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Lesson Study's Effect on Math Teacher Candidates' Attitudes, Self-Efficacy, and Teaching Anxiety*

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Abstract

This study aims to examine the effects of the lesson study model on the attitudes, self-efficacy, and math teaching anxiety of math teacher candidates. A pre- and post-test control group quasi-experimental design was utilized with a quantitative research framework. The study group consisted of a total of 14 teacher candidates (seven in the experimental group and seven in the control group), who were senior-level undergraduate students taking the "Teaching Practice" course in the pedagogical formation group of the Faculty of Education at Düzce University during the fall semester of the educational year 2019-2020. Data collection was performed using the Attitude Toward the Teaching Profession Scale, Teacher Self-Efficacy Scale, and Math Teaching Anxiety Scale. Non-parametric tests, specifically the Mann Whitney U and Wilcoxon Signed-Rank tests, were employed for data analysis. The results achieved in this study indicate that the lesson study model used in the teaching practice course positively affected the attitudes towards the teaching profession and teacher self-efficacy perceptions of math teacher candidates, as well as reducing math teaching anxiety.

Keywords: Attitude towards teaching profession, lesson study, self-efficacy, teaching anxiety

1. Introduction

The success and sustainability of schools depend on the extent, to which they achieve their educational objectives. Teachers play a very important role in the educational and instructional processes within a school, carrying substantial accountability for their outcomes. They serve as facilitators in various aspects, including implementing curriculum, organizing educational activities, ensuring instructional effectiveness, and fostering student engagement. The qualification of teachers in developing and conducting instructional processes plays a vital role in the quality of the education of individuals, who are the future of our society (Seferoğlu, 2004; Şişman, 2009).

It is very important to develop teacher self-efficacy beliefs, which are associated with student success and becoming a qualified teacher. Bandura (1997) defined self-efficacy as the confidence to successfully execute a particular task or occupation. Teacher self-efficacy, on the

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other hand, refers to a teacher's confidence in their teaching-related abilities (Schunk, 2009). From this aspect, teacher self-efficacy includes confidence in the mastery to identify effective teaching strategies, manage the classroom and promote student engagement, and plan and implement the necessary activities to enhance student achievement. Teacher's high perception of their self-efficacy can lead to their confidence in their teaching abilities and reflect on their behaviors. Furthermore, as indicated by Tschannen-Moran and Hoy (2001), a positive self-efficacy perception can positively influence different areas, such as classroom management and adoption of new methods and techniques by the teacher. All of these factors can have a positive effect on students. A teacher's self-efficacy belief affects the quality of instruction, the methods and techniques used, students' participation in learning, and the students' understanding of the material; therefore, it determines the academic success of students (Kiremit, 2006).

Teachers' professional success might be related to their professional attitudes, as well as their self-efficacy beliefs (Demirtaş, Cömert & Özer, 2011). Attitudes are significant attributes that affect teachers' impact on students' learning (Küçükahmet, 2003). Exhibiting a positive attitude towards the teaching profession will make teachers more effective in instruction (Erdem, Gezer & Çokadar, 2005). Teachers' professional attitudes have direct effects on their classroom behaviors and practices (Demirtaş, Cömert & Özer, 2011). These attitudes affect their commitment, the importance they pay to teaching, and their potential success in this field. Ocak (2005) and Üstüner (2006) emphasized the importance of teachers having a genuine passion for and dedication to their profession, along with the competence to educate students.

In order to enhance the professional success of teachers, it is necessary not only to improve their professional attitudes and self-efficacy beliefs but also to reduce their teaching anxiety. Teaching anxiety refers to concerns regarding instructional activities during lesson preparation and delivery (Gardner & Leak, 1994). Overcoming negative attitudes and fears during lesson preparation and delivery is essential for effective teaching, and teaching anxiety is often considered a primary concern (Sarı & Aksoy, 2016). Therefore, reducing teachers' anxiety levels before entering the profession is very important for the quality of teaching (Liu, 2008; Peker, 2006). Teacher's self-efficacy perception serves a pivotal role in alleviating teaching-related anxieties. Teachers with high self-efficacy perceptions tend to invest more effort in resolving teaching-related issues (Tschannen-Moran, Woolfolk Hoy & Hoy, 1998).

In various studies, it was found that teacher candidates' attitudes toward the profession are at moderate (Saracoğlu et al., 2004; Kartal & Afacan, 2012) and insufficient (Oral, 2004; Şahin & Şahin, 2017) levels, and their self-efficacy is not at the expected level (Şahin & Şahin, 2017). Teacher candidates, regardless of their knowledge, reported that they experience anxiety during the teaching practice process about what to say and how to behave in the classroom (Kuran, 2009; Peker, 2009). A teacher candidate's teacher self-efficacy, attitudes toward the profession, and teaching anxieties influence the quality of teaching. To enhance the quality of teaching, it is essential to train teachers with the necessary knowledge, skills, and attitudes before service. The teacher training process plays a very important role in ensuring that teacher candidates have the desired qualifications (Kozikoğlu & Senemoğlu, 2018).

The teaching practice course in teacher education can be considered a course, in which teacher candidates can develop the knowledge, skills, and attitudes that are required to have the desired qualifications. This course, which enables the transformation of theoretical knowledge into practice, significantly affects the professional development of teacher candidates (Wagler, 2007). However, previous studies indicate that the teaching practice course is insufficient in transforming theoretical knowledge into practice (Şahin & Özkılıç, 2005). Ineffectiveness in teaching practice might result in teacher candidates lacking sufficient knowledge and skills in areas such as lesson planning, communication with students, material usage, time management,

and motivation (Tok, 2010). This, in turn, negatively affects teacher candidates' teacher self-efficacy, attitudes toward the profession, and teaching anxieties. Interactive and collaborative teaching approaches were found to increase the self-efficacy of teacher candidates (Bümen & Özaydın, 2013; Clift & Brady, 2005) and reduce teaching anxieties (Deringöl, 2018). It was emphasized in a study carried out by Şahin and Şahin (2017) that in-class and non-class practices of teacher candidates can contribute to their attitudes toward the profession and self-efficacy. Similarly, Turan and Asal (2020) suggested in their study that collaborative practices in teacher training practice courses could reduce the anxieties of teacher candidates during the teaching process. In the context of teacher education, one of the collaborative approaches developed to put into practice the knowledge and skills acquired by teacher candidates is the lesson study model.

The lesson study model, which was developed in Japan during the late 19th century, is a widely accepted professional development model aiming to improve teaching through collaborative analysis and revision of in-class practices by teachers (Fernandez & Yoshida, 2004; Stigler & Hiebert, 1999). As per Fernandez and Yoshida (2004), the lesson study model consists of several phases. These phases include preparing the research lesson, executing the research lesson, deliberating on the research lesson, refining the research lesson, potentially re-implementing the improved research lesson, and exchanging reflections on the final iteration. During the first phase of the study lesson, educators develop customized lesson plans that align with specific learning objectives. The plan aims not only to achieve effective teaching but also to enhance student understanding (Stigler & Hiebert, 1999). Before initiating lesson planning, educators establish a study plan outlining the observation procedure and the data collection methodology (Lewis, 2002). At the phase of executing the research lesson, a teacher selected from the group has the responsibility of leading the planned lesson, and the remaining members of the group play the observer role, taking notes or recording class videos. It is essential to emphasize that the primary objective here is not to analyze or criticize the teacher's performance but to comprehend how a lesson plan collaboratively influences students' comprehension and knowledge. The ultimate objective is to identify ways to improve the effectiveness of the learning process. During the discussion and development stage of the research lesson, participants gather to share observation notes. After the presentation of the instructing teacher, other members of the group state their opinions and offer their perspectives and recommendations about the instructional process. Following collective assessments, the necessary revisions are made to the lesson plan. After the development stage of the research lesson, another group member can implement the revised lesson plan when needed. In the cycle of lesson study, it is rare to revise the lesson plan for the same topic for the third time as the program progresses (Fernandez & Yoshida, 2004).

The primary objective of lesson study is not to deliver a flawless lecture; instead, it offers teachers opportunities to improve their teaching practices. Teacher candidates gain experience in developing effective teaching strategies and enhancing classroom performance by learning cooperative working methods through this model. As reported by Verhoef, Tall, Coenders, and Smaalen (2013), teachers actively contribute to enhancing the curriculum, instructional materials, teaching methodologies, and students' learning experience by implementing lesson study. Lesson study, focusing on lesson planning and having the ability to observe and evaluate the shortcomings in the teaching process, helps teacher candidates become aware of their own development (Aykan & Kıncal, 2016). Multiple local and international studies confirmed that lesson study plays a significant role in the professional development of teachers. It was shown to improve their skills in lesson planning, improve their teaching knowledge, deepen their understanding of students, facilitate the integration of theory and practice, foster critical thinking abilities, increase teaching effectiveness, support self-efficacy perceptions, and promote collaborative learning (Ayantaş, 2019; Baki, 2012; Bayram, 2018; Budak, 2012;

Bütün, 2012; Cumhur, 2016; Doğan & Altun, 2018; Fernandez, 2005; Fernandez & Zilliox, 2011; Gözel, Erdem & Toptaş, 2020; Hiebert, Morris, Berk & Jansen, 2007; Özaltun Çelik & Bukova Güzel, 2017; Özen, 2015; Sibbald, 2009; Sims & Walsh, 2009).

It is thought that enabling teacher candidates to analyze and improve their in-class practices through the lesson study model could positively contribute to their teacher self-efficacy and professional attitudes while also reducing teaching anxieties. Previous studies also indicated a direct link between teacher candidates' attitudes toward the profession of teaching and their professional development within the lesson study framework. In the literature, there are studies highlighting the positive effect of lesson study on teachers' professional attitudes (Budak, 2012; Kandemir, 2018; Lee, 2008; Puchner & Taylor, 2006; Tepylo, 2008). The number of studies carried out on the effect of lesson study on teacher self-efficacy (Budak, 2012; Kandemir, 2018; Puchner & Taylor, 2006; Sibbald, 2009) and teaching anxieties (Mihajlović & Milikić, 2018) is limited, and it makes this study valuable in terms of its contribution to the field. Examining the literature, it can be seen that there is no study examining the attitudes, self-efficacy, and concerns of prospective teachers regarding the lesson study model together in Türkiye. The majority of previous studies related to lesson study were carried out in the field of mathematics education, with teachers, at the middle school level, and by using qualitative research methods (Aykan & Kıncal, 2016; Gülhan, 2021; Solgun & Çapuk, 2022). Therefore, this study, which was carried out at the high school level by using quantitative methods and involving teacher candidates, aims to contribute to the literature. The research problem is: "What is the effect of the lesson study model on the attitudes towards the teaching profession, levels of teaching anxiety, and self-efficacy among mathematics teacher candidates?" The research encompasses several sub-problems, which are outlined below:

- Does the lesson study model create a significant difference in the professional attitudes of mathematics teacher candidates before and after the implementation?
- Does the lesson study model create a significant difference in the self-efficacy beliefs of mathematics teacher candidates before and after the implementation?
- Does the lesson study model create a significant difference in the teaching anxieties of mathematics teacher candidates before and after the implementation?

2. Method

2.1. Research Design

The present study uses a quantitative method and a quasi-experimental design with a pre-test, post-test, and control group. The quasi-experimental design, in which individuals selected for experimental and control groups were not randomly assigned, but measurements were taken on existing groups, was utilized to measure the effectiveness of a variable (Karasar, 2014; Ekiz, 2016). The experimental design used in this work is shown in Table 1.

Table 1

Research Design

Groups	Pre-Test	Intervention	Post-Test
Experimental Group	TPAS* TSES** MTAS***	Lesson Study Model	TPAS TSES MTAS
Control Group	TPAS TSES MTAS	Existing Practice	TPAS TSES MTAS

*Teacher Profession Attitude Scale (TPAS) /**Teacher Self-Efficacy Scale (TSES) / ***Math Teaching Anxiety Scale (MTAS)

As can be seen in Table 1, the teaching practice course was conducted with the lesson study model for the experimental group, while the existing practice continued for the control group.

2.2. Study Group

The study group consists of 4th-year undergraduate students who took the "Teaching Practice" course in the pedagogical formation group of the Faculty of Education at a university in northwestern Türkiye during the fall semester of the educational year 2019-2020. The present study was carried out using a sample size of 14 candidate teachers, with seven participants assigned to the experimental group and seven to the control group. All teacher candidates were 22 years old. Teacher candidates participating in the teaching practice course were divided into groups of four by the faculty practice coordination since they visit application schools in groups due to the nature of the course. The number of teacher candidates in the groups is suitable for the research since the collaborative teaching processes are planned with groups of three-six people (Lewis, 2002). Two of these groups are randomly selected as the control group, and the other two as the experimental group. Each group has a different supervising teacher.

To examine the equivalence of the groups before the experimental procedure, each teacher candidate from both groups was asked to prepare a two-hour lesson plan on the same learning outcome, which performs calculations related to the cartesian product of two sets and was then evaluated using a lesson plan rubric. Then, four experts in educational sciences and one subject-specific education expert were consulted in order to assess the validity of the lesson plan rubric developed to measure the scores on creating lesson plans. Agreement among different raters was assessed to ensure the reliability of the rubric. The homogeneity of teacher candidates in terms of their overall GPA, grades in pedagogical formation courses, and scores on lesson plan preparation was tested by using Mann Whitney U test. The results are presented in Table 2.

Table 2

Mann Whitney U Test Results for Experimental and Control Group Equivalence

Equivalence Criteria	Group	n	Rank Mean	Sum of Ranks	U	z	p
Overall GPA	Experimental	7	7.07	49.50	21.500	-.385	.710
	Control	7	7.93	55.50			
Grades in Pedagogical Formation	Experimental	7	6.93	48.50	20.500	-.514	.620
	Control	7	8.07	56.50			
Scores in Lesson Plan Preparation	Experimental	7	7.21	50.50	22.500	-.258	.805
	Control	7	7.79	54.50			

As can be seen in Table 2, there was no statistically significant difference between the experimental and control groups of teacher candidates in terms of their overall undergraduate GPAs, the grades they received from pedagogical formation courses, and their scores on the lesson plan preparation ($p>0.05$). Considering these results, it can be stated that teacher candidates are comparable in terms of their overall undergraduate GPAs, grades from pedagogical formation courses, and scores on lesson plan preparation.

2.3. Data Collection Instruments

2.3.1. Teacher Attitude Scale Toward the Teaching Profession

This study employs Üstüner's (2006) attitude scale to measure the attitudes of high school mathematics teachers toward their teaching profession. The robustness of the scale was

confirmed by a Kaiser-Meyer-Olkin (0.91) and a Bartlett test score (7835.194). Factor analysis showed that the scale encompasses a total of 34 items, demonstrating a unidimensional structure. High scores on this scale suggest a positive attitude towards teaching, while lower scores indicate a less favorable perspective. The scale was found to have a reliability coefficient of 0.72 and an internal consistency of 0.93, and its validity was found to be 0.89 (Üstüner, 2006). In the present study, the Cronbach's Alpha internal consistency coefficient was calculated to be 0.84, signifying its reliability (Büyüköztürk, 2021).

2.3.2. Teacher Self-Efficacy Scale

This study employed the "Teacher Self-Efficacy Scale" initially developed by Tschannen-Moran and Hoy (2001) and adapted into Turkish by Çapa, Çakıroğlu, and Sarıkaya (2005) to assess the self-efficacy levels of high school mathematics teacher candidates. The scale consists of 24 items scored using a Likert-type scale, which ranges between 1 (representing low confidence) and 9 (representing strong confidence) points. It has three subscales. The first subscale, "Fostering Student Engagement", assesses teachers' confidence in motivating students to succeed in school activities. The second subscale, "Classroom Management", evaluates teachers' ability to control classroom behavior effectively. Finally, the third subscale "Teaching Strategies" measures teachers' confidence in effectively employing various assessments and teaching strategies. The total score on this scale ranges between 24 and 216 points. Reliability analysis yielded robust results, with Cronbach's Alpha coefficients of 0.82 for "Fostering Student Engagement", 0.84 for "Classroom Management", 0.86 for "Teaching Strategies", and an impressive overall scale reliability of 0.93. Confirmatory factor analysis, a test of construct validity, produced a TLI value of 0.97, indicating a sound fit. Additional fit indices, including RMSEA, fell within the acceptable range, with a value of 0.65 (Browne & Cudeck, 1993). In the context of this research, the Cronbach's Alpha values for the subscales were 0.86, 0.87, and 0.90, respectively, and the overall scale reliability was 0.95. Thus, given these results, it can be stated that the scale is reliable (Büyüköztürk, 2021).

2.3.3. Math Teaching Anxiety Scale

The scale was initially developed by Liu in 2016 and then modified for the Turkish language by Aytekin, Türkmenoğlu, and Arıkan (2017). This scale was analyzed using exploratory and confirmatory factor analyses in this study. Considering the analysis results, the Turkish-adapted scale contains four subscales and 13 items, rated on a five-point Likert scale. The subscales of the scale are as follows: "teaching anxiety originating from one's knowledge of the subject matter (consisting of 4 items)", "teaching anxiety associated with the grasp of concepts (comprising 3 items)", "teaching anxiety arising from the curriculum (comprising 3 items)" and "teaching anxiety specific to a particular subject (comprising 3 items)". These factors are also present in the original scale. The Cronbach's Alpha coefficients were reported to be 0.84 for the total scale and 0.83, 0.78, 0.77, and 0.72 for the subscales, respectively. Confirmatory factor analysis was conducted to test construct validity; x^2/sd ratio was found to be 1.727, AGFI to be 0.91, CFI to be 0.97, and RFI to be 0.93, which meet the criteria for a good fit. Other fit indices, such as RMSEA = 0.053, SRMR = 0.053, GFI = 0.94, NNFI = 0.96, and NFI = 0.94, also fall within the acceptable fit criteria. For this research, Cronbach's Alpha value was determined to be 0.89, and subscale reliability values were found to be 0.81, 0.78, 0.77, and 0.72, respectively. It can be concluded that this scale's questions are both valid and reliable (Büyüköztürk, 2021; Kline, 2011).

2.4. Data Collection

Due to the nature of the teaching practice course, teacher candidates in the experimental and control groups were divided into groups. The data collection instruments used in the present study were administered to teacher candidates in both the experimental and control groups before the application. At the end of the application, the data collection instruments were re-administered to teacher candidates in both the experimental and control groups. The pre-test data were collected by the researcher in October 2019. The post-test data, on the other hand, were collected by the researcher in January 2020 when the lesson study cycles were completed.

2.5. Implementation Process

This study was conducted between October 2019 and January 2020 and was carried out by the researcher during the teaching practice course. In the experimental group, the first four weeks of the 14-week teaching practice course were spent observing the supervising teacher at the practice schools. Then, the teaching practice course was conducted using the lesson study model. Throughout the implementation process, the phases of the lesson study model, which was integrated into the teaching practice course for the experimental group, are as follows:

- Teacher candidates were provided with a seminar on how to prepare lesson plans for two class hours. Sample lesson plans were examined, and they were instructed to prepare their lesson plans accordingly.
- During the subsequent week, detailed information about the lesson study model, one of the professional development models, was provided to the teacher candidates. The stages and implementation of the model were explained. (Figure 1). Sample research studies on the lesson study model were presented, and any questions from teacher candidates about the model were addressed. Moreover, teacher candidates filled out a form to determine their willingness to participate in this study.
- Throughout the semester, seven cycles of lesson study were completed with both groups of teacher candidates. Each teacher candidate led at least four lessons. In both groups, lesson study was completed with teacher candidates in stages including planning, the first research lesson, analyzing and revising the first research lesson, the second research lesson, analyzing and revising the second research lesson, and finalizing the plan.
- Each lesson study cycle begins with planning the learning outcomes to be covered during the week. These cycles were conducted using outcomes from the 9^{th} and 11^{th}-grade mathematics curricula. The outcomes were determined in collaboration with the supervising teacher, considering the semester plan. In the prepared lesson plans, efforts were made to incorporate methods that encourage active student participation. In the lesson plans, activities such as stations, puzzles, matching games, bingo, group work, and intellectual games were prepared aiming to draw the student's interest and enhance participation in the class.
- Before the first research lesson, planning preparations were conducted sequentially, starting with individual efforts, followed by collaborative endeavors among teacher candidates, and ultimately involving a group with the researcher in the university setting. The final version of the lesson plan was given to the teacher candidate, who would conduct the research lesson.
- During the first research lesson conducted by a teacher candidate, fellow group members, the researcher, and the mentor teacher observed and documented the proceedings. As a result of these observations, challenges encountered during the first research lesson, such as difficulties in time management, practical implementation issues, instructional problems, and classroom management issues, were collectively

discussed by the group members and the researcher. Subsequently, adjustments to the lesson plan for the second research lesson were deliberated upon, and modifications were made to enhance its effectiveness.

- The modified plan was used by a different teacher candidate for the second research lesson, and similar stages as the first research lesson were repeated. After the second research lesson, group members and researchers held a meeting again to discuss potential changes if the lesson were to be taught again, and the final version of the lesson plan was determined.
- The researcher made an effort to observe a significant portion of the research lessons in the experimental group.

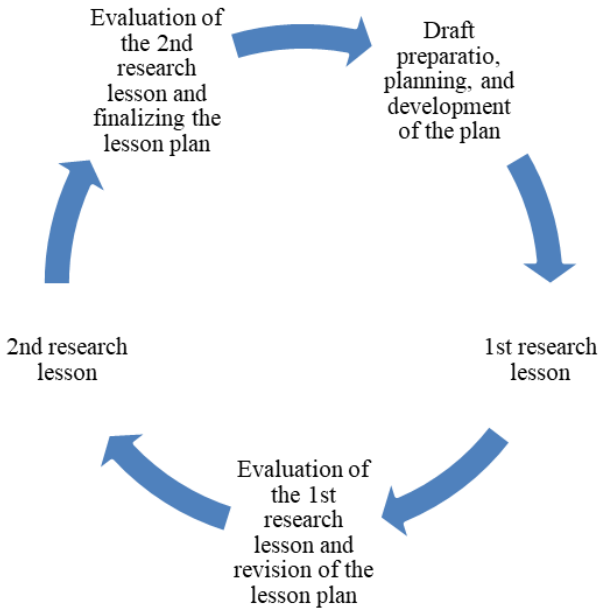

Figure 1. Lesson Study Cycle

In the control group, the teaching practice was conducted by the researcher in accordance with the course content. Teacher candidates enrolled in classroom practice in selected schools for six hours per week, every week. Moreover, to evaluate this practice, the candidates attended classes conducted by the instructor supervising the practice (YÖK, 1998). Similar to the experimental group, teacher candidates in the control group spent the initial four weeks of the 14-week teaching practice course observing the supervising teacher at the practice schools. Then, they continued with the practical requirements of the teaching practice. The teacher candidates in the control group held a meeting once a week at the university to discuss their practical experiences and receive feedback. The researcher observed the teaching processes of each teacher candidate in the control group a minimum of once and a maximum of two times.

2.6. Data Analysis

Data analysis was carried out by using SPSS software (Version 25). The Shapiro-Wilk test was utilized to assess the conformity to a Gaussian distribution. Considering the small sample size in this study, it was concluded that the data deviated from a Gaussian distribution. Therefore, to determine if there were differences between groups, the non-parametric Mann-Whitney U test was utilized, whereas the Wilcoxon Signed-Rank test was used for evaluating intragroup differences. The Mann-Whitney U test is utilized to analyze if there is a significant disparity between the results of two independent samples, whereas the Wilcoxon Signed-Rank test is

used to assess whether there is a significant difference between the scores of two dependent samples (Büyüköztürk, 2021).

2.7. Ethics

In this study, all rules stated in the directive of Scientific Research and Publication Ethics of Higher Education Institutions were followed. Ethics committee permission was obtained from the Ethics Committee of the Institute of Educational Science of Gazi University (date: 07.23.2020 and number: 91610558-302.08.01).

3. RESULTS

The effect of the lesson study used in the teaching practice course on teacher candidates' attitudes toward the teaching profession, self-efficacy beliefs, and teaching anxiety variables was examined.

3.1. Effect of the Lesson Study on Teacher Candidates' Attitudes toward the Teaching Profession

The results of the Mann-Whitney U test, which was used to assess if there was a significant difference between teacher candidates' pre- and post-test outcomes on their attitudes towards the teaching profession scale, are presented in Table 3 for all groups.

Table 3

Mann-Whitney U Test Results for Teacher Candidates' Attitudes towards the Teaching Profession Scale

Test Type	Group	n	Rank Mean	Rank Sum	U	z	p
Pre-Test	Experimental	7	7.43	52.00	24.000	-.064	.949
	Control	7	7.57	53.00			
Post-Test	Experimental	7	10.86	76.00	1.000	-3.003	.03
	Control	7	4.14	29.00			

As seen in Table 3, it was determined that there was no statistically significant difference between teacher candidates' pre-test results in both groups regarding their attitude scale towards the profession of teaching (z=-0.064, p=0.949). Therefore, it can be concluded that the attitude scores of teacher candidates in the experimental and control groups were similar before the beginning of this study. However, given the post-test results, there was a major disparity favoring the experimental group regarding the attitude scale toward the teaching profession (z=-3.003, p=0.03). This result indicates that, after the implementation of the lesson study model, teacher candidates in the experimental group exhibited higher levels of professional attitudes than their counterparts in the control group.

To assess the effect of the lesson study model implemented during the teaching practice course on teacher candidates' attitudes in both groups, the pre-test and post-test results regarding their attitudes toward the profession were compared by using the Wilcoxon Signed-Ranks Test. The detailed results can be found in Table 4.

Table 4

Wilcoxon Signed-Ranks Test Results for Pre-Test and Post-Test Scores of Teacher Candidates' Attitudes Toward the Teaching Profession Scale

Group	Post-test – Pre-test	n	Rank Average	Total Rank	z	P
Experimental	Negative Positive Tie	- 7 -	4.00	28.00	-2.384	.017
Control	Negative Positive Tie	1 5 1	1.50 3.90	1.50 19.50	-1.903	.057

The results shown in Table 4 revealed a statistically significant difference ($p<0.05$) between the pre-test and post-test results of individuals in the experimental group, who are pursuing a career in teaching, particularly regarding their perceptions of the teaching profession. After further examination of the rank sums and rank average scores, it was determined that there was a difference favoring the post-test scores.

In contrast, there was no statistically significant difference between pre-test and post-test scores in the control group regarding their attitudes toward the teaching profession ($p>0.05$). The results achieved here clearly indicate that implementing the lesson study model during the teaching practice course positively affects the attitudes of aspiring mathematics teachers toward the teaching profession.

3.2. The Effects of the Lesson Study on the Teacher Self-Efficacy of Teacher Candidates

The Mann-Whitney U test was used to evaluate the statistical significance of differences between the pre-test and post-test scores of the teacher candidates in both the experimental and control groups on the teacher self-efficacy scale and its sub-dimensions. The results of this analysis are presented in Table 5.

Table 5

Results of the Mann-Whitney U Test Regarding Teacher Candidates' Teacher Self-Efficacy Scale and its Sub-Dimensions

Test Type	Scale and Sub-Dimensions	Group	n	Rank Mean	Rank Sum	U	z	p
Pre-Test	Teacher Self-Efficacy Total	Experimental Control	7 7	8.93 6.07	62.50 42.50	14.500	-1.291	.209
	Student Participation	Experimental Control	7 7	7.21 7.79	50.50 54.50	22.500	-.266	.805
	Classroom Management	Experimental Control	7 7	8.43 6.57	59.00 46.00	18.000	-.854	.456
	Instructional Strategies	Experimental Control	7 7	8.71 6.29	61.00 44,00	16.000	-1.113	.318
Post-Test	Teacher Self-Efficacy Total	Experimental Control	7 7	11.00 4.00	77.00 28.00	0.000	-3.130	.001
	Student Participation	Experimental Control	7 7	11.00 4.00	77.00 28,00	0.000	-3.151	.001
	Classroom Management	Experimental Control	7 7	11.00 4.00	77.00 28.00	0.000	-3.151	.001
	Instructional Strategies	Experimental Control	7 7	11.00 4.00	77.00 28.00	0.000	-3.148	.001

As seen in Table 5, it was determined that there was no statistically significant difference between the pre-test scores of the teacher candidates in the experimental and control groups on the Teacher Self-Efficacy Scale and its sub-dimensions (p>0.05). This result suggests that the teacher candidates in both groups had comparable scores on the teacher self-efficacy measure and its sub-dimensions before the beginning of the study. Examining the post-test scores of the teacher self-efficacy scale and its sub-dimensions for both groups, a statistically significant difference favoring the experimental group was found (p>0.05). Results suggest that using cooperative learning strategies significantly improved teacher candidates' self-efficacy and scores on the various sub-dimensions in the scale.

The Wilcoxon Signed-Ranks test was employed when comparing pre-test and post-test scores in the experimental and control groups to evaluate the effect of cooperative learning in the teaching practice course on the teacher candidates' teacher self-efficacy scale and its sub-dimensions. The results are presented in Table 6.

Table 6

Wilcoxon Signed-Ranks Test Results of Pre-Test and Post-Test Scores of Teacher Candidates' Teacher Self-Efficacy Scale and its Sub-Dimensions

Group	Scale and Sub-Dimensions	Post-test Pre-test	n	Mean Rank	Sum of Ranks	z	p
Experimental	Teacher Self-Efficacy Total	Negative	-				
		Positive	7	4.00	28.00	-2.371	.018
		Tie	-				
	Ensuring Student Participation	Negative	-				
		Positive	7	4.00	28.00	-2.371	.018
		Tie	-				
	Classroom Management	Negative	-				
		Positive	7	4.00	28.00	-2.375	.018
		Tie	-				
	Instructional Strategies	Negative	-				
		Positive	7	4.00	28.00	-2.366	.018
		Tie	-				
Control	Teacher Self-Efficacy Total	Negative	3	3.33	10.00		
		Positive	3	3.67	11.00	-.105	.916
		Tie	1				
	Ensuring Student Participation	Negative	5	3.00	15.00		
		Positive	-			-2.070	.038
		Tie	2				
	Classroom Management	Negative	3	2.83	8.50		
		Positive	4	4.88	19.50	-.933	.351
		Tie	-				
	Instructional Strategies	Negative	2	1.50	3.00		
		Positive	4	4.50	18.00	-1.577	.115
		Tie	1				

Considering the results shown in Table 6, there was a statistically significant difference between the pre-test and post-test scores of the experimental group, specifically in relation to the self-efficacy scale and its sub-dimensions (p<0.05). Examining the total and mean scores, the difference favors the post-test results. In the control group, no significant difference was found between pre-test and post-test scores on the self-efficacy scale and its sub-dimensions, except for the sub-dimension of ensuring student participation (p>0.05). The negative difference in the sub-dimension of ensuring student participation in the control group may stem from failures in

capturing students' attention during the course. In the control group, no significant difference was observed between pre-test and post-test scores on the self-efficacy scale and its sub-dimensions, except for the sub-dimension of ensuring student participation ($p>0.05$). The negative difference in the sub-dimension of ensuring student participation in the control group may stem from failures in capturing students' attention during the course. The results achieved here suggest that the implementation of lesson study positively affected the self-efficacy of mathematics teacher candidates and might be considered a valuable model across several sub-dimensions.

3.3. Effect of Lesson Study on Math Teaching Anxiety

The results of the Mann-Whitney U test are provided in Table 7. These results were examined to determine if there is a statistically significant difference between the pre-test and post-test scores on the math teaching anxiety scale, as well as its sub-dimensions, among all groups of teacher candidates.

Table 7

Mann Whitney U Test Results for Teacher Candidates' Math Teaching Anxiety Scale and its Sub-Dimensions

Test Type	Scale and Sub-dimensions	Group	n	Mean Rank	Sum of Ranks	U	z	p
Pre-Test	Total Math Teaching Anxiety	Experimental	7	7.64	53.50	23.500	-.129	.902
		Control	7	7.36	51.50			
	Anxiety due to Content Knowledge	Experimental	7	7.86	55.00	22.000	-.323	.805
		Control	7	7.14	50.00			
	Conceptual Understanding	Experimental	7	7.71	54.00	23.000	-.198	.902
		Control	7	7.29	51.00			
	Curriculum-related Anxiety	Experimental	7	4.07	28.50	21.500	-.421	.710
		Control	7	10.93	76.50			
	Domain-Specific Anxiety	Experimental	7	8.00	56.00	21.000	-.428	.710
		Control	7	7.00	49.00			
Post-Test	Total Math Teaching Anxiety	Experimental	7	4.00	28.00	.000	-3.137	.001
		Control	7	11.00	77.00			
	Anxiety due to Content Knowledge	Experimental	7	4.00	28.00	.000	-3.155	.001
		Control	7	11.00	77.00			
	Conceptual Understanding	Experimental	7	4.00	28.00	.000	-3.165	.001
		Control	7	11.00	77.00			
	Curriculum-Related Anxiety	Experimental	7	4.07	28.50	.500	-3.122	.001
		Control	7	10.93	76.50			
	Domain-specific Anxiety	Experimental	7	4.00	28.00	.000	-3.180	.001
		Control	7	11.00	77.00			

As seen in Table 7, it was found that there was no statistically significant difference in the pre-test results of teacher candidates in both groups regarding the math teaching anxiety scale and its relevant sub-dimensions ($p>0.05$). Hence, this suggests that the teacher candidates in both the experimental and control groups had comparable levels of math teaching anxiety before the beginning of the research. After analyzing the post-test results of the teacher candidates in both groups, particularly focusing on math teaching anxiety and subsequent sub-dimensions, it is clear that the experimental group had significantly reduced anxiety levels when compared to the control group ($p<0.05$). The results achieved here suggest that the incorporation of lesson study

had beneficial effects in reducing math teaching anxiety among the teacher candidates in the experimental group.

In order to determine the differences in scores between teacher candidates in two groups regarding their levels of anxiety related to teaching mathematics, as measured by the math teaching anxiety scale and its sub-dimensions, the pre-test and post-test results of the teacher candidates were analyzed using the Wilcoxon Signed-Ranks test. The findings of this test are presented in Table 8.

Table 8

Wilcoxon Signed Ranks Test Results for Pre-test and Post-test Scores of Teacher Candidates on the Math Teaching Anxiety Scale and its Sub-Dimensions

Group	Scale and Sub-Dimensions	Post-test – Pre-test	n	Mean Rank	Total Rank	z	p
Experimental	MTA Total	Negative	7	4.00	28.00	-2.375	.018
		Positive	-				
		Tie	-				
	Knowledge-Related	Negative	7	4.00	28.00	-2.392	.017
		Positive	-				
		Tie	-				
	Conceptual Understanding	Negative	7	4.00	28.00	-2.410	,016
		Positive	-				
		Tie	-				
	Curriculum-Related	Negative	7	4.00	28.00	-2.388	.017
		Positive	-				
		Tie	-				
	Field-specific	Negative	7	4.00	28.00	-2.392	.017
		Positive	-				
		Tie	-				
Control	MTA Total	Negative	1	1.00	1.00	-1.761	.078
		Positive	4	3.50	14.00		
		Tie	2				
	Knowledge-Related	Negative	2	1.50	3.00	-1.342	.180
		Positive	-				
		Tie	5				
	Conceptual Understanding	Negative	4	3.38	13.50	-1,656	.098
		Positive	1	1.50	1.50		
		Tie	2				
	Curriculum-Related	Negative	3	2.00	6.00	-1,633	.102
		Positive	-				
		Tie	4				
	Field-specific	Negative	3	2.67	8.00	-1.134	.257
		Positive	1	2.00	2.00		
		Tie	3				

Examining the results presented in Table 8, it was determined that there is a significant difference between the results of the experimental group's math teaching anxiety scale and its sub-dimensions, both before and after the intervention ($p<0.05$). Analyzing the mean and total scores, it was found that the difference favors post-test scores. In contrast, the control groups' pre-test and post-test score differences do not show any significant difference ($p>0.05$). Therefore, it can be concluded that the lesson study implemented during the teaching practice

course effectively reduced the math teaching anxiety of the participants in the experimental group.

4. Discussion and Conclusion

This study aimed to assess how the implementation of lesson study affected the attitudes regarding the profession of education, teacher self-efficacy, and math teaching anxiety among mathematics teacher candidates. This objective was achieved by using a semi-experimental approach. Before the experimental intervention, the results indicated no statistically significant difference in attitudes toward the teaching profession between experimental and control groups. However, following the implementation of experimental intervention, it was determined that there was a statistically significant difference favoring the experimental group. In other words, it can be concluded that the lesson study model positively affects future teachers' attitudes toward the education profession when compared to traditional practices. The literature review also reveals that lesson study contributes to the teaching profession (Budak et al., 2011; Lee, 2008; Puchner & Taylor, 2006) and positively affects the attitudes of teachers, including teacher candidates (Günay et al., 2016; Kandemir, 2018; Kıncal & Beypınar, 2015; Ogegbo et al., 2019; Şahin & Kılıç, 2020). Thanks to its contribution to teacher candidates' professional development, lesson study also contributes to their professional attitudes. Teachers' attitudes toward their profession shape their approach, student interaction, classroom environment, and instructional strategies (Güneyli & Aslan, 2009). Therefore, developing positive attitudes is essential for teacher candidates to effectively fulfill their teaching responsibilities.

The results achieved in this study indicate that, in comparison to the control group, the experimental group exhibits a significantly higher level of self-efficacy. Thus, the use of the lesson study model in the teaching practice course had a beneficial impact on the self-efficacy of mathematics teacher candidates. The levels of teacher self-efficacy of the teacher candidates were at a moderate level before the experimental process, and they increased after the process. Similar studies carried out with teachers also indicated that lesson study enhanced teacher self-efficacy (Budak, 2012; Ogegbo et al., 2019; Roberts, 2010; Yılmaz Doğan, 2018). The inclusion of direct classroom applications of lesson study enables teacher candidates to observe and provide feedback to others, allowing them to revise and implement lessons, thereby providing an opportunity for the professional development of teacher candidates. Professional experience is one of the primary factors shaping the self-efficacy (Bandura, 1997). Therefore, it can be concluded that the lesson study is quite beneficial in terms of self-efficacy for teacher candidates.

Teacher candidates may encounter challenges in classroom management, time management, communication, and selecting appropriate teaching strategies while implementing lesson plans in the teaching practice course (Bay et al., 2020; Taşdere, 2014). The results achieved in the experimental group suggest a significant improvement favoring the post-test regarding student engagement, teaching strategies, and classroom management. Using the lesson study model significantly contributes to developing teacher candidates' abilities to facilitate student engagement, choose effective teaching strategies, and refine classroom management skills. Similarly, it was reported in the study carried out by Yılmaz Doğan (2018) on teachers by using the lesson study model that there was a significant increase in self-efficacy scores in student engagement and teaching strategies dimensions, but not in the classroom management dimension. In a study carried out by Ayra (2021) with teachers, it was found that the implementation of lesson study in instruction had a positive effect on classroom management skills. Hence, it can be stated that integrating the lesson study approach into the teaching practice course increases the self-efficacy of teacher candidates. This contribution might originate from the various experiences gained through lesson study, such as collaboratively

discussing and rectifying lesson plans and addressing deficiencies in teaching practices during the planning and post-lesson discussion stages.

Another result achieved in this study shows that individuals in the experimental group experienced decreased anxiety in teaching math when compared to the control group. Sub-dimensions of the scale contain anxiety associated with subject knowledge, conceptual understanding, curriculum-related concerns, and concerns related to the subject matter. Teacher candidates might experience anxiety about math teaching due to deficiencies in classroom experience or subject-specific training. In a study carried out with teachers, it was also reported that collaboration among teachers in lesson study contributes to the development of teachers' subject knowledge (Ayra, 2021). Similarly, in another study, it was concluded that lesson study enhances teacher candidates' knowledge related to the curriculum (Koçak, Soylu & Hayat, 2021). The experimental group demonstrated significant and positive differences across all sub-dimensions of the scale. Collaboratively planning lessons through lesson study necessitates an in-depth understanding of the subject and anticipating potential misconceptions and difficulties that students might face. In this context, it can be concluded that implementing lesson study model on the experimental group within the teaching practice course yields more efficacy in reducing math teaching anxiety among teacher candidates.

Considering the analysis results, it can be stated that implementing the lesson study model has a beneficial influence on individuals' attitudes toward the teaching profession and perceived effectiveness in the teaching practice lectures. Moreover, this technique also contributes to decreasing math teaching anxieties. Hence, lesson study can be considered a functional and effective technique in implementing the teaching practice course.

The results achieved in this study suggest the following recommendations:

- Given the collaborative nature of the lesson study model, the stages of the lesson study cycle can be more effectively executed when carried out with teachers or teacher candidates, who can communicate comfortably with each other.
- The time-consuming nature of the meetings and the challenges in finding meeting places during the implementation can be mitigated by supporting them with online meetings.
- Since lesson study is conducted within the context of a teacher training course, it is recommended to use the same grade level for the lessons and revision lessons to facilitate their smooth execution by teacher candidates.
- Considering the positive effect of the results achieved here on teacher candidates, the teacher training course can be conducted using the lesson study model.
- The lesson study model implemented in the teacher training course can also be applied in different undergraduate programs and courses, thereby contributing to the teaching skills of teacher candidates.
- This study with teacher candidates can also be conducted with teachers.
- In this study, besides a positive increase in teacher candidates' attitudes toward the teaching profession and their perceptions of self-efficacy, there was also a decrease in teaching anxiety. This quantitatively conducted research can be enriched with in-depth qualitative findings.

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Ethics Committee Permission:

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