



Özet: Bireylerin kendi yeteneklerine olan güvenlerini

Abstract: The concept of self-efficacy, which enhances

Matematik Öğrenme ve Öğretme Yaklaşımları Dersinin Öğretmen Adaylarının Matematik Öğretimine İlişkin Öz-Yeterlik İnançlarına Etkisi

The Effect of Mathematics Learning and Teaching Approaches Course on Pre-Service Teachers' Self-Efficacy Beliefs About Teaching Mathematics

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artırarak, motivasyon ve başarıları üzerinde doğrudan etkili olan öz yeterlik kavramı, öğretmenlerin öğretim yaparken konuyu sunma biçimlerini, kullandıkları değerlendirme metotlarını ve belirledikleri görevleri de etkilemektedir. Ayrıca genel anlamda tüm öğretmen yeterliklerinin özel anlamda da pedagojik içerik bilgisinin, öğretmenlerin inançlarını şekillendirmede etkin bir rolü olduğu da söylenebilir. Bu bakımdan şimdiki çalışmanın amacı, öğretmenlik genel yeterliklerini kazandırmada önemli rolü olduğu düşünülen "Matematik Öğrenme ve Öğretme Yaklaşımları" dersinin öğretmen adaylarının sahip oldukları öz-yeterlik inançlarına etkisini tespit etmektir. Araştırmanın çalışma grubunu Türkiye'nin Marmara Bölgesi'nde bulunan bir devlet üniversitesinin İlköğretim Matematik Öğretmenliği ve Matematik Öğretmenliği programlarının 2. sınıfında öğrenim gören 88 öğretmen adayı oluşturmaktadır. Araştırmada nicel araştırma yöntemlerinden, bir deney öncesi model olan tek grup ön test-son test model tercih edilmiştir. Araştırmanın verileri ders öncesi ve ders sonrası öğretmen adaylarına online olarak sunulan ve diğer araştırmacılar tarafından geliştirilmiş "Matematik Öğretimine Yönelik Öz-yeterlik İnançları Ölçeği" ile toplanmıştır. Araştırmanın sonucunda, ders öncesinde öğretmen adaylarının %39,8'inin orta düzeyde, %60,2'inin ise yüksek düzeyde öz-yeterlik inancına sahip olduğu tespit edilmiştir. Ders sonrasında elde edilen bulgular ise orta düzey öz-yeterliğe sahip öğretmen adaylarının oranının %19,3 ve yüksek düzeyde olanların ise %80,7 olduğunu göstermektedir. Bu bağlamda yapılan t testi sonuçları ise öğretmen adaylarının ön test ve son test puanları arasında anlamlı bir farklılık olduğunu göstermektedir. Bu doğrultuda dersin öğretmen adaylarının öz-yeterlik inançlarını artırmada olumlu bir etkiye sahip olduğu ifade edilebilir.

Anahtar Kelimeler: Öz-yeterlik inancı, matematik, öğretmen adayı, alan eğitimi dersi

individuals' confidence in their abilities and directly impacts their motivation and performance, also influences how teachers present subject matter, the assessment methods they employ, and the tasks they assign in the classroom. Moreover, it can be said that all teaching competencies, particularly pedagogical content knowledge, play a significant role in shaping teachers' beliefs. In this context, the aim of the present study is to examine the effect of the "Mathematics Learning and Teaching Approaches" course which is considered crucial for the development of general teaching competencies, on the self-efficacy beliefs of pre-service teachers. The study group consisted of 88 pre-service teacher enrolled in the second year of the Elementary Mathematics Teacher Education and Secondary Mathematics Teacher Education programs at a state university in the Marmara region of Türkiye. A pre-test-post-test group design, which is a pre-experimental model, was chosen from among quantitative research methods for this study. The data for this study were collected using the "Self-Efficacy Beliefs towards Mathematics Teaching Scale," developed by other researchers and administered online to pre-service teachers both before and after the course. Before the course, 39.8% of the pre-service teachers exhibited a medium level of self-efficacy, while 60.2% showed a high level. After the course, the results indicated that 19.3% had a medium level of self-efficacy and 80.7% demonstrated a high level. The t-test results revealed a significant difference between the pre-test and post-test scores, suggesting that the course had a positive impact on increasing the pre-service teachers' self-efficacy beliefs.

Key Words: Self-efficacy belief, mathematics, pre-service teacher, field education course

Introduction

Teachers are undeniably one of the most crucial components of an effective mathematics teaching and learning process. The ability to educate students to the desired level, in alignment with both general and specific goals set by educational systems, rests heavily on teachers, who are often regarded as the architects of the future. Moreover, teachers' beliefs, attitudes, content knowledge, and pedagogical expertise significantly influence both learning and teaching. In particular, their beliefs play a pivotal role in shaping not only what they teach but also how they teach (Battista, 1994).

Pajares (1992) emphasizes the importance of focusing on the beliefs of teachers and prospective teachers, advocating that this issue should be central to educational research. He highlights that teachers' self-efficacy beliefs are instrumental in both student achievement and motivation for teaching. This is because teachers' beliefs shape their perceptions and, consequently, their judgments. According to Kiremit (2006), teachers' self-efficacy perceptions impact various aspects of teaching, including instructional activities, classroom communication, management, and the overall classroom environment. The self-efficacy beliefs that teachers and pre-service teachers develop can significantly influence their educational and professional lives, with those possessing strong self-efficacy beliefs often excelling in their work (Oğuz, 2012).

The concept of self-efficacy, introduced by Albert Bandura and central to social learning theory, has a direct impact on motivation and performance by boosting individuals' confidence in their abilities. Bandura (1977) defines self-efficacy as "the way in which individuals assess their capability to succeed in a given situation." Zimmerman (2000) underscores that self-efficacy enhances an individual's belief in learning and success, thereby encouraging them to take an active role in the learning process. According to Bandura (1997), individuals with high self-efficacy do not shy away from new situations but approach them with determination, aiming to complete tasks successfully. This is because higher levels of self-efficacy lead to greater effort, persistence, and resilience. Additionally, self-efficacy beliefs influence a person's thinking style, problem-solving abilities, and emotional responses (Yenice, 2012). When the concept of self-efficacy is viewed in the context of teaching, it highlights the knowledge, skills, and attitudes required to effectively fulfill the duties and responsibilities of a teacher (Demirtaş et al., 2011).

Considering this, understanding the self-efficacy beliefs of teachers and pre-service teachers is crucial for gaining insights into how to enhance their professional preparation and teaching practices (Pajares, 1992). It is also frequently noted that strong relationships exist between teachers' self-efficacy beliefs and how they present subject matter, the assessment methods they choose, and the tasks they assign (Kaplan, 1991; Goldin et al., 2009). Moreover, teachers' pedagogical content knowledge significantly influences the formation of their beliefs (An et al., 2004). Given the strong connection between effective classroom management and key factors such as student achievement, teacher job satisfaction, and the development of self-efficacy, it is essential for teachers to possess the necessary professional knowledge and skills. This is because only teacher candidates who are both competent and confident in their fields can achieve the qualifications needed to undertake important roles in the country's development (Ekici, 2008).

In this context, the importance of deep pedagogical content knowledge—which encompasses not only beliefs but also content knowledge, curriculum knowledge, and teaching knowledge—is frequently emphasized for effective mathematics teaching. According to An, Kulm, and Wu (2004), the most critical component of pedagogical content knowledge is teaching itself. Similarly, Baki (2018, p. 11) describes mathematics teaching knowledge as "a network of

knowledge and skills that teachers should employ in the process of conveying mathematical concepts to students." This network includes beliefs, mathematical knowledge, curriculum knowledge, technical knowledge, and pedagogical knowledge (Figure 1).

Teachers are expected to possess these components for effective and successful mathematics instruction. This is because teachers' mathematical knowledge, curriculum knowledge, technological knowledge, and pedagogical knowledge all contribute to their overall competence. Furthermore, teacher competence is one of the most critical factors influencing students' mathematics achievement (Dursun & Dede, 2004).

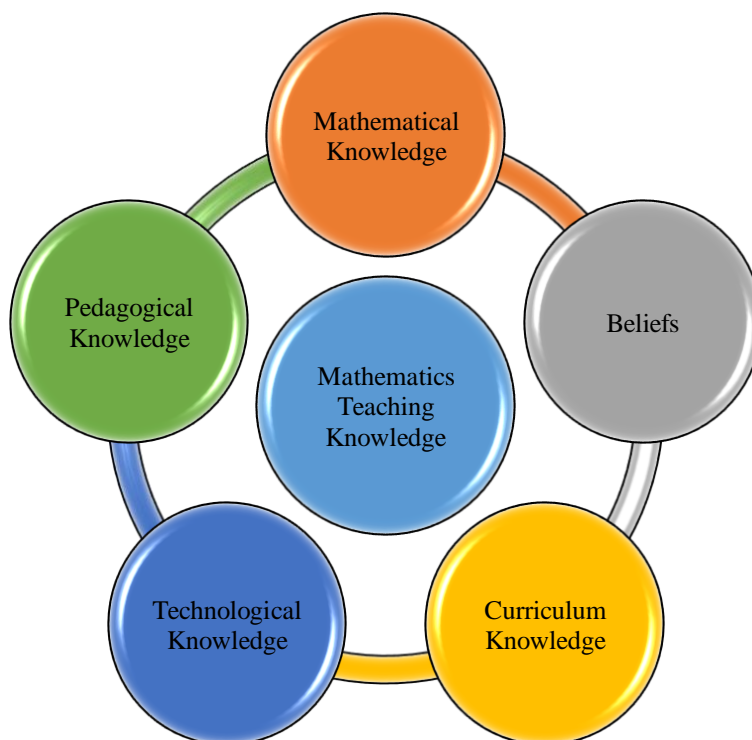


Figure 1. Mathematics teaching knowledge

The programs designed to train teachers with the necessary competencies have been the subject of extensive study for many years, with various practices being implemented. Since 1990, when teacher education was placed under the jurisdiction of faculties of education and became a four-year undergraduate program, several reforms have been made to the curriculum. Notable adjustments to undergraduate teacher education programs occurred in 1998, 2006, 2009, and 2018, with the most comprehensive changes introduced in 1998, followed by significant updates in 2018 (Turan Güllaç, 2023). It can be said that factors such as educational policy, evolving approaches to teacher training, technological advancements, and changing societal needs have influenced the regulations enacted. In fact, in 2017, the Ministry of National Education (MoNE) adopted the "Teacher Strategy Document" (2017-2023), which redefined the general competencies for the teaching profession. As a result of these efforts, "the General Qualifications for the Teaching Profession" were categorized into three competency areas, encompassing 11 competencies and 65 indicators. These areas are identified as "professional knowledge," "professional skills," and "attitudes and values" (MoNE, 2017).

Under these circumstances, it can be said that the process of training pre-service teachers according to the competencies established in 2017 directly influenced the significant changes made to teacher education undergraduate programs in 2018 (Peker & Geçici, 2023). The Council of Higher Education (CoHE) emphasized the necessity of restructuring faculties of education and educational sciences, both in terms of departments and faculty organization.

CoHE also called for the modernization of teacher education undergraduate programs, taking into account structural changes within the Turkish education system, societal needs and demands, as well as contemporary developments in educational sciences and teacher training (CoHE, 2017). When considered in the context of the changes that have been made, the courses in the updated undergraduate programs are categorized into three main groups: general culture, professional knowledge, and field education. In these programs, 30-35% of the courses are allocated to Teaching Professional Knowledge (TPK), 15-20% to General Culture (GC), and 45-50% to Field Education (FE). Specifically, in elementary mathematics education and mathematics education programs, the proportions are planned as 34% for TPK, 18% for GC, and 48% for FE (CoHE, 2018; İlhan et al., 2021).

As part of the changes, the courses "Special Teaching Methods 1" and "Special Teaching Methods 2," which were previously included in the undergraduate programs, have been excluded from the new curricula. In their place, greater emphasis has been given to courses such as Learning and Teaching Approaches, Teaching Programs, and similar subjects. In this regard, courses titled "...Teaching Programs" and "...Learning and Teaching Approaches" were introduced as field education courses for teaching both common and related fields. Consequently, while the previous programs included a single three-credit course specifically focused on teaching the relevant field, the updated programs have quadrupled both the number of field education courses and their credit value, enhancing the functionality of these courses as well (CoHE, 2017).

One of the fieldwork courses included in the teacher training programs for elementary mathematics and secondary school mathematics education is the 2-credit course titled "Mathematics Learning and Teaching Approaches", which is delivered through 2 hours of theoretical instruction per week. The "Mathematics Learning and Teaching Approaches" course aims to develop pre-service teachers in the following areas (CoHE, 2018):

- i. The nature of mathematics and mathematical reasoning
- ii. The meaning of learning and teaching mathematics
- iii. The purpose and basic principles of mathematics education
- iv. The history of mathematics education
- v. The influence of learning and teaching approaches on mathematics instruction
- vi. Basic skills in teaching mathematics
- vii. Examples of teaching practice
- viii. Current trends and issues in mathematics education
- ix. Components of effective mathematics teaching
- x. Social, cultural, and economic perspectives on mathematics teaching.

Purpose and Significance of the Study

The pedagogical content knowledge of teachers and pre-service teachers plays a significant role in shaping their beliefs (An et al., 2004). Therefore, the "Mathematics Learning and Teaching Approaches" course, which is instrumental in shaping the content knowledge of pre-service teachers, may also influence their self-efficacy beliefs. In fact, pre-service teachers' competencies and self-efficacy beliefs regarding mathematics teaching affect the quality of mathematics instruction they will provide in the future. Therefore, assessing the extent to which the course affects pre-service teachers' self-efficacy beliefs is crucial for understanding the contribution of field teaching courses to mathematics education. Additionally, based on the

findings, it is important to organize and enhance the course's content, particularly in areas related to general teaching competencies and mathematics teaching expertise.

In this regard, the aim of the study is to determine the effect of the "Mathematics Learning and Teaching Approaches" course, offered in the 2nd-year programs of Elementary Mathematics Teaching and Mathematics Teaching, on the self-efficacy beliefs of pre-service mathematics teachers enrolled in these programs. To achieve this, the study examines changes in the self-efficacy beliefs of pre-service mathematics teachers after the course and its applications, within the framework of the course objectives. Accordingly, the research problem for this study is defined as: "What is the effect of the Mathematics Learning and Teaching Approaches course on pre-service teachers' self-efficacy beliefs regarding mathematics teaching?"

With this in mind, the following sub-problems were formulated to help address the research problem:

- i. What is the level of pre-service mathematics teachers' self-efficacy beliefs regarding mathematics teaching before taking the "Mathematics Learning and Teaching Approaches" course?
- ii. What is the level of pre-service mathematics teachers' self-efficacy beliefs regarding mathematics teaching after taking the "Mathematics Learning and Teaching Approaches" course?
- iii. Is there a significant difference between pre-service teachers' self-efficacy towards mathematics teaching before and after the "Mathematics Learning and Teaching Approaches" course?

Method

Research Model

In this study, which examined the effect of the "Mathematics Learning and Teaching Approaches" course on the self-efficacy beliefs of pre-service mathematics teachers, a one-group pretest-posttest experimental design—classified as a pre-experimental model—was chosen as the quantitative research method. Experiments are useful for identifying causal relationships, as they enable the observation of the effect of a systematic variable under specific conditions (Johnson & Christensen, 2019). In other words, an experiment is a method for gathering evidence to demonstrate how one variable influences another (Miller, 2005). Therefore, experimental designs are often preferred to uncover cause-and-effect relationships between variables (Fraenkel & Wallen, 2009).

In a one-group pretest-posttest design, a pretest is administered to a group of participants before the intervention, and a posttest is conducted using the same measurement tool after the experimental intervention has been applied. The difference between the pretest and posttest scores serves as an indicator of the intervention's effectiveness (Johnson & Christensen, 2019). A diagram of this design is illustrated below (Fraenkel & Wallen, 2009):



Figure 2. One-group pretest-posttest design

Research Group

The study group consisted of 88 pre-service teachers in their second year of elementary and secondary school mathematics teaching programs at a state university in the Marmara region of Türkiye. These participants were enrolled in the "Mathematics Learning and Teaching Approaches" course. The criterion sampling method, a form of purposive sampling, was used to select the participants. This approach focuses on studying cases that meet researcher-defined or pre-existing criteria (Yıldırım & Şimşek, 2016). In this study, the selection criterion was that participants had to be enrolled in the aforementioned course.

The demographic details of the participants are presented in the table below:

Table 1. The demographic details of the participants

Departments	Female	(%)	Male	(%)	Total	(%)
Elementary School Mathematics	44	62.86	26	37.14	70	79.55
Secondary School Mathematics	12	66.67	6	33.33	18	20.45
Total	56	63.64	32	36.36	88	100.00

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As shown in Table 1, 56 (63.64%) of the pre-service teachers who participated in the study were female, while 32 (36.36%) were male. Of the 88 participants, 70 (79.55%) were enrolled in the elementary mathematics teaching program, and 18 (20.45%) were in the secondary school mathematics teaching program. In this context, it can be concluded that the majority of participants were female and were studying in the elementary mathematics teaching program.

Data Collection Tool

In this study, the "Self-Efficacy Beliefs Towards Mathematics Teaching Scale" (SEB-MTS) was used as a data collection tool to assess the pre-service mathematics teachers' self-efficacy levels before and after the "Mathematics Learning and Teaching Approaches" course and to evaluate the effect of the course. The primary reason for using this scale was that it was specifically developed based on data from pre-service mathematics teachers, making it well-suited for determining their self-efficacy beliefs regarding mathematics teaching.

SEB-MTS used as a data collection tool, was developed by Göloğlu-Demir and Çetin (2010) to measure the self-efficacy beliefs of pre-service elementary mathematics teachers. The scale consists of 12 positive and 7 negative items, presented in a five-point Likert format: "strongly disagree," "disagree," "partially agree," "agree," and "strongly agree." The scale has a three-factor structure—effort-based self-efficacy belief, academic accumulation efficacy belief, and

ability to use academic accumulation belief. The factor loadings range from .48 to .78. In the study by Göloğlu-Demir and Çetin (2010), the scale's explained variance was 50.61%, and the internal consistency coefficient (Cronbach's alpha) was .88. In this study, Cronbach's alpha reliability value was calculated as .81 for the pretest and .84 for the posttest. Considering this, the data obtained from the present study supports the suitability of the scale used for the study.

Course Process

"Mathematics Learning and Teaching Approaches" is a 14-week course, held for 2 hours per week, and is part of the compulsory course pool for both the Elementary Mathematics Teaching and Mathematics Teaching programs. The course is offered in the second year of these programs. According to the course information package from the state university where the pre-service teachers in the study group are enrolled, the course is delivered face-to-face using various teaching methods and is assessed through mid-term and final exams. The topics covered during the 14-week course are as follows:

Week 1. The nature of mathematics and mathematical reasoning

Week 2. The purpose of learning and teaching mathematics

Week 3. Mathematical skills and competencies

Week 4. Overview of learning and teaching theories

Week 5. Examining the mathematics curriculum and learning outcomes according to Bloom's Taxonomy

Week 6. Inventive learning, presentational teaching models and their applications in mathematics education

Week 7. 5E learning model and its applications in mathematics education

Week 8. Problem solving

Week 9. Problem-based learning

Week 10. Project-based learning

Week 11. Realistic mathematics education

Week 12. Technology integration in mathematics education

Week 13. STEM

Week 14. Review of topics and class discussion of their applications

Data Analysis

The data collected through the Microsoft Forms application were exported from Microsoft Office programs in Excel format and then transferred to the SPSS application for analysis. In SPSS, the responses were scored as follows: 'Strongly Disagree' = 1, 'Disagree' = 2, 'Partially Agree' = 3, 'Agree' = 4, and 'Strongly Agree' = 5. Reverse coding was applied to the 7 negative items on the scale. For the 19-item scale, the lowest possible score is 19, and the highest possible score is 95. To categorize the pre-service teachers' self-efficacy beliefs towards mathematics teaching as low, medium, or high, the total scores were calculated using the formula "score range (highest value - lowest value) / number of degrees" (Tavşancıl, 2005). Scores between 19 and 44.3 were considered low, those between 44.4 and 69.7 were considered medium, and scores between 69.8 and 95 were considered high. This scoring system helped determine the self-efficacy levels of the pre-service teachers.

To analyze the quantitative data, the normality of the data group was first examined to assess the difference between the pre-test and post-test scores obtained from the SEB-MTS. Checking for normality is important to determine whether the data distribution meets the assumptions required for selecting the appropriate analysis method. If these assumptions are not met, alternative analysis methods can be applied to avoid errors (Can, 2014). Several tests are used to assess the normality of data groups, including skewness, kurtosis, D'Agostino-Pearson,

Jarque-Bera, Kolmogorov-Smirnov, Lilliefors, Chi-square, Anderson-Darling, and Shapiro-Wilk tests (Özer, 2007).

In this study, skewness and kurtosis values were analyzed to assess the normality of the data groups. According to Lomax and Hahs-Vaughn (2012), skewness and kurtosis values between -2 and +2 indicate that the data are normally distributed. Based on this criterion, the pre-test and post-test scores of the SEB-MTS were found to be normally distributed. Consequently, the paired sample t-test was used to determine whether there was a significant difference between the pre-test and post-test scores of the SEB-MTS.

Additionally, effect size was used to measure the extent to which the Mathematics Learning and Teaching Approaches course significantly impacted prospective mathematics teachers' self-efficacy beliefs. Effect size refers to an index representing the relationship between variables (Hedges, 2008). In t-test analyses for related samples, calculating Cohen's d value is one of the preferred methods for determining effect size (Lakens, 2013). In this study, Cohen's d value was calculated to assess effect size. According to Cohen (1988), an effect size of 0.20 is considered small, 0.50 medium, and 0.80 large.

Findings

Findings related to the first sub-problem

The first sub-problem focuses on the level of pre-service teachers' self-efficacy beliefs toward mathematics teaching before they participated in the "Mathematics Learning and Teaching Approaches" course. The self-efficacy belief levels of pre-service teachers, categorized by their respective programs, prior to taking the course are presented in Table 2:

Table 2. The level of pre-service teachers' self-efficacy beliefs before the course

Departments	Medium	(%)	High	(%)	Total
Elementary School Mathematics	27	38.6	43	61.4	70
Secondary School Mathematics	8	44.5	10	55.6	18
Total	35	39.8	53	60.2	88

It was found that 38.6% (n=27) of the pre-service elementary mathematics teachers who participated in the study had a medium level of self-efficacy beliefs toward mathematics teaching, while 61.4% (n=43) had a high level. Similarly, among the pre-service teachers in the secondary mathematics teaching program, 44.5% (n=8) had a medium level and 55.6% (n=10) had a high level of self-efficacy beliefs.

Overall, approximately 40% of all pre-service teachers in the study demonstrated medium-level self-efficacy beliefs, while about 60% exhibited high-level self-efficacy beliefs toward mathematics teaching.

Findings related to the second sub-problem

The second sub-problem focuses on the level of pre-service teachers' self-efficacy beliefs toward mathematics teaching after they participated in the "Mathematics Learning and Teaching Approaches" course. The self-efficacy belief levels of pre-service teachers, categorized by their respective programs, after attending the course are presented in Table 3:

Table 3. The level of pre-service teachers' self-efficacy beliefs after the course

Departments	Medium	(%)	High	(%)	Total
Elementary School Mathematics	10	14.3	60	85.7	70
Secondary School Mathematics	7	38.9	11	61.1	18
Total	17	19.3	71	80.7	88

When Table 3 is analyzed, it shows that 14.3% (n=10) of the pre-service elementary mathematics teachers had medium-level self-efficacy, while 85.7% (n=60) had high-level self-efficacy towards mathematics teaching after completing the "Mathematics Learning and Teaching Approaches" course. In contrast, 38.9% (n=7) of the pre-service secondary mathematics teachers had medium-level self-efficacy, and 61.1% (n=11) had high-level self-efficacy.

Overall, approximately 20% of the pre-service teachers in the study had medium-level self-efficacy, and about 80% had high-level self-efficacy beliefs toward mathematics teaching after the course.

Findings related to the third sub-problem

The third sub-problem of the research aims to examine the difference in pre-service teachers' self-efficacy beliefs toward mathematics teaching before and after completing the "Mathematics Learning and Teaching Approaches" course. In this respect, the findings from the t-test analyses for related (paired) samples are presented in Table 4:

Table 4. t-Test Results for pre-service teachers' Pre-Test and Post-Test Scores on the SEB-MTS

Tests	N	\bar{X}	S	df	t	p*	Cohen d
Pretest	88	71.28	7.24	87	-5.64	.00	.57
Posttest	88	75.39	7.20				

When Table 4 is analyzed, it shows that the significance level ($p = .00$) is smaller than the threshold value of $.05$ ($p < .05$). Based on this finding, it can be concluded that there is a significant difference between pre-service teachers' self-efficacy beliefs towards mathematics teaching before and after completing the "Mathematics Learning and Teaching Approaches" course ($t = -5.64$, $p = .00$, $p < .05$). Table 4 highlights a significant difference between the mean pre-test score (71.28) and the mean post-test score (75.39) on the self-efficacy belief scale. In addition, Cohen's d effect size was calculated as $.57$. Within the framework of this finding, it can be said that the "Mathematics Learning and Teaching Approaches" course has a medium-level effect on the mathematics teaching self-efficacy beliefs of pre-service mathematics teachers.

This result demonstrates that the course had a positive effect on pre-service mathematics teachers' self-efficacy beliefs toward mathematics teaching.

Discussion, Conclusion and Suggestions

This study examined the impact of the Mathematics Learning and Teaching Approaches course on the self-efficacy beliefs of pre-service teachers enrolled in Elementary Mathematics Teaching and Secondary Mathematics Teaching programs. To assess this, a scale measuring self-efficacy beliefs related to mathematics teaching was administered at both the beginning and end of the semester.

Before the course, the results showed that 39.8% of the pre-service teachers had a medium level of self-efficacy, while 60.2% demonstrated high levels of self-efficacy. No students were identified with low self-efficacy. Following the initial data collection, the researchers conducted 2-hour weekly lessons over 14 weeks. At the end of the semester, the same scale was administered again. This time, 19.3% of the pre-service teachers were found to have medium self-efficacy, while 80.7% displayed high self-efficacy in mathematics teaching.

Similarly, in the study conducted by Dinçer et al. (2016), it was found that pre-service elementary mathematics teachers exhibited high self-efficacy beliefs regarding mathematics

teaching. The study also revealed that they had strong efficacy beliefs in the areas of personal efficacy, the teacher's role in effective teaching, and performance related to teaching. The study by Şahin et al. (2014) investigated and compared the self-efficacy belief levels of mathematics teachers and pre-service teachers regarding mathematics teaching. The findings showed that both groups had high self-efficacy beliefs. Furthermore, the analysis of specific sub-dimensions revealed that they demonstrated high personal efficacy, strong teaching performance, and a belief in the teacher's important role in ensuring effective mathematics instruction. Similarly, a study by Dede (2008) examined mathematics teachers' self-efficacy beliefs regarding their teaching. The study found that these teachers had high self-efficacy beliefs. Additionally, both elementary and secondary education mathematics teachers perceived themselves as competent in teaching mathematics and believed they taught the subject effectively. In the study conducted by Göloğlu-Demir (2011), it was found that pre-service elementary mathematics teachers had high levels of self-efficacy beliefs regarding mathematics teaching and maintained positive attitudes. Additionally, it was observed that those with positive attitudes toward mathematics teaching also exhibited higher self-efficacy beliefs in this area. In addition, it is highlighted that there is a significant relationship between the level of self-efficacy and the problem-solving skills of pre-service teachers (Yenice, 2012).

Huinker and Madison (1997) stated that the beliefs pre-service teachers hold about mathematics significantly influence their instructional behavior patterns. Another study's results showed that mathematics teachers possess a high level of self-efficacy in their teaching, which is encouraging, as teachers with higher self-efficacy tend to positively influence their students' attitudes towards mathematics, their academic performance, and their overall course success (Olawale & Hendricks, 2024). Therefore, it is expected that pre-service teachers who believe they have a high level of self-efficacy in teaching mathematics will demonstrate this situation in terms of organizing appropriate teaching activities and teaching mathematics effectively. On the other hand, Yerlikaya (2020) found that mathematics teachers' teaching efficacy beliefs and self-efficacy beliefs in mathematics were at a moderate level. This could be attributed to a tendency to select the middle option on the scale when responding, which may explain why both beliefs were reported at a medium level.

When analyzing whether there was a significant difference between the scores obtained at the beginning and end of the semester, it was found that the mean scores of the pre-service teachers increased significantly after the course compared to their initial scores. This demonstrates the positive impact of the Mathematics Learning and Teaching Approaches course on the self-efficacy beliefs of pre-service teachers regarding mathematics instruction. These findings align with results from similar studies in existing literature.

In a study conducted by Çetinkaya (2024), it was found that the development of pre-service mathematics teachers' awareness during the learning process through Massive Open Online Courses, gaining sufficient information about the teaching profession, and setting goals and coping strategies for challenges increased their self-efficacy beliefs. When examining the content of the Mathematics Learning and Teaching Approaches course, the results align, as similar practices are implemented. Similarly, in a study conducted by Ekici (2008) on the impact of a classroom management course on pre-service teachers' self-efficacy perceptions, it was found that the course significantly improved their self-efficacy levels. However, the results also indicated that there was no statistically significant difference in teacher self-efficacy perception levels based on gender, general academic achievement, or the type of high school the pre-service teachers had graduated from.

On the other hand, the study conducted by Yakar et al. (2010) examined the impact of the Special Teaching Methods course, which is somewhat equivalent to the Learning and Teaching Approaches course in the previous curriculum. The study found that the Special Teaching

Methods course influenced the teaching philosophy of pre-service teachers. Pre-service teachers need not only subject knowledge but also an understanding of how to teach effectively. Courses like Special Teaching Methods are essential in teacher education, as they help future teachers develop the skills, techniques, and strategies needed to apply their knowledge in practical teaching settings (Uçgun, 2010). Pre-service mathematics teachers find these courses essential, as they teach appropriate methods, offer practical experience, and help in knowledge transfer. They believe the courses are valuable for effective teaching, provide a new perspective on education, guide the educational process, improve communication with students, and make teaching more enjoyable (İlhan et al., 2020). It is clear that field education courses help pre-service teachers develop across various dimensions. Given the relationship between self-efficacy beliefs and content knowledge, a key competency for teachers, the significance of the course Mathematics Learning and Teaching Approaches becomes evident. Based on the findings of this study, the following suggestions can be made:

Considering the effect of the Mathematics Learning and Teaching Approaches course on the self-efficacy beliefs of pre-service teachers, policy makers may be advised to increase the course hours. In addition, the effect of the Mathematics Learning and Teaching Approaches course on different variables of pre-service teachers can be investigated. In addition to the above-mentioned course, there are other field education courses in undergraduate programs. Studies on affective factors such as self-efficacy beliefs etc. can be conducted on these courses.

References

- An, S., Kulm, G., & Wu, Z. (2004). The pedagogical content knowledge of middle school, mathematics teachers in China and the U.S. *Journal of Mathematics Teacher Education*, 7(2), 145–172. <https://doi.org/10.1023/B:JMTE.0000021943.35739.1c>
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological review*, 84(2), 191-215. <https://doi.org/10.1037/0033-295X.84.2.191>
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. W H Freeman/Times Books/ Henry Holt & Co.
- Battista, M. T. (1994). Teacher beliefs and the reform movement in mathematics education. *Phi Delta Kappan*, 75, 462-470.
- Can, A. (2014). *SPSS ile bilimsel araştırma sürecinde nicel veri analizi* (3rd ed.). Pegem Akademi.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
- Council of Higher Education (CoHE). (2017). *Programların güncelleme gerekçeleri, getirdiği yenilikler ve uygulama esasları*. <https://www.yok.gov.tr/kurumsal/idari-birimler/egitim-ogretim-dairesi/yeniogretmen-yetistirme-lisans-programlari>
- Council of Higher Education (CoHE). (2018). *İlköğretim matematik öğretmenliği lisans programı*. https://www.yok.gov.tr/Documents/Kurumsal/egitim_ogretim_dairesi/Yeni-OgretmenYetistirme-Lisans-Programlari/Ilkogretim_Matematik_Lisans_Programi.pdf
- Çetinkaya, A. (2024). *Matematik öğretmen adaylarının kitlesel açık çevrimiçi dersler (KAÇED) yoluyla öğretmenlik mesleğine yönelik öz yeterlik inançlarının incelenmesi* [Master's thesis, Osmangazi University]. CoHE Thesis Center.
- Dede, Y. (2008). Matematik öğretmenlerinin öğretimlerine yönelik öz-yeterlik inançları. *Türk Eğitim Bilimleri Dergisi*, 6(4), 741-757. <https://dergipark.org.tr/tr/pub/tebd/issue/26110/275095>
- Demirtaş, H., Cömert, M., & Özer, N. (2011). Pre-service teachers' self-efficacy beliefs and attitudes towards profession. *Education and Science*, 36(159), 96-111.
- Dinçer, B., Akarsu, E., & Yılmaz, S. (2016) İlköğretim matematik öğretmeni adaylarının matematik okuryazarlığı özyeterlik algıları ile matematik öğretimi yeterlik inanç düzeylerinin incelenmesi. *Turkish Journal of Computer and Mathematics Education*, 7(1), 207-228. <http://doi.org/10.16949/turcomat.99884>
- Dursun, Ş., & Dede, Y. (2004). Öğrencilerin matematikte başarısını etkileyen faktörler matematik öğretmenlerinin görüşleri bakımından. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi*, 24(2). <https://dergipark.org.tr/tr/pub/gefad/issue/6759/90924>
- Ekici, G. (2008). Sınıf yönetimi dersinin öğretmen adaylarının öğretmen öz-yeterlik algı düzeyine etkisi, *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, (35), 98-110.
- Fraenkel, J. R., & Wallen, N. E. (2009). *How to design and evaluate research in education* (7th ed.). McGraw-Hill Education.
- Goldin, G., Rösken, B., & Törner, G. (2009). Beliefs—no longer a hidden variable in mathematical teaching and learning processes. In J. Maaß & W. Schlöglmann (Eds.), *Beliefs and attitudes in mathematics education* (pp. 1-18). Brill Sense. https://doi.org/10.1163/9789087907235_002

- Göloğlu-Demir, C. (2011). *İlköğretim matematik öğretmenliği programında öğrenim gören öğrencilerin matematik öğretimine yönelik öz-yeterlik inançları ve tutumlarının incelenmesi* [Master's thesis, Gazi University]. CoHE Thesis Center.
- Göloğlu-Demir, C., & Çetin, Ş. (2010). İlköğretim matematik öğretmen adaylarının matematik öğretimine yönelik öz-yeterlilik inançları ölçeğinin geliştirilmesi geçerlik ve güvenilirlik çalışması. *Gazi Üniversitesi Ticaret ve Turizm Eğitim Fakültesi Dergisi*, (1), 164-175.
- Hedges, L. V. (2008). What are effect sizes and why do we need them? *Child development perspectives*, 2(3), 167-171. <https://doi.org/10.1111/j.1750-8606.2008.00060.x>
- Huinker, D., & Madison, S. K. (1997). Preparing efficacious elementary teachers in science and mathematics: The influence of methods courses. *Journal of Science Teacher Education*, 8(2), 107-126. <https://doi.org/10.1023/A:1009466323843>
- İlhan, A., Tutak, T., İç, Ü., & Ekinci, N. (2020). Matematik öğretmen adaylarının özel öğretim yöntemleri dersine yönelik görüşlerinin incelenmesi. *Elektronik Sosyal Bilimler Dergisi*, 19(73), 156-170. <https://doi.org/10.17755/esosder.477096>
- İlhan, A., Tutak, T., & Poçan, S. (2021). Matematik öğretmen adaylarının uygulanan güncel ve eski lisans programlarına ilişkin görüşleri. *Balikesir Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 24(46), 895-921. <http://dx.doi.org/10.31795/baunsobed.926763>
- Johnson, R. B., & Christensen, L. B. (2019). *Educational research: Quantitative, qualitative, and mixed approaches* (7th ed.). Sage Publications.
- Kaplan, R. G. (1991). Teacher beliefs and practices: A square peg in a square hole. *Proceedings of the Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Blacksburg, VA.
- Kiremit, H. (2006). *Fen bilgisi öğretmenliği öğrencilerinin biyoloji ile ilgili öz-yeterlik inançlarının karşılaştırılması* [Doctoral dissertation, Dokuz Eylül University]. CoHE Thesis Center.
- Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. *Frontiers in psychology*, 4, 863. <https://doi.org/10.3389/fpsyg.2013.00863>
- Lomax, R. G., & Hahs-Vaughn, D. L. (2012). *An introduction to statistical concepts* (3rd ed.). Routledge/Taylor & Francis Group.
- Miller, S. (2005). *Experimental design and statistics*. Routledge. <https://doi.org/10.4324/9780203977644>
- Ministry of National Education (MoNE). (2017). *Öğretmenlik mesleği genel yeterlikleri*. http://oygm.meb.gov.tr/meb_iys_dosyalar/2017_12/11115355_YYRETMENLYK_MESLEYY_GENEL_YETERLYKLERI.pdf
- Oğuz, A. (2012). Sınıf öğretmeni adaylarının akademik öz yeterlik inançları. *Anadolu Journal of Educational Sciences International*, 2(2), 15-28. <https://dergipark.org.tr/tr/pub/ajesi/issue/1527/18740>
- Olawale, B. E., & Hendricks, W. (2024). Mathematics teachers' self-efficacy beliefs and its relationship with teaching practices. *Eurasia Journal of Mathematics, Science and Technology Education*, 20(1), 1-10.
- Özer, A. (2007). *Normallik testlerinin karşılaştırılması* [Master's thesis, Ankara University]. CoHE Thesis Center.
- Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, 62(3), 307-332. <http://dx.doi.org/10.3102/00346543062003307>
- Peker, M., & Geçici, M. E. (2023). Öğretmenlik mesleği genel yeterlikleri çerçevesine göre ilköğretim matematik öğretmeni adaylarının 2018 öncesi ve 2018 lisans programlarındaki derslere yönelik görüşleri. *Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi Dergisi*, (57), 2059-2087. <https://doi.org/10.53444/deubefd.1317937>
- Şahin, Ö., Gökkurt, B., & Soylu, Y. (2014). Öğretmenlerin ve öğretmen adaylarının matematik öğretimi öz-yeterlik inançlarının karşılaştırılması. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi*, 22, 120-133. <https://dergipark.org.tr/tr/pub/zgefd/issue/47939/606458>
- Turan Güllaç, E. (2023). Eğitim fakülteleri lisans programlarının yeniden yapılandırılmasına ilişkin öğretim elemanlarının görüşlerinin değerlendirilmesi, *Trakya Eğitim Dergisi*, 13(1), 559-575. <https://doi.org/10.24315/tred.1065688>
- Uçgun, D. (2010). Özel öğretim yöntemleri dersinin Türkçe öğretmeni yetiştirme sürecine katkısı. *Türklük Bilimi Araştırmaları*, 27, 707-19. <https://dergipark.org.tr/tr/pub/tubar/issue/16968/177256>
- Yakar, Z., Can, B.T., & Uçak, E. Özel öğretim yöntemleri dersinin fen öğretmen adaylarının fen öğretme felsefelerine etkisi. *Education Sciences*, 5(4), 1469-1482.
- Yenice, N. (2012). Öğretmen adaylarının öz-yeterlik düzeyleri ile problem çözme becerilerinin incelenmesi. *Elektronik Sosyal Bilimler Dergisi*, 11(39), 36-58. <https://dergipark.org.tr/tr/pub/esosder/issue/6153/82657>
- Yerlikaya, G. (2020). *Matematik öğretmenlerinin matematik ve matematik öğretimine yönelik öz-yeterliklerinin incelenmesi* [Master's thesis, Sakarya University]. CoHE Thesis Center.
- Yıldırım, A., & Şimşek, H. (2016). *Sosyal bilimlerde nitel araştırma yöntemleri* (10th ed.). Seçkin Yayıncılık.
- Zimmerman, B. J. (2000). Self-regulated learning and academic achievement: An overview. In B. J. Zimmerman & D. H. Schunk (Eds.), *Handbook of self-regulation* (pp. 1-12). Academic Press. http://dx.doi.org/10.1207/s15326985ep2501_2