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Examining primary school students' performance in solving problems requiring realistic considerations

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A B S T R A C T

Problem-solving is a very important topic in mathematics education. There are various types of problems in the literature. One of them is non-standard word problems. The main purpose of this study is to examine the problems faced by primary school fourth-grade students in solving non-standard word problems. For this purpose, a problem-solving questionnaire consisting of a total of four questions was applied to 250 primary school fourth-grade students and the students' answers were examined in detail. It was determined that the percentage of correct answers given by the students to the problems varied depending on the nature of the problems. In general, it was concluded that although the students chose the correct mathematical operations for the solutions, they did not use real-life knowledge in solving the problems and therefore their results were not realistic and correct. Therefore, it was observed that non-standard problem-solving activities that require the use of real-life knowledge should be included more in classrooms.

INTRODUCTION

Problem-solving is the center of mathematics education. Several mathematical skills can be developed in the students through problem-solving. These skills, e.g. reasoning, estimation, and connection, are important in mathematics education. Individuals with advanced problem-solving skills can easily overcome the problems they face in daily life. One of the problem types encountered in school mathematics is word problems. In word problem solving, students should properly use the mathematical concepts and skills that they acquired in mathematics education (Jiménez &Verschaffel, 2014). The reasons for using word problems in mathematics and its contributions are training students to apply formal mathematical knowledge and skills acquired in school in the real world (Verschaffel, De Corte & Lasure, 1994); providing an opportunity for studying the relationship between language processes, mathematical processes, and situational reasoning and inference between text comprehension, situation comprehension, and mathematical problem solving (Reusser & Stebler, 1997). Wyndhamn and Saljö (1997) asserted that word problems create an environment in which children use the problem-solving skills they have gained in mathematics education more properly.

Researchers categorized word problems as standard and non-standard problems (Reuseer & Stebler, 1997; Yoshida, Verschaffel & De Corte,1997; Verschaffel et al., 2000; Olkun et al.,2009). Standard problems are easily and correctly solved using one or more arithmetic operations using the numbers directly provided in the problem (Jiménez &Verschaffel, 2014).

In a standard word problem, it can be understood in a simple way in which arithmetic operation is used with the given numbers to solve the problem. An example of a standard word problem can be given as "Suna bought two loaves of bread with 45 cm long each. If she wants to divide each bread into 9 cm wide slices, how many slices of bread will she get? ". The problem can be easily solved by using one or two mathematical operations with the given numbers provided in the text. Consequently, the mathematical model to be established is extremely simple and straightforward. An example of the non-standard word problem may be

provided as “Suna bought two loaves of bread with 45 cm each. If she wants to divide each piece of bread into 10 cm wide slices, how many slices of bread with 10 cm width will she get? " In solving such a non-standard problem, real-world knowledge should be taken into account, and the solution is a little more problematic. Consequently, real-world situations should be taken into consideration when solving non-standard problems (Verschaffel, De Corte & Lasure, 1994; Reuseer & Stebler, 1997; Yoshida, Verschaffel & De Corte, 1997; Olkun et al., 2009).

The individual is obliged to check and verify the consistency of the solution obtained in solving a non-standard problem in real life. The solution needs to be consistent with real life, otherwise, the solution will not be a real solution to the problem mentioned (Cotič & Felda, 2011). Xin, Lin, Zhang and Yan (2007) asserted realistic word problems essentially act as a bridge between mathematics and real life. It also plays an important role in teaching students how to use mathematics in real life. Therefore, in order to solve realistic word problems, it is not enough to have only mathematical knowledge, but also to have real life experience and knowledge. Otherwise, the results obtained will not be consistent with real life and successful results will not be obtained.

In recent years, interest in research on non-standard word problems has increased, and many researchers have conducted research on students' solutions and interpretation of non-standard problems (Greer, 1993; Verschaffel, De Corte & Lasure, 1994; Yoshida, Verschaffel &De Corte 1997; Reusser & Stebler 1997; Inoue, 2005). In order for students to make connections between real life and mathematics more easily, attention should be paid to non-standard word problems in mathematics teaching. This situation is of great importance for children to get ready for real life. When the studies in the literature on non-standard word problems were examined, it was determined that not only primary and secondary school but also undergraduate students in many different countries did not take real life into account when solving such problems (Öktem, 2009; Greer, 1993; Verschaffel, De Corte & Lasure, 1994; Yoshida, Verschaffel & De Corte, 1997; Reusser & Stebler, 1997; Inoue, 2005; Krawitz, Schukajlow & Van Dooren, 2018).

Studies have also shown that; students are often conditioned to perform arithmetic operations using the numbers given in the problem directly, without establishing a connection between the real world and the situation in the non-standard word problem (Xin, Lin, Zhang & Yan, 2007). Almost all students have a strong tendency to exclude realistic considerations from their solutions. Reusser and Stebler (1997) stated that many students who took the mathematics lesson "understand" and "solve" the word problem without considering the connection between real life and mathematical operations. Similarly, Inoue (2005) emphasized that while students are solving non-standard mathematical problems, they try to solve problems by directly applying mathematical operations without reasoning about the connection of the actions given in the problem with real life.

Students can generally solve mathematical problems using arithmetic operations, but it does not mean that they can relate the problem to real life. In order to solve this problem in schools, it is necessary to focus on realistic problem-solving (Cooper & Harries, 2005). Some researchers have tried to explain the reasons why real-life knowledge is not taken into account in solving non-standard word problems. These may be summarized as stereotyped characteristics of common word problems (Gravemeijer, 1997; Reusser & Stebler, 1997), classroom culture interpretation of problem situation (Gravemeijer,1997; Reusser & Stebler, 1997; Hatano, 1997; Wyndhamn & Saljö, 1997; Greer, 1997; Inoue, 2005). Individual interpretation of the relevant situation is of utmost importance in solving non-standard problems. Students try to understand the problems or to relate the given problem with the given facts (Hatano, 1997) and the main reasons for reaching unrealistic solutions are; students' educational beliefs about mathematics (Schoenfeld, 1991; Inoue, 2005), perceptions about problem-solving activities (Inoue, 2005), and teacher beliefs (Gravemeijer, 1997). Teachers’ conceptions and beliefs about the necessity of real-world knowledge in non-standard word problem solving are one of the important instructive factors because these conceptions affect the teachers' way of teaching regarding word problem solving (Hong, 1995; Chapman, 2003; Verschaffel et al., 1997).

Very limited studies are available in Turkey about the performance of primary school students in solving problems requiring real-life knowledge. Therefore, the main purpose of this study was to examine the performance of elementary school students in solving non-standard word problems. Also, students' realistic thinking capabilities, problem-solving and mathematical modeling strategies were examined. Therefore, the main research question of the study is "How elementary school fourth-grade students solved non-standard word problems?".

METHODS AND MATERIALS

Research design

This study, which is a descriptive research, aims at examining the problems faced by elementary school 4th grade students in solving real life problems.

Participants

A total of 250 students, aged 10-11 and selected from an ordinary primary school in Istanbul, participated in the study. The students participating in the study were randomly selected among students with average performance from six primary schools.

Data Collection and Data Analysis

Informal interviews with teachers of the classes in which students were selected show that the teaching of solving word problems has focused on typical standard word problems. Therefore, it has been determined that students generally encounter word problems involving four operations and their combinations instead of non-standard word problems.

A paper-and-pencil test consisting of four questions was applied to all students. The test consisted of four non-standard word problems in which mathematical modeling assumptions were problematic and required the use of real-life knowledge to solve them. Problems (Yoshida, Verschaffel & De Corte, 1997; Aladağ & Artut, 2012) provided to the students were as follow;

1. If a shirt dries within 10 minutes, then how long will it take to dry 5 shirts of the same type to dry? Solve this problem.
2. Grandfather gives his 4 grandchildren a box containing 14 balloons. How do they share equally? Solve this problem.
3. Feraye has 5 friends and Nehir has 6 friends. Feraye and Nehir decided to give a party together. They have invited all their friends. If all of the friends have joined the party, how many friends are there at the party? Solve this problem.
4. 450 students must be bussed to travel for a picnic. Each school bus can hold 36 students. How many buses are needed? Solve this problem.

The test was applied during a standard 45-min lecture session in the school. The tests were applied by the teachers of the students. The teachers were informed by the researchers about the study before the application of the tests.

In the analysis of the data obtained from the research, the answers given by the students to the questions are listed first, then, the same answers were combined and the frequency and percentages were calculated. Verschaffel et al. (1994) category was used for coding unrealistic written solutions. Using the data obtained from the applied test, the answers were distinguished into four categories according to Verschaffel et al. (1994):

(A) The answer obtained by solving the problem using simple arithmetic operations, regardless of the realistic situation emphasized in the problem statement, is evaluated in this category. In addition, the answers obtained as a result of errors in arithmetic operations are also evaluated in this category.

(B) Correct answer (CA), which must be a realistic answer as a result of the effective use of real life knowledge, taking into account the realistic thought given in the problem statement.

(C) No answer (NA), which was used when the participants did not provide an answer to the problem.

(D) The other answer (OA), category in which answers that could not be classified into one of the previous categories were classified. Typical errors classified under this category are; using incorrect operations (e.g. adding two given numbers instead of multiplying, which is the correct operation), given number errors (e.g., solving the problem by simply using the numbers given in the problem), and other errors without a clear explanation. During this analysis, two researchers performed data analysis at the same time.

RESULTS AND DISCUSSIONS

Results

The results obtained from the study are provided in Table 1 for each problem separately.

Table 1. Frequencies and percentages of the answers provided by the students for each problem

		Frequency	Percent
Results for problem 1	10x5=50 minutes (EA)	174	69.6
	10 minutes (CA)	42	16.8
	No answer (NA)	13	5.2
	Using irrelevant operation (OA)	21	8.4
Results for problem 2	14:4=3.5 (EA)	15	6
	14:4= 3 2 balloons remained (CA)	64	25.6
	14:4=3 (OA)	125	50
	No answer (NA)	15	6
	Using irrelevant operation (OA)	18	7.2
	Not performing an operation (OA)	13	5.2
Results for problem 3	6+5=11 (EA)	80	32
	6+5+2=13 (CA)	133	53.2
	No answer (NA)	15	6
	Using irrelevant operation (OA)	22	8.8
Results for problem 4	450:35=12 (EA)	102	40.8
	450:35=12 for 30 students a bus is needed so result is 13(CA)	63	25.2
	No answer (NA)	27	10.8
	Using irrelevant operation (OA)	42	16.8
	Not performing an operation (OA)	16	6.4

Analysis of students' reactions to the non-standard word problems in the test yielded thought-provoking results as the distributions of realistic responses and comments based on realistic consideration were low. The students performed rather well on problem 3 as the problem was solved correctly in 133 of the 250 cases. In problem-1, 69.6% of students incorrectly tried to solve the problem using

proportional reasoning. While 5.2% of the students could not solve the problem, 8.4% tried to solve the problem by using the wrong mathematical operations. Hence, only 16.8% of the students answered the problem correctly. In solving this problem, students should not use proportional reasoning and calculate the result as 10 minutes, because the shirts are all made of the same fabric, so the increase in their number will not affect the drying time.

Some examples of students' solutions are below;

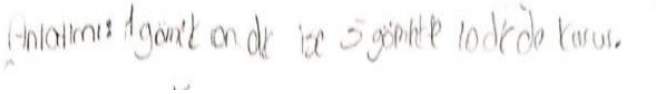

Figure 1. Example of students' solutions for problem 1

In that example (Figure 1), the student solved problem-1 correctly. S/he says if a shirt dries in 10 minutes, 5 shirts will dry in 10 minutes.

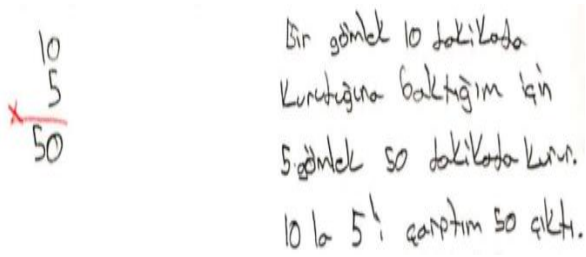

Figure 2. Example of students' solutions for problem 1

In Figure 2, 10x5=50 minutes is an example of the wrong solution. S/he says if a shirt dries in 10 minutes, 5 shirts dries in 50 minutes.

15 (6%) students responded to problem-2 with the expected answer, namely "Each grandchild gets 3.5 balloons". This answer is the operation of "14 divided by 4". 50% of the students solved the problem by performing the operation of 14: 4 = 3 without considering the remaining 2 balloons. 25.6% of the students solved the problem correctly considering the real-life situation. 6% of the students did not answer the problem, 7.2% of them used an irrelevant operation and 5.2% did not apply any operations. In this balloon-problem, students should consider that there will be no balloons when the balloons are divided into equal parts. For this reason, students should indicate that the remaining 2 balloons should not be divided.

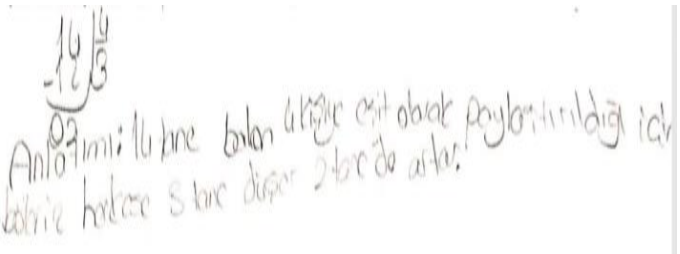

Figure 3. Example of students' solutions for problem 2

In that example (Figure 3), the student thought that since 14 balloons will be shared equally among 4 people, everyone will have 3 balloons and two balloons will remain. The participant solved the problem correctly.

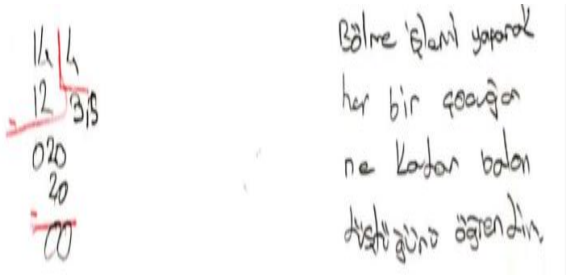

Figure 4. Example of students' solutions for problem 2

As seen in Figure 4 the participant did not solve the problem correctly as s/he did not consider real-life situations. Namely; s/he ran the operation of dividing the number 14 by 4 directly and found the result mathematically correct as 3.5. However, s/he did not take into account the fact that the balloon would actually disappear if a balloon was split in half and only approached the problem mathematically, ignoring real-life knowledge.

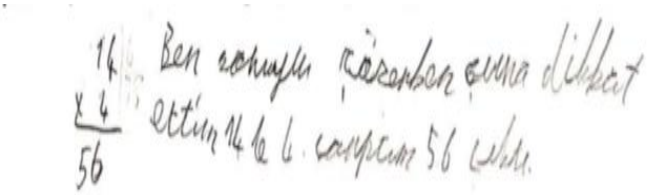

Figure 5. Example of students' solutions for problem 2

In that example (Figure 5), the participant used an irrelevant operation for solving the problem and multiplied 14 by 4, and found the solution as 56. S/he.

Since it is necessary to combine two different sets in Problem 3, it is necessary to do the addition to find the answer. However, the sum of 6 + 5 is only true if there are no common elements in the given situation. So adding 5 and 6 will be true only if Nehir and Feraye have no mutual friends, and a more unrealistic assumption is to think that Nehir and Feraye are not good friends. Most of the students found the answer as 13 by adding Feraye and Nehir to the given numbers. These students did not give any additional explanation about their answers. Therefore, 53.2% of the students solved the problem as 6 + 5 + 2 = 13 by considering Feraye and Nehir with all the given numbers, they did not consider that they might have mutual friends, and they also thought that Nehir and Feraye were good friends. 32% of the students solved the problem as 6 + 5 = 11, 8.8% did not use the correct mathematical operation, and the remaining students (6%) did not give any answer.

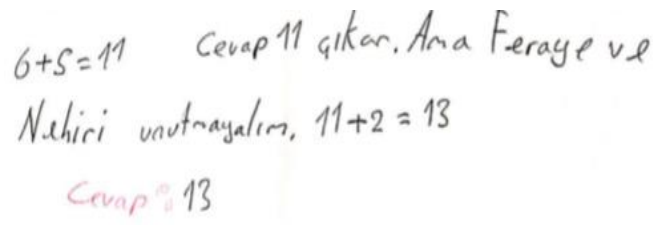

Figure 6. Example of students' solutions for problem 3

As seen from Figure 6 the participant here summed up the numbers given, considering that all of those invited to the party are different persons, or without considering that they may be common persons among the guests. However, considering that Nehir and Feraye were also good friends, s/he found the answer as 13. S/He also noted that Nehir and Feraye should not be forgotten in the explanation of his/her solution.

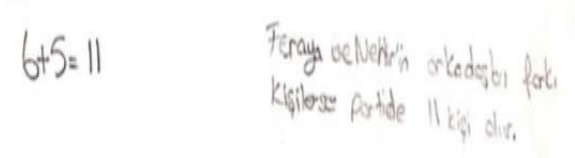

Figure 7. Example of students' solutions for problem 3

In this example (Figure 7), the participant summed up the given numbers and found the result as 11. However, the student actually commented on his/her answer using real-life knowledge and stated that this result was valid only if the friends of Nehir and Feraye were different persons. However, the student solved the problem without considering another possibility that Nehir and Feraye may be good friends.

In problem 4, a considerable number of students (%40.8) answered the problem as 450:35 =12 buses without considering the remaining students. 25.2% of the students solved the problem with realistic thinking as they answered that 13 buses are needed by performing a "450:35=12" operation and considering one more bus for the remaining 30 students. 10.8% of students did not give any answers, 16.8% of them performed irrelevant operations and 6.4% of the students did not perform any operations. The correct answer to this bus problem is 13 instead of 12, hence only 25.2% of the students gave the correct answer.

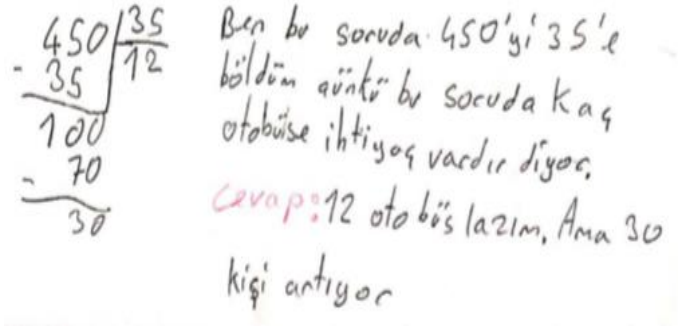

Figure 8. Example of students' solutions for problem 4

As seen from Figure 8, the participant divided 450 by 35 and found 12. S/he did not consider real life applications. Remaining 30 from the division were ignored by participants.

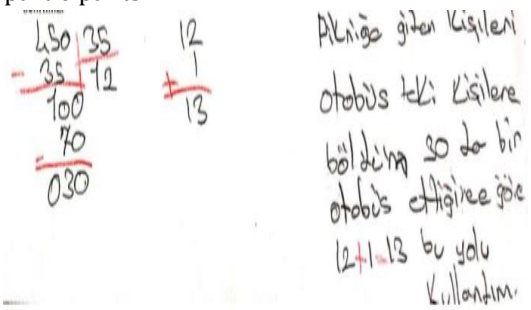

Figure 9. Example of students' solutions for problem 4

In that example (Figure 9), the participant solved the problem considering the real-life application. S/he divided 450 by 35 and added one more bus for the remaining 30 passengers, ending up with an answer of 13 buses. Hence, the participant solved the problem correctly.

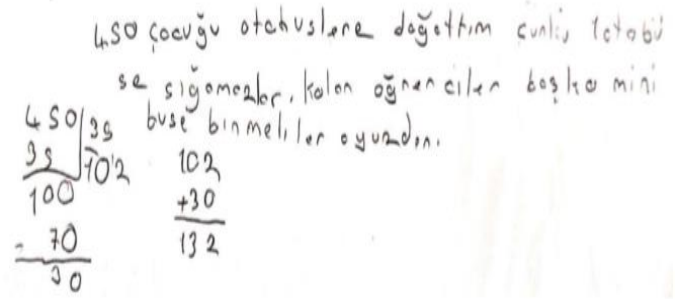

Figure 10. Example of students' solutions for problem 4

As seen from Figure 10, although the participant chose the correct mathematical operations, s/he could not reach the correct answer due to running the operations incorrectly.

DISCUSSIONS

Realizing mathematics in daily life and using it as a communication tool in daily life are among the main objectives of Mathematics education. Therefore, it is of great importance that students solve the problems they encounter in daily life. As stated by Krawitz, Schukajlow and Van Dooren (2018), when solving non-standard word problems, students should consider the realistic situation given in the problem statement. Otherwise, even if the results of the mathematical operations are correct, their solutions will not be correct and realistic. Many children focus more on syntax and arithmetic rules in the problem, and are far from seeing the problem as a real-world situation that needs to be modeled mathematically. As a result, many children perform well in standard arithmetic word problems, but fail to solve non-standard real-life problems because they do not use real-life knowledge (Xin, Lin, Zhang & Yan, 2007). In the study of Van Dooren, Lem, De Wortelaer and Verschaffel

(2019) it is indicated that one of the reasons why students react unrealistic to non-standard word problems is undoubtedly their expectations of what should be done when solving word problems at school. Students should perceive the differences between the expectations of standard word problems solved in the classroom and those of the real-world problems to gain the required realistic perspective.

In problem 1, which seems to contain proportional reasoning but requires a realistic answer, the majority of students could not solve the problem correctly by going through the proportional reasoning without considering their real-life situations. The students perceived the problem as a proportional reasoning problem, and after they determined a strategy for their solution, they reached the answer by operating (Aladağ & Artut, 2012).

In the second problem, the result of which is a decimal number but the decimal part should not be included in the result of the problem, the majority of the students did not find the result with decimals, but they did not make any explanation for the solution. A successful solution to the problem requires an interpretation of a remainder (Palm, 2008).

Although the correct answer for the third problem is in a range, the majority of students focused on the result of 5 + 6 + 2 = 13 or 6 + 5 = 11. In the party problem, it should be stated that the people who organized the party can have common friends, while very few students have referred to this situation in their solutions (Tarım & Öktem, 2014).

In the remainder division problem, which was the last one, the students approached the question only from an operational perspective and did not consider the remaining passengers (or the remainder in the division process) in their solutions using their real-life knowledge. In the study by Cooper and Harries (2005), it was determined that many working-class children failed when faced with a problem containing division with remainder. Especially, students failed to round up over the decimal result, but instead, they chose irrelevant multiplication or operated a division without rounding up. As an example, in the problem of finding the required number of buses, the number of decimal buses obtained by dividing 450 by 35 should be rounded up, taking into account the real-world knowledge. Ultimately, the student should know that the half bus will not function. Therefore, it is not enough just to choose correctly the division operation and reach the operationally correct number, but the results obtained also need to be interpreted using real-life knowledge (Palm, 2008).

CONCLUSIONS

In this study, students' performance in solving non-standard problems was evaluated. In solving non-standard word problems, children had to make realistic inferences using their real-life knowledge in order to reach the correct answer. When the data obtained as a result of the study were examined, it was determined that the percentage of children reaching the correct answer varied depending on the nature of the problem. Although a significant portion of the students chose the correct mathematical operation and performed the operation correctly, it was determined that they did not approach the situation realistically and therefore could not reach the correct answer. One of the aims of mathematics education is to provide students with a realistic approach to the problem by establishing a mathematical model in order to solve the problems they encounter in real life. However, the problems observed in this study and faced by students in solving real-life problems were also expressed in many other studies. (Chacko, 2004; Greer, 1993; Reusser & Stebler, 1997; Verschaffel, De Corte & Lasure, 1994; Yoshida, Verschaffel & De Corte, 1997; Bayazıt, 2013; Çelik &Güler, 2013). Verschaffel and De Corte (1997) highlighted that such real-life problems should be included at the primary school level.

Solutions of non-standard word problems should be included more in mathematics education. Students can be interviewed to understand their tendency to solve such problems and the problems faced by students. Students' ability to respond to real-life problems varies from problem to problem, and the reasons for this can be investigated so that mathematics can be used more easily as a tool in solving real-life problems. Therefore, such real situation problems should be included more frequently in the education of students. Students should be more involved in conversations that will increase their knowledge and understanding of mathematics and their way of thinking and deducing conclusions (Cotič & Felda, 2011). However, the better the teachers of the future are educated about word problems and understand the importance of the topic, the better students will be in solving non-standard problems in the future. Nowadays, activities aimed at solving standard word problems, choosing the correct mathematical operation and finding the correct result of the mathematical operation are focused in classroom activities. However, in addition to the standard problems based on the four operations, it would be useful to include problems that are related to real life and that require children to use real life information.

Author's Contribution

All authors discussed the result and contributed from the start to the final manuscript.

Conflict of Interest

The authors declare that they have no competing interests.

REFERENCES

Aladağ, A. & Artut, P. D. 2012. Öğrencilerin orantısal akıl yürütme ve gerçekçi problem çözme becerilerinin incelenmesi. *İlköğretim Online,* 11(4), 995-1009.

Artut, P. D. and Tarım, K. 2009. Öğretmen adaylarının rutin olmayan sözel problemleri çözme süreçlerinin incelenmesi. *Uludag University Education Faculty Journal* 12, no.1: 53-70.

Bayazit, İ. 2013. İlköğretim 7. ve 8. sınıf öğrencilerinin gerçek-yaşam problemlerini çözerken sergiledikleri yaklaşımlar ve kullandıkları strateji ve modellerin incelenmesi. *Kuram ve Uygulamada Eğitim Bilimleri, 1*3(3), 1903-1927.

Çelik, D. & Güler, M. 2013. İlköğretim 6. sınıf öğrencilerinin gerçek yaşam problemlerini çözme becerilerinin incelenmesi. *Dicle* Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 20, 180-195.

Chapman, O. 2003. Teachers' conceptions of mathematical word problems: A Basis for professional development. *Paper presented at the 27th international group for the psychology of mathematics education conference held Jointly with the 25th PME-NA conference*, July 13-18, in Honolulu, USA.

Cooper, B. & Harries, T. 2005. Making sense of realistic word problems: portraying working class 'failure' on a division with remainder problems. International Journal of Research & Method in Education, 28:2, 147-169.

Cotič, M. & Felda, D. 2011. Solving realistic problems in the initial instruction of mathematics, *Metodički obzori,* 49-61.

Greer, B. 1993. The modelling perspective on wor(l)d problems. *Journal of Mathematical Behavior,* 12: 239-250.

Hatano, G. 1997. Commentary cost and benefit of modelling activity. *Learning and Instruction* 7 (4): 383-387.

Hong, E. 1995. Preservice elementary teachers' conceptions about teaching word problem solving: The effect of methods instruction. *Paper presented at the annual meeting of the American Educational Research Association in San Francisco,* California.

Inoue, N. 2005. The realistic reasons behind unrealistic solutions: The role of interpretive activity in word problem solving. *Learning and Instruction,* 15:69-83.

Jiménez, L. &Verschaffel, L. 2014. Development of children's solutions of non-standard arithmetic word problem solving. *Revista de Psicodidáctica,* 19(1): 93-123.

Krawitz, J., Schukajlow, S. & Van Dooren, W. 2018. Unrealistic responses to realistic problems with missing information: what are important barriers?, *Educational Psychology*, 38(10): 1221-1238.

Olkun, S., Şahin, Ö., Akkurt Z., Dikkartın F. T. and Gülbağcı H. 2009. Modelleme yoluyla problem çözme ve genelleme: İlköğretim öğrencileriyle bir çalışma. *Eğitim ve Bilim,* 34 (151):65-73.

Öktem, S.,P. 2009. İlköğretim ikinci kademe öğrencilerinin gerçekçi cevap gerektiren matematiksel sözel problemleri çözme becerileri. *Unpublished master thesis.* Çukurova University

Palm, T. 2008. Impact of authenticity on sense making in word problem solving. *Educational Studies in Mathematics,* 67(1), 37-58

Reusser, K., & Stebler, R. 1997. Every word problem has a solution – The social rationality of mathematical modelling in schools. *Learning and Instruction,* 7, 309-327.

Schoenfeld, A. 1991. On mathematics as sense-making: An informal attack on the unfortunate divorce of formal and informal mathematics. *Informal reasoning and education*, ed. J. Voss, D. Perkins and J. Segal., 311-343. Hillsdale, NJ, USA:Lawrence Erlbaum Associates

Tarım, K.& Öktem, S.P. 2014. Mathematical word-problems that require realistic answer. *Çukurova Üniversitesi Eğitim Fakültesi Dergisi,* 43(2), 19-38.

Van Dooren, W., Lem, S., De Wortelaer, H. & Verschaffel, L. 2019. Improving realistic word problem solving by using humor. *The Journal of Mathematical Behavior,* 53, 96-104.

Verschaffel, L., De Corte, E., & Lasure, S. 1994. Realistic considerations in mathematical modelling of school arithmetic word problems. *Learning and Instruction,* 4, 273-294.

Verschaffel, L., De Corte,E., & Borghart, I. 1997. Pre-service teachers' conceptions and beliefs about the role of real-world knowledge in mathematical modelling of school word problems. *Learning and Instruction,* 7(4): 339-359.

Wyndhamn, J. and Saljö, R. 1997. Word problems and mathematical reasoning. A study of children's mastery of reference and meaning in textual realities. *Learning and Instruction,* 7(4):361-382.

Xin, Z. Lin, C. Zhang, L. & Yan, R. 2007. The performance of Chinese primary school students on realistic arithmetic word problems, *Educational Psychology in Practice,* 23:2, 145-159.

Yoshida, H., Verschaffel, L., & De Corte, E. 1997. Realistic considerations in solving problematic word problems: Do Japanese and Belgian children have the same difficulties? *Learning and Instruction,* 7(4), 329-338.