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AN INVESTIGATION OF 4TH GRADE STUDENTS' ABILITIES OF SOLVING PROBLEMS GIVEN IN SYMBOLIC, NUMERICAL AND STORY FORMATS

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Abstract: The purpose of this research is to examine fourth grade students' ability to solve mathematical problems which have the same solutions but are given in three different formats as "symbolic, numerical and story (word) problem" and which require four operations. Within this frame, the students' solutions in different formats, their correct / incorrect / mistaken answers, and the format type they had the most difficulty were examined. The research was conducted using the case study model of descriptive research methods. The research group consisted of 64 students who were attending at a public primary school in Eskişehir province. The data were obtained by using three problem solving sessions of each format applied to the students and a semi-structured interview performed afterwards with the students. In the research, it was found that the students had more difficulty in the story format problems than numerical and symbolic format problems since they made more errors in story problems. Regarding the reasons of the difficulty they had in story format, it was found that the students could not understand the problem if it was given in story format or they had difficulty in transforming the data in the story in text into mathematics language.

Key words: Primary school education, Problem solving, Word / Story problem, Symbolic format, Numerical format.

1. Introduction

When the national and international goals of education are examined, it is seen that the common goal is to provide individuals with a lot of knowledge, skills and values. When education systems and educational programs in particular are examined, mathematics education is undoubtedly an important area in which many skills are developed. Although it is accepted that mathematics has an important place in education systems; some people fear mathematics as a hard to achieve course, (Alakoç, 2003; Çakır, 2012), while for others mathematics is a way of life and a way of happiness (Boz, 2008). The saying of "If I feel unhappy, I study math to be happy; If I feel happy, I study math to go on being happy" is also an indicator that mathematics truly gives happiness to some individuals (Rényi and Turán, 1970; Boz, 2008). Mathematics is derived from the Ancient Greek story "matesis" which means "I know". In the Ottoman period, the story "riyaziye" which was used for mathematics was derived from the story "riyazet" which meant "taming training for callow colts" (Sertöz, 2000). Considering both meanings with Henri Poincaré's saying: "A mathematician does not suppose but knows, does not try to convince because proves, does not expect your trust but maybe wants you to pay attention"; an individual develops the feelings of difficulty and self-confidence while learning mathematics. Moreover, in the Elementary School Mathematics Curriculum, it is stated that "all students can learn mathematics", which points out that mathematics is necessary and learnable not only for a selected group but also for all students (Ministry of National Education in Turkey [MoNE], 2015). When educational research and common views of educators are considered, it is believed that students can learn mathematics and succeed in mathematics course, albeit at different levels of speed (Baykul, 2003).

In this context, the Elementary School Mathematics Curriculum aims to provide students with the ability to communicate using the language, concepts, terms and numbers of mathematics, with emphasis on conceptual learning, fluency in operations, and the relationship between mathematical

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concepts. In addition, it emphasizes the ability to make mathematical modeling, choosing the appropriate strategies for reasoning and expressing the relationships between objects in mathematical terms and having problem solving skills (MoNE, 2017).

In daily life, mathematics is a problem solving tool for many individuals. Solving daily life problem should not only be considered limited to routine and four-operation type problems, non-routine and open-ended problem solving should be addressed as well (Altun, Bintaş, Yazgan, & Arslan, 2004; MoNE, 2013). The individual uses and develops mathematical thinking skills in problem solving process. These skills help the individual to succeed not only in academic life but also in real life as an individual who can think diversely and creatively to overcome the problems he/she encounters. Mathematical thinking can be defined as direct or indirect use of mathematical techniques, concepts and methods in the problem solving process (Henderson et al., 2004). People need to consider mathematical thinking to a great extent while trying to solve problems in daily life (Yeşildere, 2006). People face various problems throughout their lives and try to find different solutions to solve many problems. Decision making and problem solving skills are not only the result of development and socialization, but also are inevitable and important processes that continue throughout an individual's life (Güçray, 2003). Miller and Nunn (2001) emphasized that problem solving skills are learned from childhood and developed during school years. However, the success of problem solving, that is, the correct solution of a problem depends primarily on the correct understanding of that problem. One of the important difficulties encountered in problem solving was found in the researches as that problems are not read and understood properly at the beginning (Karataş, 2002; Tatar and Soylu, 2006). In mathematics class problem solving traditionally and usually starts with solving story context problems, widely known as word problems or in another usage as story problems. Story problems has an important place in students' language formation, reasoning and mathematical development (Soylu and Soylu, 2006). Story problems provide possibilities of implementation for real-life problem situations, motivate students to understand the mathematical concepts, and contribute to the development of their creative and critical thinking skills (Chapman, 2006).

However, what makes daily life context story problems incomprehensible and thus unsolvable by students is not only the lack of their mathematical knowledge, but their inability to associate problems with daily life or their inadequate or misunderstanding of a story problem or their failure to write the solution in proper mathematical language (Verschaffel, Greer, Dooren, & Mukhopadhyay, 2009). Altun and Arslan (2006) revealed that students, when they encounter a story problem, mostly tend to just take a look at the problem and then quickly apply operational procedures that they perceive to be done with the given numbers and directly go to the result without enough reasoning. It is a found fact by worldwide researches that students mostly focus on numbers and operations in problem solving. School-age children tend to solve story problems by making calculations with numbers even if their operational answers do not seem realistic (Inoue, 2008).

In this context, this research was conducted to examine the abilities of the students at elementary education level in solving different format items (symbolic, numerical and story), to investigate in which form of the items they are more successful and where they make mistakes in the problem solving process. In the research, with the items given in three different forms, the students' solutions, knowledge of operational procedures, term/terminology knowledge, understanding of the problem and mathematical language/writing knowledge were examined.

2. Method

This research was done in the case study model of descriptive research methods. According to Yin (1984), case study is an empirical research model which is carried out in a real-life context and is used in situations where the boundaries between the case and the content are not clearly defined and where there is more than one evidence or data source. The case study model was preferred because it is a qualitative research method (Yıldırım and Şimşek, 2000) which is based on the questions of "how" and "why", and allows an in-depth investigation of a phenomenon or event that the researcher cannot control. Moreover, considering the research problem, this model is thought to be suitable for the

research because it provides rich explanatory information about the situation and is fed from various sources of information.

2. 1. The Research Group

The research group consists of fourth grade students attending a public school in Odunpazarı district of Eskişehir in the spring term of 2014-2015 academic year. In the research, due to the limitations in terms of time, money and labor, the sample was chosen from easily accessible and applicable units using proper sampling method (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2010) and the research was implemented in three different classes. Demographic characteristics of the research group are given in Table 1.

Table 1. *Demographic characteristics of the research group*

Student number (n = 64)	**Class – I**		**Class – II**		**Class - III**	
	Girl	Boy	Girl	Boy	Girl	Boy
	16	13	11	7	7	10

2. 2. Data Collection Tools

In this research, the students were asked to solve three different format problems which are essentially the same and have the same results. For this purpose, Problem Solving Applications (Applicaton 1, 2, and 3) and "Interview Form" were created by the researcher with expert opinion and applied one week apart. Figure 1 below shows the structure of the research process.

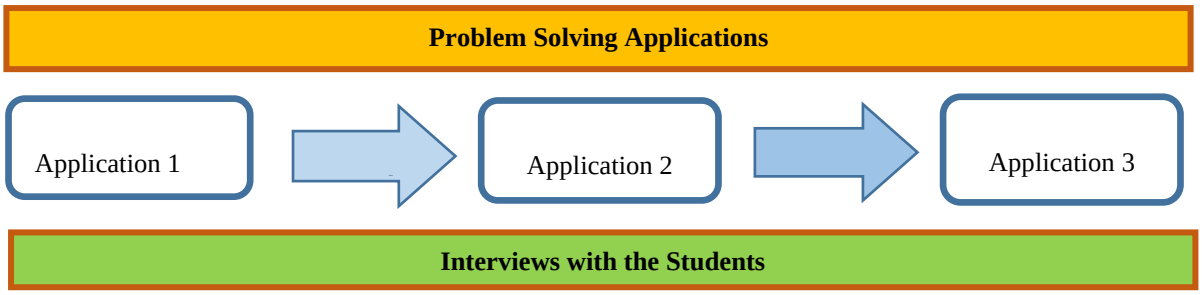

Figure 1. *The research process*

Before creating problem solving applications, literature research was conducted to select the appropriate items for the research. The items were prepared by taking into consideration the target achievements (skills to gain) in the Fourth Grade Mathematics Course Curriculum and the fourth grade mathematics textbook proposed by the Ministry of National Education for the 2014-2015 academic year. By taking samples from all of the gains for the four operation skills, the content for each gain was created and diversity was provided. The items were then arranged in a symbolic, numerical and story format in accordance with the research. In order to determine whether the items measure the gain or not, the opinions of three mathematicians who are experts in their fields were consulted. In the research, a pilot study was conducted to ensure that the items in the applications were understood by the students and to determine possible obstacles that might arise during the application. In the process of evaluating the applications included in the pilot study, it was found that some of the students misunderstood the item "Find the sum of the numbers 861, 1536 and 2065" because of the comma that lead them to read it like a decimal number and gave incorrect answers for this reason. In order to prevent this misunderstanding in the actual application, the item was corrected as "Find the sum of the numbers 861 and 1536 and 2065." Apart from this item, no other obstacles in terms of comprehension were found in the items given in the applications. Applications were then finalized and all the items used in the applications were presented in Appendix 1. Symbolic, numerical and story problems used in the applications and the gains of these forms were taken from the Mathematics

Curriculum (MoNE, 2015) and matched. Table 2 provides information on the matching of the items of each application and related gains.

Table 2. *Paired items (Symbolic, Numerical, Story Problems) and related gains*

	Symbolic	**Numerical**	**Story Problems**
	2348 + 2789=?	Find the sum of the numbers 2348 and 2789.	A mountaineer wants to climb to the climax of the Mount Ararat. First She climbs 2348 meters from the bottom. After giving a break she climbs 2789 meters more and reaches at the climax. What is the height of the Mount Ararat from the bottom?
Related Gain: Does addition operation (with two numbers) up to four-digit natural numbers. Solves problems that require the addition of natural numbers.			
	400 - 150=?	What is the result if you subtract 150 from 400?	Ali had 400 TL (Turkish Liras). He bought himself a track suit for 150 TL. How much money left does he have?
Related Gain: Does subtraction operation (with two numbers)up to four-digit natural numbers. Solves problems that require the subtraction of natural numbers.			
3	861+1536+2065=?	Find the sum of the numbers 861, 1536 and 2065.	Atatürk Primary School has participated in a tree planting campaign. 861 pine, 1536 oak and 2065 poplar saplings were planted in the forest. How many saplings in total were planted in the forest?
Related Gain: Does addition operation (with three numbers) up to four-digit natural numbers. Solves problems that require the addition of natural numbers			
4	2000 – 500 = △ △ – 120 = ?	500 is subtracted from 2000. Then 120 is subtracted from the remainder. What is the result?	Deniz's father receives a salary of 2000 TL. After he pays the house rent with 500 TL and the electricity, water and natural gas bills with 120 TL of his salary, how much TL remains?
Related Gain: Does subtraction operation (with three numbers) up to four-digit natural numbers. Solves problems that require the subtraction of natural numbers.			
5	162 ÷ 54 =?	What is the quotient if 162 is divided by 54?	Reading 54 pages in a day, in how many days does Ayşe finish her 162-page book?
Related Gain: Divides three-digit natural numbers by two-digit natural numbers (without remainder). Solves problems that require the division of natural numbers.			
6	136 x 16	Find the multiplication of the numbers 136 and 16.	How many pencils in total are there in 136 pencil boxes that have 16 pencils each?
Related Gain: Multiplies three-digit natural numbers (with two numbers) by two-digit natural numbers. Solves problems that require the multiplication of natural numbers.			
7	70 x 4 x 20 = ?	What is the result of 4 times the number 70, multiplied by 20?	One bread is 70 cents. How many TL does a family who consume 4 breads a day spend in 20 days to buy bread?
Related Gain: Multiplies three-digit natural numbers (with three numbers) by two-digit natural numbers. Solves problems that require the multiplication of natural numbers.			
8	1372 : 14 = ?	What is the quotient after dividing the number 1372 by 14?	Mrs. Özlem has purchased a refrigerator for 1372 TL in installments for 14 months. Calculate the amount of monthly installment that Mrs. Özge will pay for the refrigerator.
Related Gain: Divides four-digit natural numbers by two-digit natural numbers (without remainder). Solves problems that require the division of natural numbers.			
9		What is the remainder after dividing the number 880 by 25?	How many books remain left if 880 books that were collected in an elementary school are equally distributed to 25 schools?
Related Gain: Divides three-digit natural numbers by two-digit natural numbers (with remainder). Solves problems that require the division of natural numbers.			

Each application consists of nine items that are equally distributed such that there are three symbolic, three numerical and three story format items in each application. While selecting the samples, diversity was achieved in accordance with the gains. The meaning of each of the three formats included in the research is presented in Figure 2 below, along with appropriate examples.

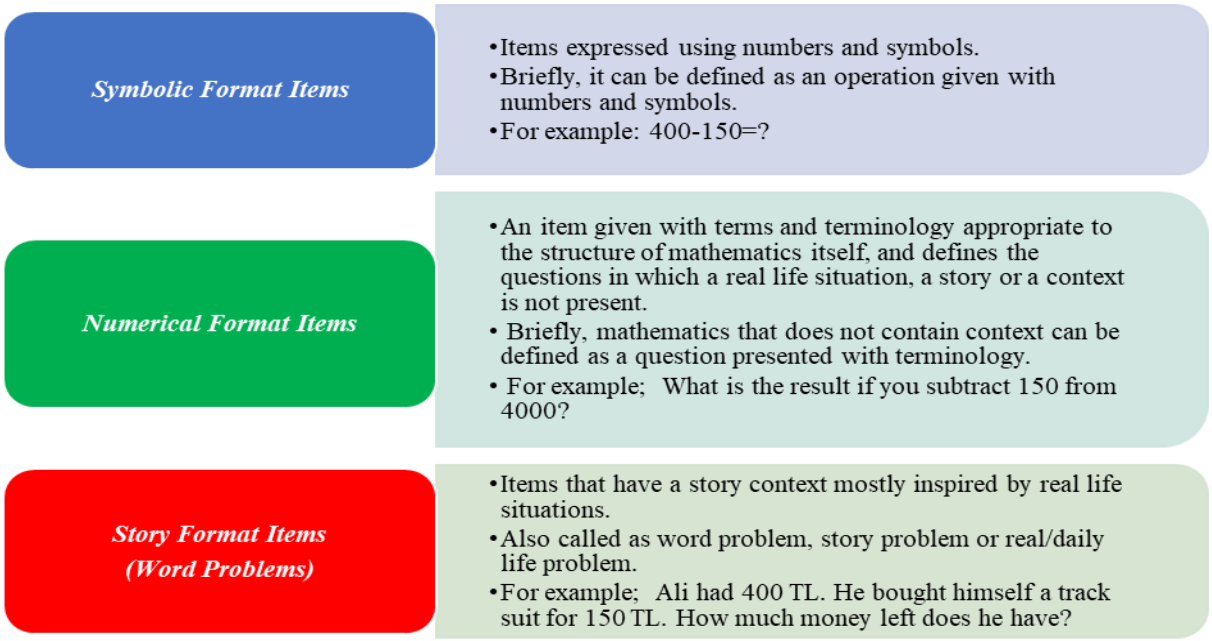

Figure 2. *Application formats and their specifications in the research*

The applications are given the codes of A1, A2, A3, whereas the items were coded as I1, I2, I3 …… I9 (For ex: A1-I1 refers to the Item 1 in the Application 1). The specifications and rankings of the items in each of the applications are given in Table 3 below (and see Appendix 1).

Table 3. *Applications 1, 2, 3 and their item types*

	Application 1 (A1)	**Application 2 (A2)**	**Application 3 (A3)**
	Type (Number)	Type (Number)	Type (Number)
Item 1	Symbolic (A1-I1)	Story (A2-I7)	Numerical (A3-I4)
Item 2	Symbolic (A1-I2)	Story (A2-I8)	Numerical (A3-I5)
Item 3	Symbolic (A1-I3)	Story (A2-I9)	Numerical (A3-I6)
Item 4	Numerical (A1-I4)	Symbolic (A2-I1)	Story (A3-I7)
Item 5	Numerical (A1-I5)	Symbolic (A2-I2)	Story (A3-I8)
Item 6	Numerical (A1-I6)	Symbolic (A2-I3)	Story (A3-I9)
Item 7	Story (A1-I7)	Numerical (A2-I4)	Symbolic (A3-I1)
Item 8	Story (A1-I8)	Numerical (A2-I5)	Symbolic (A3-I2)
Item 9	Story (A1-I9)	Numerical (A2-I6)	Symbolic (A3-I3)
View	What is the hardest/easiest item? Why?	What is the hardest/easiest item? Why?	What is the hardest/easiest item? Why?

At the end of each application, the students were asked the following two questions to determine the most difficult and the easiest item and the reasons: "(1) Which one was the most difficult item? And Why? , (2) Which one was the easiest item? And Why?" In addition, the three item format categories was introduced and explained to the students after the completion of the applications and then, with the semi-structured student interview form, student views were obtained about by asking "Which category was difficult / easy to solve for them". The opinions of the students about the meaning of problem solving and their likes and difficulties during the problem solving process were also taken.

2. 2. Data Analysis

Content analysis was used to analyze the data. The data obtained from the application and interviews were tabulated, the students' responses to the items were grouped according to the following five criteria as “correct solution, partially correct solution, incorrect solution, procedural error and null response” based on graded scoring key:

-Correct Solution: The answer to the item is to be solved completely and accurately.

-Partially Correct Solution: In case of a binary transaction, one is answered correctly and the other is incorrect.

-Incorrect Solution: The answer is not the solution to the problem.

-Procedural Error: An error is made while performing the mathematical operations, even though the correct operation is known.

-Null Response: If the problem is not solved at all, or answered as "I can't solve", "I don't know", "I don't understand" etc.

The findings were then presented together with selected sample student responses. The application data were evaluated and coded by the two researchers in accordance with the criteria. Afterwards, reliability analysis between the coders (Miles & Huberman, 1994) was performed and the reliability was calculated as 97.5%. Incompatible coding situations were discussed and eventually consensus was reached on coding. On the other hand, the data of the interview were presented with a list of new codes and themes prepared by the two researchers on the basis of the interview questions and with selected sample statements of students.

3. Conclusion

This section presents the findings under three headings as follows: 1) Findings related to students' ability to solve problems given in symbolic, numerical and story formats, 2) The findings obtained by examining the items having different format but same solution procedure, and 3) The findings obtained from interviews.

3. 1. Findings Related to Students' Ability to Solve Problems Given in Symbolic, Numerical and Story Formats

The solutions of the students were examined separately for each application and, frequency and percentages were shown in tables. Table 4 shows the distribution of student solutions produced in Application 1 with respect to scoring criteria.

Table 4. *Statistics of student solution performance for items in Application 1*

Application 1 and Item #		Response Scoring Data										Format Type
		Correct		Partially Correct		Procedure Error		Incorrect		Null Response		
		n	%	n	%	n	%	n	%	n	%	
Application 1	A1-I1	54	84.3	0	---	2	3.1	8	12.5	0	---	*Symbolic*
	A1-I2	49	76.5	3	4.6	0	---	12	18.7	0	---	*Symbolic*
	A1-I3	40	62.5	0	---	0	---	22	34.3	2	3.1	*Symbolic*
	A1-I4	34	53.1	0	---	1	1.5	25	39.0	4	6.2	*Numerical*
	A1-I5	29	45.3	1	1.5	1	1.5	28	43.7	5	7.8	*Numerical*
	A1-I6	46	71.8	1	1.5	8	12.5	8	12.5	1	1.5	*Numerical*
	A1-I7	30	46.8	1	1.5	0	---	31	48.4	2	3.1	*Story*
	A1-I8	20	31.2	0	---	0	---	35	54.6	9	14.0	*Story*
	A1-I9	49	76.5	0	---	5	7.8	7	10.9	3	4.6	*Story*

Table 4 shows that the first item given in symbolic format (A1-I1) has the highest correct answer percentage with a rate of 84.3%, and the eighth item given in story format (A1-I8) has the lowest correct answer percentage with a rate of 31.2%.

The findings obtained in Application 2 which was conducted one week later by changing the format of the items are given in Table 5 below.

Table 5. *Statistics of student solution performance for items in Application 2*

Application 2 and Item #		Response Scoring Data										Format Type
		Correct		Partially Correct		Procedure Error		Incorrect		Null Response		
		n	%	n	%	n	%	n	%	n	%	
Application 2	A2-I1	51	79.6	0	---	0	---	13	20.3	0	---	*Symbolic*
	A2-I2	26	40.6	1	1.5	3	4.6	30	46.8	4	6.2	*Symbolic*
	A2-I3	47	73.4	0	---	8	12.5	9	14.0	0	---	*Symbolic*
	A2-I4	41	64.0	1	1.5	0	---	22	34.3	0	---	*Numerical*
	A2-I5	25	39.0	0	---	1	1.5	33	51.5	5	7.8	*Numerical*
	A2-I6	53	82.8	0	---	4	6.2	7	10.9	0	---	*Numerical*
	A2-I7	52	81.2	0	---	1	1.5	10	15.6	1	1.5	*Story*
	A2-I8	40	62.5	0	---	1	1.5	21	32.8	2	3.1	*Story*
	A2-I9	27	42.1	0	---	0	---	36	56.2	1	1.5	*Story*

Table 5 shows that the sixth item given in numerical format (A2-I6) has the highest correct answer percentage with a rate of 82.8%, and the fifth item given in numerical format (A2-I5) has the lowest correct answer percentage with a rate of 39.0%. In the fifth item (What is the result of 4 times the number 70 and multiplied by 20?) students did not perform two multiplication operations needed to solve it because we think that two different wording (times and multiplied by) must have led to confusion and misunderstanding. This finding constitutes the idea that beside the formats of the items, the gains and background knowledge are also factors in problem solving success.

The findings obtained in Application 3 which was conducted one week later by changing the format of the items are given in Table 6 below.

Table 6. *Statistics of student solution performance for items in Application 3*

Application 3 and Item #		Response Scoring Data										Format Type
		Correct		Partially Correct		Procedure Error		Incorrect		Null Response		
		n	%	n	%	n	%	n	%	n	%	
Application 3	A3-I1	43	67.1	0	---	4	6.2	15	23.4	2	3.1	*Symbolic*
	A3-I2	30	46.8	0	---	0	---	29	45.3	5	7.8	*Symbolic*
	A3-I3	55	85.9	0	---	3	4.6	6	9.3	0	---	*Symbolic*
	A3-I4	54	84.3	0	---	4	6.2	6	9.3	0	---	*Numerical*
	A3-I5	53	82.8	1	1.5	1	1.5	9	14.0	0	---	*Numerical*
	A3-I6	37	57.8	0	---	0	---	24	37.5	3	4.6	*Numerical*
	A3-I7	34	53.1	0	---	1	1.5	29	45.3	0	---	*Story*
	A3-I8	28	43.7	0	---	0	---	26	40.6	10	15.6	*Story*
	A3-I9	44	68.7	0	---	6	9.3	12	18.7	2	3.1	*Story*

Table 6 shows that the third item given in symbolic format (A3-I3) has the highest correct answer percentage with a rate of 85.9%, and the eighth item given in story format (A3-I8) has the lowest correct answer percentage with a rate of 43.7%. This result shows that the students had more difficulty in story format items than numerical and symbolic format items.

The aggregated scoring data statistics from all three applications for each format type are presented together in Table 7 below.

Table 7. *Aggregated overall statistics of student solution performance for all items in Applications (1, 2, and 3)*

Application #	Response Scoring Data										Format Type
	Correct		Partially Correct		Procedure Error		Incorrect		Null Response		
	n	%	n	%	n	%	n	%	n	%	
1	143	74.4	3	1.5	2	1.0	42	21.8	2	1.0	*Symbolic*
	109	56.7	2	1.0	10	5.2	61	31.7	10	5.2	*Numerical*
	99	51.5	1	0.5	5	2.6	73	38.0	14	7.2	*Story*
2	124	64.5	1	0.5	11	5.7	52	27.0	4	2.0	*Symbolic*
	119	61.9	1	0.5	5	2.6	62	32.2	5	2.6	*Numerical*
	119	62.5	0	---	2	1.0	67	34.8	4	2.0	*Story*
3	128	66.6	0	---	7	3.6	44	22.9	7	3.6	*Symbolic*
	144	75	1	0.5	5	2.6	39	20.3	3	1.5	*Numerical*
	106	55.2	0	---	7	3.6	67	34.8	12	6.2	*Story*

According to Table 7, we can conclude that students have more difficulty and make more errors in story problems than the symbolic and numerical format items when all items are considered in three applications.

3. 2. The Findings Obtained by Examining the Items Having Different Format but Same Solution Procedure

In this section, some sample student responses are presented in order to evaluate student solutions by comparison. While presenting the findings, student solutions are quoted directly and information about the item features and student identification (school number, branch, and gender) are also presented.

Firstly, the responses of Student-10 who could solve a problem correctly when given in symbolic and numerical formats (Item #A1-I2 and #A3-I5) but could not solve it when given in story format (Item #A2-I8) is presented in Figure 3 below. Although he has the necessary subtraction operation skills to solve the Item #A2-I8, we think that he could not understand or misunderstood the problem linguistically or logically when given in text format, thus could not solve it correctly.

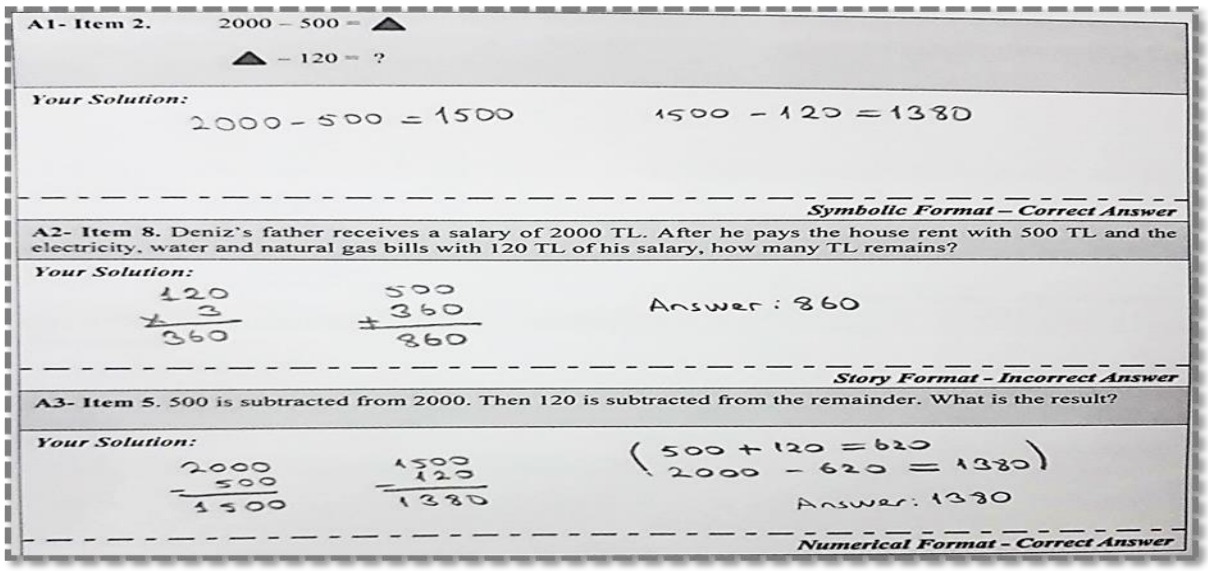

Figure 3. *A1-I2, A2-I8, A3-I5/ Student -10 (Section–1, Male)*

Figure 4 below shows the same finding for another item solved by Student-11. Although he could solve Item #A1-I3 (symbolic format) and #A3-I6 (numerical format), and has the necessary division operation skills to solve the Item #A2-I9, we think that he could not understand or misunderstood the problem linguistically or logically when given in text format, thus could not solve it correctly.

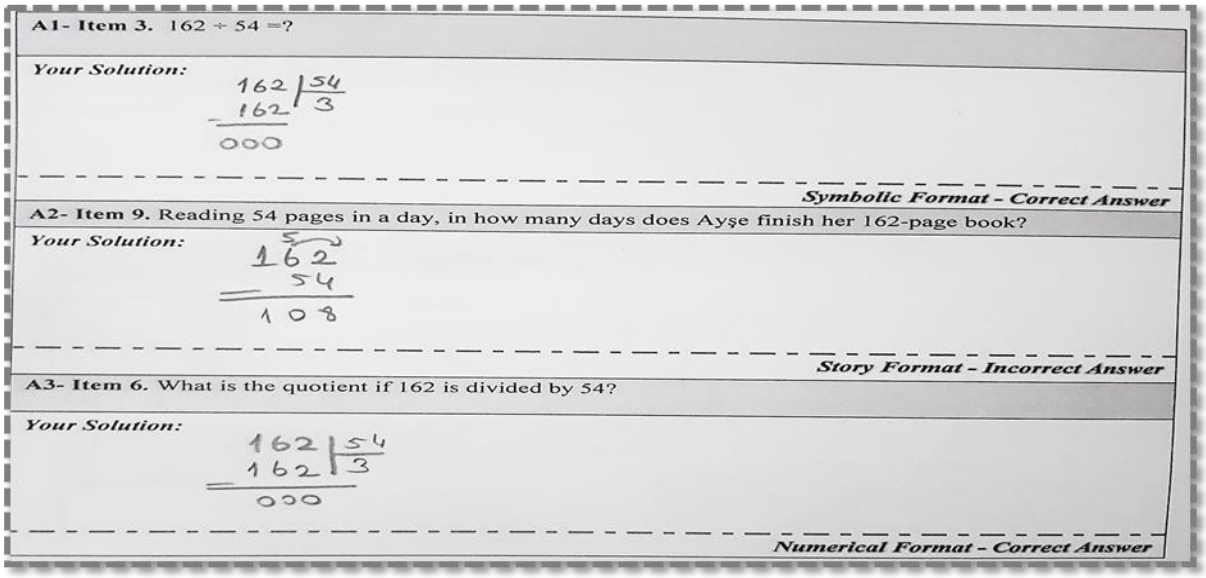

Figure 4. *A1-I3, A2-I9, A3-I6/ Student-11 (Section–2, Male)*

Likewise, Figure 5 below shows the same finding for another item solved by Student-2. Although she could solve Item #A2-I3 (symbolic format) and #A1-I6 (numerical format), and has the necessary division operation skills to solve the Item #A3-I9, we think that he could not understand or misunderstood the problem linguistically or logically when given in text format, thus could not solve it correctly. The Item # A3-I9, which was assumed easy to solve by most of the students required addition operation and was not solved correctly or left blank by some students because of the comprehension difficulty of the story format.

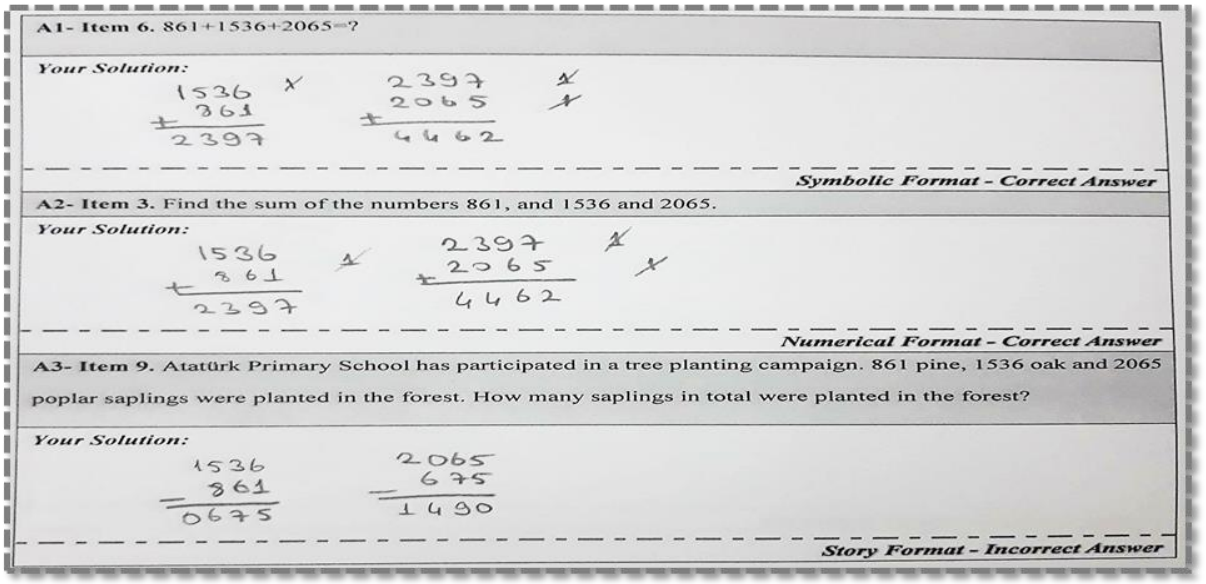

Figure 5. *A1-I6, A2-I3, A3-I9/ Student -2 (Section–3, Female)*

Figure 6 below shows a different finding for another item solved by Student-15 who could solve correctly when given in symbolic and story formats (Item #A2-I2 and #A3-I8) but could not solve it when given in numerical format (Item #A1-I5). This can be explained by procedure error in division operation.

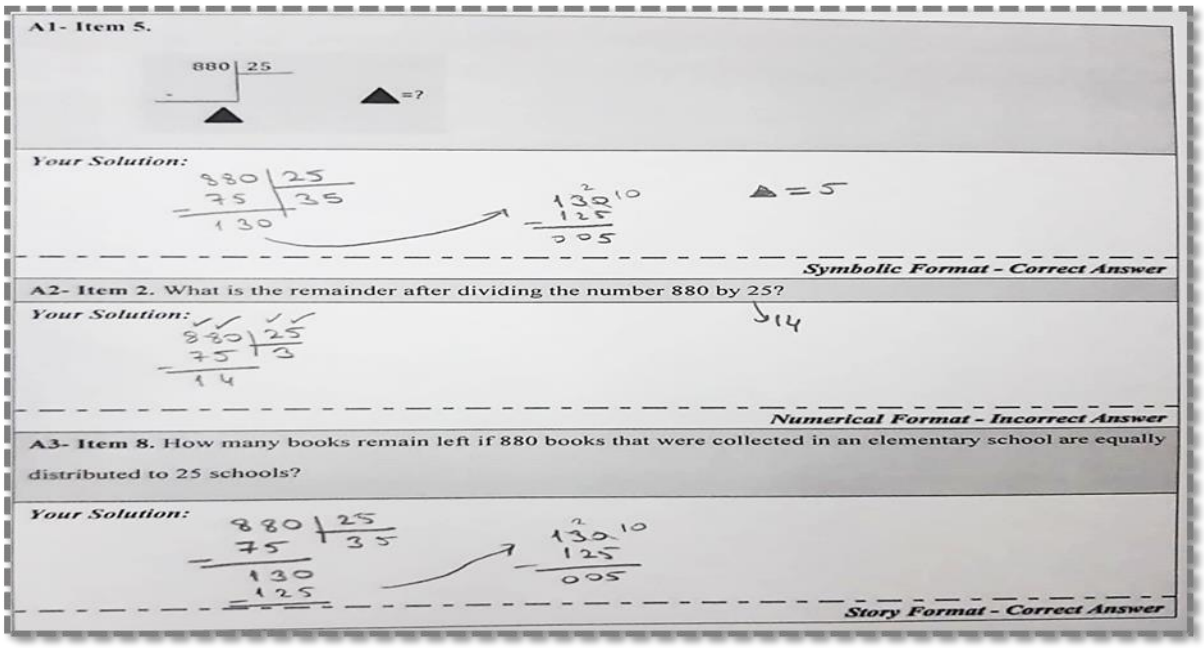

Figure 6. *A1-I5, A2-I2, A3-I8/ Student -15 (Section–2, Female)*

When the responses of each of the students and sample responses presented above are examined as a whole, the findings can be summarized as follows: While students were giving correct answers in symbolic and numerical formats, they often had difficulty in solving the problem given in the story format. The reason for this outcome was evaluated as the inability of students to determine the required procedure in the story format, which is, having problems in understanding the problem text either logically (inability to reason) or linguistically. It is also thought that the reason for making mistake in numerical format may be due to lack of knowledge of the terms and terminology in the text of the problem.

3. 3. Students' Views on Solving Problems Given in Different Format Types

Student opinions were collected using a semi-structured interview form distributed to students, and then codes were formed into categories and sub-categories. Finally, frequency and percentages were determined. Some examples of student statements were also included in the tables. These statements helped the researchers to form the codes. Table 8 below shows student answers to the interview items on the easiness of the format types.

Table 8. *Student views on the easiness of the format types*

Categories	Sub Categories (Format Type)	Sample Statements	Codes	f	%
Easy	Symbolic	"To me it is easier"	Easy	15	39
		"The operation is both easy and amusing"	Amusing	2	5
		"Items are more clear in this format"	Clear	4	10
		"It takes less time to solve"	Short	6	15
		"In the solution operation, there is no need to understand it as a problem"	No Understanding	6	15
			Other	4	10
	Numerical	-	-		
	Story	"Because it tells the problem better"	Expression	**2**	**5**

As can be seen in Table 8, most of the students stated that it was easier to solve the symbolic format items. There were also students who stated that the symbolic format items were clear and amusing because they were easy to understand. As a result of the interview, there were no students who found the numerical format items easy. Also, only two students found story format items easy because the story context explains the problem better they said. Table 9 below shows student answers and their reasons to the interview items on the difficulty of the format types.

Table 9. *Student views on the difficulty of the format types*

Categories	Sub Categories (Format Type)	Sample Statements	Codes	f	%
Difficult	**Symbolic**	"There is only operation given but no explanation or story"	No explanation or story	1	2
	Numerical	"Sometimes I don't understand what is asked"	No understanding	1	2
	Story	"There is more than one operation"	More than one operation	2	5
		"Problem is longer and more difficult to solve"	Long	7	18
		"It is difficult to think about the problem"	Thinking	4	10
		"Both there is need to understand and solve"	Understanding	10	26
		"The operation is hidden inside the problem, so it is difficult to know and understand it"	Hidden operation	3	7
		"Difficult to reason"	Reasoning	2	5
		"Problem is mixed"	Mixed	2	5
			Other	7	18

As can be seen in Table 9, only one student found a symbolic format item difficult. Also, only one student found a numerical format item difficult. This student stated that he could not understand what was asked in the numerical format item. We think that he couldn't understand because he did not have knowledge of necessary numerical terms and mathematical terminology. Consequently, we found that most of the students stated that story format problems were difficult to solve and they justified this difficulty by various reasons such as long narration, more need for comprehension, thinking and reasoning etc. Again, three of the students said that it is difficult to understand what is hidden within the procedure of the problem and that they have difficulty in understanding the problem and writing the mathematical expression necessary for the solution, that is, converting the given problem into mathematical language. As a result of the applications conducted before the interview, it was observed that the students had more difficulty in solving story problems and thus failed. An important finding of the research is that the results of the students and their answers in the interview showed parallelism.

Similarly, at the end of each application (1) Which do you think was the most difficult item? Why is that? and (2) Which do you think was the easiest item? When the students' answers were examined, it was found to be in accordance with the findings obtained in Table 8 and Table 9. For Application 1, the students stated that the easiest problem was the first problem given in symbolic format (A1-I1) and the most difficult problem was the eighth problem (A1-I8) given in story format. In the case of Application 2, they stated that the easiest item was the first item (A2-I1) in symbolic format, and the most difficult item was expressed in story format (A2-I9). In the case of Application 3, again the easiest item was the first item (A3-I3) in the symbolic format while the most difficult item is stated as the eighth item given in story format (A3-I8). Hence, in all applications students stated that the easiest item was in symbolic format and the most difficult item was in story format.

Beside students' views on the format type and their difficult / easy perceptions of the items, their views on problem solving were also obtained and the findings reached are given below. First of all, they were asked "What do you understand/know about problem solving? Table 10 below is prepared based on the students' answers to the meaning of problem solving.

Table 10. *Student views on the meaning of problem solving*

Categories	Sub Categories (Format Type)	Sample Statements	Codes	f	%
Meaning of problem solving	Solving a case	I understand as "solving a complex situation"	Solving a complex situation	3	7
	Doing operation	I understand as "doing operations in problems".	Doing operation	11	28
	Determining a strategy	I think as "finding the operation, and understanding the operation".	Finding the operation	7	18
			Understanding the operation	5	13
	Harmony between math and real life	I understand problem as "everything in daily life"	Daily life connection	1	2
	Its function	Helps us do operations	Better expression	2	5
		Tells the subject better			
		Develops my intelligence	Intelligence development	2	5
		Other	-	8	21

As can be seen in Table 10, eleven students defined problem solving as doing operations while 7 students defined finding the operation and 5 students defined it as understanding the operation. Thus, students overlap problem with operation. One of the students explained the definition of the problem as everything in daily life. Two students defined problem solving as a better expression and two of them defined as intelligence development.

Table 11. *What students like during problem solving process*

Categories	Sub Categories (Format Type)	Sample Statements	Codes	f	%
Likes about problem solving	**Understanding**	I like the story in the problem.	Story	3	7
		I like reading	Reading	3	7
		I like the clues in the problems	Clue	2	5
	Creativity	I like thinking and reasoning.	Reasoning	3	7
		I like imagining and envisioning given objects and numbers.	Imagining	1	2
	Solution	I like finding the answer.	Finding the answer	8	21
		I like doing the operations.	Doing the operations	12	31
		Other	-	7	18

Tablo 11 was created by using student answers to interview question that ask them what they like about during problem solving process. In Table 11, the likes about problem solving are divided into three sub categories as "Understanding, Creativity, Solution". Codes were then created from these subcategories. 12 of the students stated that they like to do operations while solving problems, eight of them stated that they like to find the answer. Three students liked to read stories, three students liked reading the problem and another three liked to make reasoning. One of the students said that he likes to imagine while solving problems. Here, it can be concluded that most of the students enjoy the procedure and solution part of the problem while solving. The finding that at least some of the students expressed their likes in the category of creativity, reasoning and imagining in problem solving is considered positive when the structure of problem solving is considered. Tablo 12 was created by using student answers to interview question that ask them what difficulty they had during problem solving process.

Table 12. *Students' difficulties during problem solving process*

Categories	Sub Categories		Sample statements	Codes	f	%
Difficulties in problem solving	Operations		I have difficulty in division operation.	Division operation	12	31
			I have difficulty in fraction problems.	Fraction problems	1	2
	Subject		I confuse back and forth at age finding.	Age problems	1	2
			I have difficulty in money.	Number problems	1	2
	Understanding		I have difficulty in thinking.	Thinking	3	7
			I have difficulty in finding operation of the problem.	Finding the operation	10	26
			I think too much on long written problems	Long text	2	5
			Other	-	8	21

10 of the students stated that they had difficulty in finding the operation while solving the problem. Three students in thinking, one student in fraction, one student in age and one student in numbers had difficulty in solving problems. In addition, 12 students stated that they had difficulty in division operation. The decrease in the percentage of correct answers in the items that require division operation can be explained by this opinion of students.

As it can be understood from here, most of the students are having difficulty in determining which operation to use when solving a problem. The fact that there are students who had difficulty in expressing the given information in problem sentence with mathematical language reveals the deficiencies of students in understanding the problem which is the first step in problem solving. Similarly, students think that long problem sentences reduce comprehension. When Table 11 is examined here, the finding that there are excess number of students who had difficulty in problems involving division is considered an important finding.

In addition, although very few students expressed difficulty in problems including fractions, age and money, it is considered as a significant finding that includes detail when considering the effect of context on problem solving. While students can answer correctly in a symbolic or numerical format, they cannot solve in story format since they don't comprehend the context even if they know the correct operation. Here, it is considered that they may act prejudiced because they think they do not know the context.

4. Conclusion, Discussion, and Recommendations

According to the results of this research in which fourth grade students' symbolic, numerical and story format problem solving skills were investigated, students had the most difficulty in solving story format problems. Although the students knew the four basic operations needed to solve story format problems, they had difficulty in reading and understanding the problem context, writing in mathematical language and determining which operation to do. The symbolic format items were

created as converted forms of numerical and story format item into symbolic mathematical language. In the applications, those students who could solve symbolic items but fail in numerical and story format versions should be interpreted as having a lack of knowledge in basic mathematical terms and terminology such as divisor, remainder, total, quotient etc. Similarly, the reason why a student who correctly answered the symbolic format item but could not solve the story format version of it is evaluated to be resulting from his inability to understand the problem. This finding was obtained as a result of both applications and interviews.

The International Student Assessment Program (PISA) aims to evaluate how students can make sense of what they know and apply mathematical knowledge, including new and unusual situations. To this end, most PISA mathematical units and questions refer to real-life situations where mathematical skills are required to solve a problem. Looking at the overall results of the PISA 2015 mathematics literacy areas related to application, Turkey remained below the overall average (MOE, 2016). As a reason for this, it was evaluated that students had difficulty in solving the problems given in story format. In addition to procedural knowledge, the emphasis was on the development of problem solving skills for conceptual knowledge, reasoning, and higher-order thinking skills (Özdeş, 2013).

The results obtained in this research are similar to some studies on mathematical problems in the literature. De Corte, Verschaffel, De Win (1985), by making changes in the expressions of addition and subtraction problems in their research, they re-expressed the problems without touching the semantic structure of the problems to see how this affects children. They made this research to help children understand the text of the problem better. As a result of this research, they found that the semantic structure of problems directly affects the difficulty level of problem and the solution strategy of children. This showed that there is a relationship between reading comprehension skills and problem solving success. These studies reveal the relationship between problem solving and reading comprehension and show consistency with the results obtained in this research.

As a result of the applications and interviews, it was concluded that the students who found it difficult to solve the problems given in the story format find the problem complex. Whimbey and Lochhead (cited in Gourgey, 2001) stated the necessary skills in successful problem solving and said that good problem solvers take care to understand the relationship between situations in a problem. In our research, we concluded that the students had problems in writing the given problem into mathematics language. Like Orton and Frobisher (1996) pointed out, we evaluate that the use of story fomat problems in mathematics education is considered helpful for students to use mathematical language effectively. The results obtained here support those results found by Verschaffel, Greer, Dooren and Mukhopadhyay (2009) who stated that what makes daily life story format problems incomprehensible are students' lack of mathematical knowledge, inadequacy of connecting the problem story with daily life or their lack of understanding or misunderstanding the text linguistically.

Under the light of the results obtained from this and other researches in the literature, suggestions for practitioners and researchers are presented below:

- Since students have difficulty in understanding the items given in story format, a special research can be made which will reveal the relationship between mathematics and Turkish Language.

- By examining the relationship between symbolic format and numerical format, studies can be carried out on different topics / concepts that examine whether the terms and terminology of mathematics are understood correctly by students.

- The relationship between symbolic format and story format problems can be examined by creating different contexts. It is also possible to investigate in depth the familiarity / unfamiliarity (for the students) of the contexts created in story format.

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Appendix 1. Application 1,2, 3 & The Items

ITEM		Application 1	Application 2	Application 3
1	Symbolic	2348 + 2789=?	136 x 16 _____	70 x 4 x 20 = ?
2	Symbolic	2000 – 500= ▲ ▲ – 120= ?	880 | 25 - ▲ =? ▲	1372 : 14 = ?
3	Symbolic	162 ÷ 54 =?	861+1536+2065=?	400 - 150=?
4	Numerical	Find the multiplication of the numbers 136 and 16.	What is the result of 4 times the number 70, multiplied by 20?	Find the sum of the numbers 2348 and 2789.
5	Numerical	What is the remainder after dividing the number 880 by 25?	What is the quotient after dividing the number 1372 by 14?	500 is subtracted from 2000. Then 120 is subtracted from the remainder. What is the result?
6	Numerical	Find the sum of the numbers 861, and 1536 and 2065.	What is the result if you subtract 150 from 400?	What is the quotient if 162 is divided by 54?
7	Story / Word Problems	One bread is 70 cents. How many TL does a family who consume 4 breads a day spend in 20 days to buy bread?	A mountaineer wants to climb to the climax of the Mount Ararat. First She climbs 2348 meters from the bottom. After giving a break she climbs 2789 meters more and reaches at the climax. What is the height of the Mount Ararat from the bottom?	How many pencils in total are there in 136 pencil boxes that have 16 pencils each?
8	Story / Word Problems	Mrs. Özlem has purchased a refrigerator for 1372 TL in installments for 14 months. Calculate the amount of monthly installment that Mrs. Özge will pay for the refrigerator.	Deniz's father receives a salary of 2000 TL. After he pays the house rent with 500 TL and the electricity, water and natural gas bills with 120 TL of his salary, how much TL remains?	How many books remain left if 880 books that were collected in an elementary school are equally distributed to 25 schools?
9	Story / Word Problems	Ali had 400 TL. He bought himself a track suit for 150 TL. How much money left does he have?	Reading 54 pages a day, in how many days does Ayşe finish her 162-page book?	Atatürk Primary School has participated in a tree planting campaign. 861 pine, 1536 oak and 2065 poplar saplings were planted in the forest. How many saplings in total were planted in the forest?