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THE EFFECT OF LESSON STUDY ON THE PERCEPTIONS OF MATHEMATICS TEACHERS ABOUT SUBJECT AREA COMPETENCIES[i]

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Abstract:
In this study, it was aimed to investigate the effect of lesson study, a professional development model, on the perceptions of middle school mathematics teachers about subject area competencies and the views of the teachers about this model. In this study, which was conducted with a qualitative research method, the data were collected through semi-structured interviews from the middle school mathematics teachers after three lesson-research-cycles. The descriptive analysis of the data presented some findings: a) identification/determination of Mathematics Subject Area Competencies (MSAC) while preparing and applying a lesson plan, b) being able to use their knowledge of mathematics, c) developments of the students' mathematical skills through groupwork and d) a more active teaching process with Lesson Study (LS). On the other hand, it was also seen that there are some negative findings showing that preparing a detailed lesson plan is troublesome and the teachers have difficulty in coming together and using the technology. In this context, it is believed that this study will enlighten the researchers who are interested in LS method to learn about the subject area competencies of teachers from different branches, to learn about the effect of mathematics teachers' general competencies related to teaching profession on teaching and about teachers' technological competencies.

Keywords: lesson study, mathematics teacher, professional development, teacher competencies

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1. Introduction

As in all fields in the world, we face very fast developments in the education field. Societies are in need of a successful education system to follow these developments. The success of an education system is primarily related to the development of teachers' quality. That's why; teachers' professional development should always be at the agenda of countries.

Teachers need to update themselves all the time so as to experience a qualified teaching process. Therefore, the professional development of teachers is important for learning and the productivity of teaching (Jacobs, 2012). The common characteristics of many professional development models that are used in training and development of teachers are contributing the teachers by providing them with opportunities such as the teacher's getting on professional development, the student's increasing active participation and implementing the activities that are designed collaboratively in the classroom (Darling-Hammond, 2003; Kennedy, 1999). When the studies about professional development in the related literature were reviewed, Lesson Study professional development model, which is used in Japan, attracts the attention (Mete, 2013). Lesson Study can be described as the process of the teachers' implementing a lesson plan which they prepare collaboratively, the other members' and expert educator's observing the lesson extensively and evaluating the lesson (Serbest, 2014). These lessons, which are prepared as a result of researching, are different from the others as everything is recorded by a video camera (Lewis & Tsuchida, 1998). Lesson Collective Work is a method which consists of;

1. planning;
2. implementing the plan;
3. reflections of the implementation and evaluation;
4. re-planning and implementation;
5. re-reflections of the lesson and evaluation (Lewis & Tsuchida, 1998).

LS means making the teachers develop a different understanding in preparing a lesson plan and implementing it by guiding the teachers to position the student in the center of the teaching process (Takahashi & Yoshida; 2004, Murata, 2011). LS provides the teachers with an environment that offers opportunities for them to see the implementations from the students' perspectives, making sense of those perspectives and changing their own perspectives when needed (Murata & Takahashi, 2002). The teaching qualifications of the teachers step up thanks to this kind of professional development implementations (Eraslan, 2008). In our country, School Based Professional Development (SBPD) model, in other words, learning teacher understanding, which guides the teachers to work collaboratively and update themselves, is adopted (MoNE, 2010). LS, which has been used increasingly in Turkey in the recent years, is a school based professional development model in which the teachers prepare lesson plans on student learning, implement them, make observations and share the reports that are prepared as a result of profound evaluations with the group (Lewis, Perry, Friedkin & Roth, 2012). It was observed that LS improved the

teaching qualifications of the teachers as supplementary implementations for the teachers' professional qualities are carried out (Budak, Budak, Bozkurt and Kaygın, 2011). Improving the teachers' qualities also depends on some standards and teacher competencies are the most important factor in meeting these standards (Seferoğlu, 2004). Teacher competencies can be described as possessing the professional knowledge, skills and attitudes that are necessary to perform the tasks special to this profession (MoNE, 2008). On the other hand, teacher competencies are also verbalised as a process in which duties are defined in details and these duties can be assigned to others when needed and a whole of activities that contain particular time, collaboration and continuity (Kahyaoğlu and Yangın, 2007). LS is a supplementary factor for teaching and learning mathematics as it contributes to the determination of the purpose, appropriate teaching method for this purpose, selection of techniques and materials and the preparation of a detailed lesson plan (Kıncal and Beypınar, 2015). Therefore, it is believed that this study will be beneficial for the mathematics teachers in terms of updating their knowledge about planning, implementing and evaluating their teaching states as part of Mathematics Subject Area Competencies (MSAC) and guiding them towards new approaches (Serbest, 2014; Lewis, 2009; Stepanek et al., 2007). Accordingly, LS implementations about MSAC can be carried out with the teachers (Günay, Yücel-Toy and Bahadır, 2016). In other words, the effect of LS on the teachers' perceptions about MSAC can be investigated. Some studies were conducted about this model in many countries (Stigler & Hiebert, 1999; Yoshida, 1999). It is necessary to do further research about LS model, which has become popular in the recent years. It is believed that this particular study will contribute to the related literature as there are not enough studies about teacher competencies with LS model in Turkey.

From this point of view, the problem of this research is to investigate how the perceptions of middle school mathematics teachers about subject area competencies are formed in the process of Lesson Study. The answers to the following sub-problems will be sought in this study:

1. How do the perceptions of middle school mathematics teachers about subject area competencies reflect on teaching at the end of LS cycles?
2. What are the opinions of middle school mathematics teachers about LS professional development model?

2. Material and Methods

This study is designed as a qualitative study in which the reflection of the middle school mathematics teachers about subject area competencies is investigated profoundly. It was seen that the frame of the method was not determined in many of the studies which were conducted by using LS (Isoda, 2010; Kılıç, Demir and Ünal, 2011). Besides, LS is considered as a new method by many researchers (Djajadikerta, 2010). Therefore, the lines of the research method of this study were not drawn. In this context, semi-structured interview, one of the qualitative research techniques, was used in this study. Questions in the semi-structured interview technique are prepared in

advance but some flexibility can be performed during the interview process (Ekiz, 2013). The interview was conducted face-to-face with the participant and the questions were asked to the participant both before and after the interview by being renewed. Main and sub-components of Mathematics Subject Area Competencies (MSAC), which were declared by MoNE in 2008, were taken at the heart of the study. MSAC is presented in Table 1 below.

Table 1: Subject Area Competencies of Teacher of Mathematics (MoNE, 2008)

MSAC (Main Components)	MSAC (Sub-components)
Planning and Arranging the Mathematics Teaching Status	Being able to make plans appropriate for teaching
	Organizing learning environments appropriate for teaching
	Making use of appropriate equipment and resources to enrich the learning and teaching processes
	Being able to use technological resources in teaching mathematics
	Being able to improve the affective characteristics of students
	Being able to carry out implementations that take the students with special needs and special education
Competencies about Learning Domains of Mathematics Lesson	Being able to use the knowledge on the field of numbers in teaching process
	Being able to use the knowledge on the field of geometry in teaching process
	Being able to use the knowledge on the field of assessment in teaching process
	Being able to use the knowledge on the field of probability and statistics in teaching process
	Being able to use the knowledge on the field of algebra in teaching process
	Being able to reflect Atatürk's opinions, views and studies on the implementations in the teaching process
Developing the students' skills of Mathematics Lesson	Being able to develop the students' problem solving skills
	Being able to develop the students' reasoning skills
	Being able to develop the students' association skills
	Being able to develop the students' communication skills
Monitoring, Evaluating and Improving the Mathematics Teaching	Being able to evaluate the efficacy of the learning environment which s/he arranged
	Being able to monitoring and evaluating implementations about mathematics teaching
	Being able to reflect the results of assessment and evaluation for determining the students' mathematical developments onto the implementations
Collaborating with School, Family and Society	Being able to collaborate with the family and society in developing the students' knowledge and skills of mathematics
	Being able to collaborate with the family and society in making the school a science, culture and learning center
Professional Development	Being able to determine professional competencies
	Being able to use his/her knowledge about mathematics
	Maintaining professional development as a teacher of mathematics

Similarly, the study was conducted with Lesson Study Professional Development Model consisting of four sections, which was used by Bruce and Ladky (2011). What is done in Bruce and Ladky cycle is clearly expressed in the figure below. Accordingly, the cycle consists of the following four sections;

1. Researching
2. Planning
3. Implementing the research lesson
4. Discussing the research lesson

2. Lesson Study Cycle

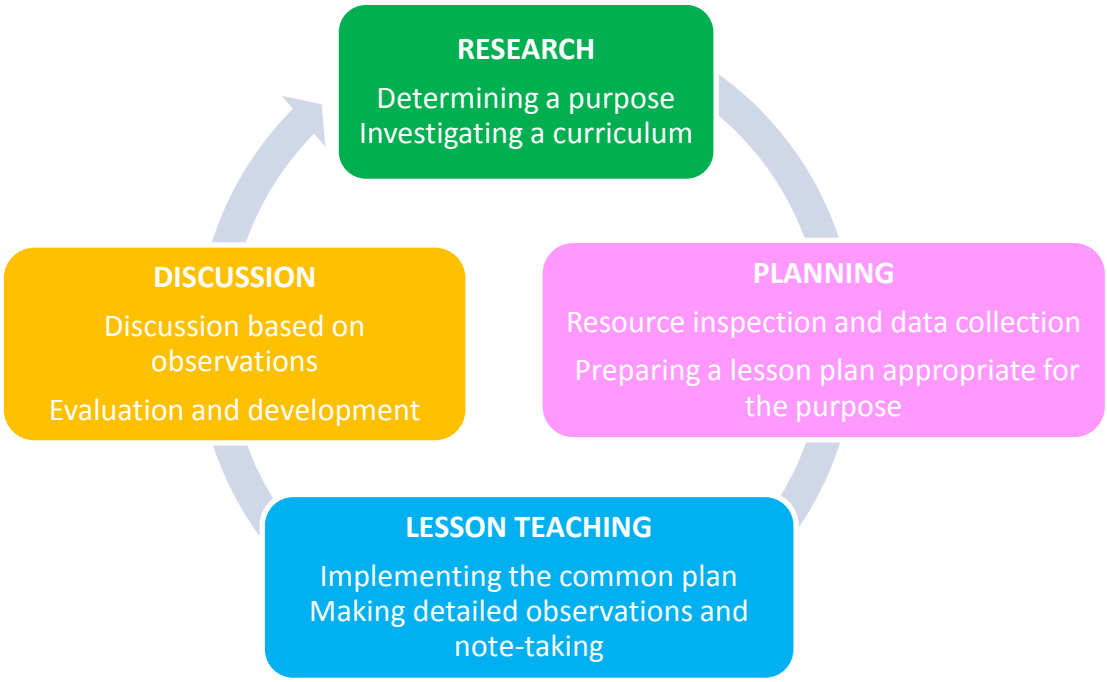

Figure 1: Four-stage LR cycle (Bruce and Ladky, 2011)

2.1 Sample

The research was conducted in a state school located in a town of a province in the south of Turkey with five middle school mathematics teachers. The characteristics of the participants searched for are; being a teacher of mathematics and being a volunteer in this six-month process which takes in fall and spring semesters of 2015–2016 educational year. Codes were used instead of the names of the teachers in the study. The demographical information of the teachers who participated in this study was presented in Table 2 below.

Table 2: Demographical Information of Participant Teachers

Person and Gender	Educational Status	Graduated Department	Years of Experience
1MT	BD	ET	13
2FT	BD	EM	11
3FT	BD	EM	7
4FT	BD	EM	4
5FT	BD	EM	5

MT: Male Teacher, **FT:** Female Teacher , **EM:** Elementary Mathematics,
BD: Bachelor's Degree, **ET:** Elementary Teacher

It is seen that two of the teachers in the sample of the study have ten years of teaching experience, two of them have five years of teaching experience and one of them has three years of teaching experience. Four of the participant teachers are females and only one of them is male. The genders of the teachers were not taken into consideration as the characteristics that were looked for in the participants were being a volunteer and a teacher of mathematics.

2.2 The Implementation Process

The study was completed in three cycles and in a six-month period and two researchers accompanied the process. RC (Research Course) and ReC (Revision Course) were implemented in two course hours and the reflections of these courses were analysed during the lunch breaks in line with the views of the participant teachers. The implementation process is presented in detail in Figure 2 below. Accordingly, LS professional development model and MSAC were aimed to be introduced to the teachers in the form of seminars in the first stage. Three cycles were carried out in the second stage.

Cycle 1: The teachers prepared a lesson plan by taking LS method and MSAC into consideration. First, the problem was defined after a long-running exchange of views. The problems on which teachers have difficulty in instructing and students have difficulty in learning were focused. As a result, the teachers agreed on the acquisition of *"establishes an equation with one variable that are appropriate for real lives"* in the 7th grade curriculum.

After the teachers had done their researches about the acquisition and prepared their individual plans, they explained their own lesson plans. Then, they came together again and prepared a detailed lesson plan. The teacher with the code of 3FT was the volunteer to implement the common plan. The first implementation (2 h) was carried out in a class which the volunteer teacher was not teaching. The other teachers and an academician made detailed observations meanwhile. The observations revealed how much the implementer followed the plan, the points that the implementer did not care about if there were any, whether the main and sub-components of MSAC were taken into consideration and what should be corrected in the plan. Next, the common plan was revised in line with the observations in the discussion part (50 min). The revised plan was implemented again by the same implementer in a different class. The experts

made observations again and took notes (2 h). The revision course (RReC) was discussed in the following part (11 min). After the second discussion and evaluation, all participants decided to end the first cycle as they believed that the lesson plan reached its ideal level.

The research courses (RC) of the first cycle were carried out in the lessons before noon (3-4), their reflections (RRC) were carried out in the lunch break and revision courses (ReC) were carried out in the lessons in the afternoon (5-6).

2.3 Working Programme

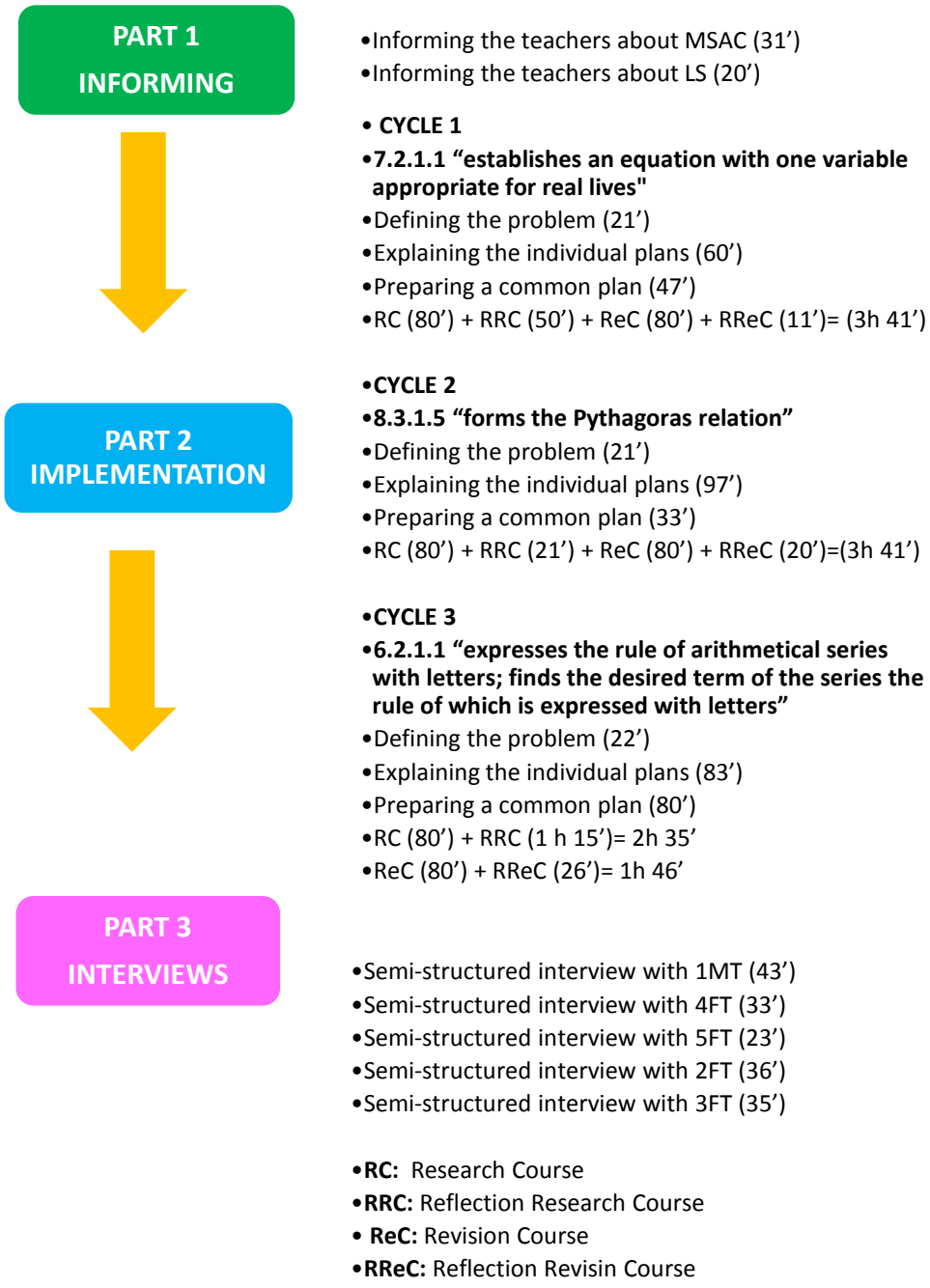

Figure 2: Working Programme

Cycle 2: The teachers came together again after a while and they determined a new problem. Accordingly, the acquisition of *"forms the Pythagoras (Pisagor) relation"* in the 8th grade curriculum was selected as the new problem. After the plans that the teachers prepared had been listened, a detailed lesson plan was prepared. In this cycle, the common plan was implemented by a different implementer in a different classroom. In the second cycle, the research courses were carried out in the morning lessons (3-4), their reflections were carried out in the lunch break, revision courses were carried out in the afternoon lessons (5-6) and its reflection was carried out in the 7th lesson.

Cycle 3: After a thirty-day break, the teachers came together again and they defined a new acquisition. After the exchange of ideas, they decided on the acquisition of *"expresses the rule of arithmetical series with letters; finds the desired term of the series the rule of which is expressed with letters"* in the 6th grade curriculum. The teachers expressed their individual plans and they deduced a lesson plan after a collaborative and long-running work. A different teacher was volunteer again for the third implementation. Similar stages were also carried out in this cycle. However, there is a slight difference in this cycle. Accordingly, the research courses were conducted in the morning (3-4), their reflections were conducted in the lunch break, the revision courses were conducted in the afternoon the next day (5-6) and their reflections were conducted in the 7th lesson. This study, which is carried out in the scope of MSAC and LS, was completed in this way. Before this study, a pilot study was conducted as a preliminary preparation with three middle school mathematics teachers in the same school year. This study was carried out in the scope of the evaluation and improvement of the pilot study.

2.4 Data Collection Tools

The data of the research were collected by a semi-structured interview form, which is frequently used in qualitative studies. While designing the form, main and sub-components of Subject Area Competencies for Middle School Teachers, which was prepared General Directorate of Teacher Training and Development of the Ministry of National Education (OYEGM, 2008) were utilized. Views of various experts were taken for the validity of the research questions and the questions were updated upon the recommendations of the experts. Each interview lasted approximately 35 minutes. The responses of the teachers were transferred into the computer and were approved by the related participants in order to check whether they were true.

2.5 Data Analysis

The participant teachers' answers were analysed through descriptive analysis, one of the qualitative analysis methods. The objective of descriptive analysis is to organize and interpret the data obtained and to present it to readers. In this analysis method, the data are systematically and openly described; these descriptions are explained and interpreted. The cause-effect relations are deeply analysed and some conclusions are drawn. The results can be related to the themes, given meaning and some further suggestions can be drawn. Therefore, descriptive analysis is used in this study to

analyse the data. In this study, five teachers who answered the questions (f=5) were given codes when quoting.

The views that were obtained were also coded in line with the evaluations and recommendations of two subject area experts who worked collaboratively during the process and the themes were composed accordingly. Therefore, the researcher did not provide any intervention throughout the study and s/he used a video recorder in order not to lose any data.

3. Findings and Discussion

While presenting the findings of the research, they were categorized in line with the perceptions of the teachers about MSAC and views of them about LS, in other words, in line with the sub-goals of the study.

3.1 The Findings about the Teachers' Perceptions about Mathematics Subject Area Competencies

The opinions of the mathematics teachers about this issue were dealt with in the scope of MSAC main components.

3.1.1. The Findings and Discussions about the Teachers' Planning and Arranging their Mathematics Teaching Status

Table 3: The Frequency Distributions of Planning and Arranging the Mathematics Teaching Status

Themes	Sub-themes	f
Planning and Arranging the Mathematics Teaching Status	Time management	1
	Making plans according to the acquisitions	5
	Following the plan	2
	Getting the students' attention with material/ action	3
	The teacher's providing guidance during the process of teaching	2
	Group work	5
	Peer teaching	3
	Arranging the learning environments according to the acquisitions	2
	Using a smart board	5
	Providing materials	2
	Adjusting the process of teaching according to the level of Class/Student	2
	Providing the participation of all students with action	4
	Solving problems appropriate for the acquisitions	2

Maximum number of views was reported in this part. As understood from Table 4, it is seen that the mathematics teachers generally gave positive answers about this issue. It can be realized from the following statements of the teachers that including plenty of group activities in the study were more productive;

"…I prefer lessons that are more prone to peer teaching and group work and more active like this in the next lesson plans.". 3FT

"We need to embed the children into the process. Definitely, I can say this." 1MT

It is understood from these statements of the teachers that the students experienced an active learning in the group work, they enjoyed the lesson and this reflected on their success. When the studies on this issue in the literature were reviewed, it was seen that there were similar studies (Johnson, D. W., and Johnson, R. T., 2010; Slavin, 2015; Yıldırım, Tarım and İflazoğlu, 2006).

It is understood from the following expressions of the teachers that the use of smart boards contributed to the instruction of the lesson;

"[Using a smart board] more remarkable, more attractive …" 5FT

"[Technology] In fact, it takes the heavy load off the teacher's shoulders … It is especially important for solving questions. …we can solve more questions by the help of the smart board… it also makes easy for me to get prepared for the lesson." 3FT

"I improved myself most in technology [laughed]… We do not use technology too much or at least we cannot use it. This can be resulting from the fact that we did not receive its training sturdily. …I use technology after this study." 2FT

Accordingly, it can be said that the use of technology contributes to making the process of teaching more productive by attracting the attention of students, reduces the burden of teachers and providing convenience for teachers. On the other hand, it is understood that the teachers consider themselves insufficient in terms of technological competency. Technology is an essential part of our age for students, education and teacher (Baki and Öztekin, 2003; Forgasz, 2006; Harter & Ku, 2007; Gündüz, Emlek and Bozkurt, 2008; Menzi, Çalışkan and Çetin, 2012; Yıldız and Baltacı, 2017). When the related literature was reviewed, it is realized that teachers need to improve themselves in terms of technological competency and technological literacy (Seferoğlu, 2009; MoNE, 2011).

Another finding which draws attention about planning and arranging the mathematics teaching status is that the teachers act according to the acquisitions while preparing the lesson plan. It is also expressed that the teachers were not attentive to prepare their lesson plans before this study but they arranged their learning environments according to the acquisition after this study. This can be understood from the following expressions of the teachers;

"I primarily pay attention to the acquisition and I also take the level of the classroom that I would teach into consideration." 4FT

"Now, everything changes according to the acquisition. We need to implement another plan for each conversation. …Something must exist at the beginning of the plan to attract the attention of the teacher, the learning environments must be arranged with regards to the acquisition and our materials or technological devices must be arranged if they will be used." 5FT.

Baki, Erkan and Demir (2012) also revealed in their study that the individual lesson plan of teachers would fall behind the lesson plans which are prepared as a result of a research, collaboration and exchange of ideas. It can be said that the findings of this study show parallelism with these results.

3.1.2. The Findings and Discussions about the Teachers' MSAC

Table 4: The frequency distribution of the findings about MSAC

Theme	Sub-themes	f
Competencies about Learning Domains of Mathematics Lesson	Using the competencies about learning domains according to the acquisition	5
	Understanding the importance of using MSAC in preparing plans	5

It was aimed here to obtain information about how the teachers' perceptions of mathematical competency take shape. When the table was considered, it was seen that all of the teachers gave positive answers about MSAC. The opinions of the teachers about this issue are as follows;

"All of the subject area competencies are used depending on the acquisition. Thus, the teacher uses his subject area competency when needed and he reflects these competencies on the instruction of the lesson in a way" 5FT.

"I assign [the subject area competencies] according to the acquisition." 4KÖ.

"I wasn't aware of these concepts as they were competencies before. We used to think that they were the titles of the units." 2FT.

"Now I believe that it would be troublesome to give all of them [subject area competencies] in a single lesson as we would prepare plans, we would prepare them correctly and I would foreground our studies. In other words, I plan to use [the learning competency] which the topic requires to be used." 1MT.

It is seen that the teachers support the idea that says it would be correct to prefer the mathematical competency which the acquisition requires to be used about MSAC. Moreover, it is understood that the information about MSAC which was presented in the seminar at the beginning of the study was not remembered easily by the teachers

but they comprehended what exactly MSAC are and they realized the contribution of using these competencies to the instruction of the lesson after this study. It is known that the professional competencies of the teachers should be high in order to be efficient in the lesson (Küçük, Arı, Demir and Baran, 2011). On the other hand, it is considered as one of the appropriate learning environments in terms of the improvement of the teachers' MSAC that the teachers use their experiences in addition to their subject area knowledge, integrate their subject area and field teaching knowledge and student learning gains continuity throughout LS (Budak et al., 2011; Cumhur and Güven, 2015; Gözel and Erdem, 2016; Özaltun, 2015; Güner and Akyüz, 2017). Therefore, it can be said that the findings of this study also exist in the literature.

3.1.3. The Findings and Discussions about the Teachers' Developing the Students' Skills of Mathematics Lesson during the Instruction of the Lesson

Table 5: Frequency distribution of developing the students' skills of Mathematics Lesson

Themes	Sub-themes	f
Developing the students' skills of Mathematics Lesson	Embedding motion into the process of teaching	3
	Developing problem-solving skills	4
	Developing reasoning skills	4
	Developing all skills by group work	4
	Developing all skills by peer teaching	1
	Developing communication skills	4
	Developing association skills	2
	Providing awareness of the importance of mathematical skills	2

Table 11 shows that the teachers managed to get on with improvements in the mathematical skills of students (communication, problem-solving, reasoning, group work, peer teaching) during LS and some of the teachers comprehended the importance of this improvement in the instruction of the lesson. The expressions of the teachers about this issue are as follows;

> *"They communicated not only with each other but also with me."* 3FT.

> *"I will not present the knowledge anymore. ...The child will reach the knowledge by himself. The most essential thing is motion in order for [him/her] to reach the knowledge as the child becomes passive unless he moves … Now, the children will communicate with each other. They will solve problems on their own since I present a problem or an issue for them. They will try to solve it. They will make associations with the other subjects so as to solve [the problem]. In other words, all [teaching skills] become involved in the process in group work."* 1MT

> *"…[the students' mathematical skills] used to be more goal-oriented, they used to be like a tool but now they are sub-goals."* 4FT.

The effectiveness of LS on the students' mathematical skills is also supported by the literature (Beypınar and Kıncal, 2015; Christiansen, Klinke and Nielsen, 2007). Besides, it is also known that it affects the cognitive, psychological, social and affective developments of the students positively in group work (Yasul and Samancı, 2015).

3.1.4. Findings and Discussions of the Teachers about Monitoring, Evaluating and Improving the Mathematics Teaching

Table 6: Frequency distribution of the findings about Monitoring, Evaluating and Improving the Mathematics Teaching

Themes	Sub-themes	f
Monitoring, Evaluating and Improving the Mathematics Teaching	Getting off the classical method	1
	Process-oriented monitoring, observing and evaluating with group work	4
	Evaluating the result-oriented plan/student	2
	Revising a lesson plan for another lesson/semester	2

It is seen in the table that the teachers expressed very few number of opinions about this issue. It is also seen in the table that many teachers expressed that group work is effective in monitoring, evaluating and improving the mathematics teaching. It is understood that the majority of the teachers agreed on the process-oriented monitoring, observing and evaluating method. The following statements of the teachers clarify this issue;

> *"I say again that I will not go on doing the same things that I did before this study. I even use the group work method in all my evaluations if needed."* 1MT.

> *"I have learnt that the assessment and evaluation methods which are carried out in the style of games become more permanent by attracting the students' attention and activate them."* 3FT

> *"…From now on, I will carry out [assessment and evaluation implementations] in a more process-oriented way as much as I can do. …I used to force the students. …The child used to improve more but he was not enjoying the lesson but now he improves less but he enjoys the lesson. He attends the lesson willingly. This is more important."* 3FT.

Process-oriented assessment and evaluation methods provide accurate information about the student (Parlak and Tatlıdil, 2013; Maral, 2009; Karakuş, 2010; Yelken, 2010; Yayla, 2011). In addition, it is known that teachers obtain professional development in process-oriented works (Taşgın and Sönmez, 2013). It is observed that the findings of this study correspond with the studies in the literature.

3.2. Findings and Discussions of the Teachers' Views about LS

3.2.1. Findings and Discussions of the Teachers' Sharing Their Knowledge and Experiences with LS

Table 7: Frequency distribution of The Mathematics Teachers' sharing their knowledge and experience

Theme	Sub-themes	f
The Mathematics Teachers' sharing their knowledge and experience	Sharing knowledge and experience with the coterie	3
	Communicating with the coterie	3
	Communicating with the teachers from different branches	4
	Building a social media group among the coteries	2
	Activating the students	2
	Doing more research	1
	Getting off the classical method	2
	Being able to look from the student's perspective	2

When the information in the table is considered, it is seen that the teachers communicated more with both coteries and teachers from different branches and they shared their knowledge and information more often with each other throughout LS. The views of the teachers are as follows;

> *"This was one of the best sides of this study. We know each other now and I believe that we can cooperate more easily and freely."* 5FT

> *"In fact, we can communicate with the teachers from the other branches. …For example, Science and Technology is not very different from Mathematics, knowledge exchange can be made between the teachers, we can get our friends' recommendations or we can recommend them."* 1MT.

LS method not only guides the teachers to collaboration and cooperation but also provides the continuity of this situation (Stoel and Thant, 2002). It is seen that the findings of this study correspond with these detections.

3.2.2. Findings and Discussions about the Contributions of LS Method to the Teachers' Professional Development

It is observed in this study conducted within the scope of LS method that the teachers are more active in the process, communicate with each other more, get off the classical method and make the students love the lesson. This can be understood from the following expressions of the teachers;

Table 8: Frequency distribution of the contribution of LS method to the teachers' professional development

Theme	Sub-themes	f
The contributions of LS method to the teachers' professional development	Preparing a plan appropriate for the student	3
	Activating the process of teaching	5
	Sharing the experiences and exchanging ideas with the coterie	4
	Building a better communication with the student/teacher	5
	Getting an expert's view's being beneficial for the teacher	1
	Getting off the classical method in the process of teaching	3
	Communicating with the teachers from different branches	1
	Noticing that making the students love the lesson is more important	3
	Searching the reasons of the student's forgetting the knowledge	1
	Being able to use the technology more and better	1

"I noticed that the children were bored… Then, I decide to bring some motion to the class. Communication is really important; the child should come to class willingly so he should build good communication with his friends. I think this can be realized by peer teaching and group work. As I always say, it is very important for a child to love the lesson." 3FT

"That is to say, we are getting off the classical method. It is not like "You! Come to the board and explain the topic to the class" anymore." 4FT

"Our lecturer, who accompanied us and walked together with us in this way, came from the university. Not only I but also my coteries catch something from his/her every single sentence … In other words, a teacher of mathematics has got all the knowledge of subject area in all extents... However, subject area is never enough. There is always something to learn… Exchange of ideas, brainstorming and sharing with my friends contributed me a lot …" 2FT

LS is a professional development model in which the teacher is the manager of the teaching process of themselves (Cerbin and Kopp, 2006; Serbest, 2014; Chocksi and Fernandez, 2004). Besides, the planning which was made by an expert in the LS process contributed to the teachers in terms of professional development (Baki and Arslan, 2015). These findings support the findings of this research.

3.2.3. Findings and Discussions about the Contribution of the use of LS Model to the Teachers' Learning MSAC

Table 9: Frequency Distribution of the findings about the contribution of the use of LS model to the teachers' learning MSAC

Theme	Sub-themes	f
the contribution of the use of LS model to the teachers' learning MSAC	Learning through experience	5
	Raising awareness about LS and MSAC	5
	The knowledge's being permanent by LS	3
	Being able to reflect LS and MSAC to teaching	5

When the table is considered, it is presented that all teachers think that their knowledge of MSAC become more permanent as they learn through experience by LS method. This can be understood from the following expressions of the teachers;

> *"[This study] has been really beneficial for us. Instead of instructing a verbal topic directly to the student, asking what is remembered and passing on to another topic, learning through experiencing and running into the work were more useful. For example, I became aware of what the thing I was doing was. Now I know better what I used where, what I need to use or what it is related with."* 4FT.

> *"It was really beneficial in terms of reflecting [MSAC] to teaching. If I had attempted to think something else, nothing better would have come to my mind. This was much better for use as we experienced personally compared to a briefing or a seminar. Seeing and listening from our friends was much more useful for us."* 5FT.

According to the findings of the study, it is seen in the study of Kılıç et al. (2011) that this method would be advantageous for Turkish students. It can be said that the findings of this study correspond with the literature.

3.2.4. Findings and Discussions of the Negative Sides of LS Model

According to the table, it is seen that some part of the teachers continue using the classical method. It is known as the reason that they find LS method exhausting and the classical method easier. In addition, it is also emphasized that it is difficult for the teachers to gather. This is understood from the following expressions;

Table 10: Frequency distribution of the negative sides of LS method

Theme	Sub-themes	f
Negative sides of LS method	Preparations for arranging a lesson plan are troublesome	1
	Gathering of the teachers is difficult	1
	Easiness of instructing through classical method	2
	The teachers' making sacrifices of their time	1
	The school management's not taking kindly to long-running studies	1
	Problems that are occurred because of letting the students free during study	1
	The knowledge that is obtained in the process of LS is not permanent	1

"…I have to prepare a program perpetually, it is hard. …It is exhausting for the teacher, … instructing directly would be easier." 3FT

When the related literature is reviewed, it was found out that the teachers' workload and time problems would limit this kind of studies about LS method in Turk (Bütün, Kaya and Şentürk, 2014). Therefore, it is stated in similar studies that the teachers must definitely gather and have time and energy if it is desired to implement more LS activities at schools (Eraslan, 2008). On the other hand, it is observed that one teacher expressed that the knowledge which a student learned during the LS process is not permanent in his mind. The following statements of 4FT clarify this situation.

"But this [LS] also has some disadvantages. For example, the next day, they provide inadequate feedback about the lesson that had been instructed the day before or we cannot/ don't get any feedback …"

Accordingly, Yeşilyaprak (2006) supports in his own study that knowledge must definitely be stored in the long term memory in order to be retained. The findings of similar studies revealed that people's remembering a case in details indicate that these experiences have become permanent in their mind (Ersanlı and Uzman, 2008). It can be said that the findings of this study about the retention of knowledge correspond with the findings in the literature.

4. Results

According to the findings of this study, in which MSAC was dealt with in the context of LS model and the views of middle school mathematics teachers about this issue were investigated, it was concluded that the LS implementations reflected positively on the professional developments of the teachers, learning became permanent as the teachers experienced MSAC personally and they could transfer MSAC more into the teaching of the lesson. In other respects, it was understood that the teachers feel themselves insufficient in terms of technological competency, the LS activities have positive reflections on the students' learning throughout the process but they are not effective enough in the following days.

5. Recommendations

Some recommendations can be given when the findings of this research are considered. Accordingly, another study can be conducted to investigate how the teachers from different branches reflect their subject area competencies on the lesson or the effect of the mathematics teachers' general competencies on the lesson within the scope of LS. Similarly, the technological competencies of the teachers can be investigated in the context of LS. Professional competencies of the pre-service teachers can be dealt with in another study. Besides, another issue that can be surveyed might be the effect of the lessons instructed by LS on the permanency of the students' knowledge.

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