Lesson Study and Middle School Science Teaching

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ABSTRACT

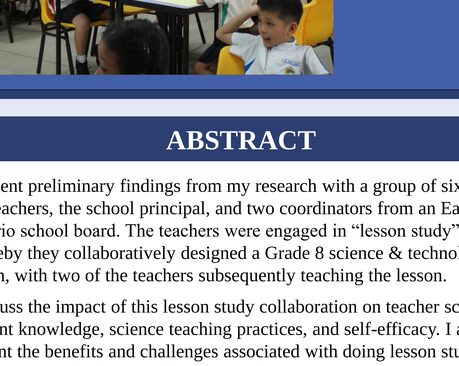
I present preliminary findings from my research with a group of six Grade 7-8 teachers, the school principal, and two coordinators from an Eastern Ontario school board. The teachers were engaged in "lesson study", whereby they collaboratively designed a Grade 8 science & technology lesson, with two of the teachers subsequently teaching the lesson.

I discuss the impact of this lesson study collaboration on teacher science content knowledge, science teaching practices, and self-efficacy. I also present the benefits and challenges associated with doing lesson study for the teachers, principal, and Board coordinators.

INTRODUCTION & PURPOSE

Research reveals links between (a) teachers' science content and pedagogical content knowledge, and self-efficacy, and (b) teacher effectiveness and student achievement in math and science (e.g. Bruce et al., 2010). Research also shows that elementary teachers often have poor science knowledge, that they hold misconceptions in all areas of science (e.g. Wandersee et al., 1994), and that they lack confidence in teaching science (Appleton, 1995). We need teacher professional development to improve science subject matter knowledge, teaching practices, and confidence in teaching science.

In lesson study, teachers work in groups to identify goals for student learning, develop lessons to meet these goals, teach the lessons while observing their impact on students, and reflect on and improve the lessons (Lewis, 2002). Lesson study is teacher-led, school-based, and focused on student learning, and incorporates characteristics important for effective teacher professional development (Loucks-Horsley et al., 2003). Lesson study has been shown to increase teacher pedagogical content knowledge and self-efficacy in math and science teaching (Puchner & Taylor, 2006).



Most lesson study research has been done in math, and there are few studies with Canadian science teachers. This motivated me to investigate the impact of lesson study on the science knowledge, teaching practices, and confidence of a group of Canadian middle school teachers. I worked with middle school teachers because these years are crucial for student science achievement and attitudes toward science. My project incorporates the benefits seen in previous studies (hands-on inquiry, teacher collaboration, and working with students), while collecting a wider range of data to better probe changes in teacher knowledge and self-efficacy.

My research questions:

(1) How does participation in a science-based lesson study project influence middle-school teachers' science subject matter knowledge, science pedagogical content knowledge, and self-efficacy in teaching science?

(2) What are the perspectives of grade 7-8 teachers, their principal, and Board coordinators on science-based lesson study, and what benefits and challenges do they associate with lesson study?

METHOD

Participants:

I recruited six teachers from a public elementary school in an Eastern Ontario school board. All taught either in grade 7-8, except for one who taught a 6/7 split, and another who was a P/J prep teacher. This was a relatively young group, with 3-10 years of teaching experience. Three teachers had a university science degree, while the others only had high school science. Some of the teachers had taken part in math professional development similar to lesson study, where they designed and taught a three-part math lesson in one day. The school principal, and the Board science/technology and research coordinators attended most of the meetings, and were also participants in this study. My role in the project was as researcher and facilitator.

Lesson Study Project and Timeline:

At the first meeting (Feb 7), I introduced lesson study and discussed the project. The group decided to design a lesson for the Grade 8 Structures & Mechanisms strand.

At the next meeting (Feb 28), I administered the STEBI instrument to assess initial teacher self-efficacy (Riggs & Enochs, 1990). The group decided to design a three-part lesson using a kit provided by the science coordinator. A rough draft of the lesson was developed, later written up by one of the teachers.

I carried out individual interviews with all teachers (Mar 7), to assess their science content and pedagogical content knowledge. In these interviews, I probed for conceptual understanding of forces, knowledge of student thinking, and strategies for teaching these concepts.

During the third group meeting (Mar 21), the draft lesson was discussed and refined, and decisions were made about who would teach the lesson, student groupings, the role of observers, and the video-recording of students.

The lesson was taught for the first time to a Grade 8 class on Apr 3. Afterwards, the group met to discuss and revise the lesson. The lesson was taught to a different Grade 8 class, by a different teacher, on Apr 10, again followed by a debriefing.

I carried out final interviews with the teachers and principal on Apr 11. I again administered the STEBI instrument, assessed content and pedagogical content knowledge, and asked the teachers and principal for their views on the benefits and challenges of lesson study. On Apr 24, I interviewed the two Board coordinators for their views on lesson study.

Sources of Data:

- Initial teacher questionnaires
- STEBI instrument to assess self-efficacy, pre-/post
- Interviews-about-instances to assess science content and pedagogical content knowledge, pre-/post
- Exit interviews
- Teacher reflections
- Researcher field notes and audio recordings of group meetings and interviews
- Video-recording of the teachings of the lesson

Data Analysis:

The STEBI instrument has been scored. The interviews, audio recordings, teacher reflections, and field notes will be transcribed and coded. The coded data, together with the STEBI data, will be used to look for changes in teacher science knowledge, pedagogical content knowledge, and self-efficacy. The data will also be used to determine teacher, principal, and coordinator perspectives on lesson study, and an inductive analysis used to look for other themes that emerge for the participants. All participants will be given pseudonyms that will appear in all transcriptions and publications. My interpretations and conclusions will be checked with the participants.

FINDINGS

Please note that the findings below are very tentative.

Teacher Self-Efficacy:

Riggs & Enochs (1990) propose that self-efficacy has two components: (1) *personal science teaching self-efficacy* (PSTE), a teacher's belief in his/her ability to perform required science teaching, and (2) *Outcome Expectancy* (OE), a teacher's beliefs about students being able to learn science given external factors such as family background, SES, or school conditions.

I used the STEBI instrument to look for changes in teacher self-efficacy before and after lesson study. Changes in self-efficacy were not large, and are probably not statistically significant. However, some interesting findings did emerge:

- The teacher with the lowest initial self-efficacy had the largest gain in overall self-efficacy and in OE, while the teacher with the highest initial self-efficacy had the largest drop in self-efficacy.
- The teacher showing the most leadership and commitment to the study had the highest final overall self-efficacy.
- The two teachers with the largest gains in PSTE were the two teachers who taught the lesson. This agrees with the well-known finding that *mastery experiences* are the most powerful influence on self-efficacy.
- The two teachers with the least teaching experience had the largest drops in PSTE.

Teacher Science Content and Pedagogical Content Knowledge:

Changes in teacher science CK and PCK were harder to assess, since the lesson was designed around a technology activity (constructing an apparatus to remove a coin from a jar), and not directly on a science concept. I based my interview questions on forces and simple machines, and found:

- Teachers were able to identify more forces acting on objects at rest (e.g. reaction force of ground, friction) afterwards
- Teachers were better able to identify a clothespin as a lever afterwards, and how a lever functions
- Teachers were better able to assess student thinking about forces and motion

Benefits of Lesson Study:

Teacher collaboration; having many eyes in classroom; teacher ownership of lesson; time for planning and reflection; seeing colleagues teach

Challenges of Lesson Study:

Time and money; being away from students; difficulty for teachers as observers; student reactions to observers

Emergent Themes:

- Nearly all teachers showed leadership at some point during study (volunteering to take notes, write lesson, teach lesson, etc).
- Group trust is important: group progresses faster, and participants are more comfortable critiquing each other.
- The importance of having the principal and coordinators as participants– they provided interesting perspectives on the benefits and challenges of lesson study, as well as valuable support.
- Importance of two implementations of the lesson, which highlighted the role of the teachers, their knowledge of students, and the students being taught.
- Importance of having teacher professional development align with the needs of board and school.

DISCUSSION

Teachers saw both teachings of the lesson as successful, in terms of student engagement, collaboration, problem-solving, and co-construction of learning goals.

This group of teachers also realized several benefits from doing lesson study, and would like to continue doing lesson study or similar professional development. At the same time, I have also identified several challenges associated with doing lesson study in a Canadian context.

Several questions arise, including:

- How reproducible is lesson study?
- What is the impact of: who teaches the lesson? the students being taught to? the group of teachers doing lesson study?
- How would lesson study unfold with a different group of teachers, a different school, and different administrators?

Clearly further studies are needed!

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