (1991). Groups were observed working together and given feedback on their video-taped lessons by the instructor during the phases of the MLS. Field notes of these observations and interactions were kept. At the end of the four week MLS experience, final surveys assessing prospective teachers' views of lesson feedback, analysis, collaboration and understanding of reform-oriented teaching were gathered.

The multiple data sources described above were used to triangulate the findings. Analysis began with the MLS projects. The videotapes of the lessons and the written lesson plans, submitted as part of the MLS projects, were coded with respect to the pedagogy used and the knowledge of the subject-matter presented. In particular, lessons were coded and compared with respect to the engagement of student peers in discovering, developing or constructing relationships or concepts (student-centeredness), and teacher telling, showing, and stating the relationships or concepts (teacher-centeredness). The MLS projects and observation notes were coded with respect to the prospective teachers' learning about content and pedagogy, and their perceptions of the experience. Findings from the projects and the observations were triangulated with prior findings from the analyses of the videotaped lessons and lesson plans. Finally, responses to the Microteaching Feedback Surveys were tallied and open-responses coded, and then compared and contrasted with the emerging themes. The Microteaching Feedback Surveys were analyzed for participants' perceptions of their learning and views about the MLS experience. As themes developed throughout the data analyses, they were confirmed or disconfirmed through data triangulation.

FINDINGS

From analysis of the video-taped lessons and the written lesson plans, as prospective teachers engaged in the MLS their second lessons became less teacher-centered and incorporated more student experimentation, analysis and reasoning than their first lessons. For example, the group teaching Euler's formula for polyhedrons, had in their first lessons typically provided the formulas or definitions for their topic and focused on application of that information. Later during the second phase of the project, after receiving feedback from the instructor and analyzing the video-tape of their own lesson, they engaged the students in experimenting with a variety of polyhedrons, looking for patterns and using reasoning to generate a relationship. The prospective teachers themselves observed this difference in their own lessons:

The improvement from our first to second lesson was dramatic. Our first lesson was far more teacher-centered and did not really center around the idea of constructing a concept or discovering a relationship. This time, we kept to the idea of constructing definitions, not stating, and then justifying them. This time it seems as though we had a better understanding of how to do this. (MSL Group 1)

In the MLS group teaching about ellipses, one of the participants was one of the high math content exam scorers. Her group observed that her lessons were more effective

in engaging students' thinking and all three improved on their student-centeredness and engagement of students in the discourse during the second lesson:

As a group we realized how important it was to make each lesson more student led rather than teacher led. Getting away from a teacher-centered classroom is hard, since that is how most of us learned. After seeing how a student-led lesson can improve a student's performance, we see how valuable it is in our teaching. (MSL Group 6)

Participants also reflected on their own changes with respect to student participation. For most of the prospective teachers, the feedback and analysis of their video-taped lessons seemed to be an important aspect of the MLS. This feedback and analysis helped them to think about their own teaching. One prospective teacher reported,

I feel that the input that I received from the first lesson had an impact on the way I intend to run my classroom. It made me realize that I needed to get the students to participate and play a more active role in the learning process. I think this helped a lot with the success of the [second] lesson" (member MLS Group 2)

Through the MLS experience, in addition to developing their understanding of teaching strategies aligned with recent reforms, the prospective teachers enhanced their mathematics subject matter knowledge. For example, after the first lesson, a few groups struggled with understanding the relationships they were teaching and the need to understand more in-depth arose from questions raised during the lessons. For example, toward the end of the initial lesson on traceable paths, the students being taught asked why a traceable path can have at most two odd vertices (the teacher could not figure it out before time ran out). After the lesson, when the teacher for that lesson got together with her MLS Group members they further explored the relationship in order to understand why this occurred and incorporated this into their next lesson. The next two times the lesson was taught, the teachers did not raise this question and their students did not bring it up as in the first group. The teachers in all of the MLS groups tended to focus less attention on deductive reasoning, justifying the relationships that were discovered or constructed, and more on inductive reasoning, analyzing, looking for patterns and making conjectures. In another example, during the initial lesson on permutations, the group member teaching about permutations had students develop two formulas for determining permutations but did not engage the students in explaining how the formulas were related nor had she thought about it with the group members. The instructor's feedback challenged this aspect of their lesson and the group struggled to understand the relationship and incorporated this connection into their next lessons.

Although most of the lessons improved as the groups progressed through the MLS cycles, the last lesson on traceable paths did not demonstrate as much improvement as the others. This group engaged in limited collaboration as a whole and tended to be overly concerned with others feelings as they discussed the lessons taught. (Their concern for the others feelings was expressed in the Microteaching Feedback Survey.) The member teaching the third lesson did not fully develop her understanding of traceable paths. During her teaching, although she tried to engage

the students in reasoning about traceable paths and non-traceable paths, she quickly gave up when the students began to struggle with discovering the relationship (this struggle is a normal aspect of problem solving). She moved on to provide the definition for them and then explained how to use paths to represent maps. Although her MLS group members' assessment of her lesson lacked some depth because of concern for her feelings, through the experience of reflecting on her group members prior lessons on traceable paths, she recognized that she gave up and did not achieve the overarching lesson goal of developing students' reasoning and ability to study patterns in discovering relationships or constructing concepts. She commented, "I believe that I could have been a little more prepared with the definitions and paid a little more attention to the students constructing their ideas of the concepts but I don't think that John and Tami would say that to me."

The Microteaching Feedback Survey provided valuable information about individual and group perspectives on the MLS experience and its components. When asked "What were the two most important things you got out of the Microteaching Project, the participants tended to feel primarily that the feedback they received from their own group members along with their own observations through the videotapes was most beneficial in their learning to teach. Several commented on learning to facilitate student engagement in exploration, analysis and explanation as most important while others felt that the experience help them understand lessons as "works in progress."

On the feedback survey, the participants were asked to provide a rating and explanation of their rating for each statement. The ratings were (1) Strongly Agree, (2) Agree, (3) Neutral, (4) Disagree, (5) Strongly Disagree. Table 1 summarizes their perceptions by average ratings.

Feedback Item Summary	Ave.
1. Planning in a group broadened my knowledge of teaching ideas	2.0
2. Analyzing others' lessons helped me think more deeply about mine	2.0
3. Analyzing each others' lessons helped me learn to assess lessons	2.3
4. The video analysis framework was helpful in analyzing our lessons	2.6
5. Feedback from group members was helpful	1.8
6. Concern for others' feelings influenced my feedback	3.3
7. I was upset by feedback from my peers	4.4
8. I was upset by feedback from my instructor	4.0
9. Planning together broadened my knowledge of the mathematics	1.9
10. Preparing to teach this topic caused me to engage in mathematical reasoning and problem solving	2.2

Table 1: Summary of MLS Feedback Survey

From the survey, group member feedback and group planning were revealed to be very important to the participants. The participants, however, expressed some

concern for other's feelings when providing feedback. This is important to be aware of in experiences where prospective teachers are asked to provide feedback to one another or engage them in thinking critically about their teaching because they may not be helping their partners reach higher levels of thinking about their teaching. The role of the instructor or expert in these cases becomes more important in order to facilitate greater learning opportunities for prospective teachers. The feedback also indicated that students felt they were broadening their mathematics knowledge through the MLS experience.

CONCLUSIONS AND IMPLICATIONS

The MLS experience seems to help prospective teachers understand and begin implementing teaching practices that are consistent with reform-oriented teaching. It also raised the tension between subject matter knowledge, pedagogical knowledge, and practice for prospective teachers to begin experiencing, reflecting on, and working through. This experience provides an opportunity for prospective mathematics teachers to begin linking theory and practice as they engage in cycles of planning, implementing and reflecting on lessons.

In communities where appropriate placements for prospective secondary mathematics teachers are limited, MLS can reduce the burden of school placements. This opportunity can be used in addition to school-based experiences to provide less idiosyncratic teacher preparation experiences.

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