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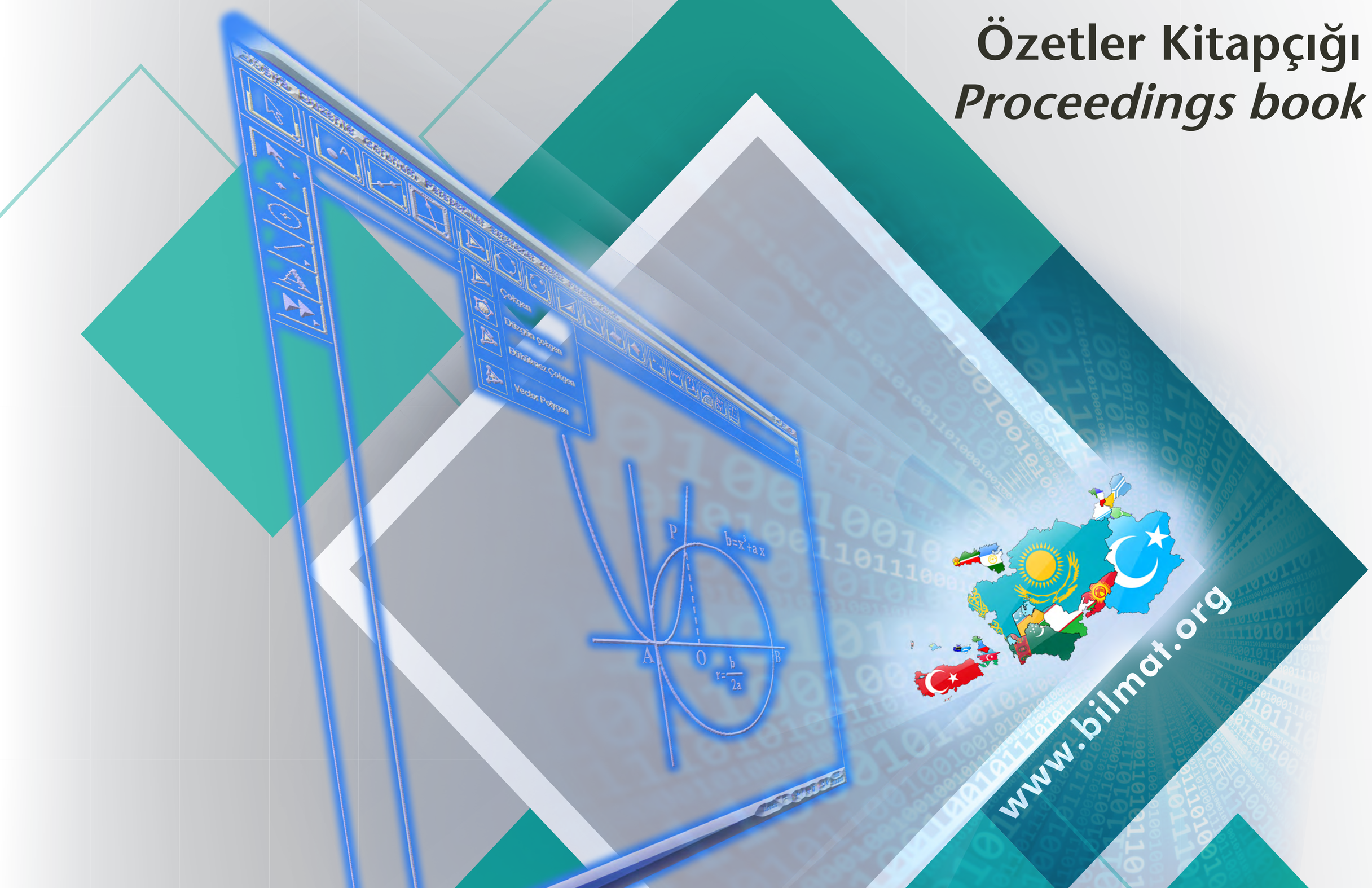


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ÇEŞME
altın yunus
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araştırmacı tarafından analiz edilirken PKF verilerinin yaklaşık dörtte birlik kısmı (14 öğretmen adayının kâğıdı) rastgele seçilerek ayrıca başka bir doktora öğrencisi tarafından da analiz edilmiştir. İki kodlayıcının puanlamaları arasındaki uyum %92 olarak belirlenmiştir. PKF'den elde edilen veriler yine araştırmacı tarafından literatürdeki benzer ölçekler incelenerek oluşturulan Problem Değerlendirme Ölçeği (PDÖ) ile değerlendirilmiştir. PDÖ oluşturulurken yapılan literatür taraması ile Leung & Silver (1997), Silver vd. (1996), Stickles, (2011), Shuk-Kwan (2013) ve Xie'nin (2016) oluşturduğu benzer problem değerlendirme formları incelenmiştir. PDÖ'deki ana alt kategoriler, *çözülebilir matematik problemi*, *çözülemez matematik problemi* ve *problem değil* olarak belirlenmiştir. Çözülemez matematik problemi ise *imkânsız* ve *yetersiz verili* olarak iki alt kategoriye ayrılmıştır. Problem değil kategorisi de, *problem değil*, *matematiksel değil* ve *alıştırma* olarak üç farklı alt kategoriye ayrılmıştır. Değerlendirme işleminde, PDÖ'deki her alt başlık için bir puan karşılığı oluşturulmuş ve öğretmen adaylarının kurdukları tüm problemler puanlanarak toplam puan değeri elde edilmiştir. Araştırmanın sonucunda, öğretmen adaylarının ortalama olarak serbest tipte problem kurmada en düşük puanı aldıkları, yarı yapılandırılmış ve yapılandırılmış tipteki problemlerin ortalama puanının ise neredeyse aynı çıktığı; öğretmen adaylarının serbest tipteki problem kurma örneklerinin %68'i; yarı yapılandırılmış tipteki problem kurma örneklerinin %84'ü ve yapılandırılmış tipteki problem kurma örneklerinin %82'si bir matematik problemi olarak tanımlandığı ve dördüncü sınıfların serbest tipte, ikinci sınıfların yarı yapılandırılmış tipte ve üçüncü sınıfların da yapılandırılmış tipte problem kurmada en yüksek ortalama puana sahip oldukları belirlenmiştir. Ayrıca oluşturulan problem örneklerinin yaklaşık %80'i bir matematik problemi, %7'si ise bir alıştırma olarak tanımlanmıştır. Oluşturulan problem örneklerinin yaklaşık %13'ü ise PDÖ'den sıfır puan almıştır. Çalışmamızın alana katkı yapacağı ve diğer araştırmaların kurgulanmasında yararlı bilgiler sağlayacağı düşünülmektedir.

**Anahtar Kelimeler: Problem, problem kurma, matematik öğretmen adayı, matematik eğitimi.**

## The Effects Of Problem Solving Strategies On 5Th Grade Students' Problem Solving Achievement

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**INTRODUCTION**

Problem solving is generally regarded as the most important cognitive activity in everyday and professional context. National Council of Teachers of Mathematics (NCTM) also underlines the importance of the developing students 'problem solving skills as one of the main goals of teaching mathematics (NCTM, 2000) and asserts that mathematics lessons should be designed by thinking about problem solving (NCTM, 1980). Turkish middle school curriculum also underlines the importance of problem solving at all levels (Ministry of National Education [MoNE], 2018).

Although the problem solving is so important for mathematics and daily life, many students have difficulties (e.g., The Programme for International Student Assessment [PISA], 2003; Trends in International Mathematics and Science Study [TIMMS], 2000). According to 2003 PISA results, Turkey was 33rd out of the 41 countries participating the implementation, and it was also 28th among the 30 OECD (Organization for Economic Cooperation and Development) countries (Yılmaz, 2011). From this respect, there have been many research studies conducted about positive effects of problem solving on students' achievement in mathematics (e.g., Karaoğlan, 2009; Ulu, Tertemiz & Peker, 2016; Yıldız, 2008). In addition to that, according to Posamentier and Krulik (2009), problem solving is the most important content at all levels of school mathematics.

In this study, problem solving strategies developed by Posamentier and Krulik were used in the treatment and the problems were developed according to that. We aimed to investigate the effect of problem-solving strategies treatment on 5th grade students' problem-solving achievement. In spite of the importance of problem-solving strategies on students' achievement, problem solving strategies treatment has not been investigated much in Turkey in terms of its contribution.

**METHODS**

The study included 79 5th grade students from 4 classes from one private school in Niğde, Turkey. Convenience sampling method was used. Firstly, a pre-test (see Figure 1) which included five problems was implemented. After the pre-test, a treatment was provided over five weeks in each classroom. The treatment consisted of 30 problems, and six of these problems were discussed each week. During these sessions, five problem solving strategies that are widely used in problem solving in both mathematics and real-life situations,

were discussed with the students. These problem-solving strategies were organizing data, making a drawing, solving simpler equivalent problems, working backwards and intelligent guessing and testing strategies. After the treatment, a post-test that was identical with the pre-test was implemented.

| | |
|---|---|
| 1 | Mari, bir kitap evine gider. Şeker Portakalı, Küçük Prens, Kraliçeyi Kurtarmak ve Küçük Kara Balık isimli dört kitap beğenir. Tüm kitapların fiyatı aynıdır fakat Mari'nin elindeki para bu kitaplardan sadece 2 tanesini almaya yetecek kadardır. Buna göre, bu kitaplardan 2 tanesini seçmek isteyen Mari kaç farklı seçim yapabilir? Seçimlerinizi detaylı gösteriniz. |
| 2 | İsmail bilgisayarda sevdiği strateji oyununu oynamaktadır. Bu strateji oyununda 10 bölüm vardır. İsmail tamamladığı her bölüm için 5 puan kazanmakta, tamamlayamadığı her bölüm için ise 2 puan kaybetmektedir. Oyun sonunda 29 puan kazanan İsmail kaç bölümü tamamlayamamıştır? |
| 3 | Esin Öğretmen; tanesi 7 liradan 15 tane kitap, bir kutusu 3 liradan 4 kutu ataş ve 13 tane dosya alıyor. Kasiyere 200 TL para vermiş ve 5 TL para üstü almıştır. Buna göre dosyalardan bir tanesi kaç liradır? |
| 4 | 5. sınıf öğrencilerinden 8 arkadaş Kütüphane Haftası'nda birbirlerine kitap hediye etmek istemektedirler. Öğrencilerin her biri diğerlerine 1 tane kitap hediye edeceğine göre; hediye edilecek toplam kitap sayısı kaçtır? |
| 5 | Zeynep kibrit çöpleri ile ev yapıyor. Şekildeki gibi bir ev yapmak için 5, iki ev yapmak için 9 adet kibrit çöpüne ihtiyacı vardır. Buna göre, 7 tane ev yapmak için kaç tane kibrit çöpüne ihtiyaç vardır? |

Figure 1. Pre-test/post-test problems

The pre-test/post-test problems were piloted with 5th grade students before the main study research. After the pilot implementation, analyses were conducted with a mathematics teacher to examine the appropriateness of the problems in regards to the mathematics curriculum, and the grade level of the students, and necessary adjustments were done also in light of the feedbacks from experts and students. To increase the reliability, in the pre-test and post-test, 20% randomly selected sample was coded by a mathematics teacher. The inter-rater agreement was found as approximately 87% and discrepancies were discussed and reflected to the analysis.

**FINDINGS**

The main purpose of the present study was to investigate how problem-solving strategies treatment affects 5th grade students' problem-solving achievement. Research question was sought by the comparison of the pre and post-test. The results about students' solutions in the pre-test and post-test showed that students' problem-solving achievement increased depending on the use of problem-solving strategies (see Table 1).

Table 1

*The percentages of the most commonly used problem-solving strategies for each problem in the pre- and post-test*

| | **Pre-test** | **Post-test** |
|---|---|---|
| **P1-Organizing data** | 41.8 | 79.7 |
| **P2-Intelligent guessing and testing** | 26.6 | 49.4 |
| **P3-Working backwards** | 73.4 | 78.5 |
| **P4-Solving simpler equivalent problem** | 27.8 | 46.8 |
| **P5-Making a drawing** | 58.2 | 74.7 |

Table 1 showed that students were more successful in using the strategies of organizing data, intelligent guessing and testing, working backwards, solving a simpler equivalent problem and making a drawing in the post-test compared to the pre-test.

There were five problems in the pre-test and post-test, and students' problem-solving achievement in each problem increased considerably (see Table 2).

Table 2

*The percentages of correctness of students' solutions in the pre-test and post-test for each problem*

| | Pre-test | Post-test |
|---|---|---|
| **P1** | 43.0 | 82.3 |
| **P2** | 30.4 | 59.5 |
| **P3** | 59.5 | 77.2 |
| **P4** | 35.4 | 69.6 |
| **P5** | 55.7 | 68.4 |

Moreover, there were many strategies encountered in student responses. For instance, for the 4th problem in post- test, 46.8% of the students used "solving a simpler equivalent problem" strategy, 19.0% of the students used "making a drawing" strategy, and 3.8% of the students used "organizing data" strategy.

**DISCUSSION**

When students' solutions in the pre- and post-test were compared, students were found to use the problem-solving strategies more often and reached correct answers more in the post-test. This could be due to the problem-solving strategies treatment conducted over five weeks. Also, for some problems, several strategies came up in the post-test. This was similar to the findings of Ulu, Tertemiz and Peker (2016) and Saygılı (2017) who found that students solved some problems more than one way. The researchers similarly found that using problem solving strategies improve students' problem-solving skills and achievement.

According to Posamentier and Krulik (2009), if the students express themselves freely, and the teacher encourages the students to use different strategies to solve problems, students think different ways and create elegant and efficient solutions to solve the problems. Along these lines, this study showed that to increase students' problem-solving achievement in mathematics, problem-solving strategies may be taught to the students and students can be posed problems that they can solve using these strategies more than one way.

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**Keywords: Problem solving, problem solving strategies, problem solving achievement**