

*Full Length Research Paper*

# Mathematics teachers' engaging in a lesson study at virtual settings

Ayfer Budak

Erzincan University, School of Education, 24030, Erzincan, Turkey. E-mail: [aybudak@gmail.com](mailto:aybudak@gmail.com).  
Tel: +90 (446) 224 0089. Fax: +90 (446) 223 1901.

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**This study investigated how involving in a lesson study process at virtual settings impacted participating teachers' knowledge. The two elementary mathematics teachers, teaching in two public elementary schools at distant cities and meeting occasionally face to face and regularly at virtual settings formed the sample of this study. Neither of the teachers had any math teacher colleague they can collaborate in improving their instruction or their own knowledge. Teachers developed seven reform-based math lesson plans during one semester of a school year. They followed every step of lesson study, except they had to adapt the observation phase due to long distance between them. The teachers could not observe each other's teaching. They had to rely on the reflections of their colleagues about how the lesson went at the observation stage. The data were collected through teachers written responses to three open ended questions and written reflections after each math lesson. The data is categorized based on the commonalities of teacher statements. The results of this study suggest that lesson study is an effective professional development model in improving their knowledge even for the teachers who cannot talk face to face and observe each other's classroom.**

**Key words:** Professional development, lesson study, teacher knowledge, elementary mathematics teacher, online communications, technology use.

## INTRODUCTION

The impact and effectiveness of traditional professional development seminars and workshops around the world have been increasingly questioned by the teachers, teacher educators, and researchers (Fullan, 1995; Huberman, 1995; Wilson and Berne, 1999). The main source of dissatisfaction is that these seminars do not provide enough of a contribution to students' learning. Countries who wish to improve their students' learning, especially the countries, including Turkey, whose children's success on the international large-scale assessments such as Trends in International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA) below the international average or the top-ranking countries, are in the search of different professional development models to increase and adapt their teachers' knowledge to the needs of rapidly changing world.

Consequently, many countries examined the schools, instruction methods, and professional development models of top ranking countries on the TIMSS and PISA. Japan is one of the high ranking countries on the international large-scale assessments. In the past two decades, the success of Japanese students on these large scale assessments has led the researchers to study the Japanese education system, mainly their professional development model, 'Japanese lesson study'. One of the outcomes of those studies is to try out the Japanese lesson study, in their home country. Particularly, in the United States, it has been highly implemented by the teachers and studied by various researchers (that is, Choski and Fernandez, 2004; Fernandez, 2005; Lewis, 2000). However, it is a highly new construct for the researchers, the teacher educators, and teachers in Turkey.

In Seferoglu's (2001: 17) study of elementary teachers' views' about their own professional development, participating teachers recommended a professional development model very much like Japanese lesson study, in which they can partner with another teacher and "discuss professional issues and problems they faced in the classrooms, exchange ideas in developing educational materials, develop lesson plans, implement variety of class activities together, and teaching in each other's classes". This shows that what teachers ask or need is not a one time or occasional professional development seminars, but a more frequent and ongoing collaboration with their colleagues in planning and implementing lesson plans and solving issues faced in their own professional life.

In Turkey, teachers' in-service training or professional development has been done through in-service education seminars by the In-service Training Department run by Ministry of National Education (MNE). The seminars offered by MNE were found to be highly insufficient, and most of the time low in quality in helping teachers improve their teaching skills or knowledge of students' learning (Ozdemir, 1997; Seferoglu, 2001). With the introduction of reform-based mathematics program at schools in 2005, mathematics teachers of Turkey particularly need support in teaching student-centered, or reform-based mathematics. The Japanese lesson study can be a better response to this need in helping teachers build knowledge of newly introduced content, materials, and alternative assessment methods as opposed to regular seminars or workshops led by a third party. Rather than hearing from an outside expert talk about an ideal situation or a new method, teachers can shape their own learning according to their interests and needs (Taylor et al., 2005). Lewis (2009) divides teacher learning during lesson study into three categories: development of knowledge (content, students' thinking and misconceptions, etc.); development of interpersonal relationships (development of relationships among teachers); and development of personal qualities and dispositions (such as curiosity and skepticism).

Lesson study is a collaborative professional development model that "has a long history in Japan as a shared professional culture with potential for enhancing learning, enriching classroom activities and transforming the school environment" (Arani et al., 2010: 171). It is a cycled process, in which teachers may repeat a stage or the whole cycle. Different studies list different lesson study cycles (that is, Chassells and Melville, 2009; Lewis, 2009; Taylor et al., 2005), but they are all expanded around the three cycled model: planning/revising, teaching/observing, and discussing (Lewis et al., 2003).

This study followed the three cycled model with the exception of observation step due to the fact that the teachers in this study were in two different cities of Turkey. Therefore, this stage was completed through

classroom teachers' own observations, and then reflections through online chat programs or e-mail exchanges.

### Objectives of the study

This study is an adaptation of lesson study in two aspects that: the study did not include observation of lesson by the team member; and the teachers completed most of the lesson study cycle at a virtual setting. Within the scope of this research, three research questions were investigated:

1. How did the lesson study impact teachers' teacher knowledge?
2. How did the lesson-study teachers use the technology?
3. What conditions must be met to form more effective lesson study?

### METHODOLOGY

This research is a qualitative case study in which two teachers' experiences of a 'new' professional development through online communications were reported.

### Sample

The two elementary mathematics teachers, teaching in two different public schools at a distance and meeting occasionally face to face and regularly at virtual settings formed the sample of this study. The teachers, one male and one female, who were both teaching in grades 6 to 8 in two urban village schools of two different cities in Turkey. Both teachers were the only mathematics teachers of their school at the time of data collection and had no math teacher to collaborate planning mathematics lessons. Both of these teachers were taking a graduate level course in which the author was the instructor.

As part of this course, they read research articles on teacher collaborations around the world, including Japanese lesson study, and developed math activities for grades six through eight. The teachers were assigned to do a small scale lesson study. As part of this assignment, the two teachers met face to face once every other week and scratch a draft lesson plan, and went back to their schools and kept meeting regularly to continue the process through online chat programs, and e-mail exchanges. The selection of topics for lesson plans were made based on the topics the teachers had hard time to teach or on the topics that were hard to understand by the students (Lewis, 2002).

### Procedure

The teachers developed seven lesson plans at one semester. All the lesson plans were prepared student-centered where students were very active on working math activities. The first two lesson plans were used to train the teachers to show how they will collaborate, what they should observe, how they can work more productively, etc. The student outcomes, misconceptions and all

other issues raised during other five lessons were discussed partly face to face and mainly through online communications.

The team developed a lesson plan first, and then one of the teachers implemented it in his or her classroom and shared his or her observations on the internet with his/her teammate. The lesson plan was revised based on the reflections of the first implementing teacher, and then the plan was reimplemented in the second teacher's classroom. Again, their own reflections about how the lesson went, what the students learn, what problems they faced etc., were shared through internet communications.

The lesson plans were implemented one day apart. The re-implemented lesson plan was revised again based on online discussions. The observation of the implemented lesson plan, one step of regular lesson study (Chassells and Melville, 2009) could not be completed by both teachers due to a long distance between their schools and their homes.

### Data collection and analysis

The data were gathered through teachers' written reflections on the lesson plans and on open-ended questions about their collaborations at the end of the semester.

Analysis of the data was done qualitatively. In the analysis of the first research question, Lewis' (2009) model was used to categorize teacher learning. For the rest of the research questions, teachers' statements were grouped into categories and for each category participants written responses were given as example.

## RESULTS

In this study, an alternative professional development method, Japanese lesson study, was tried out by two elementary mathematics teachers at virtual settings over the course of a semester. Table 1 shows what lesson study teachers think about their collaborations and how the lesson study impacted their knowledge. Teachers' statements were grouped under three categories: knowledge, interpersonal relations, personal qualities and dispositions. The brackets and the dots between the quotes were added.

Table 1 indicates that teachers' collaboration on planning math lessons improved teachers' knowledge of students, ability to prepare better math activities, communication skills, and self confidence. The following their brainstorming with his teammate on ideas impacted their creativity.

On *Calculating the Volumes of Solids in Class* activity, I really like it when [male teacher] said that we can also calculate the volume of classroom. In lesson study, when you discuss and brainstorm on an idea, very different and good ideas can emerge. Perhaps, you can not be this much successful when you work alone...when we both constantly and mutually generate ideas, this enhanced our creativity.

Another excerpt from the female teacher shows how the activities teachers developed were successful in motivating her students and frequent communications and discussions minimize the problems they face in the

classroom.

On *Making a Triangular Cake* activity, I saw that this type of activities could be helpful in gathering the interest of students who have lack of interest in this course. The irony is that the students who thought to be not successful completed the activity, At the end of the lesson, students' stating that they had a good time and had fun made me happy. Even after the activity, a few students continued to ask questions and explain. Therefore, I saw that these kinds of activities need to be done for sure. Exchanging information before and after the implementation of activities with my colleague made the lesson more efficient. In fact, I have seen that if we stay in constant communication we to minimize the problems we face.

Teachers in this study completed the steps of lesson study cycle through online communications. Therefore, the teachers were asked to report about their use of technology in this process (Table 2). Four categories emerged from their written reflections: communicating, recording communications, researching, and developing and presenting materials. In other words, the teachers excerpt from the female teacher's reflection shows how used the technology, to communicate with the other lesson study team member, to record their online discussions, to research about the activity they plan to develop, and finally develop class materials and present them to the class. Teachers reported that while being able to express their ideas freely was an advantage of online communication, leading some misunderstandings between the two parties was a disadvantage of it.

The teachers were asked about the conditions that need to be met in order to form more effective lesson study. Table 3 shows the three categories emerging from teachers' written statements: lesson study group members, students, and control and dissemination. The teachers reported mostly about the quality and quantity of group members to form an effective lesson study. They suggested that the lesson study group should be formed by the teachers who live in the same city; who can work collaboratively, who have some years of teaching experience, who are open to discuss their ideas, and who believe in the benefits of the study, etc. The teachers also believed that this process should be disseminated to more teachers through Ministry of Education and this process should be controlled by experts.

## DISCUSSION

This study investigated how the involvement of a lesson study impacted two teachers' knowledge living in distant cities; their use of technology; and their thoughts about the requirements needed to form more effective lesson study groups. The results of this study suggest that lesson study is an effective professional development

**Table 1.** Impact of lesson study on participating teachers' knowledge.

Category	Quotes from teachers' reflections
Knowledge	Teachers can go to class better prepared....Activity-based lesson plans were created....Teachers learn what to have students gain....Teachers can estimate and take actions towards what students can say and do based on teachers' discussions....It [LS] will have a great impact on their [teachers'] professional development....We were doing brain-storming... and that was developing our creativity. <i>(Female Teacher)</i> The teachers who have concerns on how to teach more efficiently can find answers by using the experiences of other teachers. <i>(Male Teacher)</i> Based on the ideas that were put forward by the team, teachers can develop activities suiting to their students. <i>(Both Teachers)</i>
Interpersonal relations	The sense of confidence has dramatically changed my dialogues with other people. <i>(Female Teacher)</i> The first thing the teacher will gain is communication....When the team members find your ideas favorable, that leaves a positive impact on you. <i>(Male Teacher)</i>
Personal qualities and disposition	With the impact of producing something and of being appreciated by the team increases your self-confidence....The activity you have prepared on a topic, especially your students had trouble with, and when that activity yields to a desired result, it gives you happiness. <i>(Female Teacher)</i> Teachers' doing something for their students outside of class gives them a pleasure and happiness. <i>(Both Teachers)</i>

**Table 2.** The participating teachers' use of technology in lesson study process.

Category	Quotes from teachers' reflections
Communicating	Some people who can not express themselves [face to face] can talk on the internet more freely....Sometimes our communication [through internet] led to misunderstandings. <i>(Female Teacher)</i> I have communicated with the other teacher mostly through internet. <i>(Male Teacher)</i>
Recording communication	Since we communicated through internet we did not have to take extra notes. <i>(Male Teacher)</i>
Researching	We obtained the required information about the content and the details of the study through internet. <i>(Male Teacher)</i>
Developing, and presenting materials	Technology provided a huge benefit in the creation of materials, in class presentation, to prepare the outputs to distribute each student group. <i>(Female Teacher)</i>

model even for the teachers who cannot talk face to face and observe each other's classroom.

Lesson study in the literature has been tried out with preservice teachers at the same university (Pothen and Murata, 2007) or with the inservice teachers usually teaching at the same school or at least teaching at the same or close by school district (Lewis et al., 2003). However, doing lesson study with teachers living at two different cities is not a type of study we see frequently in the literature. Besides, due to long distance, teachers in this study had to rely on their team mate's reflections about their teaching because they did not get a chance to observe their teammate's teaching. This approach, conducting lesson study at virtual setting, is particularly

valuable approach for teachers who is the only math teacher of the school and have no other teacher close by to share ideas and work together to improve their instruction.

Based on Lewis (2009) categories of teacher learning during lesson study, the lesson study impacted teachers' knowledge of creating reform based activities and lesson plans, knowledge of student abilities and thinking; improved their abilities to communicate with other colleagues; and improved their personal qualities such as motivation, and self confidence. Teachers' brainstorming on ideas (Kerridge et al., 2009); sharing strategies, products and experiences (Helms et al., 2005) helped them improve not only their pedagogical content

**Table 3.** Conditions required in forming more effective lesson study groups.

Category	Quotes from teachers' reflections
Lesson study group members	<p>...should be selected among the people who can work collaboratively.... Eares must be wide open to receive information.....should be aware that their purpose is to know how to teach more effectively and how we could be more useful to our students... should be open to criticism ...should feel free to openly express their thoughts ...should have people feel that your ideas are important... should build healthy dialogues and should not forget the purpose of meeting and stay on task... be information receiver and away from being domineering...be connected to the group and able to act collectively.. For a better interaction, the number of teachers in a lesson study group should not exceed a certain number....The group must be formed by the teachers on the basis of voluntary. The teachers should build healthy dialogues and should not forget the purpose of meeting and stay on task (<i>Female Teacher</i>)</p> <p>...should be living in the same city...[And] should be aware that the type of benefits study provides both to them and to their students In order to get more effective results from lesson study, first, the group should believe in the necessity and importance of lesson study. Teachers must have at least 2-3 years of professional experience. Because a starting new teacher may not know or determine what difficulties students may experience in learning a topic. (<i>Male Teacher</i>)</p>
Students	The levels of students of the lesson study teachers must be close to each other. ( <i>Female Teacher</i> )
Control and dissemination	<p>Ministry of Education should direct more teachers to use this method....The teachers' use of the method must be controlled by the specialists. (<i>Female Teacher</i>)</p> <p>Implementing in my own class, I might have missed somethings. Obviously, observations or criticisms of my colleague would have been more useful. (<i>Male Teacher</i>)</p>

knowledge but also their self-confidence and happiness.

Results about the use of technology suggest that teachers used technology for several purposes: communicating, recording communications, researching, and developing and presenting materials. Meeting at virtual settings saved teachers extra time in recording their communications (Chang and Lee, 2010), sharing and developing materials and made them feel more comfortable in expressing their ideas. Although the teachers reported to have teachers live in the same city for more effective lesson study, in order to "foster the growth of social as well as professional skills" of teachers who live in different cities or countries, conducting a lesson study through online communications can be a better choice (Francescato et al., 2006: 173).

Teachers' suggestions about forming effective lesson study groups were grouped into three categories: the lesson study group members, the students, and control and dissemination. Results suggest that teacher characteristics are the most important features of forming a lesson study group. In addition, the teachers must be in close distant, have some years of experience, open to new ideas, and respect each others' ideas, and believe that this method can be beneficial both to them and their students. Teachers in this study recommended that teachers' use of lesson study must be controlled by experts. This is a valid recommendation because, in Perry and Lewis (2003) study, outside specialists were incorporated to teach teachers how to collaborate on

every step of the lesson study and participating teachers reported that the outside specialists helped them to think differently about the assumptions behind their teaching.

Based on the data, the study recommends that lesson study can be an effective way of professional development for teachers who live in distant cities and do not have enough academic support. Ministry of Education in Turkey should support and encourage teachers to form lesson study groups to help them adapt to new reform-based mathematics curricula. In line of the results of this study, further research is needed in which a researcher or the partner teacher observe the lesson created through online communications. Finally, teachers' online communications should be analyzed to investigate the sources of success and failure in creating better lesson plans and having healthier dialogues.

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