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Research Article

# The Effect of the Out-of-School Learning Environments Course in Teaching Mathematics on the Opinions of Teacher Candidates

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*Abstract* – In this study, it was aimed to determine the self-efficacy beliefs of elementary mathematics teacher candidates towards out-of-school learning activities and their thoughts about out-of-school learning environments before and after the out-of-school learning environments in mathematics teaching course. In line with this purpose, the effect of out-of-school learning environments course in mathematics teaching taught at the undergraduate level was examined. In the study, a mixed research method was adopted. The participants of the study consisted of 59 elementary mathematics teacher candidates studying in the 4th grade at a state university in Türkiye. "Teacher Self-Efficacy Beliefs Scale for Out-of-School Learning Activities" and six open-ended questions about out-of-school learning environments were used as data collection tools. It was concluded that the out-of-school learning environments course in mathematics education had a positive effect on pre-service teachers' self-efficacy and their thoughts about out-of-school learning.

*Key words*: Mathematics teaching, out-of-school learning environments, self-efficacy, elementary mathematics teacher candidates.

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## Introduction

Today, the progress in science and technology has affected all areas of life, as well as education and training. Within the framework of development and progress, new approaches and teaching methods are applied in the fields of education and training. In this context, one of the approaches used in education is constructivism. From a philosophical perspective, it is

stated that constructivism is based on the principles of progressivism (Keskin & Şahin, 2018). In other words, it is emphasized that the constructivist approach emerged depending on the progressive philosophy (Öztürk, 2013). The progressive perspective has a remarkable impact on curriculum today, as it focuses on students' thinking skills by centering their interests and needs, and one of its main points is that students are active throughout education (İlhan Beyaztaş et al., 2013). The main principles of the progressive philosophical perspective are such as (i) the individual is active in education, (ii) problem-solving is taken as the basis in education, (iii) school is life itself rather than preparation for life, (iv) the teacher's duty is to guide, (v) the school encourages students to cooperate, (vi) democratic education environment (Demirel, 2020a, p. 21-22). In this context, the nature of the constructivist approach, which adopts a student-centered perspective, has led to the opinion that out-of-school learning environments (OoSLE) should also be used in the teaching process (Yazıcı & Yıldırım, 2017).

It can be said that the use of different learning and teaching processes within the framework of the constructivist approach has opened the door to new dimensions in 21st-century education. One of these dimensions is teachers' utilization of different learning environments in teaching. Among different learning environments, there are also OoSLE. In the context of learning and sociocultural approach, the constructivist approach has become very popular in schools, especially in mathematics learning and teaching (Voskoglou, 2019). In the context of the social constructivist approach, it emphasizes that learning should take place not only in the classroom environment but also outside the school. Considering these developments, with the innovations in education and training, the idea that education cannot be limited only to school has emerged and that education should also be provided outside the school (Köseoğlu & Mercan, 2020). In this context, in order to understand individuals' mathematics learning, it is necessary to focus not only on the learning they do at school but also on the learning that takes place outside of school. Because, according to the report published by Life Center (2005), when the waking hours of individuals are examined, it is seen that they spend most of their lives (over 80% of the time they stay awake) in out-of-school environments. This also shows that learning is not only in classrooms at schools but that individuals also have learning experiences outside the classroom environment (Eshach, 2007; Sen et al., 2021). Within this regard, it can be said that the interactions of individuals in OoSLE and in school have an undeniable effect on individuals' mathematics learning.

Today, the measurement of 21st-century learning and the competencies and skills needed in this context is carried out with Programme for International Student Assessment (PISA) (Ananiadou & Claro, 2009). One of the main elements that PISA aims to measure is the extent to which students use the knowledge they learn at school in real life (Organisation for Economic Co-Operation and Development [OECD], 2019). When we focus on the results obtained in PISA, it becomes clear that students from most countries cannot adequately use the knowledge they have learned at school. Students can have the chance to associate the information they have learned with new information in different environments (Falk & Dierking, 2000). In other words, students can have the opportunity to understand what the information they have learned is useful in real life by having the chance to associate the information they have learned in the classroom environment with the experience they have gained outside of school. Activities held outside of school provide students with the opportunity to apply their academic skills in real life, contributing to the reinforcement of the knowledge they have learned in the classroom environment (O'Brien & Rollefson, 1995). In this context, activities carried out outside of school provide students with the opportunity to apply the mathematical knowledge they have learned in the classroom environment. It may offer the opportunity to use it in real life. Students' mathematical literacy levels can be improved within the framework of out-of-school learning (OoSL) experiences and activities to be carried out in this direction.

OoSLE provide awareness (Jarvis & Pell, 2005), develop skills of relating to real life (Ertaş et al., 2011; Tortop & Özek, 2013) and 21st century skills (Genç et al., 2019). In this context, OoSLE affect students' attitudes (Andersson & Johansson, 2013; Sturm & Bogner, 2010; Şentürk & Özdemir, 2014), interest (Bozdoğan, 2008; Bozdoğan & Yalçın, 2006; Morag & Tal, 2012) and motivation (Çığrık & Özkan, 2016), increase academic success (Bozdoğan, 2008; Bozdoğan & Yalçın, 2006; Guberman, 2004; Sturm & Bogner, 2010), contribute to acquiring values (Keskin & Kaplan, 2012) and develop 21st century skills (Altan et al., 2019). In the literature, there are many studies conducted with students, as well as with teachers and teacher candidates in OoSLE. Some studies emphasize that applications for OoSLE are rarely preferred by teachers (Aydoğdu et al., 2023; Carrier, 2009; Orion & Hofstein, 1994). In this context, no matter how well-prepared the curriculum and designed lesson plans are, they are only as effective as teachers can implement them (Göloğlu Demir & Çetin, 2021). Therefore, teachers' approaches to the subject, their attitudes, behaviors, and self-efficacy are considered important in terms of the effectiveness, efficiency, and

achievement of the planned goals of the course. Considering the problems in the field of mathematics education in today's 21st century age (not realizing what mathematics is used for in real life, where it can be used, not associating mathematics with real life, not associating mathematics within itself and with other disciplines, etc.), it is thought that the learning activities designed by teachers for OoSLE will open a door to the solution of these problems. In line with this, teachers' knowledge of OoSLE, their attitudes, and self-efficacy play an important role in carrying OoSL activities.

When the literature is examined, it is seen that while there are studies on OoSLE in areas such as science, preschool, and social studies, there are not enough studies on mathematics education. In other words, while there are many resources for disciplines such as science, history, and art for OoSLE, it is also emphasized in studies on mathematics that such resources are quite limited in number (Aydoğdu et al., 2023; Bahadır & Hırdıç , 2018; Kayhan Altay & Yetkin Özdemir, 2022). Saraç (2017) conducted a content analysis of research on OoSLE in Türkiye. He emphasized that the majority of studies on OoSL in the national arena are in the field of science, and excursions/nature practices and museum/science center visits are used more frequently. When Saraç's (2017) study is examined, it is seen that studies on OoSLE in mathematics education in Türkiye are not included at a sufficient level. One of the limited studies on OoSLE in the field of mathematics education is Kır et al. (2021). In the study, they tried to determine the opinions of teachers about the OoSLE used in mathematics lessons and the practices they carried out in OoSLE. In the study conducted with 12 secondary school mathematics teachers, it was revealed that almost all of the teachers did not receive any training regarding OoSLE. In addition, teachers did not have enough experience in education, event planning and planning for OoSL. In this context, they made suggestions for the development of teachers in related subjects. Similarly, another study was by Aydoğdu et al. (2023). The study examined secondary school teachers' opinions about OoSLE. As a result of the research, it was emphasized that teachers found OoSLE useful, but they expressed opinions that they had difficulty in implementing them due to legal procedures, time, and economic reasons. Among the striking results of the study is that teachers do not have enough information about OoSLE.

Studies on mathematics in the literature aim to determine teachers' opinions about OoSLE or activities. In this context, it can be said that the majority of studies on OoSL in mathematics teaching are aimed at determining the situation. While the "Out-of-School Learning Environments" course is included in the "Vocational Knowledge Elective Courses"

in the "New Teacher Training Undergraduate Programs" courses renewed in 2018, the "Out-of-School Learning Environments in Mathematics Teaching" course is among the field education elective courses in the elementary school mathematics teaching and mathematics teaching programs (Council of Higher Education [CoHE], 2018) In this study, focusing on why OoSLE should be included in mathematics teaching, the effect of the OoSLE course in mathematics teaching, which is taught as an elective course in the elementary school mathematics teaching program, on the self-efficacy and thoughts of teacher candidates towards OoSL was examined. The study differs from other studies in that it offers a perspective on how teacher candidate's activities, academic skills and self-efficacy towards OoSL in mathematics education can be improved.

### Research Problem

What is the impact of the OoSLE course in mathematics teaching on teacher candidates' self-efficacy towards OoSL activities and their thoughts about OoSL?

#### *Subproblems*

1. What are teacher candidates' self-efficacy perceptions of OoSL activities and their thoughts on OoSL before the OoSLE course in teaching mathematics?

2. What are teacher candidates' self-efficacy perceptions of OoSL activities and their thoughts on OoSL after the OoSLE course in teaching mathematics?

3. Is there a significant difference between the self-efficacy of teacher candidates towards OoSL activities before and after the OoSLE course in mathematics teaching?

4. Is there a significant difference between the self-efficacy of teacher candidates for OoSL activities according to gender before and after the OoSLE course in mathematics teaching?

## Method

### Research Design

A mixed research method was adopted in this study, which examined the effect of the OoSLE course in mathematics teaching on the self-efficacy of teacher candidates towards OoSL activities and their thoughts about OoSLE. Mixed research is a research method that involves the combined use of qualitative and quantitative methods or features of other paradigms (Johnson & Christensen, 2014) and provides researchers with the opportunity to

collect more powerful data (Silverman, 2010). Creswell (2009) defines the mixed method as a method in which researchers collect data, perform analysis, present findings and make inferences by adopting qualitative and quantitative approaches in order to find answers to problems. In this context, it is thought that qualitative or quantitative data alone will not be sufficient to examine the effect of the OoSLE course in mathematics teaching within the framework of the opinions of teacher candidates.

It is thought that the effect of the OoSLE course can be determined more clearly by combining the results obtained from quantitative and qualitative methods, supporting and overlapping the findings. In this context, the triangulation model, one of the mixed research designs that allows comparisons to be made by combining the results obtained in line with the data obtained by collecting both quantitative and qualitative data, was preferred in this research. It can be said that this model corresponds to "Triangulation", one of the five aims of mixed research according to Greene et al. (1989). Using quantitative and qualitative methods together in triangulation model allows an in-depth examination of the subject under investigation by utilizing many research designs and many data sources (Cohen et al., 2007). One of the main goals of the triangulation design is to combine the results obtained in line with the data obtained from quantitative and qualitative methods. The quantitative part of this research is based on data obtained from the scale to determine the self-efficacy of teacher candidates for OoSL activities. The qualitative part was created within the framework of open-ended questions asked to the participants in order to determine the opinions of prospective teachers about OoSL in mathematics teaching.

**Participants**

The study group of the research consists of 59 teacher candidates who are studying in the last year of the elementary mathematics teaching program at a state university in Türkiye in the 2022-2023 academic year. Criterion sampling method, one of the non-random purposive sampling methods, was preferred in the research. The main purpose of criterion sampling is stated to be the study of situations that meet pre-existing criteria or are determined by the researcher (Yıldırım & Şimşek, 2016). In this regard, since the study carried out studies on the effect of the OoSLE course in mathematics teaching, the fact that the participants were taking the OoSLE course in mathematics teaching was determined as the selection criterion for the study group. In this context, the participants of the research are teacher candidates who took the OoSLE course in mathematics teaching as an elective course in the 4$^{th}$ grade and participated voluntarily. Table 1 includes the demographic characteristics of the study group:

**Table 1** Demographic characteristics of teacher candidates

| Have you participated in OoSL activities before? | Female | % | Male | % | Total | % |
|---|---|---|---|---|---|---|
| Yes | 28 | 68.3 | 13 | 31.7 | 41 | 69.5 |
| No | 13 | 72.2 | 5 | 27.8 | 18 | 30.5 |
| Total | 41 | 69.5 | 18 | 30.5 | 59 | 100.0 |

Among the teacher candidates participating in the research, 41 were female (69.5% ) and 18 were male (30.5%). While 69.5% (n=41) of the participants stated that they had participated in OoSL activities before, 30.5% (n=18) stated that they had not participated in any OoSL activities before. Of the teacher candidates who had previously participated in the activity for OoSLE, 18 stated that they participated in a school trip, 12 of them stated that they participated in the "pi day" event held at the place where they completed their undergraduate education, and 7 of them stated that they visited a museum.

## Data collection

In order to determine the self-efficacy beliefs of teacher candidates towards OoSL activities before and after the course on OoSLE in mathematics teaching, the data of the study were obtained by asking "Teacher Self-Efficacy Beliefs Scale for Out-of-School Learning (OoSL) Activities" in the quantitative dimension and open-ended questions about "What are the OoSLE that can be used in mathematics teaching", "Advantages and disadvantages of OoSLE" and "What are the contributions of OoSLE to mathematics teaching" in the qualitative dimension.

### *Teacher Self-Efficacy Beliefs Scale for Out-of-School Learning (OoSL) Activities*

“Teacher Self-Efficacy Beliefs Scale for Out-of-School Learning (OoSL) Activities” was developed by Göloğlu Demir and Çetin (2021). Six expert opinions were received to ensure the content validity of the scale, and expert opinion was sought for language and face validity. In the construct validity phase, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were applied. As a result of EFA, a structure consisting of 29 items and four factors was obtained, explaining 61.01% of the total variance. 15 of the items in the scale are positive and 14 are negative items. Reverse coding is required during the analysis phase of negative items. "Preparation Competence", which is one of the sub-dimensions of the scale, consists of 11 items, "Application and Evaluation Competence" consists of 10 items, "Learning Support Competence" consists of 4 items, and "Knowledge and Experience Competency" consists of 4 items. In line with the CFA results, it was stated that the scale had

"acceptable fit" and "perfect fit" indices. The reliability of the Teacher Self-Efficacy Beliefs Scale for Out-of-School Learning (OoSL) Activities, which is a five-point Likert type, was found to be .94 using the Cronbach alpha method. The Cronbach alpha reliability value of the scale for this study was .91 in the pre-test. In the post-test, it was calculated as .92.

### *Open-ended questions*

9 open-ended questions were created before the research in order to determine teacher candidates' thoughts about OoSL in mathematics teaching, in parallel with their self-efficacy towards OoSL activities. The opinions of the faculty members including 1 Assoc. Prof. and 1 Dr. were taken for 9 open-ended questions. Within the framework of expert opinions, 3 questions were removed as it was seen that they did not reflect the purpose of the research. Afterwards, 6 open-ended questions were reviewed by 1 language expert to ensure face and language validity. The open-ended questions were finalized in line with the comments received. 2 of the open-ended questions were about "What are the OoSLE that can be used in mathematics teaching", 2 were about "The advantages and disadvantages of OoSLE", and 2 were about "What the contributions of OoSLE can be to teaching mathematics". It aims to reveal the opinions of the teacher candidates.

### *OoSLE Course Process in Teaching Mathematics*

The OoSLE in mathematics teaching course is a 2-hour weekly course in the 14-week period in the elective course pool of the elementary school mathematics teaching program. The aim of the course is to introduce the process of teaching mathematics in OoSLE, to provide information about teaching methods and techniques that can be used in appropriate OoSLE for teaching mathematics, and to enable teacher candidates to develop, plan, implement, and evaluate sample activities that they can carry out for teaching mathematics in OoSLE. During the 14-week period, teacher candidates discussed what OoSL is, its importance, things to consider in OoSL activities, practices to be done before, during and after OoSL activities, and each teacher candidate designed at least one activity for OoSL in mathematics teaching and developed these designs. The lessons they shared have been realized.

## Data Analysis

In order to provide flexibility in terms of data collection and to reach participants more easily via the web, the Teacher Self-Efficacy Beliefs Scale for Out-of-School Learning (OoSL) Activities and open-ended questions were transferred to the online environment using

Microsoft Forms application. In the stage before the application of the scale and open-ended questions, participants were informed through text that included explanations about the importance of reflecting their views and opinions clearly in order to achieve the purpose of the application, that participation was voluntary, and how they should mark the scale items. During the data collection phase, the threat posed to the validity of the measurement tools when they were applied (Creswell, 2009) was taken into account. In this context, an online meeting was planned with all participants at the same time to apply the data collection tools online, links to the data collection tools were shared with the participants, and data was obtained from all participants at the same time.

### *Analysis of Quantitative Data*

The data obtained online was transferred to Microsoft Excel format via Microsoft Forms. The Excel form includes participants' demographic information, their answers to open-ended questions, and their answers to the Teacher Self-Efficacy Beliefs Scale for Out-of-School Learning (OoSL) Activities. The demographic characteristics of the participants and the data obtained from the scale were transferred to the quantitative data SPSS application. The items of the scale, which is a 5-point Likert type, were coded with SPSS application in line with the coding criteria in the scale, with "I Strongly Disagree" 1 point, "I Disagree" 2 points, "Somewhat Agree" 3 points, "I Agree to a Great extent" 4 points, "Totally Agree" 5 points. Reverse coding was performed for 14 negative items on the scale. The lowest score that can be obtained on the scale consisting of 29 items is 29 and the highest score is 145. In line with the total scores obtained from the scale, "Score range (largest value - smallest value) / (number of degrees)" was used to evaluate the self-efficacy beliefs of teacher candidates towards OoSL activities as very low, low, medium, high and very high. The calculation was carried out in accordance with the formula (Tavşancıl, 2005). In this context, the values between 29-52.2 points for the total scores obtained from the scale are very low, 52.3--75.4 points are low, 75.5-98.6 points are medium, and 98.7-121.8 points are high and a score between 121.9 and 145 was considered as very high self-efficacy. Within the framework of this scoring, the level of self-efficacy of teacher candidates is revealed.

In determining the significant difference between the pre-test scores and post-test scores for the analysis of quantitative data obtained from “the Teacher Self-Efficacy Beliefs Scale for Out-of-School Learning (OoSL) Activities”, the normality of the data group was first examined. The reason for this situation is the decision on the analysis method to be

performed. By examining the normal distribution, it was decided whether parametric or non-parametric methods would be used to determine the difference (Büyüköztürk, 2013; Karasar, 2008). In examining the normality of the data group, Lilliefors, Chi-square, Anderson-Darling, Skewness, Kurtosis, D' Agostino-Pearson, Kolmogorov -Smirnov and Shapiro Many tests such as Wilk tests are encountered (Özer, 2007). In this study, Skewness and Kurtosis values were examined to determine whether the data groups showed normal distribution. According to Tabachnick and Fidell (2013), skewness and kurtosis values being between 1.5 and +1.5 indicate that the data is normally distributed. Within the framework of this information, the skewness and kurtosis values of the pre-test and post-test scores of the teacher candidates were examined and it was seen that these values were between -1 and +1, and it was concluded that the data showed a normal distribution. Similarly, according to the pre-test and post-test, it was determined that the skewness and kurtosis values of the total scores in terms of gender variable were between -1 and +1.

According to the normality analysis, it was determined that the pre-test and post-test scores of the Teacher Self-Efficacy Beliefs Scale for Out-of-School Learning (OoSL) Activities and the total scores in terms of gender variable showed a normal distribution. Within the framework of these findings, t-test for related samples was used to determine the significant difference between pre-test and post-test scores, and t-test analyzes for independent samples were used to determine the significant difference between pre- test and post-test scores in terms of gender variable.

### *Analysis of Qualitative Data*

The qualitative data of the research were obtained from the answers given to seven open-ended questions directed to teacher candidates. The content analysis method was used to analyze qualitative data. Content analysis is a research method that aims to make repeatable and valid inferences from texts or other topics regarding the contexts in which they are used (Krippendorff, 2018). One of the main purposes of content analysis is to obtain concepts and relationships that can explain the data (Selçuk et al., 2014). In this context, within the framework of a research technique, content analysis provides information about situations by increasing the researcher's understanding of certain situations by providing new insights (Krippendorff, 2018). In this context, content analysis brings together seemingly separate data within the framework of certain codes and themes and organizes them in a way that readers can understand (Yıldırım & Şimşek, 2016).

The answers given by teacher candidates to open-ended questions were evaluated within the context of "What are the OoSLE that can be used in mathematics teaching?", "Advantages and disadvantages of OoSLE" and "What is the role of the teacher in OoSLE and what can be their contributions to mathematics teaching?" After transferring the answers obtained via Microsoft Forms to the Excel document, content analysis was carried out on the answers given to the open-ended questions. The opinions of each teacher candidate were protected by expressing them as T1, T2, T3… in order to keep the identities of the people who expressed their opinions confidential (Cohen et al., 2007). In line with the opinions of teacher candidates, codes were created for each question regarding the topics it relates to. The codes are presented through tables in order to make sense of the codes created, to ensure the comprehensibility of the data, and to present them in a framework that the reader can understand. In addition, the opinions of teacher candidates regarding some analyses were directly quoted and code examples for the data were also presented.

To provide validity and reliability criteria for the research; (i) data collection and analysis processes were explained in detail, (ii) frequency tables within the framework of the codes were created and participant opinions regarding the codes were presented by direct quotations, and (iii) the researcher conducted content analysis again 4 weeks after performing the first coding and reliability analysis was performed for the coding determined. In order to reveal the reliability of the qualitative data in the analyses carried out by the researcher at two different times, calculations for reliability analysis were carried out using Miles and Huberman's (1994) security level formula (reliability = consensus/consensus + disagreement). The reliability of the coding performed by the researcher at different times was calculated as 94%. According to Yıldırım and Şimşek (2016), 70% reliability is considered sufficient for the reliability of analysis results.

## Findings

### Findings regarding the first sub-problem

The first sub-problem of the study aims to determine the level of elementary school mathematics teacher candidates' self-efficacy towards OoSL activities and their thoughts on OoSL before the OoSLE course in mathematics teaching. First of all, the findings obtained regarding the teacher candidates' out-of-school self-efficacy levels in pre-lesson mathematics teaching and their thoughts on OoSLE in mathematics teaching are given below. Teacher candidates' thoughts on OoSLE in teaching mathematics include "What are the OoSLE that

can be used in teaching mathematics?", "The advantages and disadvantages of OoSLE", "The role of the teacher in OoSLE" and "What the contributions of OoSLE can be to teaching mathematics." are presented within the framework of categories. In this context, teacher candidates' self-efficacy levels in teaching mathematics before OoSLE course are presented in the Table 2:

**Table 2** Self-efficacy level before the course

| Gender | Very low | % | Low | % | Moderate | % | High | % | Very High | % | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Female | - | - | - | - | 13 | 31.7% | 28 | 68.3% | - | - | 41 |
| Male | - | - | - | - | 5 | 27.8% | 13 | 72.2% | - | - | 18 |
| Total | - | - | - | - | 18 | 30.5% | 41 | 69.5% | - | - | 59 |

70% of elementary school mathematics teacher candidates had high levels of self-efficacy beliefs regarding out-of-school activities in mathematics teaching. There are no teacher candidates with very low, low, or very high levels of self-efficacy. 30.5% (n=18) of teacher candidates have a moderate level of self-efficacy belief. According to the findings in Table 2, it can be stated that the results are close to each other in the context of the gender variable.

***Findings regarding "What are the OoSLE that can be used in mathematics teaching" before the course***

Before the lesson on OoSLE in teaching mathematics, teacher candidates were asked open-ended questions including "What are OoSLE?" and "What are OoSLE that can be used in teaching mathematics?". Findings regarding the OoSLE of teacher candidates are presented in the Table 3:

**Table 3** Opinions about the OoSLE before the course

| OoSLE | N | % | OoSLE | N | % |
|---|---|---|---|---|---|
| Museums | 23 | 38.98 | Park | 2 | 3.39 |
| Any environment planned for the purpose | 14 | 23.73 | Planetarium | 1 | 1.69 |
| School Trips | 10 | 16.95 | Fairs | 1 | 1.69 |
| Science/Art Center | 7 | 11.86 | House | 1 | 1.69 |
| Zoo | 6 | 10.17 | National parks | 1 | 1.69 |
| Botanical Gardens | 4 | 6.78 | Science festivals | 1 | 1.69 |
| Conference/Workshop/Seminars | 4 | 6.78 | Historical places | 1 | 1.69 |
| Nature | 4 | 6.78 | Bank | 1 | 1.69 |
| Library | 4 | 6.78 | Schoolyard | 1 | 1.69 |
| The whole sphere of life | 3 | 5.08 | No idea | 5 | 8.47 |
| Exhibitions | 2 | 3.39 | | | |

As shown in Table 3, before the course on OoSLE in teaching mathematics, approximately 40% of the teacher candidates stated that museums (n=23) could be used in OoSLE. Afterwards, 23.73% of the teacher candidates stated that " any environment planned for the purpose" (n=14, 23.73%) could be used as OoSLE. According to Table 3, among the striking findings is that school trips (n=10, 16.95%) are considered as OoSLE, and five teacher candidates declared that they have no idea.

The findings regarding the OoSLE that can be used for mathematics teaching are presented in the Table 4:

**Table 4** Opinions on OoSLE in mathematics teaching before the course

| OoSLE in mathematics teaching | N | % | OoSLE in mathematics teaching | N | % |
|---|---|---|---|---|---|
| Museums | 20 | 33.90 | Jeweler | 2 | 3.39 |
| Bank | 14 | 23.73 | Math Village | 2 | 3.39 |
| Factories/Industrial Establishments | 11 | 18.64 | Schoolyard | 2 | 3.39 |
| Science arts center | 8 | 13.56 | Library | 2 | 3.39 |
| Everywhere (All place) | 7 | 11.86 | Stationary | 1 | 1.69 |
| Science Festivals | 5 | 8.47 | Book fairs | 1 | 1.69 |
| Trips | 5 | 8.47 | Mathematics Exhibitions | 1 | 1.69 |
| Markets | 5 | 8.47 | Gym | 1 | 1.69 |
| Notary | 4 | 6.78 | Field | 1 | 1.69 |
| Shopping mall | 3 | 5.08 | House | 1 | 1.69 |
| Construction Sites | 3 | 5.08 | Observatory | 1 | 1.69 |
| Parks | 3 | 5.08 | Historical buildings | 1 | 1.69 |
| Nature | 3 | 5.08 | Conference | 1 | 1.69 |
| Workplaces | 2 | 3.39 | No idea | 5 | 8.47 |

When Table 4 is examined, it is seen that teacher candidates consider many areas such as museums (n=20, 33.90%), banks (n=14, 23.73%), factories/industrial establishments (n=11, 18.64%), science and art centers (n=8, 13.56%) as OoSLE that can be used in mathematics teaching. According to the findings, 12% of teacher candidates see all places outside the school (n=7) as OoSLE in teaching mathematics. The fact that the trip (n=5, 8.47%) is considered as an OoSLE stands out in the findings. Approximately 9% of teacher candidates emphasized that they had no idea.

***Findings on the advantages and disadvantages of OoSLE before the course***

One of the questions asked to teacher candidates in order to reveal the effect of the OoSLE course in mathematics teaching is about the advantages of OoSLE. The findings

obtained as a result of the content analysis of the answers given by teacher candidates regarding the advantages of OoSLE are presented in the Table 5:

**Table 5** Opinions on the advantages of OoSLE before the course

| Advantages of OoSLE | N | % |
|---|---|---|
| Permanent learning | 24 | 40.68 |
| Learning by doing | 11 | 18.64 |
| Concretization | 9 | 15.25 |
| Relation to real life | 9 | 15.25 |
| Attracting Interest/Attention | 4 | 6.78 |
| Understanding the function of the course in real life | 4 | 6.78 |
| Meaningful Learning | 3 | 5.08 |
| Making Lesson Fun | 3 | 5.08 |
| Ability to apply what you have learned | 2 | 3.39 |
| Developing positive attitude | 1 | 1.69 |
| Association with different disciplines | 1 | 1.69 |
| Effective Teaching | 1 | 1.69 |
| No Idea | 2 | 3.39 |

According to Table 5, the majority of teacher candidates (40.68% ) stated that OoSLE provide permanent learning. Teacher candidates stated that OoSLE contributed to areas such as learning by doing and experiencing (n=11, 18.64% ), concretizing concepts (n=9, 15.25%), relation to real life (n=9, 15.25%), attracting students' interest and attention (n= 4, 6.78%), understanding the function of the course in real life (n=4, 6.78%), etc. Some opinions of teacher candidates regarding the themes created in Table 5 are presented below:

T22: "*It ensures permanent learning of the student. It accelerates the learning process by associating abstract information in your mind with concrete information*." (Permanent learning and concretization)

T39: "*Outside of school, the student is more in touch with the subject and learns by doing and experiencing. A student's interest and curiosity in out-of-school environments keeps him/her committed to the activity*." (Learning by doing and Attracting Interest/Attention)

T11: "*It enables students to associate what they have learned with real life*." (Relation to real life)

Findings regarding the disadvantages of OoSLE within the framework of the opinions of teacher candidates are given in the Table 6:

**Table 6** Opinions on the disadvantages of OoSLE before the course

| Disadvantages of OoSLE | n | % |
|---|---|---|
| Time | 14 | 23.73 |
| Class dominance and order may not be achieved | 13 | 22.03 |
| Economic | 11 | 18.64 |
| Unfavorable learning environment | 9 | 15.25 |
| Inability to focus on the subject | 9 | 15.25 |
| Learning that differs from its purpose may occur | 4 | 6.78 |
| Bureaucratic difficulties (Permits, official correspondence, etc.) | 4 | 6.78 |
| No idea | 3 | 5.08 |

When the Table 6 is examined, the most stated disadvantage by teacher candidates regarding OoSLE is time (n=14, 23.73%). Moreover, it was emphasized that " Class domination and order may not be achieved" (n=13, 22.03%) and economic difficulties (n=11, 18.64% ) may be encountered because the activity requires a certain amount of budget. Approximately 15% of the teacher candidates think that the OoSLE may be problematic in terms of readiness, suitability to the learning outcome, health, etc., and that these environments may turn into an unfavorable learning environment (n=9, 15.25%). As another disadvantage of OoSLE, teacher candidates stated that students may encounter a situation of "Inability to focus on the subject" (n=9, 15.25% ), thinking that different phenomena other than the main purpose may attract their attention in these environments. Some teacher candidates' opinions regarding the findings in the Table 6 are given below:

T17: *"Too much time may be wasted."* (Time)

T50: *"Crowded classes can be difficult to keep under control."* (Class dominance and order may not be achieved)

T24: *"It may be costly and time-consuming"* (Economic and Time)

T29: *"There may be some limitations. An event may not take place in every environment, they may be harmful to health and psychology."* (Unfavorable learning environment)

T54: *"Students' interest and attention can be quickly distracted"* (Inability to focus on the subject)

***Findings regarding the role of the teacher in OoSLE before the course and the contributions of OoSLE to mathematics teaching***

Another situation examined in the study within the framework of the first research problem is the examination of teacher candidates' thoughts about the role of teachers in OoSLE before the course. As a result of the analysis, the findings regarding the role of teachers in OoSLE of teacher candidates are given in the Table 7:

**Table 7** Opinions on the role of teachers in OoSLE before the course

| The Role of the Teacher | N | % |
|---|---|---|
| Guide | 40 | 67.80 |
| Determining the OoSLE | 7 | 11.86 |
| Planner | 6 | 10.17 |
| Designing/organizing activities | 5 | 8.47 |
| Taking security precautions | 4 | 6.78 |
| Provides meaningful/permanent learning | 1 | 1.69 |
| Educate acquisitions | 1 | 1.69 |
| Providing acquisition-place matching | 1 | 1.69 |
| Establishing a relationship between information and the environment | 1 | 1.69 |
| No Idea | 3 | 5.08 |

68% of teacher candidates are of the opinion that the teacher's role in OoSLE is to guide (n=40). Then, it was stated that they had the roles of determining the OoSLE (n=7, 11.86%), carrying out all kinds of planning (n=6, 10.17%), and designing/organizing activities (n=5, 8.47%). Some answers from teacher candidates regarding the role of the teacher in OoSLE in mathematics teaching are presented below:

T4: *"The teacher should be a guide and pathfinder"* (Guide)

T23: *"They determine the environments that meet the learning goals of the students and show the information that the students need to learn in these environments."* (Determining the OoSLE and guide)

T13: *"The teacher should make correct plans before, during, and after the lesson in order for the students to stick to the goal."* (Planner)

Another situation examined in the study is the contribution of teacher candidates' OoSLE to mathematics teaching. In this context, the findings obtained from teacher candidates are presented in the Table 8:

**Table 8** Opinions on the contribution of OoSLE to mathematics teaching before the course

| Contribution | N | % |
|---|---|---|
| Permanent learning | 23 | 38.98 |
| Concretization | 13 | 22.03 |
| Relating mathematics to real-life | 9 | 15.25 |
| Realizing the function of mathematics in real life | 8 | 13.56 |
| Learning by doing | 6 | 10.17 |
| Attracting Interest/Attention | 5 | 8.47 |
| Making math fun | 3 | 5.08 |
| Making learning easier | 3 | 5.08 |
| Eliminating prejudices against mathematics | 2 | 3.39 |
| Active participation | 2 | 3.39 |
| Making you love mathematics | 1 | 1.69 |
| Motivation | 1 | 1.69 |
| Meaningful learning | 1 | 1.69 |
| No Idea | 3 | 5.08 |

The most frequently expressed opinion of teacher candidates regarding the contribution of OoSLE to mathematics teaching is that OoSLE support permanent learning (n=23). Approximately 39% of teacher candidates think that OoSLE will provide permanent learning in mathematics education. Approximately 22% of teacher candidates emphasize that concretization in mathematics can be achieved through OoSLE. 15.25% of the participants stated that mathematics could be relating to real life through OoSLE. Additionally, 13.56% of teacher candidates emphasized that realizing the function of mathematics in real life can be achieved through OoSLE. The opinions of some participants regarding these findings are given below:

T5: *"It provides permanent learning by associating mathematics with daily life."* (Associating with real life and permanent learning)

T40: *"Since there are many abstract concepts in mathematics, these activities help to concretize them."* (Concretization)

T26: *"Mathematics is not only taught in class; It is learned by observing and seeing it used in daily life."* (Realizing the function of mathematics in real life)

**Findings regarding the second sub-problem**

The second sub-problem of the research aims to determine the level of elementary school mathematics teacher candidates' self-efficacy towards OoSL activities after OoSLE course in mathematics teaching and their thoughts on OoSL. First of all, teacher candidates' self-efficacy levels for after-course OoSL activities are presented in the Table 9:

**Table 9** Self-efficacy level after the course

| Gender | Very low | % | Low | % | Moderate | % | High | % | Very High | % | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Female | - | - | - | - | - | - | 24 | 58.5% | 17 | 41.5% | 41 |
| male | - | - | - | - | - | - | 11 | 61.1% | 7 | 38.9% | 18 |
| Total | - | - | - | - | - | - | 35 | 59.3% | 24 | 40.7% | 59 |

After the OoSLE course in mathematics teaching, 40.7% of the teacher candidates reached a very high level of self-efficacy (n=24), which is the highest level. It can be seen in the Table 9 that the teacher candidates with a very high level of self-efficacy are 17 female and 7 male. 59.3% of teacher candidates have a high level of self-efficacy for OoSL activities. There are no teacher candidates with moderate-level proficiency after the course.

***Findings regarding "What are the OoSLE that can be used in mathematics teaching" after the course***

The findings of the answers given by the pre-service teachers about the OoSLE after the course are presented in the Table 10:

**Table 10** Opinions about the OoSLE after the course

| OoSLE | N | % | OoSLE | N | % |
|---|---|---|---|---|---|
| Environments outside the classroom planned for the purpose | 28 | 47.46 | Botanical gardens | 4 | 6.78 |
| Science/Art Centers | 15 | 25.42 | Natural protected areas | 4 | 6.78 |
| Museums | 12 | 20.34 | Non-governmental organizations | 3 | 5.08 |
| Places outside the classroom | 10 | 16.95 | Schoolyard | 2 | 3.39 |
| Historical places | 10 | 16.95 | Ruins | 1 | 1.69 |
| Planetarium | 8 | 13.56 | Environments where students can learn while having fun | 1 | 1.69 |
| Parks | 7 | 11.86 | Recreation areas | 1 | 1.69 |
| Factories/Industrial Establishments | 5 | 8.47 | Virtual classes | 1 | 1.69 |
| Libraries | 4 | 6.78 | Zoos | 1 | 1.69 |
| Universities | 4 | 6.78 | | | |

According to Table 10, almost half of the pre-service teachers see OoSLE as "environments outside the classroom planned for the purpose". Subsequently, teacher candidates consider science/art centers (n=15, 25.42%), museums (n=12, 20.34%), any place outside the classroom (n=10, 16.95%), historical places (n=10, 16.95%), planetarium (n=8, 13.56%) as OoSLE.

Teacher candidates' opinions about OoSLE that can be used for teaching mathematics are given in the Table 11:

**Table 11** Opinions on OoSLE in mathematics teaching after the course

| OoSLE in mathematics teaching | N | % | OoSLE in mathematics teaching | N | % |
|---|---|---|---|---|---|
| Anywhere that can be associated with profit | 28 | 47.46 | Natural protected areas | 5 | 8.47 |
| Museum | 27 | 45.76 | Field-Garden | 5 | 8.47 |
| Science/Art Center | 27 | 45.76 | Banks | 5 | 8.47 |
| Factories/Industrial Establishments | 22 | 37.29 | Libraries | 5 | 8.47 |
| Parks | 18 | 30.51 | Historical places | 4 | 6.78 |
| Planetarium | 14 | 23.73 | Laboratories | 4 | 6.78 |
| Zoos | 12 | 20.34 | Universities | 4 | 6.78 |
| Public Institutions and organizations | 8 | 13.56 | Virtual Classroom | 3 | 5.08 |
| Technoparks | 7 | 11.86 | Market | 2 | 3.39 |
| Science Festivals | 6 | 10.17 | Schoolyard | 2 | 3.39 |
| Mosque | 6 | 10.17 | Ruins | 1 | 1.69 |
| Botanical Gardens | 5 | 8.47 | Shopping malls | 1 | 1.69 |

According to the findings in Table 11, almost half of the teacher candidates stated that OoSLE in mathematics teaching can be carried out wherever a relationship can be established with the learning outcomes. Teacher candidates stated that places such as museums (45.76%), science/art centers (45.76%), factories/industrial establishments (37.29%), parks (30.51%), planetarium (23.73%), zoos (20.34%) are OoSLE that can be used in mathematics teaching.

***Findings on the advantages and disadvantages of OoSLE after the course***

Another question asked to teacher candidates in order to determine the effect of the OoSLE course in mathematics teaching is about the advantages and disadvantages OoSLE. In this context, findings regarding the advantages provided by OoSLE are presented in Table 12:

**Table 12** Opinions on the advantages of OoSLE after the course

| Advantages of OoSLE | N | % | Advantages of OoSLE | N | % |
|---|---|---|---|---|---|
| Permanent learning | 39 | 66.10 | Students learn at their own pace | 2 | 3.39 |
| Learning by Doing | 14 | 23.73 | Physical Skill Development | 1 | 1.69 |
| Making the course fun | 12 | 20.34 | Understanding relationships with ecology | 1 | 1.69 |
| Active Participation | 10 | 16.95 | Self-confidence boost | 1 | 1.69 |
| Motivation | 9 | 15.25 | Supporting lifelong learning | 1 | 1.69 |
| Attracting Interest/Attention | 6 | 10.17 | Supporting 21st-century skills | 1 | 1.69 |
| Relating to real life | 5 | 8.47 | Making teaching easier | 1 | 1.69 |
| Understanding the importance of the course in real life | 4 | 6.78 | Learning different forms of representation | 1 | 1.69 |
| Positive Attitude | 3 | 5.08 | Supporting students' personal development | 1 | 1.69 |
| Eliminating prejudices against the course | 3 | 5.08 | Increasing collaboration | 1 | 1.69 |
| Concretization | 3 | 5.08 | Values education | 1 | 1.69 |

| | | | | | |
|---|---|---|---|---|---|
| Improving Communication Skills | 2 | 3.39 | Giving opportunities to examine objects or situations that cannot be brought into the classroom | 1 | 1.69 |
| Improving social skills | 2 | 3.39 | | | |

According to the findings in Table 12, 66.10% of teacher candidates think that OoSLE provide permanent learning. Besides, learning by doing OoSLE (n=14, 23.73% ), making the course fun (n=12, 20.34%), active participation (n=10, 16.95%), motivation (n=9, 15.25%) ), OoSLE are advantageous in situations such as attracting interest/attention (n=6, 10.17%). Below are some opinions of teacher candidates regarding the advantages of OoSLE:

T3: *"More permanent learning occurs for students. "Students see where what they learn in class will be encountered in daily life."* (Permanent learning, understanding the importance of the course in real life)

T28: *"It helps the student learn the subject in a more permanent way by doing and experiencing it."* (Learning by doing, permanent learning)

T33: *"It makes the lesson more fun for the student because it is outside the school…"* (Making the lesson fun)

Findings regarding the disadvantages of OoSLE, in line with the thoughts of teacher candidates after the course, are given in Table 13:

**Table 13** Opinions on the disadvantages of OoSLE after the course

| Disadvantages of OoSLE | N | % |
|---|---|---|
| Time | 22 | 37.29 |
| Economic | 20 | 33.90 |
| Class dominance and order may not be achieved | 18 | 30.51 |
| Bureaucratic difficulties (Permits, official correspondence, etc.) | 11 | 18.64 |
| It may lead to misconceptions | 7 | 11.86 |
| Considering the activity only as a trip | 7 | 11.86 |
| Shift of interest to another direction | 6 | 10.17 |
| Security | 5 | 8.47 |
| Failure to achieve the intended goal | 4 | 6.78 |
| Unfavorable learning environment | 3 | 5.08 |
| Failure to determine the appropriate environment | 2 | 3.39 |
| Teacher's lack of knowledge about out-of-school environments | 1 | 1.69 |
| Lack of preparation for the event | 1 | 1.69 |

After the OoSLE course, teacher candidates mentioned that among the disadvantages of OoSLE, time (n=22, 37.29% ) was the biggest disadvantage. Teacher candidates stated that

economic situations (n=20, 22.90% ), class dominance and order may not be achieved (n=18, 30.51%), bureaucratic difficulties (n=11, 18.64%), situations that may lead to misconceptions when proper planning cannot be made ( n=7, 11.86%), considering the activity only as a trip (n=7, 11.86%) are disadvantages. Some opinions of teacher candidates regarding these findings are given below:

T18: *"Too much time is spent. Financial means may be insufficient."* (Time, economy)

T21: *"It can be difficult to maintain control when we go on a crowded trip."* (Class dominance and order may not be achieved)

T40: *"Permissions and arrangements that need to be taken during the preparation process may discourage the teacher."* (Bureaucratic difficulties)

***Findings regarding the role of the teacher in OoSLE before the course and the contributions of OoSLE to mathematics teaching***

Another situation related to the second sub-problem of the research is the thoughts of teacher candidates after the course about the role of teachers in OoSLE and their contributions to mathematics teaching. In this context, findings regarding the role of teachers in OoSLE of teacher candidates are presented in Table 14:

**Table 14** Opinions on the role of teachers in OoSLE after the course

| The Role of the Teacher | N | % |
|---|---|---|
| Guide | 50 | 84.75 |
| Planner | 20 | 33.90 |
| Providing acquisition-place matching | 10 | 16.95 |
| Getting the permits | 6 | 10.17 |
| Enabling students to discover knowledge | 4 | 6.78 |
| Providing solutions to problems that may be encountered | 3 | 5.08 |
| Provides method diversity | 3 | 5.08 |
| Familiar with the OoSLE | 3 | 5.08 |
| Taking security precautions | 3 | 5.08 |
| Relating concepts to real-life | 3 | 5.08 |

According to Table 14, approximately 85% of teacher candidates emphasized the guiding role of teachers in OoSLE. Teacher candidates see the roles of OoSLE teachers as planners (n=20, 33.90% ), providing acquisition-place matching (n=10, 16.95%), and as getting permission for OoSL activities (n=6, 10.17%). The opinions of some teacher candidates regarding the findings are given below:

T31: *"…In out-of-school learning environments, the teacher is not the one who transfers knowledge, but the one who helps the student in the learning process. He is in the position of a guide."* (Guide)

T48: *"The process must be managed well. Must make good planning. Must obtain necessary permits. He/she should know the out-of-school learning environment well."* (Planner, Getting the permits and Familiar with the OoSLE)

T35 : *"The teacher must be able to match the outcomes and spaces well."* (Providing acquisition-place matching)

Findings regarding teacher candidates' thoughts on the contributions of OoSLE to mathematics teaching after the course on OoSLE in mathematics teaching are presented in Table 15:

**Table 15** Opinions on the contribution of OoSLE to mathematics teaching after the course

| Contribution | N | % | Contribution | N | % |
|---|---|---|---|---|---|
| Permanent learning | 24 | 40.68 | Physical skill development | 1 | 1.69 |
| Concretization | 17 | 28.81 | Development of communication skills | 1 | 1.69 |
| Eliminating prejudices against mathematics | 13 | 22.03 | Problem-solving | 1 | 1.69 |
| Making math fun | 11 | 18.64 | Analytical thinking | 1 | 1.69 |
| Realizing the function of mathematics in real life | 9 | 15.25 | Critical thinking | 1 | 1.69 |
| Attracting Interest/Attention | 9 | 15.25 | Taking responsibility | 1 | 1.69 |
| Learning by doing | 8 | 13.56 | Eliminate your fear of math | 1 | 1.69 |
| Relating mathematics to real-life | 7 | 11.86 | Making teaching easier | 1 | 1.69 |
| Positive attitude | 5 | 8.47 | Increasing self-confidence | 1 | 1.69 |
| Meaningful learning | 3 | 5.08 | Improving mathematical literacy, | 1 | 1.69 |
| Active participation | 3 | 5.08 | Realizing the relationship between mathematics and art and aesthetics | 1 | 1.69 |
| Developing a different perspective | 2 | 3.39 | Enabling self-paced learning | 1 | 1.69 |
| Motivation | 2 | 3.39 | Examining objects and situations that cannot be brought into the classroom | 1 | 1.69 |

According to Table 15, 40% of the teacher candidates think that OoSLE will contribute to mathematics teaching in the context of permanent learning (n=24). The participants also emphasized that OoSLE contribute to mathematics education in terms of concretization (n=17, 28.81%), eliminating prejudices against mathematics (n=13, 22.03%), making mathematics fun (n=11, 18.64%), realizing the function of mathematics in real life (n=9,

15.25%), and attracting interest/attention (n=9, 15.25%). Examples of some of the teacher candidates' views are given below:

T12: *"As students participate voluntarily, their motivation increases and permanent learning is achieved."* (Motivation, permanent learning)

T31: *"Mathematics is an abstract course due to its structure. In this respect, it is considered a course that students have difficulty understanding. Out-of-school learning environments provide students with the experience of learning by doing. This experience enables the student to consider abstract mathematical concepts in a concrete context."* (Concretization, learning by doing)

T34: *"It eliminates the perception of students who see mathematics as an abstract and boring lesson. More effective and permanent learning occurs because concrete experiences occur."* (Concretization, Permanent learning, eliminating prejudice against mathematics)

**Findings regarding the third sub-problem**

The third sub-problem of the research is about whether there is a significant difference between the self-efficacy of teacher candidates towards OoSL activities before and after the OoSLE course in mathematics teaching. The results of the t-test analysis for related samples conducted in this context are presented in Table 16:

**Table 16** T test result to determine the difference between pre-test and post-test scores

| Tests | N | M. | SD | df | t | p * |
|---|---|---|---|---|---|---|
| Pre-test | 59 | 102.25 | 9.50 | 58 | -7.92 | .00 |
| Post-Test | 59 | 115.05 | 11.05 | | | |

*p<.05

When the results of the t-test analysis for related samples are examined, it is seen that the significance level (p=.00) is lower than the significance value (p<.05). According to this finding, it can be said that there is a significant difference between teacher candidates' self-efficacy for OoSL activities before the OoSLE course in teaching mathematics and their self-efficacy after the course (t=-7.92, p=.00, p<.05). It can be seen in Table 16 that there is a significant difference between the teacher candidates' self-efficacy score average after the OoSLE course ( $M_{post\text{-}test}$ = 115.05) and their pre-test self-efficacy score average ($M_{pre\text{-}test}$ = 102.25). These results show that the OoSLE course in mathematics teaching has a positive effect on teacher candidates' self-efficacy beliefs regarding OoSL activities.

**Findings regarding the fourth sub-problem**

It was determined that the data groups showed a normal distribution in determining the significant difference between the self-efficacy of teacher candidates for OoSL activities according to gender before and after the OoSLE course in mathematics teaching. In this context, before the course, t-test analysis for unrelated samples was performed to examine the significant difference between the self-efficacy of teacher candidates for OoSL activities according to gender. The findings for the t-test analysis are presented in the Table 17:

**Table 17** T test result according to pre-tests in terms of gender

| Pre-test | N | M. | SD | df | t | p |
|---|---|---|---|---|---|---|
| Female | 41 | 101.85 | 8.86 | 57 | .-49 | .63 |
| Male | 18 | 103.17 | 11.04 | | | |

p >.05

In the t-test analysis for unrelated samples conducted according to the gender variable in the context of pre-tests, it was determined that the variances were equal according to Levene's Test. In the t-test analysis examined in this context, it was seen that the significance level (p=.63) was greater than the significance value (t=.-49, p=.63, p>.05). According to this finding, it can be said that there is no significant difference between the self-efficacy of teacher candidates towards OoSL activities in terms of gender variable before the lesson. According to Table 17, although the mean score of male teacher candidates ( $M_{male}$ = 103.17) was higher than the mean score of female teacher candidates ( $M_{female}$ = 101.85) before the course, this is not a statistically significant difference according to the t-test results.

Another situation examined within the scope of the fourth sub-problem is whether there is a significant difference between the self-efficacy of teacher candidates towards OoSL activities according to the gender variable after the OoSLE course in mathematics teaching. To determine whether there is a significant difference, t-test analysis was performed for unrelated samples and the findings are given in the Table 18:

**Table 18** T test result according to post-tests in terms of gender

| Post-test | N | M. | SD | df | t | p |
|---|---|---|---|---|---|---|
| Female | 41 | 114.61 | 10.47 | 57 | .-46 | .65 |
| Male | 18 | 116.06 | 12.51 | | | |

p >.05

According to the analysis of the data obtained from the "Teacher Self-Efficacy Beliefs Towards Out-of-School Learning (OoSL) Activities" scale applied to teacher candidates after the OoSLE in mathematics teaching course, no significant difference was found in terms of gender in post-tests (t=.-46, p=.65, p>.05). Although the mean scores of male pre-service teachers ($M_{male}$= 116.06) were higher than the mean scores of female pre-service teachers ($M_{female}$= 114.61) in the post-tests as in the pre-tests, this was not sufficient for a significant difference.

## Discussions and Conclusion

In today's 21st century, which is referred to as the age of information and technology, teachers are expected to use various methods and techniques in the context of rich learning and teaching processes, taking into account the needs of the age and the expectations of societies (Göloğlu Demir & Çetin, 2021). It can be said that these methods and techniques include using OoSLE in teaching activities. However, there are studies showing that teachers do not have a sufficient tendency to carry out activities outside of school (Carrier, 2009; Aydoğdu et al., 2023) and although students want out-of-school activities to be more frequent, such activities are carried out occasionally (Fűz, 2018). In the study carried out in the light of this information, elementary school mathematics teacher candidates' self-efficacy beliefs regarding OoSL activities and their thoughts about OoSLE were determined before and after the OoSLE course. In line with the purpose, the effect of the OoSLE course on mathematics teaching at the undergraduate level was also revealed.

Mathematics teacher candidates take many courses regarding the field, field education and professional knowledge during their undergraduate education. In addition, the development of prospective teachers in the field, field education and general cultural knowledge is supported through elective courses. Teacher candidates are often given little or no training on how to integrate or incorporate OoSLE into their curriculum (Johnson & Chandler, 2009). First of all, in the research, it was determined that although the majority of teacher candidates participated in OoSL activities before the lesson, all participants had not received any training on OoSL before. If the participants had not chosen the optional OoSLE course, they would not have received training on OoSLE during their undergraduate education. This situation was reported by Aydoğdu et al. (2023) and Kır et al. (2021) studies, this appears as an indication that mathematics teachers have not received training for OoSLE before. In addition, some of the teacher candidates who stated that they had participated in

OoSL activities before stated that they participated in the "pi day activities". In this context, it can be said that the "pi day activities" that teacher candidates participate in cannot be fully evaluated within the scope of out-of-school activities, as they are activities carried out individually and are not aimed at achieving a specific goal. Apart from this, the museum visits that teacher candidates attend before the lesson can be considered as OoSL activities. Therefore, it is seen that the majority of teacher candidates did not fully participate in OoSL activities in the past.

Before the course on OoSLE in mathematics teaching, it was determined that the self-efficacy of teacher candidates towards OoSL activities in mathematics teaching was at a moderate level in some teacher candidates, but the majority was at a high level. There are no teacher candidates who have very high self-efficacy beliefs, which is the highest level before the lesson. This finding is similar to the findings of the studies conducted by Bolat and Köroğlu (2022) with the Turkish language and literature teachers, Fırat Durdukoca (2023) with pre-service elementary education teachers, Demir and Çetin (2022) with teachers, and Demirel (2020b) with pre-service elementary education teachers. The reason why teacher candidates do not have a very high level of proficiency may be because they do not have enough knowledge of OoSL activities or they have not received training in this direction before. Although teachers participate in many out-of-school activities, the fact that they do not have sufficient knowledge and experience to carry them out (Tal & Morag, 2009) affects their self-confidence in OoSL activities. Another reason may be that they do not have experience in how to carry out their extracurricular activities. Regarding this situation, Olson et al. (2001) state that experienced teachers, like insufficiently experienced teachers, do not have enough knowledge about OoSLE. Therefore, the lack of adequate training for teachers and teacher candidates regarding OoSL activities (Johnson & Chandler, 2009) may prevent them from being self-confident in OoSL activities.

It was observed that teacher candidates' self-efficacy beliefs regarding OoSL activities in mathematics teaching increased after the course. While there were no teacher candidates with a very high level of proficiency before the course, it was determined that 40% of the teacher candidates had the highest level of proficiency after the course. This increase in the self-efficacy of teacher candidates can be explained by the positive effect of the OoSLE course in mathematics teaching. As a matter of fact, the results of the related samples t-test analysis support this situation. In this course, teacher candidates get to know OoSLE and gain a questioning perspective on OoSL by participating in practice activities (Ay et al., 2015). In

addition, the learning and teaching activities that teacher candidates carry out in the classroom will encourage them to engage in out-of-school activities with their students in their teaching lives. This will increase teacher candidates' self-confidence towards OoSL activities. Providing teacher candidates with information about how to carry out OoSL activities will help reduce their concerns about possible problems they may encounter in their planned OoSL activities (Johnson & Chandler, 2009). Considering these situations, it can be stated that OoSLE course in mathematics teaching increases the self-efficacy of teacher candidates. While this finding supports the studies of Gürsoy (2018) and Kayhan Altay & Yetkin Özdemir (2022), it is parallel to Demirel's (2020b) result that the self-efficacy of teacher candidates developed positively after museum education.

The examination of open-ended questions created to determine the effect of the OoSLE course on the perceptions of teacher candidates in mathematics teaching was carried out within the framework of "what OoSLE are", "advantages and disadvantages of OoSLE" and "the teacher's role and contributions to mathematics teaching" for these areas. According to the findings, it was concluded that the OoSL environment that teacher candidates mentioned most before the course was museums. While this finding of the study coincides with the findings of many studies on OoSL (Aydoğdu et al., 2023; Fırat Durdukoca, 2023), it differs from some studies (Ay et al., 2015; Bostan Sarıoğlan & Küçüközer, 2017; Kır et al., 2021; Tatar & Bağrıyanık, 2012). In the studies of Ay et al. (2015) and Kubat (2018), the most frequently mentioned OoSL environment is the science center. In the study conducted, science/art centers were among the OoSLE that teacher candidates stated the most. The reason why the OoSL environment that teacher candidates mentioned most before the lesson was museums may be that they do not have enough knowledge about OoSLE. Because the answers given by teacher candidates about where their OoSLE could be before course are parallel to the out-of-school activities they have carried out before. The majority of teacher candidates who participated in OoSL activities before the course expressed these activities as school trips, museums and pi day activities. The results of the study reveal that the most frequently mentioned places for OoSLE are in this direction. Places such as school gardens, national parks, houses, and planetariums were mentioned less before the lesson. This situation contradicts the fact that the most frequently mentioned OoSL environment in the studies of Bostan Sarıoğlan and Küçüközer (2017) is the "home environment". In Kubat's (2018) study, the planetarium is among the least mentioned places. In this context, the finding supports Kubat's (2018) study.

After the OoSLE course, the majority of teacher candidates stated that "purpose-planned environments" could be used as OoSLE. This shows that teacher candidates are knowledgeable about OoSLE and their self-efficacy towards OoSLE is positive. While places such as historical places, planetariums, parks, and universities were not expressed sufficiently as OoSLE before the course, these places were mentioned more after the course. In addition, it can be seen from the results that the teacher candidates mentioned areas such as recreation areas, virtual classrooms, and botanical gardens that they had not mentioned before, after the lesson, and that they mentioned more places for OoSLE. This situation reveals the effect of the OoSLE course.

The answers given by teacher candidates to the question of where OoSLE can be are consistent with their answers to the question of where OoSLE can be used in mathematics teaching. The OoSLE that can be used in teaching mathematics, which was most frequently mentioned by teacher candidates before the course, is museums, as in the first question. Later, banks, factories/industrial organizations, science and art centers, and trips were seen as OoSLE that could be used in teaching mathematics. This finding differs from Kır et al. (2021) who stated that the most common out-of-school places that can be used in mathematics teaching are the environment-terrain and historical places. After the OoSLE course, almost half of the teacher candidates think that it is possible to teach mathematics wherever there is a connection with the outcome. This is another proof that teacher candidates' self-efficacy for OoSL activities is at a very high level after the course. It is seen that the OoSLE that can be used in teaching mathematics after the course are considerably more than the places mentioned before the course. This shows that teacher candidates have knowledge about OoSLE after the course. When we focus on the learning environments that can be used in teaching mathematics after the course, other than the places mentioned in the first question, places such as planetariums, zoos, public institutions and organizations, technoparks, science festivals, mosques and botanical gardens are mentioned. It is noteworthy that in the answers given, virtual classroom environments are also expressed as learning environments that can be used in mathematics teaching. The activities of Aydoğdu et al. (2022) on the use of virtual classrooms in mathematics education by using virtual museum environments in mathematics lessons support the opinion of the teacher candidates.

Another situation in which the effect of the OoSLE course in mathematics teaching is examined is the opinions of prospective teachers regarding the advantages and disadvantages of OoSLE. Before the course, 40% of the teacher candidates thought that OoSLE provided an

advantage in supporting permanent learning, and this rate increased to 66% after the OoSLE course. In this context, the majority of teacher candidates think that OoSLE will provide advantages in terms of permanent learning. This result overlaps with the findings of Aydoğdu et al. (2023), Bostan Sarıoğlan and Küçüközer (2017) and Kır et al. (2021). In addition, this finding is parallel to Haji et al. (2019)' s idea that examining and solving mathematical problems in areas such as surrounding neighborhoods, libraries, and industrial establishments provides permanent learning. Before the course, attention was drawn to 12 different advantages of OoSLE, such as learning by doing, concretization, relation to real life, and attracting interest/attention. After the course, they expressed 25 different advantages in the context of many situations such as eliminating prejudices against the course, improving communication and social skills, supporting lifelong learning, supporting 21st century skills, and supporting values education. This finding shows the effect of OoSLE course on teacher candidates' thoughts about OoSLE.

Johnson & Chandler (2009) revealed that OoSL activities carried out with teacher candidates are fun, increase interest, and enable association with real life. In a study conducted with science teachers, Çetingüney and Büyük (2022) stated that OoSLE provide permanent learning, active participation, learning by doing and experiencing, and increase interest and motivation. The findings regarding the advantages of OoSLE overlap with the views of Johnson & Chandler (2009) and Çetingüney and Büyük (2022).

According to the findings before and after the course, teacher candidates' most concern about OoSLE is in terms of time. This finding contradicts Fırat Durdukoca's (2023) view that OoSLE save time. Time-related anxiety is also expressed in the studies of Ay et al. (2015), Aydoğdu et al. (2023), Sarıoğlan and Küçüközer (2017), Kubat (2018). Before the course, teacher candidates expressed various difficulties related to OoSLE in terms of administrative (financial difficulties, inability to focus on the subject), pedagogical (unfavorable learning environment, learning that is different from its purpose), guidance (inability to maintain classroom dominance and order) and bureaucratic (permissions, official correspondence) aspects. After the course, the disadvantages stated by the teacher candidates regarding OoSLE include situations such as " it may lead to misconceptions" when a proper plan is not made, "security", "considering the activity only as a trip", "teacher's lack of knowledge about OoSLE". Possible security problems are addressed by Ay et al. (2015), Dillon et al. (2006) and Kubat's (2018) studies. In the Johnson and Chandler (2009) study, approximately 10% of teacher candidates stated that cost could be a disadvantage for OoSLE.

Another situation examined in the study is the role of the teacher in OoSLE. While approximately 68% of teacher candidates emphasized the guiding role of teachers before the course, it was observed that this rate was close to 85% after the course. Teacher candidates are aware that teachers will guide students in OoSLE. The planning role of the teacher in OoSLE after class is also among the notable findings. If teacher candidates or teachers are not given the necessary training or in-service training for OoSLE, their self-efficacy for OoSL activities will not be at a sufficient level. At the same time, it is difficult to achieve the desired goal when the activities to be done before, during and after the activity are not planned correctly for OoSL activities. In this context, planning is important in OoSLE. The main reason why teacher candidates draw attention to the planning role of teachers is thought to be their knowledge of this situation.

Regarding the contribution of OoSLE to mathematics education, teacher candidates think that OoSLE will support permanent learning by concretizing abstract concepts in mathematics teaching. Similar views were found in Kır et al. (2021) study. As the content of mathematics teaching becomes more abstract and less concrete, many students will see mathematics as a discipline that is foreign to them and difficult to understand. In this context, teacher candidates think that OoSLE will contribute to mathematics education by associating mathematics with real life, realizing the function of mathematics in real life, and providing concretization. In the findings obtained, it is also noteworthy that OoSL can contribute to mathematics teaching by improving students' skills such as problem-solving, analytical thinking, critical thinking, communication skills, and taking responsibility. These skills appear as 21st-century skills. Based on these findings, it can be said that the use of OoSLE in mathematics teaching will contribute to the development of students' 21st-century skills.

It was concluded that teacher candidates experienced profound changes in their opinions about OoSLE in mathematics teaching before and after the course and that there was a significant difference between their self-efficacy beliefs in this context. It can be said that the main reason for this result stems from the OoSLE course, as seen in the qualitative findings. It can be said that the activities carried out in the OoSLE course, the introduction of places for OoSL, and the realization of sample application activities prevent teacher candidates' concerns about OoSLE. In this context, it is thought that teacher candidates' self-efficacy increased after the course and they felt empowered towards mathematics education outside of school. In addition, it was concluded in the study that self-efficacy for OoSLE did not differ according to gender. Similarly, Sontay et al. (2017) concluded that science teachers' self-

efficacy beliefs in organizing trips to OoSLE in science teaching did not vary significantly according to gender. Demir and Çetin (2022) also revealed findings that teachers' attitudes towards OoSL activities do not change in the context of the gender variable. In their research with secondary school teachers, Pekin and Bozdoğan (2021) determined that self-efficacy in organizing trips to out-of-school environments did not vary according to gender.

## Suggestions

According to the findings, it was determined that teacher candidates were not sufficiently involved in OoSL activities during their student years. In this context, increasing OoSL activities in mathematics courses at primary, secondary and high school levels will enable students to see the place of mathematics in real life by making them realize what mathematics is used in real life.

The study also determined that teacher candidates did not take enough courses on OoSLE during their undergraduate education. Teacher candidates' knowledge of OoSL activities and carrying out OoSL activities within the framework of education may encourage them to engage in OoSL activities with their own students in the future. In this regard, it is recommended to increase the number of courses on OoSL in teacher undergraduate programs in order for teacher candidates to receive more training on OoSLE and activities.

Studies in the literature show that teachers do not receive adequate in-service training for OoSL or are inadequate in OoSL activities (Aydoğdu et al., 2023; Güngör & Göloğlu Demir, 2022; Kır et al., 2021). Thus, teachers should be given in-service training on OoSLE and activities. In addition, teachers should be encouraged to carry out activities outside of school in order to increase their experience in OoSLE.

Economic and bureaucratic difficulties regarding OoSL activities create concern for teachers and teacher candidates. The difficulties experienced by teachers in obtaining the necessary permissions for OoSLE and the financial inadequacy for out-of-school activities prevent them from implementing OoSL in classes. Therefore, support should be provided to solve the economic and bureaucratic problems experienced by teachers regarding OoSL.

## Compliance with Ethical Standards

*Disclosure of potential conflicts of interest*

No material or moral benefit was provided at any stage of the article. As the author of the research, I declare that I have no declaration of interest/conflict.

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None.

*CRediT author statement*

The study was conducted by a single author and the entire process was carried out by the corresponding author.

*Research involving Human Participants and/or Animals*

The study involves human participants. In this study, all the rules specified in the "Directive on Scientific Research and Publication Ethics of Higher Education Institutions" were followed. In this context, it was approved that the research complies with the ethical rules with the decision taken at the meeting of Balıkesir University Science and Engineering Sciences Ethics Committee dated 12.04.2023 and numbered 2023/2 and with the ethics committee permission certificate numbered E-19928322-302.08.01-248055.

## Matematik Öğretiminde Okul Dışı Öğrenme Ortamları Dersinin Öğretmen Adaylarının Düşüncelerine Etkisi

**Özet:**

Bu çalışmada ilköğretim matematik öğretmen adaylarının matematik öğretiminde okul dışı öğrenme ortamları dersi öncesi ve sonrasında okul dışı öğrenme faaliyetlerine yönelik öz yeterlik inançları ve okul dışı öğrenme ortamlarına yönelik düşüncelerinin tespit edilmesi amaçlanmıştır. Amaç doğrultusunda lisans düzeyinde okutulan matematik öğretiminde okul dışı öğrenme ortamları dersinin etkisi incelenmiştir. Çalışmada karma araştırma yöntemi benimsenmiştir. Araştırmanın katılımcıları Türkiye'deki bir devlet üniversitesinde 4. sınıfta öğrenim görmekte olan 59 ilköğretim matematik öğretmen adayından oluşmaktadır. Veri toplama aracı olarak "Okul Dışı Öğrenme Faaliyetlerine Yönelik Öğretmen Öz-Yeterlik İnançları Ölçeği" ve okul dışı öğrenme ortamlarına yönelik altı açık uçlu soru kullanılmıştır. Matematik eğitiminde okul dışı öğrenme ortamları dersinin öğretmen adaylarının öz yeterliklerine ve okul dışı öğrenmeye ilişkin düşüncelerine olumlu etkisi olduğu sonucuna ulaşılmıştır.

Anahtar kelimeler: Matematik öğretimi, okul dışı öğrenme ortamları, öz-yeterlik, ilköğretim matematik öğretmen adayları.

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