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Effect of the Lesson Study Practice on Students' Academic Achievements in Life Sciences Course

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Abstract

The aim of this research is to examine the effect of the lesson study practice on the academic achievements of primary school students in the Life Sciences Course. The study was performed with quantitative research method by using a quasi-experimental design, namely, the pretest-posttest control group design. The research was conducted with the participation of six primary school teachers and 167 third-year students who were enrolled at six different sections in two different primary schools at the center of Ağrı province of Turkey. The participants were selected through purposive sampling method. As the data collection tool, the academic achievement test which was prepared by the researchers was utilized. The practice of the lesson study took seven weeks and was performed in the context of achievements referred to in the Life Sciences Course Instruction Program in relation to 'Life at Our Home' unit. At the primary school with relatively low socio-economic and academic achievement levels, there was an increase in the academic achievements of the experimental groups in association with the practice of lesson study whereas there was no statistically significant difference in the control group. At the primary school with relatively high academic achievement and socio-economic levels, there was a statistically significant increase in the academic achievements of both the experimental groups and control group. Upon the analysis of research findings, it was found that there was a significant improvement in students' academic achievements in association with the practice of lesson study practice particularly at schools with low level of academic achievements.

Keywords: Lesson Study, Professional Development, Primary School Teacher, Life Sciences Course

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Introduction

The need for good quality education and instruction required that teachers as the primary building blocks of the education systems should continuously take part in in-service education activities. Lalitha (2005) defines the teacher education as activities organized for developing teachers' knowledge base, skills and understanding for the purpose of enhancing their thinking and classroom behaviors. Guskey (2000) perceives it as a continuous and systematic process which is consciously designed and aspires to enhance the individual's professional knowledge, skills and attitude with a view to improving students' learning outcomes. During professional development activities performed at schools individually and in groups, teachers transform the school into a learning setting collectively in a cooperative environment through efforts to reach certain results, exchange information, find common solutions to problems, overcome communication challenges, solve school problems and so on (Köşterelioğlu & Akın Köşterelioğlu, 2008). Lieberman (2000) stated that the professional development was an integral part of the daily school life and there should be continuity in professional organizations. A good quality professional development process will enhance the quality of teacher's practical activities and subsequently will have positive effect on the learning process of students (Borko, 2004).

In this conjunction, professional development models were put forward for raising the quality of education and instruction and accordingly for developing teacher qualifications. Departing from teachers' competencies in content knowledge, professional knowledge and pedagogical content knowledge, it is discerned that professional development models recommended for teachers are concentrated on a highly broad area such as fundamental goals of education, structure of the instruction program, instruction materials and equipment, technology and technological materials, students' perception, achievement and learning styles and the atmosphere of the instruction setting (Kop, 2003; Tekin, 2004; Gaible & Burns, 2005; Yadigaroğlu, 2014; Kaleci, 2018; Meral Kandemir, 2018; Yar Yıldırım, 2018). One of these professional development models is the 'Lesson Study' which emerged in Japan (Yoshida, 1999) and became popular across the world today.

Lesson study is the literal translation of the Japanese word *jugyokenkyu* to English. *Jugyokenkyu* is formed of the combination of the Japanese words *jugyo* (lesson or instruction) and *kenkyu* (studying or researching) (Lewis, 2000). In English resources, it is expressed as 'Lesson Study' or 'Research Lesson' (Murata & Takahashi, 2002; Fernandez, 2002; Lewis, Perry & Murata, 2006). As per the literature review, the concept of lesson study was used in Turkey in 2008 for the first time (Eraslan, 2008). When the lesson study is literally translated into Turkish, its literal translation does not exactly correspond to the lesson study. As the teachers exchange information by coming together as a group and prepare a course plan in cooperation with each other under this

practice, it brings the concept of 'collective work' ("imece" in Turkish) to mind. That is why, the concept of 'Lesson Study' is termed as 'Collective Work for the Course' ("Ders İmecesi" in Turkish).

Lesson study was implemented in Japan as of the 1960s onwards until today in both in-service training programs and undergraduate and graduate schools for the purpose of developing the content knowledge (Fernandez & Yoshida, 2004; Takahashi & Yoshida, 2004). In the USA, Fernandez and Yoshida performed the study lesson practices for the first time in consultation with Stigler in Los Angeles in 1994 (Fernandez & Yoshida, 2004). In this respect, the lesson study became even more popular across the world together with the book co-authored by Stigler and Hiebert, '*The Teaching Gap: Best Ideas From the World's Teachers for Improving Education in the Classroom'* (Stigler & Hiebert, 2009), and was studied by researchers in different countries for the last two decades and found areas of practice in different cultural contexts as a new professional development approach (Lewis, 2000; Takahashi & Yoshida, 2004; Lee, 2008; Isoda, 2010; Murata, 2011; Bütün, 2012; Ylonen & Norwich, 2013; Karadimitriou, Rekalidou & Moumoulidou, 2014; Cumhur, 2016; Shimizu, 2019; Sato, Tsuda, Ellison & Hodge, 2020).

The lesson study is a comprehensive and well-structured process which comes to the forefront for promoting the professional development of teachers in relation to the development of teaching practices (Fernandez, Cannon & Chocksi, 2003). It is an approach in which teachers plan the instruction process as a group for a common goal and make evaluations by carrying out this process together (Fernandez & Yoshida 2004). As for Lewis (2002), it is a long-lasting professional development activity which extends over a certain time period and in which teachers move towards a common goal. As well as supporting the professional development of teachers by allowing them to work in cooperation, it is an approach which is effective also in combining the theory with practice (Murata, 2011). As noted by Takahashi and Yoshida (2004), it is a cyclical professional development approach which is based on cooperation, respect for ideas and collective production and in which the instruction process is collectively planned and practiced and the process of the lesson is monitored and evaluated so that teachers or prospective teachers can ensure that the students obtain the most ideal and effective outputs. Yoshida (1999) asserts that the lesson study is a professional development approach which is exercised in groups, develops ideas about how a good instruction will be and focuses directly on developing instruction activities and on student learning in discussions. The lesson study is the name of the professional development process in which systematic and cooperative in-class practices are analyzed and revised (Murata & Takahashi, 2002). While professional development programs are in general organized as response to teacher needs, the lesson study can be defined as the entire set of processes which are planned solely on the basis of student learning and in which participant teachers are cognitively, socially, affectively and kinesthetically developed.

By working on a series of lessons collectively, teachers get involved in planning these lessons, and implementing, observing and evaluating them in the real classroom setting in the context of the lesson study (Lewis & Tsuchida, 1997; Fernandez & Yoshida, 2004). Yoshida and Jackson (2011) designated the stages of the lesson study process as the preparation of a detailed lesson plan, participants' observation of the practice of the lesson and, following the observations, discussion on learning and instruction aspects of the lesson. Even if the modes of practice of the lesson study vary on the basis of the cultural differences, the fundamental stages and elements of the process do not change (Murata, 2011).

Lesson study activities begin with the meeting of teachers for planning the lesson and specifying goals which will ensure that students learn and are developed (Fernandez & Yoshida, 2004; Lewis et al., 2006). The lesson study groups are in general comprised of three to six teachers from the same branch of study (Cerbin & Kopp, 2006; Back & Joubert, 2011). In the planning stage, teachers read books and articles about the topic of the lesson which they prepare (Weeks, 2001), and exchange ideas about how they can most effectively plan the lesson upon examining their previous observations on students, teacher manuals, course books and other books relevant to the lesson (Fernandez & Yoshida, 2004). At this stage, points which the students have difficulty in learning, likely errors, students' answers and reactions should be predicted in advance, student's style of thinking should be taken into consideration, and solutions to these situations should be developed and instructional measures should be taken by teachers (Fernandez & Yoshida, 2004; Ono & Ferreira, 2010; Murata, 2011). Besides, teachers have exchanges also about instruction strategies which serve their goals in relation to the lesson which they prepare (Fernandez, 2002). In the instruction of the topic, it is essential that teachers know and identify what type of materials they will use and what type of methods are recommended for the instruction of the topic. A well-planned relationship between the topic and its content is essential to the effective execution of the lesson study practice (Takahashi & Yoshida, 2004). It is asserted that experts called 'knowledgeable others' partake in the lesson study activities, and these experts help teachers go beyond their borders in terms of content, instruction program and instruction knowledge and form a deep understanding, and they also support teachers in the planning stage (Lewis & Tsuchida, 1998; Yoshida, 1999; Takahashi & Yoshida, 2004). It is stated that, as these experts offer guidance when discussions come to a deadlock and sometimes raise new questions for discussion, the productivity of the lesson study process is enhanced (Takahashi, 2013; Takahashi & McDougal, 2016). The first stage of the lesson study is concluded when the lesson plan which is prepared in a detailed format and on which all participants agree is in place (Fernandez & Yoshida, 2004). This stage was characterized as the lesson planning stage in which lesson goals and data collection plan were in place, which contained predictions about student thoughts and in which instruction approach and instruction materials were specified (Lewis et al., 2006). Rather than making

a very good plan, the primary goal of this stage is to create a plan which will assure that students better understand the lesson (Murata, 2011).

After the lesson plan is prepared, implementation of the lesson plan in the classroom comes next. The course which is practiced in the classroom is called 'research lesson' (Lewis, 2002). When one of the teachers from the group teaches the lesson in the classroom, the remaining teachers observe the students and take notes (Fernandez & Yoshida, 2004; Lewis et al., 2006). Observer teachers take detailed notes about the lesson by using the lesson plan and other documents (observation form, worksheet and so on.) which were previously prepared (Fernandez, 2002; Lewis, 2002; Fernandez & Yoshida, 2004). At this stage, observing teachers evaluate the answers given by students, examine to what extent the goals of the lesson are reached, take note of the unexpected situations and student behaviors and gather facts about students' learning, thinking and class participation (Fernandez & Yoshida, 2004; Hart, Alston & Murata, 2009). The focal point in observations in the implementation stage is not the teacher who teaches the lesson, rather, it is the instruction activities which are prepared collectively by group members and responses which are given by students to these activities (Takahashi & Yoshida, 2004; Saito, 2012). As per Cerbin and Kopp (2006), the focal point of the observation should be how students learned the lesson, not what students learned. During the lesson, the observers avoid having communication for any instruction or help with the teacher and students who are occupied with the lesson (Takahashi & Yoshida, 2004; Doig & Groves, 2011). Research lesson is recorded by the observers by means of observation notes, video records, photos, audio records, student works and so on (Weeks, 2001; Lewis, 2002). Instructors from out of the group (teachers, academicians, school administrators and so on.) can also be invited by group members to this lesson (Doig & Groves, 2011). Murata (2011) characterized this stage as the stage of observing the lesson and gathering data about the learning and development of students. In the context of the lesson study, observer teachers have the chance to observe situations which they are unable to observe when they teach the lesson themselves and which give ideas about how students think, how students react, what students talk with each other about and under what circumstances students are confronted with setbacks and so on (Lewis, 2000).

In the last stage of the lesson study, teachers in the group come together for evaluating the lesson which they observed. This stage is called as reflection and development by certain researchers (Lewis & Tsuchida, 1998; Weeks, 2001). Teachers share their observations, criticisms and recommendations in relation to the lesson (Fernandez & Yoshida, 2004; Doig & Groves, 2011). If possible, this meeting is held on the same day in the classroom where the research course is practiced. Thus, the participants are enabled to remember and express their observations regarding the lesson more easily. (Yoshida, 1999; Takahashi & Yoshida, 2004). First of all, the teacher who taught the lesson as per the plan makes evaluations. Points on which the plan succeeded and failed are discussed,

and what the problems are is identified. Subsequently, other teachers also express their views by relying on their observations (Lewis, 2000; Takahashi & Yoshida, 2004; Doig & Groves, 2011). Guest observers' evaluations, if any, on the lesson are received following the group members (Doig & Groves, 2011). Not the teacher who teaches the lesson but the research lesson itself is at the center of discussions to be held. In other words, the goal of the discussion is not to present feedback or recommendation to the teacher who teaches the lesson but to exchange views and recommendations as to how to develop the research lesson (Takahashi & Yoshida, 2004; Doig & Groves, 2011; Saito, 2012). Teachers make changes in the plan by taking into consideration the problems encountered in the practice of the plan. In general, necessary changes are made by paying attention to student misunderstandings which are noted down during observations (Weeks, 2001). Murata (2011) described this stage as reflecting the thoughts on the lesson by means of utilizing the collected data. Also, this is the stage which provides knowledge and experience essential to the next cycle of the lesson study. After the discussion of the lesson, certain groups can put an end to their efforts if they wish to do so. Besides, occasionally, joint decisions which are made during the evaluation of the lesson are reflected on a new plan, and preparations are put in place for repeating the lesson in a different section of the class.

After the end of the evaluation stage, teachers have the renewed version of the lesson plan which is based on classroom observations and includes all changes in the original plan (Fernandez, 2002). Another teacher from the group practices the renewed plan in his/her classroom. Other group members attend again the lesson in order to observe this renewed practice of the lesson (Yoshida, 1999; Weeks, 2001 Fernandez, 2002; Fernandez & Yoshida, 2004). Having different teachers and students provides teachers with more comprehensive knowledge and experiences. By coming together once again, teachers make evaluations and exchange views on the lesson which is prepared and practiced according to the renewed lesson plan. In this meeting held in a format similar to the first one, group members and, if any, other observers submit their views and have a discussion on differences observed in the second practice of the lesson, reasons for these differences and effectiveness of the changes made in the lesson plan. In general, there is scarcely any group that prefers to prepare the same lesson again for a third time. In practice, this is also highly unlikely due to time pressure as the next lessons in the curricula should be taught. The process comes to an end with an updated lesson plan which reflects all changes which group members agree to make in the research lesson (Fernandez & Yoshida, 2004).

In a nutshell, the first stage of the lesson study which begins with setting the goals is completed with the production of a detailed lesson plan by virtue of teachers' intensive efforts and the cooperation between them. At the second stage, the lesson plan is practiced in a classroom in which one of the teachers in the group is responsible for teaching. During the implementation stage, other

teachers make observations and take notes on student learning and on the effect of the practice. Lastly, after the implementation stage, teachers discuss and make evaluations on the plan. Shortcomings of the plan and certain aspects in need of revision are identified, and the lesson plan is reorganized.

Lesson study is an approach which aspires to raise the student achievement by improving instruction practices (Novakowski, 2006, cited by Meral Kandemir, 2018). Although it stems from the idea that teachers learn through the instruction process, its aim is to facilitate the student learning rather than teacher's professional development (Isoda, 2010). The lesson study process assures that teachers focus particularly on students' learning processes (Yarema, 2010). Moreover, the practice which supports student-based approaches allows students to be active throughout lessons (Baki, 2012). Students are at the core of all activities of the lesson study (Takakashi & Yoshida, 2004). Lesson study is a professional development activity which places the student at the center and incorporates the activity-based instruction (Fernandez, 2002).

Upon the review of the relevant literature, it is discerned that there are several studies which explore the effect of lesson study practice on teachers from different perspectives. The main goal of a professional development program should be to enhance the instruction quality and hence to contribute to student development. In this context, this study aimed to examine the effect of lesson study on students' academic achievements in the framework of 'Life at Our House' unit of the Life Sciences Course. The lesson study approach practiced in this research is also important in terms of providing teachers their professional competencies in a learning organization that will support each other, apart from in-service training. By coming together of teachers to increase the educational quality in schools, and presenting the results of taking responsibility in decision processes with experimental data will contribute to the literature.

Method

Research Design

In order to evaluate the effect of lessons, which were prepared with the lesson study, on the student achievement, this study utilized the pretest-posttest control group design which was categorized under the quasi-experimental designs within the context of experimental studies which had quantitative approach. Quasi-experimental models are preferred in cases when controls necessitated by experimental models cannot be put in place or sufficiently practiced (Karasar, 2016). In this design, experiment and control groups are selected from previously-created groups. As the random assignment cannot be used in the selection of experiment and control groups, this process is called quasi-experimental design. Pretest-posttest designs are the preferred method to compare participant groups and measure the degree of change occurring as a result of treatments or

interventions (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz & Demirel, 2012). The design of this research was shown in Table 1.

Table 1. Research Design used in Research

School	Group	Pretest	Process	Posttest
School A	Experiment A1	UAT	Lesson Study	UAT
	Experiment A2	UAT	Lesson Study	UAT
	Control A	UAT	Standard Instruction	UAT
School B	Experiment B1	UAT	Lesson Study	UAT
	Experiment B2	UAT	Lesson Study	UAT
	Control B	UAT	Standard Instruction	UAT

UAT: Unit Achievement Test

Participants

Participants of this study was composed of six primary school teachers (n=6) and 167 third-year students (n=167) who were enrolled at six different sections in two different primary schools at the center of Ağrı province of Turkey in the school year of 2019-2020. Purposive research method was conducted in this research (Büyüköztürk et al., 2012). While selecting the study group, firstly, necessary permissions were obtained from the National Education Directorate of Ağrı Province, and then, 21 schools with characteristics deemed eligible for being covered by the research (to have minimum three third-year sections) were selected by the researcher from among schools in the list received from the National Education Directorate of Ağrı Province. Later, meetings were held with the principals of 21 schools that were on the list. At the end of these meetings, eight school principals refused to host the study whilst thirteen school principals agreed that the researchers could meet third-year teachers to introduce the study. During the meeting with the classroom teachers, the stages of the lesson practice, how long these stages will take, the time interval of this study, the scope of the subject, and how to hold other meetings with the teachers in the coming days, were mentioned. In short, after the introduction of the research procedure, teachers were informed that the participation in the research was on a voluntary basis. At the end of the meetings, three schools from which three teachers would voluntarily participate in the research were identified. From among these schools, two schools were selected for conducting the research by paying attention to certain aspects such as the socio-economic level, perception of success level across the province and geographical location within the province. School A, located in the suburb of city, was choosen as a school with a low socio-economic and success level; School B was choosen as a school with a high socio-economic and success level. The principle schematic diagram of study group is as shown in Figure 1.

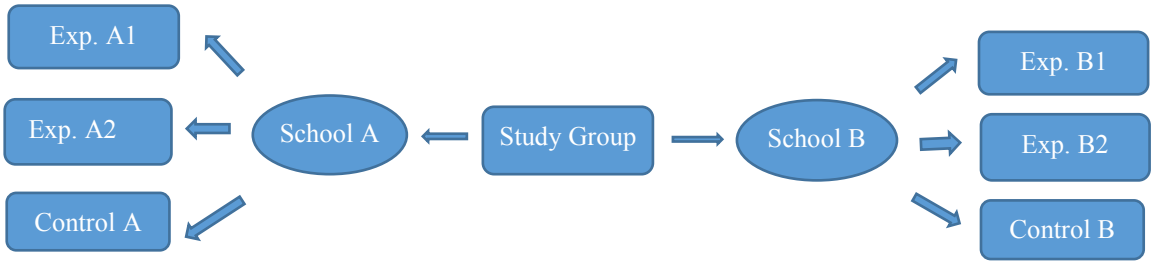

Figure 1. Study Group

Socio-economic levels of School A and School B are as shown in Table 2.

Table 2. Socio-economic characteristics of students of School A and School B

Income Level of the Family			Mother's Education Level		Father's Education Level	
Level	School A %	School B % Level	School A %	School B %	School A %	School B %
Very Low	5	0.0 No education	30.4	4.4	10.7	0.2
Low	30	6.2 Primary Sch.	65.0	46.9	72.8	22.0
Medium	50	37.4 High School	4.6	28.5	15.0	37.4
High	12.5	51.6 Undergraduate	0.0	18.8	1.5	36.6
Very High	2.5	4.8 Master Progr.	0.0	1.4	0.0	3.8

Data Collection Tools

The achievement test which was prepared by researchers in relation to 'Life at Our Home' unit of the Life Sciences Course was utilized as pretest and posttest practiced for the purpose of identifying students' academic achievements. The Life Studies Instruction Program was examined for the content validity of the prepared achievement test, and 28 multiple-choice questions were prepared to measure the relevant achievements. These questions were practiced in written format to twelve randomly-selected third-year primary school students in Hamur district of Ağrı province, and students were invited to ask their teachers about the questions which they failed to understand, and in the end, the feedback that each question was understood by students in accordance with the purpose of tentative question proposals was received from students. Steps were taken to receive the opinions of experts (measurement-evaluation and program development) on 28 questions, and four questions were excluded from the achievement test and necessary changes were made in certain questions as per the expert opinions. Table 3 indicates the targeted achievements addressed by the achievement test made up of 24 questions was prepared for the reliability study.

Table 3. Achievements of 'Life at Our Home' Unit as Per the Achievement Test

Achievement	Question No
The student compares the characteristic features of family elders' childhood period to those of his/her childhood period.	1, 18, 19
The student gives examples which indicate the importance of neighborhood relationships to his/her family and himself/herself.	2, 10, 21
The student draws the sketch of the place where his/her home is located.	6, 16, 20
The student fulfills duties and responsibilities assigned to him/her at home.	3, 4, 8
The student gives examples showing that tools and technological products used at home improve our lives.	14, 23, 24
The student makes unique recommendations on the effective and efficient use of resources at home.	11, 15, 22
The student gives examples demonstrating that having a good plan improves his/her personal life.	7, 9, 17
While meeting his/her own demands and needs, the student makes efforts to avoid exerting pressure on his/her and family's budget.	5, 12, 13

The achievement test which was prepared after certain changes were made was practiced to 457 students who were third-year students at primary schools in the school year of 2018-2019. On the basis of answers given by students to test questions, item analysis was performed. Following the analysis, the KR-20 reliability coefficient was calculated as 0.84 for the achievement test. Item difficulty index (Pj) and item discrimination index (rjx) values were calculated for each item of the test. The distinctiveness of the items as a result of item analysis are classified as very good if the distinctness index is 0.40 or greater, and quite good if between 0.30-0.39. If the index is between 0.20-0.29, item can be used with expert opinion. If the index is negative or less than 0.20, then item is evaluated as very weak and it isn't included in the research (Turgut, 1992; Tekin, 2000 cited by Akbulut & Çepni, 2013). The distribution of difficulty index between 0.20 and 0.80 is taken into account as a criterion for the items that make up the test (Kline, 1986, cited by Elbay, 2020). Upon the review of item discrimination and item difficulty values for the achievement test of 'Life at Our Home' unit, two questions were excluded from the achievement test as item distinctness values of these questions were less than 0.20. By paying attention to the content validity, six questions which corresponded to six other targeted achievements but had low item difficulty index values, in other words, six questions which were too easy for the participant students, were also excluded from the achievement test, and hence, an achievement test which contained a total of 16 questions and assigned two questions to each targeted achievement was prepared. As per the item analysis, item discrimination and item difficulty index values were demonstrated in Table 4 for each item of the achievement test which included 16 items.

Table 4. Item Discrimination Index (rjx) and Item Difficulty Index (Pj) Values for the Achievement Test of 'Life at Our Home' Unit

Question No	Item Discrimination Index Value (rjx)	Item Difficulty Index Value (Pj)
1	.283	.77
2	.509	.78
3	.476	.75
4	.317	.49
5	.569	.76
6	.422	.63
7	.462	.77
8	.496	.77
9	.326	.51
10	.393	.78
11	.512	.79
12	.321	.56
13	.344	.54
14	.498	.65
15	.333	.58
16	.454	.66

According to the results of item analysis, it is discerned that, in the final version of the achievement test composed of 16 questions, the third item was the most difficult (Pj=.49) whereas the eleventh item was the least difficult (Pj=.79), and the fourth item was the best in discriminating between examinees (rjx=.57). Finally, KR-20 reliability coefficient was calculated as 0.81 for the achievement test. In addition, the average difficulty of the achievement test was determined as Pj=.67 and the distinctness index of the test was rjx=.42.

Experimental Procedure

After selecting the schools where the research would be conducted, a seminar was organized for introducing the lesson study to participant teachers. Then, the achievement test was practiced to the experimental groups and control groups as pretest. On dates on which teachers agreed in cooperation, each stage of the lesson study was set in motion. The planning stage was scheduled to be held on Thursday for School A and on Monday for School B. The instruction of the lesson, namely, the implementation stage of the lesson study, was scheduled to be held on Tuesday for Experiment A1 and Experiment B1 and on Wednesday for Experiment A2 and Experiment B2. Observer primary school teachers were free as their sections had foreign language course and hence the routine instruction and education activities were performed without any disturbance or interruption at schools. In the immediate aftermath of the implementation stage, the discussion stage was put in place and the lesson plan was reorganized in light of teacher observations. After the lesson study practice was implemented for seven consecutive weeks, the achievement test was practiced to the experimental and control groups once again as posttest.

Data Analysis

In the analysis of data, SPSS 22.0 software was employed. Kurtosis and skewness values, Kolmogorov-Smirnov and Shapiro-Wilk normality tests and histograms were utilized in the normality analysis of collected data (Büyüköztürk, 2019). As per the results of normality tests, One-way analysis of variance (ANOVA) and Paired samples t-test which were parametric tests were practiced to data groups with normal distribution (p>.05) whereas Kruskall Wallis H Test and Wilcoxon Signed Rank Test were used for data groups with non-normal distribution (p<.05) (Büyüköztürk, 2019).

Results

Scores obtained by the experimental groups and control group from achievement tests practiced as pretest and posttest at School A were analyzed through One-way ANOVA, and results of analysis were exhibited in Table 5.

Table 5. One-way ANOVA Results

Test	Group	N	$\bar{x}$	Sd	Source of Variance	Sum of Squares	df	Mean of Squares	F	p
Pretest	Exp. A1	23	7.87	3.00	Between Groups	9.0	2	4.5	.406	.668
	Exp. A2	24	8.67	3.61	Within Groups	746.9	67	11.2		
	Control A	23	7.96	3.36						
	Total	70	8.17	3.31	Total	755.9	69			
Posttest	Exp. A1	23	10.70	2.99	Between Groups	203.4	2	101.7	8.469	.001*
	Exp. A2	24	12.21	3.72	Within Groups	804.7	67	12.0		
	Control A	23	8.09	3.63						
	Total	70	10.36	3.82	Total	1008.1	69			

Note: *p<0.05

There was no statistically significant difference between groups of School A in terms of the pretest scores (p>.05). It was determined that the level of students' knowledge in relation to 'Life at Our Home' unit was close to each other before the practice of the lesson study. On the other hand, upon the examination of posttest scores, it is ascertained that there was a statistically significant difference between scores obtained from the achievement test (p<.05). In order to find between group differences, post-hoc Tukey test was used. As a result of Tukey test, it was found that there were statistically significant differences between ExperimentA1 and ControlA groups in favor of ExperimentA1 group (p<.05) and between ExperimentA2 and ControlA groups in favor of ExperimentA2 (p<.05). It was observed that there was a statistically significant increase in the academic achievement test scores in the classes where the lesson study was applied compared to the control group. Upon the calculation of effect size for pretest and posttest (Kilmen, 2015), it was determined that, at School A, the effect size of the pretest ($\eta^2_{pretest}$=.011) was small whilst the effect size of the posttest ($\eta^2_{posttest}$=.201) was large. The lesson study practice explains 20% of the variance in the level of student achievements in the experimental groups. In this respect, effect of the lesson study practice on student achievements is statistically large.

Scores obtained by experimental groups and the control group at School B from the achievement test practiced as pretest and posttest were analyzed through Kruskall Wallis H Test, and results of analysis were displayed in Table 6.

Table 6. Kruskall Wallis H Test Results

Test	Group	N	$\bar{x}$	Sd	Mean Rank	X^2	p
Pretest	Exp. B1	32	11.84	1.14	39.75	5.350	.069
	Exp. B2	33	11.91	3.19	53.15		
	Control B	32	11.84	3.96	53.97		
	Total	97	11.87	2.98			
Posttest	Exp. B1	32	14.16	2.00	47.08	.376	.829
	Exp. B2	33	14.24	2.09	48.71		
	Control B	32	14.03	2.90	51.22		
	Total	97	14.14	2.34			

There was no statistically significant difference between pretest and posttest scores obtained from the academic achievement test at School B ($p>.05$). It was determined that the level of students' knowledge at School B in relation to 'Life at Our Home' unit was close to each other both before and after the practice.

To identify whether there was any statistically significant difference in pretest and posttest scores obtained by experimental groups and control groups from the achievement test, Paired Samples T Test was practiced to Experiment A1, Experiment A2, Control A, Experiment B1 and Control B groups, and results were shown in Table 7.

Table 7. Results of Paired Samples T Test

Group	Test	N	$\bar{x}$	Sd	Df	T	p
Exp. A1	Pretest	23	7.87	3.00	22	6.316	.000*
	Posttest	23	10.70	2.99			
Exp. A2	Pretest	24	8.67	3.61	23	4.623	.000*
	Posttest	24	12.21	3.72			
Control A	Pretest	23	7.96	3.36	22	.230	.820
	Posttest	23	8.09	3.63			
Exp. B1	Pretest	32	11.84	1.14	31	7.400	.000*
	Posttest	32	14.16	2.00			
Control B	Pretest	32	11.84	3.96	31	5.180	.000*
	Posttest	32	14.03	2.90			

Note: *$p<0.05$

It was found that the positive difference between posttest and pretest scores obtained from the achievement test by Experiment A1, Experiment A2, Experiment B1 and Control B was statistically significant ($p<.05$) whereas the positive difference between posttest and pretest scores obtained from the achievement test by Control A was not statistically significant ($p>.05$).

To identify whether there was any statistically significant difference in pretest and posttest scores obtained by Experiment B2 from the achievement test, the Wilcoxon Signed Rank Test was utilized, and results were indicated in Table 8.

Table 8. Results of Wilcoxon Signed Rank Test

Group		N	Mean Rank	Sum of Ranks	z	p
Exp. B2	Negative Rank	0	.00	.00	-5.023	.000*
	Positive Rank	32	16.50	528.00		
	Equal	1				

Note: *p<0.05

It was found that posttest scores of Experiment B2 were higher than its pretest scores, and the difference between pretest and posttest scores was statistically significant [Z=-5.023, p<.05].

Discussion, Conclusion and Recommendations

This study explored the effect of lesson, which was prepared with lesson study in the context of 'Life at Our Home' unit of the third-year primary school Life Sciences Course, on students' academic achievements. In association with the instruction of 'Life at Our Home' unit with the lesson study, there was a statistically significant increase in student achievement at the school with low academic achievement level as compared to the student achievement before the practice of the lesson study and vis-à-vis other lessons taught by teachers individually without the lesson study according to study results. This is an expected result as the lesson study aims to develop a better perspective about how the students learn best (Lewis et al., 2006). As it is to be inferred from this point, participant teachers incorporated the necessary measures into the lesson plan by observing how students learned better. Thus, the students who learned better did better in the achievement test at the end of the process. In the study by Meyer (2005), it was ascertained that the lesson study practices had a positive effect on students with low achievement levels. In the research conducted by Hoong, Fwe, Yvonne, Subramaniam, Zaini, Chiew and Karen (2010), it was found that teachers collectively developed the lesson plan on a topic on which students had low achievement levels and, in association with the practice of instruction with lesson study, there was a significant increase in students' achievements in the lesson and in their interest in the topic of the lesson. In the research by Wright (2009), it was asserted that the lesson study had a positive effect on student achievements. Also in certain studies, it was put forward that the lesson study helped the students (Eraslan, 2008; Elipane, 2011) and students' knowledge and abilities were enhanced and their beliefs were shaped in the positive direction in conjunction with the lesson study (Cheng & Yee, 2012; Lewis, Perry, Friedkin & Roth, 2012). Murata (2011) argued that the professional development of teachers was promoted by the lesson study and this was directly proportionate to the student achievement (Murata, 2011). In certain studies, the participant teachers reported that the lesson study enhanced the student achievements (Kaya, 2018; Kükey, 2018).

At the school with relatively high socio-economic and academic achievement level, it was found that there was a statistically significant increase in students' achievement levels alongside both the instruction with the lesson study and the instruction provided by teachers individually without the

lesson study. It is an expected outcome that, irrespective of the practiced learning strategies, the presentation of new knowledge and skills to students will expand their existing knowledge base to upper levels. In the master thesis by Serbest (2014) which focused on the lesson study practices and used the meta-analysis method, it was ascertained that lesson study practices had positive effect on student learning and enhanced student achievements. In a study, it was discerned that expected results in terms of knowledge and skill levels were reached in relation to the lesson topic by virtue of lesson study practices (Baki, Erkan & Demir, 2012). There are also studies asserting that the lesson study had positive effect on student learning (Tepylo, 2008; Kıncal & Beypınar, 2015). Moreover, the lesson study practice enables students to learn in a meaningful sense (Pektaş, 2014). By virtue of a practice in which the focus is placed on student learning and comprehension (Yoshida, 1999), it is an expected result that students' academic achievements are enhanced.

It is stated that the lesson study practices promote the communication both between the student and teacher and between students (Baki, Erkan & Demir, 2012; Budak, 2012). There are studies indicating that the increased communication between students was positively associated with the academic achievement (Theodora, 2001; Dollard, & Mahoney, 2010). Moreover, it is alleged that the lesson study activated the students mentally (Baki, 2012) and encouraged them to participate in the lesson more effectively (Meyer, 2005; Baki, Erkan & Demir, 2012; Özdemir-Baki, 2017). It can be suggested that encouraging the students to participate in the lesson had positive effect on student achievements since it acted as the basis of learning by doing. Besides, it was asserted that, along with lesson study practices, teachers made more use of student-oriented instruction strategies in lessons (Ceppi-Bussmann, 2006; Yoshida & Jackson, 2011; Budak, 2012; Bütün, 2012; Richit & Ponte, 2017). It was put forward that teachers would be able to raise students' achievement levels by developing instruction strategies (Lewis, Perry, Friedkin & Roth, 2012; Bozkuş, Kablan, Pak, Özdişçi, Özdemir, Aydın & Boğazlıyan, 2017). It was found that the lesson study contributed positively to the process that teachers got to know their students better (Chassels & Melville, 2009; Lewis, Pery & Hurd, 2009; Ni Shuilleabhain, 2015; Gözel, 2016; Özdemir-Baki, 2017). Sisofo (2010) emphasized that the use of student thoughts on which the lesson study process focused would make the instruction more effective and productive. It was stated that the lesson study was successful in attracting the student attention to the lesson, enabled the development of positive attitudes and raised student motivation (Eraslan, 2008; Corcoran & Pepperell, 2011; Budak, 2012).

Yoon, Duncan, Lee, Scarloss and Shapley (2007) examined studies addressing the effect of professional development of teachers on student achievements. It was asserted that promoting the professional development of teachers had a modest effect on student achievements. It is perceived that the results obtained through this current study are in parallel to the relevant literature. Serbest (2014) states that the lesson study cycle can be repeated twice or three times so that results effective in

promoting student achievements can be obtained through the lesson study practices. The research by Darling-Hammond, Wei, Andree, Richardson and Orphanos (2009) highlighted that professional development programs should last long rather than having a short time frame so that they could have positive repercussions on student achievements. The lesson study is a professional development approach generally with a long-term perspective which can be planned from the start of the education and instruction process until the end. This practice which developed the teacher cumulatively in a long time frame and with a cooperative spirit also paved the way for significant increase in student achievements.

In conclusion, it was found that there was increase in students' academic achievements in third-year sections where the lesson study practice was practiced in relation to the achievements of 'Life at Our Home' unit of the Life Sciences Course. It was discerned that the lesson study practice gave rise to a statistically significant difference in student achievements especially at the school with low social and academic levels. Departing from this point, it is projected that the lesson study will help to reduce differences in achievement levels of students in the country.

Upon the review of research findings, it was discerned that the use of lesson study by teachers especially at schools with low academic achievement levels affected students' academic achievements significantly. Thus, by virtue of establishing lesson study groups at all schools, especially at schools with low academic achievement levels, if teachers make plans in cooperation in all courses well-suited to the lesson study, observe the lessons, indicate how the lesson can be taught better in the context of recommendations based on reflective thinking arising from observation results and the lesson study process is spread across the entire school year, students will be more developed academically. Moreover, the effect of lesson study groups, which will be formed by the teacher responsible for each branch of study, on students' academic achievements can be analyzed by researchers. Furthermore, as well as the cognitive development of students, how the lesson study influences affective and social development of students can be addressed through new studies.

References

Akbulut, H. İ., & Çepni, S. (2013). Bir üniteye yönelik başarı testi nasıl geliştirilir?: İlköğretim 7. sınıf kuvvet ve hareket ünitesi. *Amasya Üniversitesi Eğitim Fakültesi Dergisi, 2*(1), 18-44.

Back, J., & Joubert, M. (2011). *Lesson study as a process for professional development: Working with teachers to effect significant and changes in practice.* Proceedings of 7th Congress of the European Society for Research in Mathematics Education, Rzeszow, Poland.

Baki, A., Erkan, İ., & Demir, E. (2012). *Ders planı etkililiğinin lesson study ile geliştirilmesi: Bir aksiyon araştırması.* X. National Science and Mathematics Education Congress, Niğde, Turkey.

Baki, M. (2012). *Sınıf öğretmeni adaylarının matematiği öğretme bilgilerinin gelişiminin incelenmesi: Bir ders imecesi (lesson study) çalışması.* Unpublished doctoral dissertation, Karadeniz Technical University, Trabzon.

Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher*, *33*, 3-15. doi:10.3102/0013189X033008003

Bozkuş, F., Kablan, Z., Pak, K., Özdişçi, S., Özdemir, A., Aydın, M., & Boğazlıyan, D. (2017). Ders imecesi (lesson study) modeli hakkında uygulayıcı görüşleri. *Turkish Studies,12*(28), 141-160. doi:10.7827/TurkishStudies.12545

Budak, A. (2012). Mathematics teachers' engaging in a lesson study at virtual settings. *Educational Research and Reviews. 7*(15), 338-343. doi: 10.5897/ERR12.018

Bütün, M. (2012). *İlköğretim matematik öğretmeni adaylarının uygulanan zenginleştirilmiş program sürecinde matematiği öğretme bilgilerinin gelişimi*. Unpublished doctoral dissertation, Karadeniz Technical University, Trabzon.

Büyüköztürk, Ş. (2019). *Sosyal bilimler için veri analiz el kitabı*. Ankara: Pegem Akademi

Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2012). *Bilimsel araştırma yöntemleri.* Ankara: Pegem Akademi.

Ceppi-Bussmann, S. (2006). *A case study of a technology professional development program involving lesson study on teachers' perceptions of their professional practice.* Unpublished doctoral dissertation, New Mexico State University, New Mexico.

Cerbin, W., & Kopp, B. (2006). Lesson study as a model for building pedagogical knowledge and improving teaching. *International Journal of Teaching and Learning in Higher Education, 18*(3), 250-257.

Chassels, C., & Melville, W. (2009). Collaborative, reflective, and iterative Japanese lesson study in an initial teacher education program: Benefits and challenges. C*anadian Journal of Education, 32*(4), 734-763.

Cheng, L. P., & Yee, L. P. (2012). A Singapore case of lesson study. *Mathematics Educator*, *21*(2), 34-57.

Corcoran, D., & Pepperell, S. (2011). Learning to Teach Mathematics Using Lesson Study. In T. Rowland & K. Ruthven (Ed.) *Mathematical Knowledge in Teaching*. London: Springer.

Cumhur, F. (2016). *Matematik öğretmeni adaylarının soru sorma davranışlarının gelişiminin incelenmesi: Bir ders imecesi çalışması*. Unpublished doctoral dissertation, Karadeniz Technical University, Trabzon.

Darling-Hammond, L., Wei, C., R., Andree, A., Richardson, N., & Orphanos, S. (2009). *Professional learnin in the learning profession. A status report on teacherdevelopment in the United States and abroad.* Technical report. California: National Staff Development Council.

Doig, B., & Groves, S. (2011). Japanese lesson study: Teacher professional development through communities of inquiry. *Mathematics Teacher Educationand Development, 13*, 77-93.

Dollard, M. W., & Mahoney, K. (2010). How effective is the jigsaw method when used to introduce new science curricula in middle school science. *Ontario Action Researcher, 10*(3), 50-64.

Elbay, S. (2020). T.C. İnkılap Tarihi ve Atatürkçülük dersi 2. ünitesine yönelik kazanım odaklı başarı testi geliştirme çalışması, *E-Uluslararası Eğitim Araştırmaları Dergisi, 11*(1), 53-68. doi: 10.19160/ijer.679934

Elipane, L. (2011). Incorporating lesson study in pre-service mathematics teacher education. In Ubuz, B. (Ed.) *Proceedings of the 35th Conference of the International Group for the Psychology of Mathematics Education,* 305-312. Ankara, Turkey: PME.

Eraslan, A. (2008). Japanese lesson study: Can it work in Turkey. *Education and Science, 33*, 62-67.

Fernandez, C., Cannon, J., & Chokshi, S. (2003). A U.S.- Japan lesson study collaboration reveals critical lense for examining practice. *Teaching and TeacherEducation*, *19*, 171-185. doi:10.1016/S0742051X (02)00102-6

Fernandez, C., & Yoshida, M. (2004). *Lesson study: A japanese approach to ımproving mathematics teaching and learning.* Mahwah: Lawrence Erlbaum Associates.

Fernandez, C. (2002). Learning from japanese approaches to professional development: The case of lesson study. *Journal of Teacher Education, 53*(5), 393-405. doi: 10.1177/002248702237394

Gaible, E., & Burns, M. (2005). *Using technology to train teachers: Appropriate uses of ICT for teacher professional development in developing countries.* Washington, DC: infoDev / World Bank.

Gözel, E. (2016). *Ders imecesi çalışmalarıyla sınıf öğretmenlerinin problem çözmeye dayalı matematiği öğretme becerilerinin gelişiminin incelenmesi.* Unpublished doctoral dissertation, Pamukkale University, Denizli.

Guskey, T. R. (2000). *Evaluating professional development*. California: Corwin Press.

Hart, L., Alston, A., & Murata, A. (2009). Lesson study working group. In S.L. Swars, D.W. Stinson, & S. Lemons-Smith (Eds.). *Proceedings of the 31st annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Atlanta, GA: Georgia State University.

Hoong, L. Y., Fwe, Y. S., Yvonne, T. M. L., Subramaniam, T., Zaini, I. K. B. M, Chiew, Q. E., & Karen, T.K. L. (2010). Concretising factorisation of quadratic expressions. *Australian Association of Math Teachers, 66*(3), 19-24.

Isoda, M. (2010). Lesson study: Problem solving approaches in mathematics education as a Japanese experience. *International Conference on Mathematics Education Research*, *8*, 17–27. doi:10.1016/j.sbspro.2010.12.003

Kaleci, F. (2018). *Bilgi ve iletişim teknolojilerinin matematik eğitimi sürecine entegrasyonuna yönelik hizmet içi eğitim programı uygulaması ve etkililiği.* Unpublished doctoral dissertation, Necmettin Erbakan University, Konya.

Karadimitriou, K., Rekalidou, G., & Moumoulidou, M. (2014). The practicum in pre-service teachers' education in Greece: The case of lesson study. *Procedia- Social and Behavioral Sciences 152*, 808–812. doi: 10.1016/j.sbspro.2014.09.325

Karasar, N. (2016). *Bilimsel araştırma yöntemi.* Ankara: Nobel Yayınları.

Kaya, Ü. (2018). *Lise matematik öğretmenlerinin ders imecesi modeline dayalı mesleki gelişim uygulamalarının değerlendirilmesi.* Unpublished masters thesis, Cumhuriyet University, Sivas.

Kıncal, R. Y., & Beypınar, D. (2015). Ders araştırması uygulamasının matematik öğretmenlerinin mesleki gelişimlerine ve öğrenme sürecinin geliştirilmesine etkisi. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi, 33*, 186-210.

Kilmen, S. (2015). *Eğitim araştırmacıları için SPSS uygulamalı istatistik.* Ankara: Edge Akademi.

Kop, S. (2003). *Fen bilgisi öğretmenlerinin hizmet içi eğitim ihtiyaçlarının belirlenmesi ve bazı ihtiyaçların giderilmesine yönelik rehber materyallerin geliştirilmesi.* Unpublished masters thesis, Karadeniz Technical University, Trabzon.

Kösterelioğlu, İ., & Akın Kösterelioğlu, M. (2008). Okul temelli mesleki gelişim çalışmalarının okullarda öğrenen örgüt kültürü oluşturmaya katkısı. *Sakarya Üniversitesi Fen Edebiyat Dergisi, 10*(2), 243-255.

Kükey, H. (2018). *İlköğretim matematik öğretmen adaylarının 5. sınıf kesirler konusunda derse hazırlık süreçlerinin lesson study (ders imecesi) modeli kapsamında incelenmesi.* Unpublished masters thesis, Inönü University, Malatya.

Lalitha, H. D. (2005). *Development of a model for the continuing professional development of teachers: A qualitative ınvestigation.* Unpublished doctoral dissertation, University of Wollongong, Australia.

Lee, J. F. (2008). A Hong Kong case of lesson study-benefits and concerns. *Teaching and Teacher Education, 24*(5), 1115-1124. doi:10.1016/j.tate.2007.10.007

Lewis, C. C., Perry, R. R, Friedkin, S., & Roth, J. R. (2012). Improving teaching does improve teachers: Evidence from lesson study. *Journal of Teacher Education, 63*, 368-375. doi: 10.1177/0022487112446633

Lewis, C. C., Perry, R. R., & Murata, A. (2006). How should research contribute to instructional improvement?: The case of lesson study.*Educational Researcher, 35*(3), 3-14. doi:10.3102/0013189X035003003

Lewis, C. C., Perry, R. R., & Hurd, J. (2009). Improving mathematics instruction through lesson study: A theoretical model and North American case. *Journal ofmathematics teacher education, 12*(4), 285-304. doi:10.1007/s10857-009-9102-7

Lewis, C. (2000). *Lesson Study: The core of Japanese professional development.* Retrieved from https://files.eric.ed.gov/fulltext/ED444972.pdf

Lewis, C. (2002). Does lesson study have a future in the United States? *Nagoya Journal of Education and Human Development*, *1*, 1-23. doi: 10.4119/UNIBI/jsse-v3-i1-967

Lewis, C., & Tsuchida, I. (1997). Planned educational change in Japan: The case of elementary science instruction. *Journal of Educational Policy, 12*(5), 313-331. doi: 10.1080/0268093970120502

Lewis, C., & Tsuchida, I. (1998). A lesson is like a swiftly flowing river: How research lessons improve Japanese education. *American Educator, 22*(4), 12-17. doi: 10.1177/136548029900200117

Lieberman, A. (2000). Networks as learning communities: Shaping the future of teacher development. *Journal of Teacher Education*, *51*(3), 221–227. doi: 10.1177/0022487100051003010

Meral Kandemir, E. (2018). *Sınıf öğretmenlerinin öğretim becerilerini geliştirmeye yönelik bir uygulama: Ders imecesi.* Unpublished doctoral dissertation, Pamukkale University, Denizli.

Meyer, R. (2005). *Lesson study: The effects on teachers and students in urban middle schools.* Unpublished doctoral dissertation, Baylor University.

Murata, A., & Takahashi, A. (2002). Vehicle the connect, theory and practice: How teacher thinking changes in district-level lesson study in Japan. *The Psychology of Mathematics Education, 1*(4), 1879-1888.

Murata, A. (2011). Introduction: Conceptual overview of lesson study. In C. Hart, A. S. Alston & A. Murata (Ed.), *Lesson Study Research and Practice in Mathematics Education,* 1-12. Dordrecht: Springer.

Ni Shuilleabhain, A. (2015). *Developing mathematics teachers' pedagogical content knowledge through lesson study: A multiple case study at a time of curriculum change.* Unpublished doctoral dissertation, University of Dublin.

Ono, Y., & Ferreira, J. (2010). Acase study of continuing teacher professional development through lesson study in South Africa. *South African Journal of Education, 30*(1), 59–74. doi: 10.4314/saje.v30i1.52602

Özdemir-Baki, G. (2017). *Ortaokul matematik öğretmenlerinin matematiği öğretme bilgilerinin gelişim sürecinin incelenmesi: Ders imecesi modeli.* Unpublished doctoral dissertation, Atatürk University, Erzurum.

Pektaş, M. (2014). Effects of lesson study on science teacher candidates' teaching efficacies. *Educational Research and Reviews*, *9*(6), 164-172.

Richit, A., & Ponte, J. P. (2017). Teachers' perspectives about lesson study. *Acta Scientiae, 19*(1), 20-30.

Saito, E. (2012). Key issues of lesson study in Japan and the United States: A literature review. *Professional Development in Education*, *38*(5), 777-789. doi: 10.1080/19415257.2012.668857

Sato, T., Tsuda, E., Ellison, D., & Hodge, S. R. (2020). Japanese elementary teachers' Professional development experiences in physical education lesson studies. *Physical Education and Sport Pedagogy, 25*(2), 137-153. doi: 10.1080/17408989.2019.1692808

Serbest, A. (2014). *Ders imecesi yönteminin etki alanları üzerine bir meta-sentez çalışması.* Unpublished masters thesis, Karadeniz Technical University, Trabzon.

Sisofo, E. J. (2010). *Evaluating the effects of lesson study as a way to help student teachers learn how to use student thinking when planning and revising mathematics lesson plans*. Unpublished doctoral dissertation, University of Delaware, Newark.

Shimizu, Y. (2019). *Lesson study as a vehicle for the synergy of research and practices: A japanese perspective.* XV CIAEM-IACME, Medellín, Colombia, 2019.

Stigler, J. W., & Hiebert, J. (2009). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom.* Retrieved from https://www.amazon.com/

Takahashi, A., & McDougal, T. (2016). Collaborative lesson research: Maximizing the impact of lesson study. *ZDM-Mathematics Education*, *48*(4), 513–526. doi: 10.1007/s11858-015-0752-x

Takahashi, A. (2013). The role of the knowledgeable other in lesson study: Examining the final comments of experienced lesson study practitioners. *Mathematics Teacher Education and Development, 16* (1) 4-21.

Takahashi, A., & Yoshida, M. (2004). Ideas for establishing lesson-study communities. *Teaching Children Mathematics, 10*(9), 436–443.

Tekin, S. (2004). *Kimya öğretmenleri için kavramsal anlama ve kavram öğretimi amaçlı bir hizmet içi eğitim kurs programı geliştirilmesi ve etkililiğinin araştırılması.* Unpublished doctoral dissertation, Karadeniz Technical University, Trabzon.

Tepylo, D. R. H. (2008). *Investigating the effects of lesson study*. Unpublished masters thesis, University of Toronto Toronto, Canada.

Theodora, D. P. (2001). The effectiveness of jigsaw cooperative learning on students' achievement and attitudes toward science. *Science Education International,12*(4), 6-11.

Weeks, D. J. (2001) Creating happy memories. *Northwest Teacher*, *2*(2), 6-11.

Wright, T. D. (2009). *Investigating teachers' perspectives on the impact of the Lesson Study process on their mathematical content knowledge, pedagogical knowledge, and the potential for student achievement.* Unpublished doctoral dissertation, University of New Orleans, Louisiana, United States.

Yadigaroğlu, M. (2014). *Kimya öğretmenlerinin teknolojik pedagojik alan bilgisi modeline yönelik bilgi ve becerilerinin geliştirilmesi amacıyla bir hizmet içi eğitim kurs programı geliştirilmesi ve etkililiğinin araştırılması.* Unpublished doctoral dissertation, Karadeniz Technical University, Trabzon.

Yarema, C. H. (2010). Mathematics teachers‟ views of accountability testing revealed through lesson Study. *Mathematics Teacher Education and Development, 12*(1), 3-18.

Yar Yıldırım, V. (2018). *Okul yöneticilerinin program okuryazarlıklarına yönelik bir hizmet içi eğitim programının geliştirilmesi ve değerlendirilmesi.* Unpublished doctoral dissertation, Gaziosmanpaşa University, Tokat.

Ylonen, A., & Norwich, B. (2013). Professional learning of teachers through a lesson study process in england contexts, mechanisms and outcomes. *Journal of Lesson and Learning Studies*, *2*(2),137-154. doi: 10.1108/20468251311323388

Yoon, K. S., Duncan, T., Lee, S. W.-Y., Scarloss, B., & Shapley, K. (2007). *Reviewing the evidence on how teacher professional development affects student achievement.* Retrieved from http://ies.ed.gov/ncee/edlabs

Yoshida, M., & Jackson, W. C. (2011). Ideas for Developing Mathematical Pedagogical Content Knowledge Through Lesson Study. In L, C, Hart., A. Alston & A. Murata (Eds.), *Lesson Study Research and Practice in Mathematics Education,* 279-288. Dordrecht: Springer.

Yoshida, M. (1999). *Lesson study: A case study of a japanese to improwing insruction through school-based teacher devolepment.* Unpublished doctoral dissertation, The Universty of Chicago, Chicago.