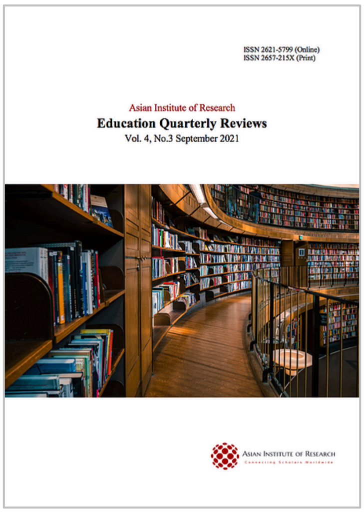

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Examination of Semantic Structures Used by Teacher Candidates to Transform Algebraic Expressions into Verbal Problems

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Abstract
The aim of this study is to examine the semantic structures used by mathematics teacher candidates to transform algebraic expressions into verbal problems. The research is a descriptive study in the survey model, which is one of the quantitative research types. The study group of the research consists of 165 teacher candidates studying in the primary school mathematics teaching department of a state university in the south of Turkey in the 2019-2020 academic years. 73.2% of the teacher candidates in the study group are female and 26.8% are male. Criterion sampling method, one of the purposeful sampling methods, was used in the selection of teacher candidates in the study group. While the Algebraic Expression Questionnaire Form was used as the data collection tool, the evaluation rubric of verbal problems was used in the analysis of the data. As a result of the research, it has been revealed that pre-service teachers are more successful in transforming algebraic expressions into verbal problems, but they have problems in creating problems with algebraic expressions that make up systems of equations. Again in the study, it was concluded that pre-service teachers used addition and subtraction problems more than multiplication and division problems. On the other hand, when the problems in the type of addition and subtraction are examined in the study, in the type of combining and separating; It has been concluded that the category of equal groups is mostly used in the problems of multiplication and division.

Keywords: Semantic Structures, Algebraic Expressions, Verbal Problems, Problem Structure, Teacher Candidates

1. Introduction

Algebra, one of the most important areas of mathematics, covers a wide range from numbers to unknowns, from variables to functions. According to many researchers, algebra; it is defined as the generalized form of arithmetic (Katz, 2007; Van Amerom, 2003; Vance, 1998) and interpreted as the symbolic side of arithmetic (Tabach & Friedlander, 2017). From this perspective, according to Kieran (1992), algebra; it is one of the most important mathematical learning areas that can show the relationships between numbers with symbols and use mathematical structures. Because of this feature, the algebra learning field emerges as a process that requires more reasoning than other mathematical learning fields such as arithmetic and geometry. Again, the algebra learning area; it serves as the backbone of mathematical learning in the analysis of quantitative relations, solving problems, modeling, providing the necessary instrumental language for representations and specifying generalizations (NCTM, 2000; Stacey & Macgregor, 2000). According to Williams (1997), it is a basic need for students to learn algebra, which makes itself felt in all areas of life.

On the other hand, algebra is one of the most used learning areas in solving mathematical modeling problems in many fields such as physics, chemistry, engineering and economics, as well as mathematics as a form of mathematical expression or a language (Kieran, 2007; Usiskin, 1997). In this context, transforming the language of algebraic expression into verbal problems emerges as an important element in terms of understanding the problem and creating semantic structures in learners (Villages, Castro, & Gutierrez, 2009). These structures are generally gathered under two main headings in the literature as conceptual structures covering both addition and subtraction and conceptual structures covering multiplication and division (Carpenter & Moser 1982; Powell & Fuchs, 2018; Riley et al., 1983; Riley & Greeno 1988; Van de Walle, Karp, & Bay-Williams, 2015). According to this, conceptual structures covering addition and subtraction consist of four categories: joining, separating, part whole and comparison. Again, problem diagrams involving multiplication and division are handled in four categories as equal groups, comparison, area (array) and combination (Riley et al., 1983; Van de Walle, et al., 2016). When the studies in the literature (Cañadas, Molina, & Río, 2018; Fernandez-Millan & Molina, 2017) examining the semantic structures used by learners to transform algebraic expressions into verbal problems are examined, it is seen that these studies are generally conducted with secondary school students and primary school teacher candidates; as a result of these studies, it was found that teachers and teacher candidates had difficulties in problem schemes involving multiplication and division; it is clearly seen that they can perform operations more easily in problem diagrams involving addition and subtraction. In this context, for example, Fernandez-Millan and Molina (2017) analyzed the semantic structures of the problems posed by high school students regarding algebraic expressions. As a result of the research, it was concluded that students' conceptual knowledge was sufficient in algebraic expressions with one unknown and that students were more successful in addition and subtraction problems. Again, in their study, Cañadas et al. (2018) concluded that pre-service classroom teachers were more successful in problems they posed about algebraic expressions than in addition problems, but they had difficulties in other types. Despina and Loukidou (2014), in their study examining the verbal problem structures in Greek textbooks, revealed that not all problem structures are included in the textbooks and some of them are given a limited number of places, and therefore students have difficulty in understanding the structures of verbal problems. Similarly, many studies examining mathematics textbooks in different countries indicate similar results (Olkun & Toluk, 2002; Parmjit & Teoh, 2010; Sarıbaş & Aktaş Arnas, 2017; Singh, 2006; Tarim, 2017). On the other hand, Canbazoglu and Tarim (2019) revealed that as a result of their studies in which they examined the verbal problem structures applied in the classroom, teachers generally included the developmental characteristics of the students and the type of problems included in the mathematics curriculum, therefore they did not use all the problem structures in the classroom.

As can be seen from the studies mentioned above, it is seen in the literature that studies examining the semantic structures used by learners to transform algebraic expressions into verbal problems are generally conducted with secondary school students and primary school teacher candidates. However, in the context of the accessible literature, no study has been found that examines the semantic structures used by mathematics teacher candidates to transform algebraic expressions into verbal problems. Based on this phenomenon, this study aims to examine the semantic structures used by mathematics teacher candidates to transform algebraic expressions into verbal problems and to contribute to the literature in the field. For this purpose, an answer will be sought for the research question mentioned below:

1. How is the situation of mathematics teacher candidates in transforming algebraic expressions into verbal problems?
2. What are the semantic structures that mathematics teacher candidates use in transforming algebraic expressions into verbal problems?

2. Method

2.1 Research Model

This study is a descriptive study in the survey model, which is one of the types of quantitative research conducted with the aim of examining the semantic structures used by mathematics teacher candidates in transforming algebraic expressions into verbal problems. Survey research; these are the studies carried out with the aim of obtaining information about the existing situation in terms of the individuals in the sample (Fraenkel, Wallen, & Hyun, 2012). In this study, it was tried to determine what kind of semantic structures the mathematics teacher candidates used in the process of transforming algebraic expressions into verbal problems.

2.2 Study Group

The study group consists of teacher candidates studying in the primary school mathematics teaching department of a state university in the south of Turkey in the 2019-2020 academic years. Criterion sampling method, one of the purposeful sampling methods, was used in the selection of teacher candidates in the study group. Criterion sampling method; the aim is to investigate the situations that meet the predetermined and important criteria (Patton, 2014). The criterion that is considered important in the selection of the sample for this study is that the teacher candidates successfully complete the basics of mathematics course and are willing to participate in the study. Within the basics of mathematics course, basic concepts in the field of learning numbers and algebra and related problem solving and problem posing issues are included in practice. For this reason, the students in the study group already have sufficient knowledge about algebraic expressions to show the meaning and properties of variables, constants, letters in the concept of algebraic expression within the scope of the basics of mathematics course. 73.2% of the teacher candidates in the study group are female and 26.8% are male. When the mathematics achievement grades are examined, it is seen that 25% of the teacher candidates participating in the research have very good, 42% good and 33% moderate success grades. The age range of the study group is 21.

2.3 Data Collection Tool

The "Algebraic Expression Questionnaire Form" developed by Canadas et al. (2018) was used as a data collection tool in the research. Table 1 shows the characteristics of the items in the algebraic expression questionnaire.

Table 1: Algebraic Expression Questionnaire Form

Item number	Symbolic expression	Number of variables	Type of expression	Transaction structure
1	x + 6 = 8	1	First order equation with one unknown	Addition/subtraction
2	x2 = 16	1	Quadratic equation with one unknown	Multiplication/Division
3	x + y = 7	2	First order equation with two unknowns	Addition/subtraction
4	2×-1 = 5	1	First order equation with one unknown	Addition/subtraction
5	x + y = 7 x.y = 10	2	First order system of equations with two unknowns	Addition/subtraction Multiplication/Division
6	x-3y = 3 x-2y = 1	2	First order system of equations with two unknowns	Addition/subtraction Multiplication/Division
7	3×=20	1	First order equation with one unknown	Multiplication/Division
8	x(x + 1) = 18	1	Quadratic equation with one unknown	Addition/subtraction Multiplication/Division

When Table 1 is examined, when the types of algebraic expressions in the form are examined; some of the items in the form (1st, 4th, 7th) have a first-degree unknown, some (3rd, 5th, 6th) have two first-degree unknowns, some (2nd, 8th) are equations with second-degree unknowns, and two item (5th, 6th) is in the form of a system of equations. In the form, there are algebraic expressions consisting of five items with one unknown and three items with two unknowns, a total of eight items. In addition, when analyzed in terms of problem structures, three items are in addition and subtraction, two are in multiplication and division, and the others are in both addition and subtraction and multiplication and division.

2.4 Data Collection and Analysis

In the collection of data, the Algebraic Expression Questionnaire, which was applied to mathematics teacher candidates in the 2019-2020 academic years, was applied without a time limit. The questionnaire in question consists of personal information (gender, basics of mathematics pass mark and age) and algebraic expressions. In the data analysis process, an evaluation rubric of verbal problems was prepared by using the literature (Canadas et al., 2018; Van de Walle et al., 2016; Riley et al., 1983) to transform the items in the algebraic expression questionnaire into verbal problems. As seen in Table 2, the prepared rubric was coded according to its conformity with the semantic structure in transforming algebraic expressions into verbal problems.

Table 2: Verbal Problem Structure Assessment Rubric

Verbal problem structure	Category	Description	Symbolic representation	Example
Addition and subtraction problem structure	Joining	It is the addition of a quantity to another quantity.	120+80=?	Ece has a total of 120 liras in her pocket. If her mother gave 80 liras to Ece, how much money would Ece have in total?
	Separation	It is the subtraction of another quantity from one quantity.	200 -80=?	Ece has a total of 200 liras in her pocket. When Ece gives 80 liras of her money to her mother, how many liras will Ece have left?
	Part part whole	A problem consisting of two parts that can be combined into a single whole.	18+12=?	There are 18 apple and 12 plum trees in the garden. How many fruit trees are there in total in the garden?
	Comparison	Comparing the number of elements of two sets with respect to each other.	79-55=?	Nilgun solved 79 questions and İrem solved 55 questions in the exam. According to this, how many questions did Nilgun solve more than İrem?
Multiplication and division problem structure	Equal groups	The successive subtraction or addition of a certain number of objects from a set to find the number of groups.	2x3=?	Ali has 2 boxes of pencils. If there are 6 pencils in each box, how many pencils does Ali have in total?
	Comparison	The number of elements of one set from two different sets consists of a certain multiple of the number of elements of the other set.	2x3=6	Ali has 2 pencils. Fatman's pen is 3 times more than Ali's pen. How many pencils does Fatma have in total?.
	Area (Array)	It is the multiplication made by placing objects in equal rows and columns in an orderly manner.	30x20=?	If the long side of the frame of a table is 30 cm and the short side is 20 cm, what is the total area of the table?
	Combination (Cartesian)	Constructing ordered pairs with objects from two or more sets.	2x3=6	Ali bought 2 pants and 3 shirts in different colors. In how many different ways can Ali wear a pair of pants and a shirt?

When Table 2 is examined, there are problem structures under two themes as addition and subtraction type and multiplication and division type. Problems under the theme of addition and subtraction are in four categories as joining, separating, part-whole and comparison. Similarly, problem structures in the theme of multiplication and division type consist of problems in four categories: equal groups, comparison groups, area (array) and combination (cartesian) categories. On the other hand, within the scope of data analysis reliability, a mathematics educator, who is an expert in the problem, served as the second coder together with the researcher. Forty randomly selected questionnaires were coded independently by the coders and the reliability value between the coders was calculated as .92. The fact that this value is higher than .80 is an indicator of the reliability of data analysis (Miles & Hubermann, 1994).

3. Results

Within the scope of the first sub-aim of the research, the situation of transforming algebraic expressions into verbal problems of mathematics teacher candidates in the study group was examined. The results obtained are given in Table 3.

Table 3: Distribution of Teacher Candidates' Transformation of Algebraic Expressions into Verbal Problems

	Same structure		Equivalent structure		Different structure		Meaningless		Total	
Algebraic expression	f	%	f	%	f	%	f	%	f	%
1) x + 6 = 8	114	69	40	24.2	-	-	11	6.8	165	100
2) x2 = 16	108	65.5	-	-	26	15.8	31	18.7	165	100
3) x + y = 7	85	51.5	-	-	47	28.4	33	20.1	165	100
4) 2×-1 = 5	122	73.9	-	-	15	9.1	28	17	165	100
5) x + y = 7 x*y = 10	100	60.6	-	-	-	-	65	39.4	165	100
6) x-3y = 3 x-2y = 1	78	47.3	-	-	24	14.5	63	38.2	165	100
7) 3×=20	138	83.6	0	0	0		27	16.4	165	100
8) x(x + 1) = 18	94	56.9	-	-	14	8.6	57	34.5	165	100

If interventions were studied, detail all important adverse events (events with serious consequences) and/or side effects in each intervention group. When Table 3 is examined, it is seen that the teacher candidates are mostly successful in the first question (f=114+40=154) and the seventh question (f=138) with one unknown. For example, in the first question, while the majority of the students created the problem structure of the algebraic expression with the same feature, some students created it to be equivalent to this expression, such as 6+x=8, 8=6+x, 8-6=x. In this context, for example, the student with the code T101 said, *“There are 6 pencils in Ali's pencil case. His mother leaves some of the pens on the table to Ali's pen holder. Since there are 8 pencils in Ali's pencil holder, how many pencils did his mother leave in Ali's pencil holder?”.* He used an equivalent problem structure in the form of 6+x=8 to the question. Again, the other question in which the students were most successful is the seventh question. In this context, for example, the student with the code T9 said, *“A grasshopper is jumping on a long-distance path. However, whether it is a bumpy or straight road, it can travel the same distance each time. If he can cover a distance of 20 meters in 3 jumps, what is the approximate value of the distance he takes in each jump?”* He used the same problem structure in the form of 3x=20 to the question.

On the other hand, the fifth question (f=100) and the sixth question (f=78+24=102) that make up the system of equations are the types of questions in which teacher candidates show the lowest success. In these questions, it is clearly seen that the teacher candidates made mistakes because of the situations where problems were not created by evaluating the two equations that make up the equation systems together. In this context, for example, the teacher candidate with the code T43, *"If the product of Fatih's blue and red shirts is 10, how many blue shirts does Fatih have?".* He tried to pose a problem with a different structure by accepting the question given as a system of equations in the form of a single equation without considering other values. Again, regarding the sixth statement, the teacher candidate with the code T45 said, *"Kenan sells the goods he bought for y liras for x liras. There is a relation X-3Y= 3 between the goods bought and sold. Accordingly, for how many liras can Kenan sell a property that he bought for 25 liras?".* Without considering all the values of the variables in the algebraic expression given in the form given in the algebraic expression, he created a word problem with a different structure over a single equation. Similarly, in the third question, in which only the sum of the variables was given, the teacher candidate with the code T21 set up a new problem with a different structure by giving value to one of the variables, although it was not mentioned in the root of the question: *"David and Murat have 7 pens. If David has 2 pencils, how many pencils does Murat have?"*

Another finding obtained from the research is related to the meaningless structures used by the teacher candidates in the fifth, sixth and eighth questions. In this context, for example, in relation to the sixth statement, *"Find the coordinates of the point where the lines X-3Y= 3 , X-2Y= 1 intersect."* formed a question (T32). Similarly, in the eighth question, the student coded T5 created an exercise-type question in the form of *"Divide into the roots of the equation x(x+1)=18".* Regarding the same question, the example of the unrelated problem of the teacher candidate with the code T23 was *"Since there are 820 handshakes when each person shakes hands with all their friends in a meeting attended by x+1 people, x=?"* In the form of the question, values that are not related to the algebraic expression were also added.

In the second sub-question of the study, the distribution of the semantic structures of the problems posed by the teacher candidates about algebraic symbols are given in Table 4.

Table 4: Distribution of the Semantic Structures of the Problems Posed by the Teacher Candidates about Algebraic Symbols

Algebraic expression	Addition and Subtraction Type Problem Structure		Multiplication and Division Type Problem Structure		Both		Total	
	f	%	f	%	f	%	f	%
1) x + 6 = 8	154	100	-	-	-	-	154	100
2) x2 = 16	26	19.5	108	80.5	-	-	134	100
3) x + y = 7	132	100	-	-	-	-	132	100
4) 2×-1 = 5	137	100	73	54.4	81	60.4	137	100
5) x + y = 7 x*y = 10	100	100	73	73	88	88	100	100
6) x-3y = 3 x-2y = 1	102	100	63	61.7	75	73.5	102	100
7) 3×=20	-	-	138	100	-	-	138	100
8) x(x + 1) = 18	92	85.2	108	100	95	87.9	108	100

When Table 4 is examined, it can be seen that teacher candidates use only addition and subtraction type problem structure in some statements (1., 3.), multiplication and division type problem structure in some statements (7.) are seen to use both problem structures together (4., 5., 6., 8.). In this context, examples of the problem structures solved by the participants in the second question are as follows: *"A plant grows every day by the square of its height. If the height of the plant has reached 16 square centimeters on the second day, what is the height of the plant on the first day?"* (T26). In this context, while the teacher candidate coded T26 uses the multiplication and division type problem structure, the teacher candidate coded T42 for the same problem says, *"Ece and Muge have an equal number of pencils. Since the total number of pencils for the two of them is 16, how many pencils does Muge have?".* He used the problem structure in the form of addition and subtraction. On the other hand, in the fifth question, both addition and subtraction and multiplication division should be used in the same question. On this subject, the teacher candidate with the code T56 asked, *"If the sum of the short and long sides of a rectangle is 7, the product is 10, what is the length of the short side?"* posed a problem that requires the use of two structures together.

In addition, the distribution according to the categories used by the mathematics teacher candidates in the study group of the research in transforming algebraic expressions into verbal problems is given in Table 5.

Table 5: Categories used by teacher candidates in transforming algebraic expressions into verbal problems

	Addition and Subtraction Type Problem Structure								Multiplication and Division Type Problem Structure									
	Joining		Separation		Part part whole		Comparison		Equal groups		Comparison		Area		Combination		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
1. x+6=8	102	66.2	52	33.8													154	100
2.x²=16			26	19.4					74	55.7			24	17.4	10	7.5	134	100
3. x+y=7	32	24.2			85	64.3	15	11.5									132	100
4.2×-1=5	15	10.9	92	69.7			30	21.9									137	100
5. x+y=7 x*y=10	38				62				18						82		100	100
6. x-3y=3 x-2y=1	24		78						43		20						102	100
7.3×=20									117		21						138	100
8.x(x+1)=8	60				14		20		14				94				108	100

When Table 5 is examined, it is seen that teacher candidates use addition and subtraction problems more than multiplication and division problems. Among the problems in the addition and subtraction type, the problems in the joining and separating type were mostly used; it is clearly seen from Table 5 that fewer problems were created in the part part whole and comparison type. Accordingly, it is seen that the joining type problems are mostly used in the first, fifth and eighth questions. In this regard, for example, for the first question of the teacher candidate with the code T65, *"Gaye had some money. When her uncle gave 6 more liras, Gamze had 8 liras. Accordingly, how many liras did Gamze have in the beginning?"* It created a problem in the form of merging. Similarly, the problem structure created by the teacher candidate with the code T64 for the fifth question is as follows: *"Nazli and Evin have some buckles. When you join Nazlı and Evin's buckles, there are seven. Multiplying the numbers of these buckles gives 10. Accordingly, how many buckles do Nazlı and Evin have?"*. However, in the eighth question, teacher candidate with the code T44, *"Selin's study table is a certain length. Aybuke's desk is 1 meter longer than Selin's desk. If the product of Selin's and Aybuke's desks is 18 square meters, how long can Selin's desk be?"* posed a problem in the form of merging.

When the separation type problems are examined, it is seen that the problems in the 4th and 6th question types are mostly created by the teacher candidates. In this regard, for example, the teacher candidate with the code T102 said, "*Miray has two boxes of candy. Miray ate one of the candies in these boxes. Miray has 5 candies left. Accordingly, how many candies are there in total in a box?"* It created a problem in the form of separation. Similarly, the teacher candidate coded as T53, on the other hand, has the following verbal problem related to the 6th question: "*Omer owes Ali and Ali owes Omer. When we subtract Omer's debt from 3 times Ali's debt, we get 3 liras. When we subtract Omer's debt from twice Ali's debt, we get 1 lira. According to this, how many liras does Omer owe Ali?"*

In the third, fifth and eighth questions regarding the part whole category, it is seen that the teacher candidates created questions in the type of verbal problem. Regarding the third question on this subject, for example, the verbal problem posed by the teacher candidate with the code T39 is as follows: *"Emre has 7 reading books in his bag. Some of these books are novels and some are poetry books. If Emre has at least two poetry books, how many novels does he have at most?"*. Again, in the fifth question, the teacher candidate with the code T81 said, *"Ali has two piggy banks, one blue and one red. The sum of the coins in the two piggy banks is 7 and their product is 10 liras. How many liras can Ali have in his blue piggy bank? In the form of pieces, it has created a problem in the whole category."*

Regarding the comparison category, it is clearly seen that the teacher candidates pose verbal problems in the third, fourth and eighth questions. For example, the problem posed by the teacher candidate with the code T22 regarding the fourth question is as follows: *"Ali's chocolate is one less than twice the amount of Ayse's chocolate. If Ayse has 5 chocolates, how many chocolates does Ali have?"*. Similarly, regarding the eighth question, for example, the teacher candidate with the code T91 said, *"The number of girls in a class is one more than the number of boys. If the product of the number of male and female students in the class is 18, how many female students are there in the class?"* posed a problem in the category of encounter. Within the scope of the multiplication and division problem structure, it is seen that the teacher candidates mostly use the equal groups category. Then, it can be said that problems such as area, comparison and cartesian are used.

Accordingly, the problems in the type of equal groups were mostly used in the second and seventh questions. In this context, for example, regarding Question 7, the teacher candidate with the code T1 said*, "Cenk wants to distribute the 20 kilos of apples they picked from the garden equally among three chests. Accordingly, how many kilos of apples can Cenk place in each chest?"* It created a problem with equal groups. Similarly, the type of problem posed by the teacher candidate with the code T5 regarding the second question is as follows*: "His fathers received an equal number of pens as gifts for Polen and Can. Since the product of the two pens is 16, how many pens do Polen and Can have?*

Within the scope of the problems in the area type, it is clearly seen from the table that the teacher candidates mostly use this problem type in the eighth and second questions. Regarding this question example, the teacher candidate with the code T22 said, *"Uncle Ali wants to fence all the edges of his rectangular garden, which he has just bought, with the long side 1 km longer than the short side. Since the area of this garden is 18 km2, how many kilometers of wire should Uncle Ali have to surround the edge of his garden?*" formed an area-type question about calculating the side lengths of the shape whose area is given in the form of. Similarly, in the second question, the problem of the teacher candidate with the code T67 is as follows: *"If the area of a square field is 16 square meters, how many meters is one side of this field?"*

In the context of combination type problems, it is clearly seen from Table 5 that teacher candidates mostly use this type of problem in the second and fifth questions. Regarding this question example, the problem of the teacher candidate with the code T79 regarding the second question is as follows*: "Zeynep makes 16 different combinations with shorts and t-shirts in different colors. Accordingly, how many shorts can Zeynep have so that the number of shorts and T-shirts is equal?"*. Similarly, regarding the fifth question, the teacher candidate with the code T10 said, "The sum of Ali's trousers and t-shirts is seven. The product of trousers and t-shirts is equal to 10. Accordingly, how many trousers does Ali have?"

Finally, in Table 5, the least used question type by the teacher candidates are the fourth, sixth and seventh question types in the comparison category. In this context, the problem posed by the teacher candidate coded T12 regarding the sixth question type is as follows: *"Selin will travel from Ankara to Istanbul. Therefore, wondering about the temperature in Istanbul, he called his friend Hilal and asked for information on this subject. Hilal replied to Selin as follows: The air temperature in Istanbul is 3 times higher than the air temperature in Ankara or 1 more than 2 times. Accordingly, how many degrees could Selin have calculated the air temperature of Istanbul?"*.Similarly, regarding the seventh question, the teacher candidate with the code T91 said, *"Fatma's age is 3 times that of Aylin. If Fatma is 20 years old, how old can Aylin be?"* posed a problem.

4. Discussion

This study was conducted to examine the semantic structures used by mathematics teacher candidates to transform algebraic expressions into verbal problems. As a result of the study, it was concluded that teacher candidates were more successful in transforming algebraic expressions in verbal problems into first-order algebraic expressions with one unknown than in second-order algebraic expressions with two unknowns. This situation is similar to the relevant literature (Canadas et al., 2018; Dede, 2005; Duru & Köklu, 2011; Fernandez-Millan & Molina, 2017; Isık & Kar, 2012; Swastika et al., 2018). In this context, for example, Canadas et al. (2018) concluded that teacher candidates were more successful in equations with one unknown, as a result of their study, in which they examined the problems related to algebraic expressions. Similarly, Isık and Kar (2012) examined the problems posed by mathematics teacher candidates regarding algebraic expressions, and concluded that teacher candidates had difficulty in posing problems with words due to the inability to understand operations, symbols and signs in algebraic expressions. Duru and Köklu (2011) also concluded in their study that secondary school students are weak in transferring and transforming algebraic problems into verbal structures because they do not fully grasp the meaning of algebraic expressions and signs.

According to the second sub-objective of the study, it was concluded that teacher candidates used addition and subtraction problems more than multiplication and division problems. Studies on this subject in the literature point to similar results (Cañadas, et al., 2018; Christou & Philippou, 1998; Fernandez-Millan & Molina, 2017; Haylock & Cockburn, 2008; Pilten, 2010; Kılıc, 2013; Olkun & Toluk, 2002; Sitrava & Isık, 2018; Tarim, 2017; Tertemiz, 2017). In this context, for example; In the study of Tertemiz (2017), primary school students set up problems that require operations such as addition and subtraction; revealed that they are more successful than the problems that require multiplication and division operations.

On the other hand, when the problems of addition and subtraction were examined in the study, it was found that the teacher candidates mostly used the problems in the joining type and separation type; It was concluded that they preferred part whole and comparison problems less. Studies in the literature on this subject point to similar results (Canbazoglu & Tarim, 2019; Marshall, 1995; Kılıc, 2013; Kar, Ocal, Ocal & Demirci, 2021; Kılıc, 2013; Sitrava & Isık, 2018; Tertemiz et al., 2015; Tertemiz, 2017).In this context, for example; In their study, Canbazoglu and Tarim (2019) also concluded that primary school teachers apply joining and separating problems in the classroom more than other problem types (part-part-whole and comparison). Similarly, Kılıc (2013) finds that the fourth and fifth grade students are mostly joining; In the subtraction type problems, it was concluded that they preferred the problem type in the separation type the most.

In the study, in terms of multiplication and division problem structure, the teacher candidates mostly used the equal groups category; It was concluded that they used less area, comparison and cartesian problems. Studies on this subject in the literature show similar results (Kar, Ocal, Ocal, & Demirci, 2021; Kılıc, 2013; Yeap & Kaur, 2001; Tertemiz et al., 2015; Tertemiz, 2017). In this context, for example; Yeap and Kaur (2001) concluded in their study that third grade students were more successful in peer group problems they set up about diameter and division than in comparison type problems.

As can be clearly seen from the findings mentioned above, as a result of the research, it has been revealed that the teacher candidates are more successful in transforming algebraic expressions in verbal problems, but they have problems in evaluating the two equations that make up the equation systems together and creating a meaningful relationship between the variable. For this reason, it may be recommended to provide detailed information about the transformation of algebraic expressions into verbal problems and to organize practical activities in this direction in the training given to teacher candidates on algebraic expressions.

Again in the study, it was concluded that teacher candidates used addition and subtraction problems more than multiplication and division problems. With regard to this result, studies can be conducted to enable learners to use all problem structures in order to be successful.

On the other hand, when the problems in the type of addition and subtraction are examined, in the type of joining and separating; in the problems of multiplication and division, it was concluded that the category of equal groups was mostly used. In order to determine the reasons for this situation, it may be recommended to examine the studies conducted in the classroom. This study was carried out with teacher candidates in the department of mathematics teaching. It is also recommended to conduct similar studies and make comparisons with participants in different sample groups.

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