

The Impact of Using Lesson Study with Pre-Service Mathematics Teachers

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This study examines the effects of using Lesson Study with pre-service secondary mathematics teachers as they moved from the methods classroom to the field experience classroom (practicum). The participants were pre-service teachers who were enrolled in a mathematics methods course in an undergraduate teacher preparation program at a private university. Lesson Study engaged the pre-service teachers in collaboratively crafting lessons, as well as field testing, revising, and re-teaching the lessons in their field placement classroom. Data were collected from weekly reflections and summative interviews of the pre-service teachers. The findings indicate that Lesson Study for pre-service teachers was an effective methodology for enhancing the efficacy of pre-service teachers due to the collaborative nature of the process, the practice teaching opportunities, and the observation of others' teaching. The pre-service teachers successfully transitioned from teaching in the methods classroom to their field experience classroom which enhanced their confidence as they entered student teaching.

There is strong evidence that preparing effective teachers of mathematics is one of the most urgent problems facing those in teacher education due to the pressure for academic achievement (Hiebert, Morris, Berk, & Jansen, 2007; Morris, Hiebert, & Spitzer, 2009). Teaching is very complex work, yet some novices presume it to be easy (Grossman et al., 2009). In fact, many pre-service teachers believe that teaching is mostly common sense and professional study is not needed (Ball & Cohen, 1999; Kennedy, 1999; Munby, Russell, & Martin, 2001). The challenge for teacher educators is to provide pre-service teachers opportunities to develop habits of continued professional learning (Chassels & Melville, 2009; Ganesh & Matteson, 2010; Hiebert et al., 2007). Furthermore, planning and teaching lessons can be overwhelming for pre-service teachers in the early stages of their teacher education (Carrier, 2011). Therefore, providing opportunities to learn by doing with careful coaching by experts in low-risk settings is critical to begin learning their practice (Schön, 1987). The university education classroom can provide practice for pre-service teachers under less stressful conditions through role-playing

and practice teaching in an environment of support and feedback (Fernandez, 2005; Ganesh & Matteson, 2010; Grossman et al., 2009).

Unfortunately, methods courses in university settings can seem far removed from the reality of an actual classroom (Cohan & Honigsfeld, 2006; Grossman et al., 2009). University classes are typically taught through lectures and discussion of theory and research but are often not focused on the actual practice of teaching (Fernandez, 2005). Providing multiple learning opportunities and a considerable amount of practice with support from mentors and their peers can provide value to pre-service teachers (Bowman & McCormick, 2000; Chassels & Melville, 2009; Morris et al., 2009; Tobin, Roth, & Zimmerman, 2001). Further, pre-service teachers often do not see the connection between their methods courses and their field-experience (Darling-Hammond, 2006; Lampert & Ball, 1999). Much of the knowledge needed to teach effectively “is situated in practice, [and] it must be learned in practice” (Ball & Cohen, 1999, p. 3-4).

This article describes a qualitative investigation of six pre-service secondary mathematics teachers

who engaged in Lesson Study as part of their secondary mathematics methods course. The purpose of the research was to determine the effects of using Lesson Study with pre-service secondary mathematics teachers as they moved from teaching in a methods classroom to their field-experience classroom before entering their student teaching experience.

LESSON STUDY PROCESS

Lesson Study is a process that focuses on successful teaching and learning using a systematic method of refining lessons through collaborative planning, implementing the plan, testing the plan with students, and revising the plan based on the feedback (McMahon & Hines, 2008; Stigler & Hiebert, 1999). Lesson Study was first introduced to American educators by Lewis and Tsuchida (1998) in their article “A Lesson is Like a Swiftly Flowing River” and later by Stigler and Hiebert (1999) in their book *The Teaching Gap*. Since that time, Lesson Study has been implemented in schools across the United States and is finding its way into pre-service teacher education (Chassels & Melville, 2009; Chokshi & Fernandez, 2004; Groth, 2011; Tolle, 2010).

There is strong evidence to suggest that many aspects of the Lesson Study process can have a positive impact on pre-service teachers. Lesson Study can provide the opportunity to build professional learning communities, deepen understanding of content and pedagogy, and develop habits of critical observation, analysis, and feedback (Chassels & Melville, 2009; Chokshi & Fernandez, 2004; Groth, 2011; Tolle, 2010). Allowing pre-service teachers to re-teach lessons after receiving feedback and revising has been shown to improve the quality of their lessons (Chassels & Melville, 2009; Ganesh & Matteson, 2010). Pre-service teachers report appreciating the insights that their peers provided while participating in Lesson Study (Chassels & Melville, 2009). Observing lessons from their classmates enhanced pre-service teachers’ skill in critiquing lessons as well as exploring effective and ineffective teaching strategies (Chassels & Melville, 2009).

Lesson Study assists teachers in learning that their lessons can and will improve from observation and feedback. This realization allows them to accept and learn from the constructive criticism that Lesson Study can provide (Sims & Walsh, 2008).

The use of Lesson Study in pre-service methods classes was found to have a positive impact on the delivery of lessons in field experience teaching (Chassels & Melville, 2009; Ganesh & Matteson, 2010) by serving as a bridge between the methods classroom and field experience (Carrier, 2011).

However, implementing Lesson Study with pre-service teachers can be problematic due to the challenges of coordinating with the field experience school and teachers. For example, having students design lessons that can be implemented into the sequence of instruction in the field experience classroom requires close cooperation with the mentor teachers and the coordination of scheduling of the college classroom to the field experience classroom. Additionally, mentor teachers need to understand the Lesson Study process to support the pre-service teachers; otherwise, adaptations to the process could be necessary (Carrier, 2011; Chassels & Melville, 2009; McMahon & Hines, 2008).

THEORETICAL FOUNDATION

This study is based on Vygotsky Space as the theoretical framework (Gallucci, DeVoogt, Van Lare, Yoon, & Boatright, 2010). The Vygotsky Space has four phases that are cyclical rather than linear; a learner can be functioning at any given time in any of the quadrants. This theory represents learning in terms of relationships between collective and individual actions and between public and private settings (Gallucci et al., 2010). Vygotskian notions of development about learning and change focus on the internalization and transformation of cultural tools that occur as individuals participate in social practice. The individual internalizes the social practice, transforms the practice in their context, and eventually externalizes (shares) the practice with others (Gallucci et al., 2010).

The iterative stages of the learning process as proposed by Vygotsky and depicted by Gallucci et al. (2010) include the following:

- Individual appropriation of particular ways of thinking through interaction with others
- Individual transformation and ownership of that thinking in the context of one’s own work
- Publication of new learning through talk or action
- Process whereby those public acts become conventionalized in the practice of that individual and/or in the work of others.

These distinctions help us to see the ways that new ideas of practice are used by practitioners and eventually transformed and integrated into practice (Gallucci et al., 2010).

METHOD

Action research is any systematic inquiry by teacher-researchers that gathers information about how well their students learn based on an innovation (Mills, 2007). This study implemented an action-research model, collecting qualitative data as the study progressed.

SETTING

This study was conducted in a secondary mathematics methods classroom at a private university in the Southwestern United States. The participants were undergraduate pre-service teachers studying secondary education and majoring in mathematics. This 16-week course consisted of three 65-minute class sessions per week. This methods course is the only mathematics methods course required in the secondary education program at this university. Coupled with the face-to-face class meetings, each pre-service teacher was required by the university to participate in 15 hours of field experience in a secondary mathematics classroom. As part of this study, each pre-service teacher agreed to use the designated teacher in a field experience partner school and to teach two lessons in the assigned field placement classroom. The field experience teacher was debriefed on the Lesson Study process prior to the innovation.

PARTICIPANTS

There were eight pre-service teachers in this secondary mathematics methods class; six of them chose to participate in this study. These six pre-service teachers were directly involved on a daily basis with Lesson Study by collaboratively planning their lessons, individually teaching lessons in both the methods and the field experience classrooms, and participating in the weekly reflections, surveys, and interviews.

DATA SOURCES

There were two sources of qualitative data that were collected: weekly reflections written by the participants (a total of 47 double-spaced typed pages) and semi-structured post-innovation interviews

of the participants (a total of 30 double-spaced typed pages). The purpose of the weekly reflections was to elicit responses from the participants about the Lesson Study process and how this experiential method was evolving for them. Some examples of prompts used for the weekly reflections were:

- How are you feeling about teaching in your field experience classroom?
- What are the three most important ideas you have learned from this class so far?
- Are you developing more confidence in your ability to meet expectations in a real classroom as a future teacher? Why or why not?
- How did you feel about finally teaching in front of real students in your field experience?

The post interview was used to summarize the participant thoughts on the entire Lesson Study process. Some examples of post-interview questions included: What were the main benefits of the Lesson Study process for you? Did Lesson Study impact your instructional ability (mathematical teaching)? Did Lesson Study impact your math teaching efficacy?

LESSON STUDY PROCESS

During the first phase of Lesson Study in the methods classroom, students were introduced to the process while learning about effective high school mathematics instruction, the focus of the course. Twice during this phase of instruction, the pre-service teachers, working in two groups of three, collaboratively planned an algebra lesson that consisted of a written lesson plan and a math plan including all the necessary example problems, handouts, and activities. These were handed in to the instructor, who provided feedback for revision. The revised lessons were then taught in class by one member of each team. The debriefing session, which followed each teaching episode, started with a self-reflection by the pre-service teacher who taught the lesson, followed by a class discussion about the lesson that included comments, suggestions, and questions. The instructor guided this discussion and gave additional feedback following the debriefing session. The lessons were revised again and re-taught the following class period by another team member. After the second teaching episode and debriefing, the lessons were revised for the final time. The process for the second lesson plan mirrored that of the first. Between the teach-

ing episodes, the instructor taught the course materials, including pedagogical strategies as well as modeled lessons with debriefing sessions.

The second phase of Lesson Study directly prepared students for teaching in the field placement classroom by targeting lessons on topics that were assigned by the field experience teacher two weeks in advance of the scheduled teaching episodes. Each Lesson Study team took a week of class to collaboratively plan their lesson and receive feedback before teaching it in the methods classroom. The following week of class was used to teach, revise, and re-teach those lessons before going to the field experience classroom. Each pre-service teacher was given the opportunity to teach the lesson during these rounds of the Lesson Study in order to practice for the field experience classroom. Therefore, these lessons were taught and revised three times before being taught in the field experience classroom.

The Lesson Study teams went to the field experience school on their assigned days and each pre-service teacher taught at least one class. While one pre-service teacher was instructing, the other members of the team observed and video recorded the lesson. The video recordings of the lesson were shown in the methods classroom the following week and the class participated in a debriefing session for each pre-service teacher. Afterwards, the entire process as described above was used in preparing and teaching a second lesson for the field placement classroom. Figure 1 outlines the phase one and phase two model used for this study.

Figure 1: Lesson Study innovation model

Phase one (two rounds)	Phase two (two rounds)
1. Collaboratively Plan	1. Collaboratively Plan
2. Instructor Revisions	2. Instructor Revisions
3. Teach (1st Team Member)	3. Teach (1st Team Member)
4. Debriefing Session	4. Debriefing Session
5. Revise Collaboratively	5. Revise Collaboratively
6. Re-Teach (2nd Team Member)	6. Re-Teach (2nd Team Member)
7. Debriefing Session	7. Debriefing Session
8. Final Revisions Submitted	8. Revise Collaboratively
	9. Re-Teach (3rd Team Member)
	10. Debriefing Session
	11. Revise Collaboratively
	12. Field Experience Teaching
	13. Debriefing Session (Video-Recordings)

ANALYSIS

Each of the two data sets was analyzed separately. Data analysis began with open coding and then collapsing codes into categories based on similar dimensions (Corbin & Strauss, 2008). Saturation of the data came after multiple attempts of defining and redefining the categories. Eventually themes were created. A colleague in math education also analyzed the raw data and independently created themes as a cross-check of my analysis. Considering the results of the cross-check, I finalized the themes for both sets of qualitative data. The themes, theme-related components, and assertions presented in each analysis were organized into tables.

WEEKLY REFLECTION RESULTS

The two themes, theme-related components, and assertions are noted in Figure 2.

Figure 2: Reflection themes

Themes	Theme-Related Components	Assertions
Building Confidence	Confidence was gradually building from rounds of practice teaching. Confidence improved from teaching in the field experience classroom.	<i>Pre-service teachers gained confidence from multiple teaching opportunities.</i>
Collaborative Planning	Collaborative planning was difficult for some teams initially. The Lesson Study teams eventually thrived from the collaborative planning.	<i>Collaborative planning was a major benefit to the lesson quality despite some issues working together initially.</i>

The first assertion that emerged from the weekly reflections was that the pre-service teachers gained confidence from multiple teaching opportunities. In week three a pre-service teacher noted, “Well, I have to say that I was very nervous teaching for the first time in front of my peers. But, after realizing we all had wobbly knees about it, I guess it wasn’t really that bad.” In the same week, a pre-service teacher mentioned the fear of the upcoming field experience teaching stating, “I’m nervous about the differences in a real high school classroom.” In week four a pre-service teacher discussing their confidence claimed, “I would say my confidence is in a good spot right now. I don’t feel overly confident, but I’m not in a situation where I’m rethinking my career if that makes sense.” In week five before teaching the first field experience lesson a student wrote:

To be completely honest, I am really nervous about teaching in the practicum classroom. I have never taught a lesson in an actual high school classroom before, so it should be interesting. I feel more comfortable with the practice that I've gotten in class.

However, after the first field experience lesson it is ideal to see the shift in the confidence of the pre-service teachers. After the first field experience teaching, one pre-service teacher pointed out:

The teaching experience was by far the most beneficial thing I have done so far. Even though we teach lessons in our own classroom each week, being in an actual high school classroom with real students had a much different feel.

By week eight one pre-service teacher made this statement, "I am much more confident in my own abilities, which makes it much easier to focus on the students and their learning rather than worrying about messing up my teaching." By week 12 after the final field experience teaching, one pre-service teacher wrote, "After stressing out for a week about the teaching, I felt it went really well. The nervousness went away almost immediately this time, so I guess that means my confidence is getting better." Another pre-service teacher stated the same week, "I felt more comfortable with my ability to teach the students, and to hold their attention. Just from a confidence stand point I felt better about this lesson." Finally, one pre-service teacher summed up the final reflection by stating, "I would say that I definitely felt a lot more confident and teacher-like instead of college student-like."

The second assertion that resulted from the weekly reflections was that collaborative planning was a major benefit to the lesson quality despite some issues working together initially. For example, in week two of the innovation one pre-service teacher said, "This week has been very trying for me. I feel as though we didn't have enough time to collaborate on our lesson plans. Also, I found myself not feeling comfortable in expressing my opinion to my group." However, by week four that same pre-service teacher stated:

The group planning is going better. Having more time in class to collaborate with our groups has been really good. I think we all have a feel for each other's personality and style, so it's a bit easier to adjust ourselves to help the planning process flow.

Another member from that same team said after week three of the innovation that, "Working in teams is helpful, but sometimes it can be difficult to make a lesson that everyone can feel good about."

A member of the other Lesson Study team stated after week four that, "I think our group planning is going great. We work really well together and everyone has a chance to share the ideas and give their opinion." Another pre-service teacher from that same Lesson Study team during the week added, "When one of us has a different idea, the others are willing to listen and incorporate that idea into the lesson." In week seven one pre-service teacher stated:

We work incredibly well together. We share similar ideas, but when we have differing ideas, they help stimulate discussion that leads to an even better idea. I think we collaborate really well when creating our lessons. Because every person brings a slightly different perspective, we are able to mesh those ideas together to create a better lesson as a group than any of us could create on our own.

By week nine of the innovation, both teams were thriving with the collaboration as one team member noted, "I definitely think we are working as a group much better. We are getting more ideas flowing and starting to sort out what we think will work and will not work. It feels more collaborative than previous lessons." By week 10 one pre-service teacher stated when talking about the planning process for the last field experience lesson that, "It wasn't so much about how we were going to teach, rather how we were going to make it exciting for the learners."

SEMI-STRUCTURED INTERVIEW RESULTS

All six pre-service teachers in the study were interviewed following the innovation. The three themes, components from which the themes resulted, and assertions are outlined in Figure 3.

Figure 3: Reflection themes

Themes	Theme-Related Components	Assertions
Building Confidence	Confidence was gradually building from rounds of practice teaching. Confidence improved from teaching in the field experience classroom.	<i>Pre-service teachers gained confidence from multiple teaching opportunities.</i>
Collaborative Planning	Collaborative planning was difficult for some teams initially. The Lesson Study teams eventually thrived from the collaborative planning.	<i>Collaborative planning was a major benefit to the lesson quality despite some issues working together initially.</i>

The first theme from the interview data was that collaborative planning was essential to improving the quality of the lessons. One pre-service teacher stated, “I think being able to work in a group and get different ideas of how to create lesson plans and different ways to implement them and different ideas was really beneficial.” Another pre-service teacher when asked about the main benefits of Lesson Study said, “I think the key benefit was getting input from the group members on the actual planning of the lessons.” Another pre-service when asked about collaborative planning said:

You know you don't typically get to do that and having other people's feedback is really nice. Even if it's something to where their ideas slightly differ, it is still nice to see how other people think about it because you get more benefits out of it.

One pre-service teacher summed up the benefits of collaborative planning by saying, “It helped a lot with getting a little more diverse ideas and other people's perspectives outside of my own and I think that really opened me up a little bit to different ideas and different strategies to teach.” Another pre-service teacher pointed out the importance of looking for possible student misconceptions during the planning stage by saying:

We tried to anticipate some of the hiccups that the kids might encounter in the lesson like things that they might get confused on...We try and clear those things up as you're teaching it. I thought that was really interesting because it is something I had not thought of before. Instead of letting them get confused, just straighten it out right out of the chute and then everything will be fine....

The second assertion from the interview data was that the confidence of the pre-service teachers continued to grow throughout the innovation. One pre-service teacher stated, “I feel like I'm more prepared to go into my student teaching having gone through the Lesson Study process.” Another pre-service teacher said it this way, “Having the opportunity to teach and get in front of a classroom before leaving the university and going into my student teaching next semester it just increased my comfort level a thousand fold.” When asked if the classroom is easier to navigate now, the same pre-service teacher stated, “I am still scared, but not quite as much.” One pre-service teacher summarized the field experience teaching by stating, “Just being able to do it and tell myself that I did it and it wasn't so hard boosted my confidence level.” One pre-service teacher summarized how their confidence was influenced by the Lesson Study process this way:

So you take all of the thoughts into consideration and make all of your changes and you have that much better of a lesson and then you get to re-teach it and again it is that much better a teaching lesson because you remember what they told you and you make the changes necessary...and because it did go better it boosts your confidence. Then you feel more comfortable teaching and it is like a giant cycle and it works well to improve all of your teaching abilities.

The third assertion from the interview data was that practice teaching in the classroom and field experience was essential to the growth of the pre-service teachers. The idea of starting out teaching in front of their peers seemed to be something that benefitted the pre-service teacher as one pre-service teacher said, “You get to work out all of the kinks in front of your peers and they tell you all of the things they think went good and things that could possibly change for the better.” In fact, practicing the exact lesson before the field experience classroom seemed to impact the innovation. One pre-service teacher noted:

We could teach the lessons in class and then get our revisions and make those changes and see what worked and what didn't

work...and make those changes for the high school students...it was like a lesson we already taught three times as opposed to doing something for the first time.

When asked about the main benefits of the Lesson Study process, one pre-service teacher said, "The most beneficial for me was actually teaching in our class here and the one in the field experience classroom." When asked if they did this sort of thing in their other methods classes, they said, "I had never actually made, I guess you could call it, a real life math lesson before." One pre-service teacher added this key point about the real life practice, "With most of our classes now we just write lesson plans, but being able to actually teach it helps to see what are some flaws that you might have that you didn't think of before."

POSSIBLE CONCERNS WITH IMPLEMENTING LESSON STUDY

There were three issues that emerged from this study that need to be discussed. First, although the daily collaboration of the pre-service teachers was a major benefit as the study progressed, dealing with team dynamics can be a problem. There were more than a few times instructor intervention was needed in order to assign roles and responsibilities. Second, aligning with the field experience classroom and teacher can be difficult due to scheduling, teaching styles, and the constant communication required. Third, the small sample size (six pre-service teachers) could have greatly impacted the results of this study.

DISCUSSION

The primary finding of this research is that Lesson Study can have an influence on the perceived efficacy of pre-service mathematics teachers due to increased collaboration, multiple practice-teaching opportunities in the methods and field experience classrooms, and observation and analysis of mathematical instruction. Lesson Study can be used as a bridge from a methods classroom to the field experience classroom that allows pre-service teachers to gain confidence before entering their student teaching experience. This is critical because pre-service teachers often do not see the connection between their methods courses and their field-experience (Darling-Hammond, 2006; Lampert &

Ball, 1999). Teacher education programs should be designed to help pre-service teachers develop the ability to learn from teaching that will enable them to grow beyond their university experience (Darling-Hammond & Hammerness, 2005).

In addition, there is evidence that incorporating Lesson Study in methods classrooms that directly link to the field experience has benefitted pre-service teachers' development (Carrier, 2011; Chassels & Melville, 2009; Sims & Walsh, 2008). In fact, pre-service teachers report being most influenced by their field experiences due to the connection between their coursework and fieldwork (Darling-Hammond, 2006; Feiman-Nemser, 1983; Lampert & Ball, 1999; Tabachnik, Popkewitz, & Zeichner, 1979-1980). Programs that integrate coursework and field experience are characterized by a "pedagogy of investigation" which allows pre-service teachers to experience some of the realities of teaching through real practice (Ball & Cohen, 1999, p. 13). In conclusion, pedagogy that is gradually integrated into the field experience allows pre-service teachers the opportunity to learn from actual teaching rather than theory (Sims & Walsh, 2008).

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Author Biography

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