

Teachers' Collaborative Use of the Lesson Study Approach to Foster Student Achievement in Geometry

By

¹*Diane Barrett*, ²*Laurie Riggs* and ³*Jan Ray*

¹Associate Professor of Education, University of Hawai'i at Hilo, United States

²Professor of Mathematics, California State Polytechnic University, United States

³Assistant Professor of Education, University of Hawai'i at Hilo, United States

Abstract

A workable model of mentoring support, collaboration and reflection among university mathematics education faculty and mathematics high school teachers that positively impacted student achievement is offered. Faculty, serving as mentors, and teachers, working as a team, developed methods to improve mathematics instruction through the use of lesson study. Through their efforts, student engagement and achievement in geometry were improved.

Keywords: *Lesson study, geometry achievement*

1. Introduction

Many high school mathematics teachers work in isolation and without the tools necessary to help their students achieve success. As a result, many of their students struggle to pass state and district benchmarks. In an effort to improve student achievement, mathematics faculty at a university formed a partnership with mathematics teachers at a high school. The high school had a diverse student population and was considered a high-needs school, as determined by the number of students on free and reduced lunch. This descriptive case study explored the collaborative work of the mathematics partnership over a two-year period of time, as well as the impact the mathematics partnership had on student achievement in a specific mathematics content area—geometry.

Lesson study was used to inform the collaboration and promote reflection among the mathematics teachers. Partnership teachers focused on the geometry curriculum and worked as a team to improve instruction. By focusing on the content and pedagogy, it was hoped that teachers would be successful in engaging students and improving student achievement. This descriptive case study highlights the implementation and results of this collaboration and reflection.

Brief Background on Lesson Study

Lesson study first came into the educational spotlight after the release of the findings from the Third International Mathematics and Science Study (TIMSS). The TIMSS study compared instruction and student achievement in industrialized nations. According to the study, Japanese students scored near the top of all countries that were studied, while American students scored an entire grade level lower (Wilms, 2003). In response to these findings, researchers began to look for ways to improve mathematics instruction in the United States. Suggestions included reducing class size, lengthening school days, and tying teacher salary to test results. Teachers and administrators in the schools met many of these proposals with opposition. Additionally, when implemented, these approaches often failed to achieve the desired result of increased student achievement (Wilms, 2003). Many researchers noted that the primary difference between Japan and the United States was the amount of collaboration in lesson design and

Teachers' Collaborative Use of the Lesson Study Approach to Foster Student Achievement in Geometry

reflection after lesson completion. As a result, it was proposed that the way to improve instruction in the United States was through teacher collaboration and reflection (Viadero, 2004).

Lesson study invites teachers to come together, identify their goals, and collaborate in small groups in an effort to create lessons that foster the achievement of these goals. While lesson study varies from school to school, it generally consists of (1) problem identification, (2) lesson development, (3) teaching and observation, and (4) evaluation and reflection (Kieff, 2003). Teachers first work together to design a lesson that meets the needs of their students. After careful lesson development, the lesson is taught by one of the teachers, while the others observe. During the observation, teachers look for evidence of student learning, as opposed to simply evaluating the teacher. Next the teachers reflect upon the lesson and then revise it prior to another teaching the lesson. This is followed by further reflection and revision. Wilms (2003) refers to the process as a "Plan, Do, Check, Act" (p. 610), where teachers plan together, try out new ideas, check for success, and then make improvements. Both Kieff (2003) and Viadero (2004) agreed that the most important part of the process is the collaborative reflection at the end of each lesson. This reflection, according to Kieff (2003), turns teachers into researchers who are trying to transform everyday teaching by seeking fresh approaches, creative ideas, and new pedagogical knowledge—all designed to improved instruction.

The value for teachers comes if lesson study can increase their students' performance. Lesson study provides a venue for ongoing authentic assessment (Fernandez and Choskshi, 2004). According to Boss (2002) teachers who have implemented lesson study may not see increased test scores from their students by the end of the school year. However, in the long term, students' understanding deepens when teachers work collaboratively. In the short term, one can expect enthusiastic teachers, a growing depth of understanding of content, and an increased ability to critique a lesson. Lesson study provides an opportunity for teachers to learn from one another, as a great deal can be learned from imperfect lessons (Choskshi, 2004). Hence, it is neither the teaching style nor the pedagogy that is the key element. Rather, it is the chance to try out various strategies and to gather evidence of their success or lack thereof. Viadero (2004) supported process and claimed that the reflection was the key component and the part that drove improved instruction.

2. Method

University mathematics faculty partnered with high school geometry teachers in a district east of Los Angeles, California. This school served approximately 3,000 students in grades nine through twelve. It had a very diverse student population with a majority of Hispanic students. Further, it was a high-needs school with many students receiving free or reduced lunch. The school had been faced with low student achievement, as determined by standardized test scores, and was identified by the state as an underperforming school.

Funding was obtained to hire one full-time mathematics teacher, enabling four mathematics teachers to be given one additional preparation period per day. The four teachers shared a common preparation time, allowing them to engage in discussions regarding curriculum, assessment and teaching methods. The funding for the additional hire was attained through the Collaborative Academic Program Initiative of the California State University System.

Upon joining forces it was discovered that the teachers were working in isolation, with no collaboration. Several were new teachers, some lacked certification, and others were teaching out of their content areas. It was apparent that the high school needed help, and a plan of action needed to be created.

Taking Action

The first action taken was to work with the teachers, helping them become reflective practitioners. They needed to think about how they were teaching, what they were teaching, how they could improve their

lessons, and how they could engage their students. Prior to this, none of the teachers had formally reflected on their own teaching or had even been in one another's classrooms.

After the first year, the teachers were comfortable reflecting on what they were doing in the classroom and how they were doing it. Next, the concept of lesson study was introduced as a means to foster collaboration. Initial planning and curriculum design took place in two one-day summer workshops prior to the start of the school year. The workshops included in-depth content discussions, reviews of research, best practices for observations and classroom assessment, discussions of teaching-related case stories, organizational planning for semester lesson cycles, and the initial development of lesson plans.

Implementation of Collaboration and Reflection

A group of four mathematics teachers were selected to work on collaboration and reflection with the focus on geometry. With administrative support, each of the four participating teachers had a common preparation period, which provided planning and observation time. There were a total of six geometry teachers at the school with a total of 451 geometry students. The ability levels of the students whose teachers were in the collaboration and reflection group was equivalent to the ability levels of the students whose teachers who were not in the collaboration and reflection group.

Teachers used a (1) plan, (2) teach, (3) reflect and (4) apply cycle. In collaboration with one another, they planned the lesson, which included determining the desired outcome and the best way to achieve it. The first part of developing a new lesson was creating an assessment tool. For the first lesson, this was done with their mentor on their campus. They spent a day designing the assessment tool and discussing possible lessons. It initially took some encouragement to get teachers to move away from wanting to use the test provided by the book as their assessment tool. They were soon able to identify the important concepts and standards that needed to be covered and how they could best meet them. Teachers then split into pairs. Each pair developed a lesson that would help them achieve their goal.

One teacher then taught the lesson while the other teacher observed. This included observing how the lesson was presented and received, as well as the degree of engagement of the students. Teachers then reflected on the lesson, discussing both the positives and negatives. Next, the teachers made revisions. Following this, the other teacher taught using the revised lesson. Afterwards, teachers again reflected and revised with the intention that the final product would be a well thought out, effective lesson, which could be shared and implemented by themselves or by other teachers in the future. This process produced various modes of instruction such as lecture, projects, activities, group work, and the use of technology.

Occasionally, content questions arose among some of the members. In these instances a just-in-time approach was used to rectify these deficiencies. This process resulted in improved instructional knowledge and pedagogy and overall effectiveness.

Throughout this process, the college mentors did not bring the teachers lessons or tell them how to teach. The college mentors were merely a support system and a resource. The high school teachers were the ones doing the work. As a result, the teachers took ownership of the process. This was evidenced by teachers putting their names on each assessment they created. This degree of ownership was important for lasting change and sustainability. Even after funding disappeared, these teachers continued with the lesson study process. To date, they are still working collaboratively, and they are still making positive impacts in their students' learning.

Findings and Discussion Related to Student Achievement

One of the main goals of this lesson study project was to raise student achievement in mathematics—specifically, geometry. In an attempt to determine the impact that the lesson study had on student achievement, data was collected from district benchmark exams and a one-way analysis of variance of means was performed on the benchmark scores of all 451 geometry students. The results revealed that

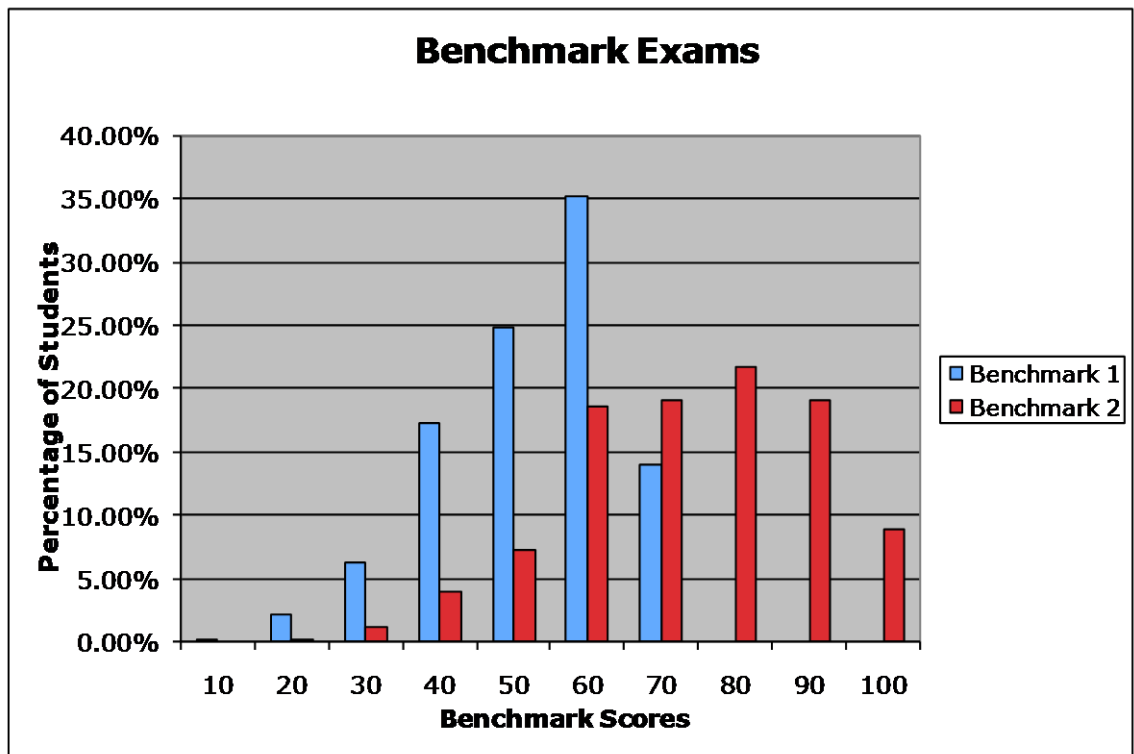
Teachers' Collaborative Use of the Lesson Study Approach to Foster Student Achievement in Geometry

the students whose teachers were in the lesson study groups scored significantly better ($p < .001$) than the students whose teachers were not in the lesson study groups.

The mean scores of the students of the teachers in lesson study groups increased from 51 percent to 72 percent. Plus, the only subject in the mathematics department that showed any improvement from the first benchmark to the second benchmark was geometry. All of the other benchmark scores decreased. The lesson study teachers were excited to share this finding. It was very empowering to them. This was a badge of honor to them.

Also, in doing the analysis, it was noted that there were some large jumps in the scores of the low-end students. On the first benchmark 51 percent of the students scored at or below 50 percent, while on the second benchmark only 13 percent scored at or below 50 percent. On the first benchmark 26 percent of the students scored at or below 40 percent and this dropped to 5 percent on the second benchmark. (See **Figure 1: Comparison of Benchmark Scores** below.) Thus, the data suggests that there was a significant impact on the low-end students.

Figure 1: Comparison of Benchmark Scores



Conclusion

The collaboration and reflection, informed by lesson study, inspired these high school geometry teachers to improve their lessons, engage their students and ultimately improve student achievement. These teachers were solely responsible for the improved student achievement since they created all of the goals,

lessons and assessments. Faculty mentoring was used only to foster a collaborative environment from which this all flourished. These teachers took pride and ownership of their students' achievement. They took responsibility for the standards that they had to teach and what the students actually achieved, and by early April they had covered all of the standards that were required for the year. This showed that teacher collaboration and active learning could actually take less class time and with improved results than lecturing.

References

- Boss, S. (2002). A closer look at learning. *Principal Leadership*, 2, 12-16.
- Fernandez, C., & Choskshi, S. (2004). Challenges to importing Japanese lesson study: Concerns, misconceptions, and nuances. *Phi Delta Kappan*, 85, 520-526.
- Fernandez, C. & Choskshi, S. (2002). A practical guide to translating lesson study for a US setting. *Phi Delta Kappan*, 84, 128.
- Viadero, D. (2004). In lesson study sessions, teachers polish their craft. *Education Week*, 23, 8-9.
- Wilms, W. (2003). Altering the structure and culture of American public schools. *Phi Delta Kappan*, 84,606-817.