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THE EXAMINATION OF FOURTH GRADE PRIMARY SCHOOL STUDENTS' PROBLEM POSING SKILLS

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Abstract: This study focuses on the types of problems that fourth-grade students produce when faced with free, semi-structured, and structured problem-posing situations. The study is conducted within the framework of a qualitative research approach, utilizing a case study design. The study group consists of 65 fourth-grade elementary students from one of the central districts in Ankara. The data collection tool used in the research was the "Problem Posing Test Including Different Problem Posing Situations," which was developed by the researchers. The researchers developed and implemented the "Problem Posing Test Including Different Problem Posing Situations" as the data collection tool. A general observation of the problems posed by the students indicates that, despite minor differences across various dimensions, students predominantly constructed verbal story problems, followed by verbal exercises, mathematical sentences, and non-routine problems.

Furthermore, students attributed meanings such as equal groups, part-whole relationships, combining, separating, and comparing to the problems and primarily posed problems that required solving in two, three, or more steps. The analysis revealed that students added new data to the information related to the problems they posed. The findings also showed that students' problem-posing skills were associated with their ability to transform different mathematical representations.

Key words: Primary education, problem posing in mathematics, structured, semi-structured and free problem posing.

1. Introduction

In mathematics education, children must acquire essential mathematical process skills, including problem-solving, reasoning and proof, communication, representation, connections, and conjecturing. Among these skills, problem-solving is a fundamental skill emphasized in mathematics programs. In recent years, there has been discussion about including problem-posing activities in the problem-solving process. Studies have shown that problem-posing not only contributes to the development of problem-solving skills but also supports the enhancement of all process skills (Cai & Hwang, 2002; Cai et al., 2013; Ellerton, 2013; Silver & Cai, 1996; Van Harpen & Sriraman, 2013). Problem-posing is a part of the problem-solving process. The problem-solving process includes various stages. These stages are identifying the problem, creating a plan for the solution, developing the plan and strategies, observing the implementations, analyzing the information obtained from the solution process, evaluating the solution's effectiveness, and identifying new problems (Polya, 1973). This complex process's fifth and final stage is known as problem-posing (Gonzales, 1998).

Problem posing involves reshaping a problem or creating a new problem from a specific situation (English, 1997a, 1997b; Kilpatrick, 1987; Silver, 1994; Silver & Cai, 1996; Silver et al., 1996). Problem posing can be applied by generating a new and original problem from a specific situation, revising or correcting an existing problem, and creating a new problem by altering the goal or conditions of a previously solved problem (Silver, 1994). The problem posing focuses more on the problem than its solution (Polya, 1973; Brown & Walter, 1990; Silver, 1994).

Stoyanova and Ellerton (1996) categorize problem-posing situations into three main types: (a) free problem posing, (b) semi-structured problem posing, and (c) structured problem posing. In free problem-posing situations, educators provide students with a scenario and ask them to construct a mathematical problem based on that context without supplying a predefined example. In semi-structured problem-posing situations, educators present a specific scenario and encourage students to

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examine its structure and complete it by drawing upon their prior knowledge, skills, concepts, and mathematical experiences. Educators present a clearly defined problem or problem situation in structured problem-posing contexts and guide students to generate new problems that align conceptually with the given task.

A problem-posing model developed by Constantinos, Nicholas, Marios, Demetra, and Bharath (2005) considers how students think during the problem-posing process. This model reveals that students can fall into different problem-posing categories based on their ability to interact with quantitative information. According to this model, students can be divided into four distinct problem-posing categories, reflecting their thinking and problem-posing skills.

- Adding quantitative information: Students can add quantitative information to a given situation without restrictions, allowing them to pose problems freely.
- Selecting quantitative information: Students can select quantitative information from a given context, enabling them to pose problems consistent with the selected information.
- Understanding and organizing quantitative information: Students demonstrate skills in understanding and organizing quantitative information, leading to the creation of problems that include mathematical equations or operations.
- Transforming quantitative information from one form to another: Students can convert quantitative information from one representation form (e.g., graph, diagram, table) to another, necessitating the posing of problems that match the given form.

This classification matches Stoyanova's (1998) descriptions of structured and semi-structured problem-posing situations. Researchers utilize the classifications in the literature to analyze students' problem-posing performance and to gain insight into their problem-posing processes (Christou et al., 2005; Silver & Cai, 1996; Stoyanova & Ellerton, 1996).

Examining the benefits of problem-posing activities for students reveals that even the simplest activities have a positive impact on students (Cifarelli & Cai, 2006; Silver & Cai, 1996; Toluk-Uçar, 2009). These activities enable students to understand, explore, and precisely articulate mathematical situations (Akay et al., 2006). Problem-posing enhances students' reasoning and problem-solving abilities, attitudes toward mathematics, self-confidence, flexibility, reflective thinking, and mathematical creativity (Çetinkaya & Soybaş, 2018; Guvercin & Verbovskiy, 2014; Rosli et al., 2014; Singer et al., 2013). Furthermore, problem-posing activities significantly contribute to a more lasting learning process, boost critical thinking skills (Nixon-Ponder, 1995), alleviate anxiety and fears (Brown & Walter, 2005), expose misconceptions (Tichá & Hošpesová, 2013), and offer potential as an assessment tool (English, 1998). Studies indicate that students' problem-posing abilities are generally inadequate (Arıkan & Ünal, 2013; Gökkurt et al., 2015). Additionally, findings show that while students might succeed in problem-posing across specific dimensions, they struggle to create suitable problems in others (Tertemiz & Sulak, 2013). Therefore, it is apparent that while some students display proficiency in problem-posing skills, others face shortcomings and difficulties.

Studies in the literature have shown increasing interest in recent years in mathematical problem-posing skills and the strategies used in this process (Ada et al., 2020; Bevan & Capraro, 2021; Erdoğan & Gül, 2020; Ergene, 2022; Kar & Işık, 2014; Kılıç, 2017; Silber & Cai, 2021; Xu et al., 2020). These studies indicate that problem-posing activities have a positive influence on students' problem-solving skills, enhance higher-order thinking skills, improve attitudes toward mathematics, and increase students' self-confidence (Cankoy & Darbaz, 2010; Çetinkaya & Soybaş, 2018; English, 1997b; Katrancı & Şengül, 2019). Furthermore, findings suggest that problem-posing can stimulate mathematical creativity and support mathematics teaching and learning (Ayvaz & Durmuş, 2021; Kontorovich & Koichu, 2016; Leikin & Elgrably, 2020).

This study thoroughly investigates how fourth-grade elementary school students pose problems in free, semi-structured, and structured problem-posing situations. It aims to understand how students pose mathematical problems, identify the challenges they face, and highlight the successes they achieve. The study emphasizes that problem-posing skills are closely related to students' ability to

transform different mathematical representations during the learning process. Furthermore, it seeks to inform the development of pedagogical approaches that effectively support the enhancement of these skills.

By gaining deeper insight into students' problem-posing abilities, educators can address existing difficulties and design more effective instructional strategies. Therefore, this research aims to provide a comprehensive analysis of elementary students' mathematical problem-posing skills and assess their current proficiency in this area. The findings offer valuable implications for educational policies and classroom practices, supporting the development of strategies that enhance students' ability to pose meaningful mathematical problems.

In this context, the research aims to examine the problems fourth-grade elementary students pose in free, semi-structured, and structured problem-posing situations. The research seeks answers to the following questions in line with its purpose:

For fourth-grade elementary students:

a) What nature do the problems they pose in free problem-posing situations have regarding the type of problem, the meaning carried by the four operations, the number of operation steps, and their characteristics?

b) What nature do the problems they pose in semi-structured problem-posing situations have regarding the type of problem, the meaning of the four operations, the number of operation steps, and their characteristics?

c) What nature do the problems they pose in structured problem-posing situations have regarding the type of problem, the meaning carried by the four operations, the number of operation steps, and their characteristics?

2. Method

2. 1. Research design

In this study, a qualitative research method known as a case study, one of the qualitative research types, has been employed to examine the problems posed by fourth-grade elementary students in free, semi-structured, and structured problem-posing situations. Yıldırım and Şimşek (2008) define a *case study* as a research method that provides an opportunity to comprehensively examine a situation or event by focusing on the 'Why,' 'What,' and 'How' questions. Creswell (2009) describes a case study as a method in which the researcher explores one or more systems over time, collecting detailed and comprehensive data from various sources (observations, face-to-face interviews, visual and auditory materials, documents, and reports), describes the situation, and reports relevant themes. The study focused on analyzing students' problem-posing skills in detail, including the type of problems they posed, the meaning carried by the four operations used in their solutions, the number of operations employed, and the characteristics of the posed problems.

2.2. Participants

Researchers conducted this study with 65 fourth-grade elementary school students from a state school affiliated with the Ministry of National Education in the central district of Keçiören, Ankara province. The school was selected from a moderately socio-economic environment to avoid extreme cases influenced by significantly positive or negative resource-related factors and to facilitate the analysis and interpretation of data representative of typical or average schools. Convenience sampling was employed primarily to conduct the research in schools where the researchers were teaching, allowing for easy interaction and classroom teachers' voluntary participation, which motivated their students and enhanced the practicality and accessibility of the study (Yıldırım & Şimşek, 2008).

2.3. Data collection tool

In the research, problem-posing situations were prepared by the researcher appropriate for the fourth-grade level, based on the four operations within the dimensions of comprehension, transformation, arrangement, and selection, as outlined in the model proposed by Stoyanova and Ellerton (1996) and Christou et al. (2005). These problem-posing situations included free, semi-structured, and structured problem-posing tasks. For each sub-dimension, researchers prepared one question for the comprehension and selection dimensions in the structured problem-posing situation, one for the arrangement and transformation dimensions in the semi-structured problem-posing situation, and one for each sub-dimension in the free problem-posing situation. Researchers utilized these problem-posing situations as data collection tools.

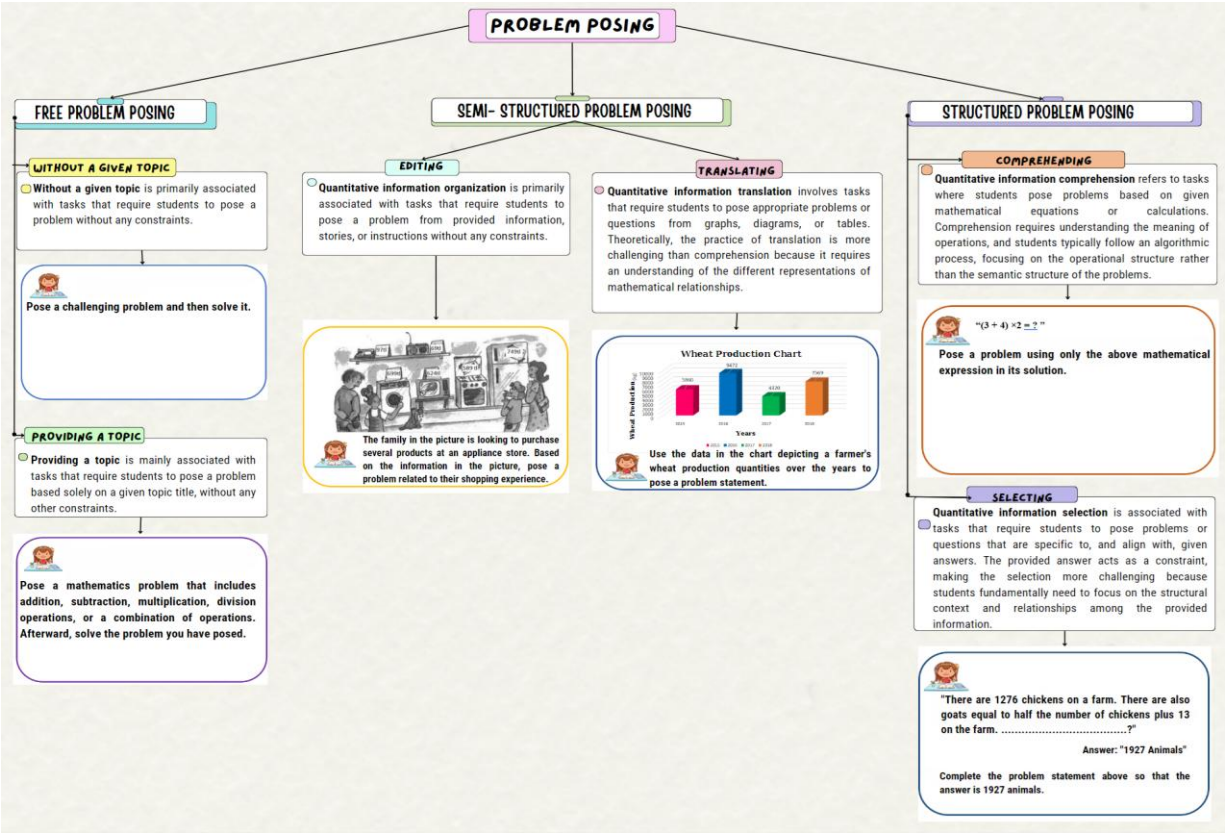

Figure 1. *Items and Characteristics Included in the Problem-Posing Test.*

2.4. Data collection process

The researcher collected the data from 65 fourth-grade elementary school students who participated in the study. Before instructing the students to pose problems, the researcher provided information about the problem situation and presented an example of another problem situation. Additionally, the researcher explained to the students how to proceed with the task. In some problem-posing situations, the students were asked to consider their peers and pose problems directed towards them. The researcher distributed work papers for each problem situation and provided the students with information about the problem situation. Afterward, the researcher instructed the students to pose as many problems as they wished verbally. Then, the researcher gave the students 15-20 minutes to write down their problems related to six different problem situations on their work papers. The data collection process took three class hours. Teachers were absent in the classroom throughout the data collection phase, and the researcher interacted individually with each students. The researcher guided the students during the implementation, refrained from intervening in the problems they posed, and did not provide direction regarding accuracy or correctness.

2.5. Data analysis

We analyzed the qualitative data obtained in the study using document analysis, following a series of systematic steps. First, we organized the data and prepared it for analysis. Next, we examined all written documents in detail and established an initial analytical framework based on the categories developed by Çarkcı (2016) in a similar study. We then conducted descriptive analysis within this framework. However, when the existing framework proved insufficient to explain certain cases, we extended the analysis through content analysis by generating new codes and developing related categories and subcategories. After completing the coding process, we reviewed and refined the categories and subcategories. Two researchers analyzed the data independently and then compared their analyses to reach a consensus. To present the findings clearly and systematically, we calculated frequencies and percentages for each category and subcategory, presented the results in diagrams and tables, and included direct quotations to support the findings.

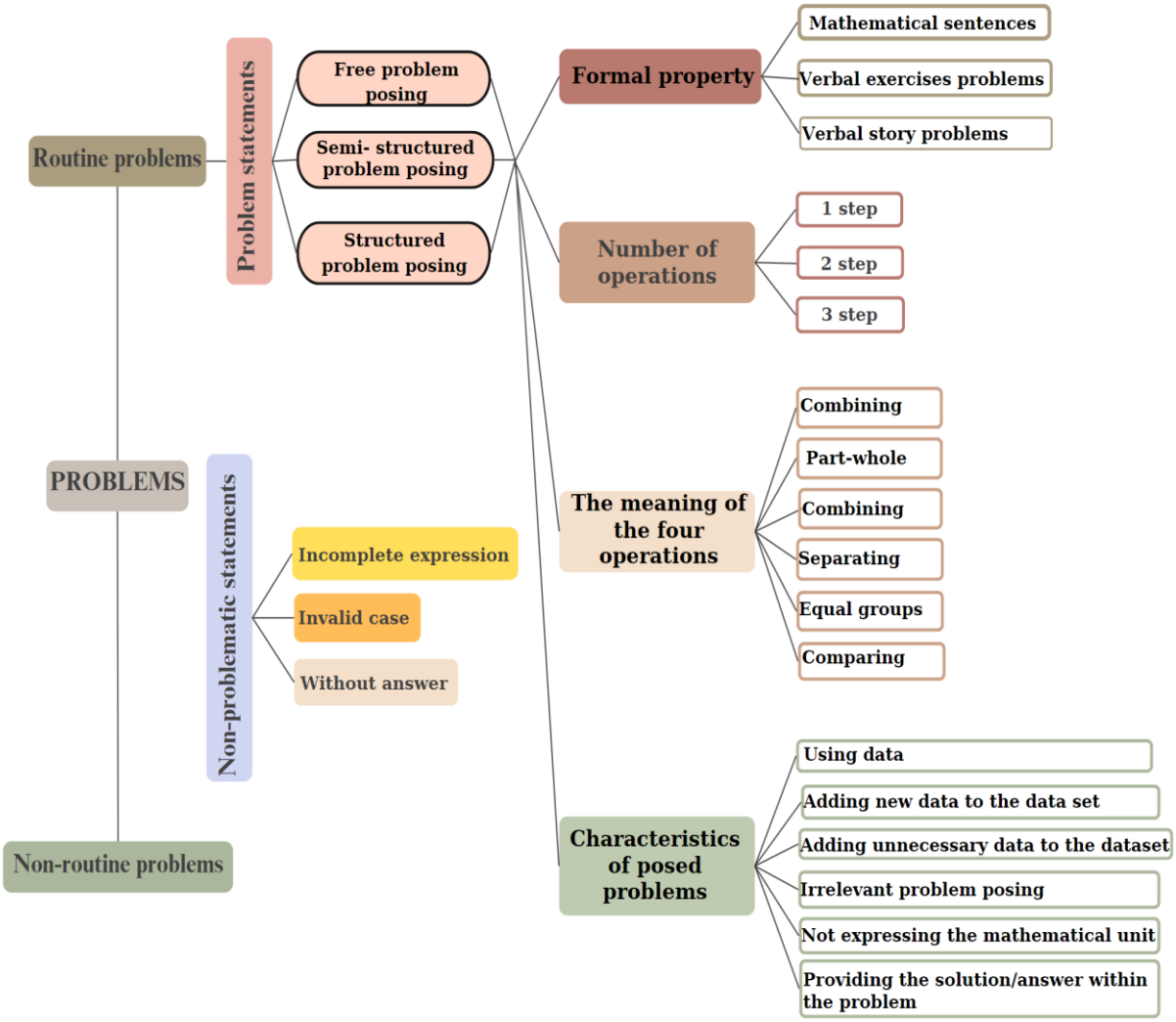

Figure 2. *The Dimensions and Characteristics of the Assessment Form for the Problems Posed by Students.*

Figure 2 presents the classification framework for identifying and evaluating student responses that qualify as problem statements. We first categorized the problems students posed as routine or non-routine. We then distinguished responses as problem statements or non-problematic statements. In this study, we examined only routine problems that qualified as problem statements. Within this scope, we assessed formal properties, step count, meanings of the four basic operations, and features of the routine problems students posed in free, semi-structured, and structured situations. Although Figure 2

includes non-routine problems, we did not analyze them in detail. Thus, the figure's subcategories pertain only to the routine problem statements examined in this study.

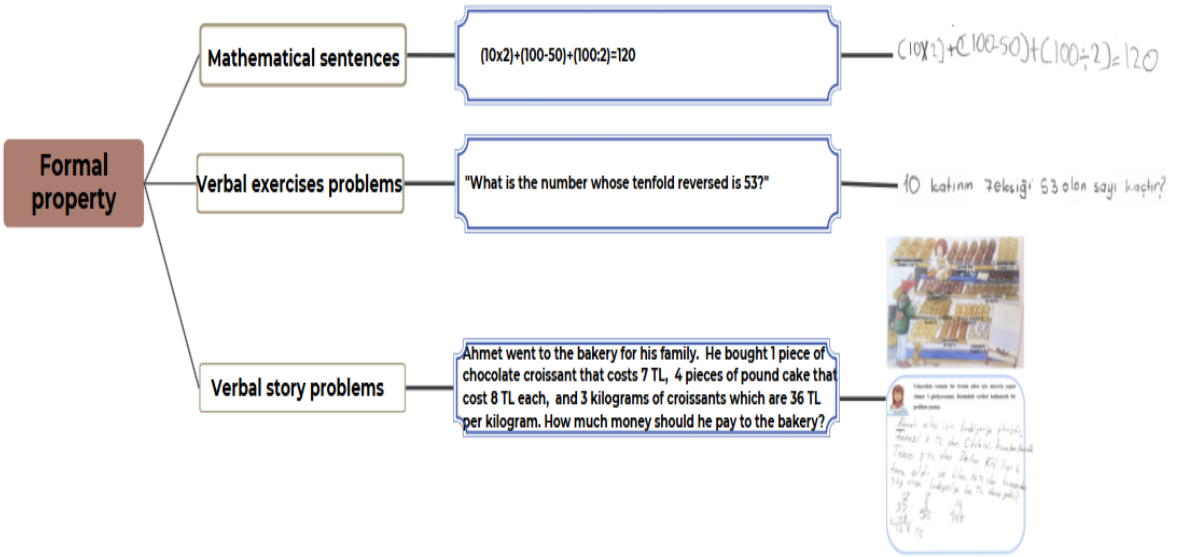

Figure 3. *Mathematical Problem Types Categorized by Formal Properties with Examples.*

Figure 3 presents a classification of mathematical problem types based on formal properties. It includes three main categories—mathematical sentences, verbal exercise problems, and verbal story problems, along with examples for each. This classification serves as a guiding reference for students by illustrating the formal differences between problem types.

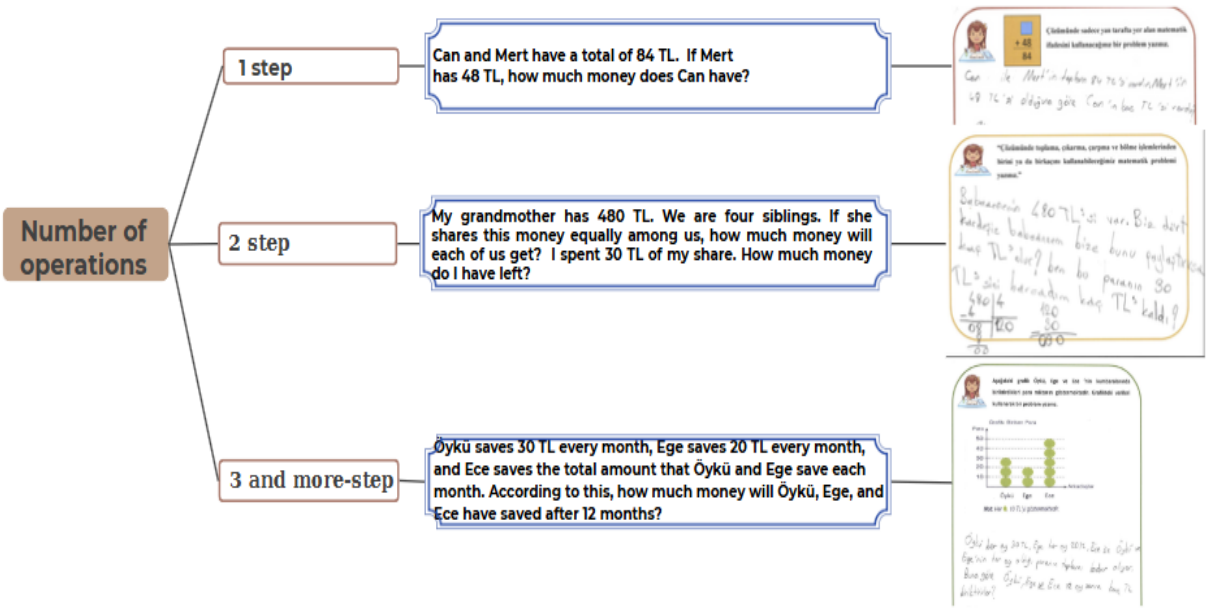

Figure 4. *Mathematical Problem Types Categorized by Number of Operations with Examples.*

Figure 4 presents a classification of mathematical problems based on the number of steps required to solve them. It includes examples of one-step, two-step, and three and more-step problems, as well as problems posed by students for each category. As the number of steps increases, both the complexity

of the problems and the cognitive effort expected from students also increase. This classification offers valuable insights into how problem structure influences students' problem-posing processes.

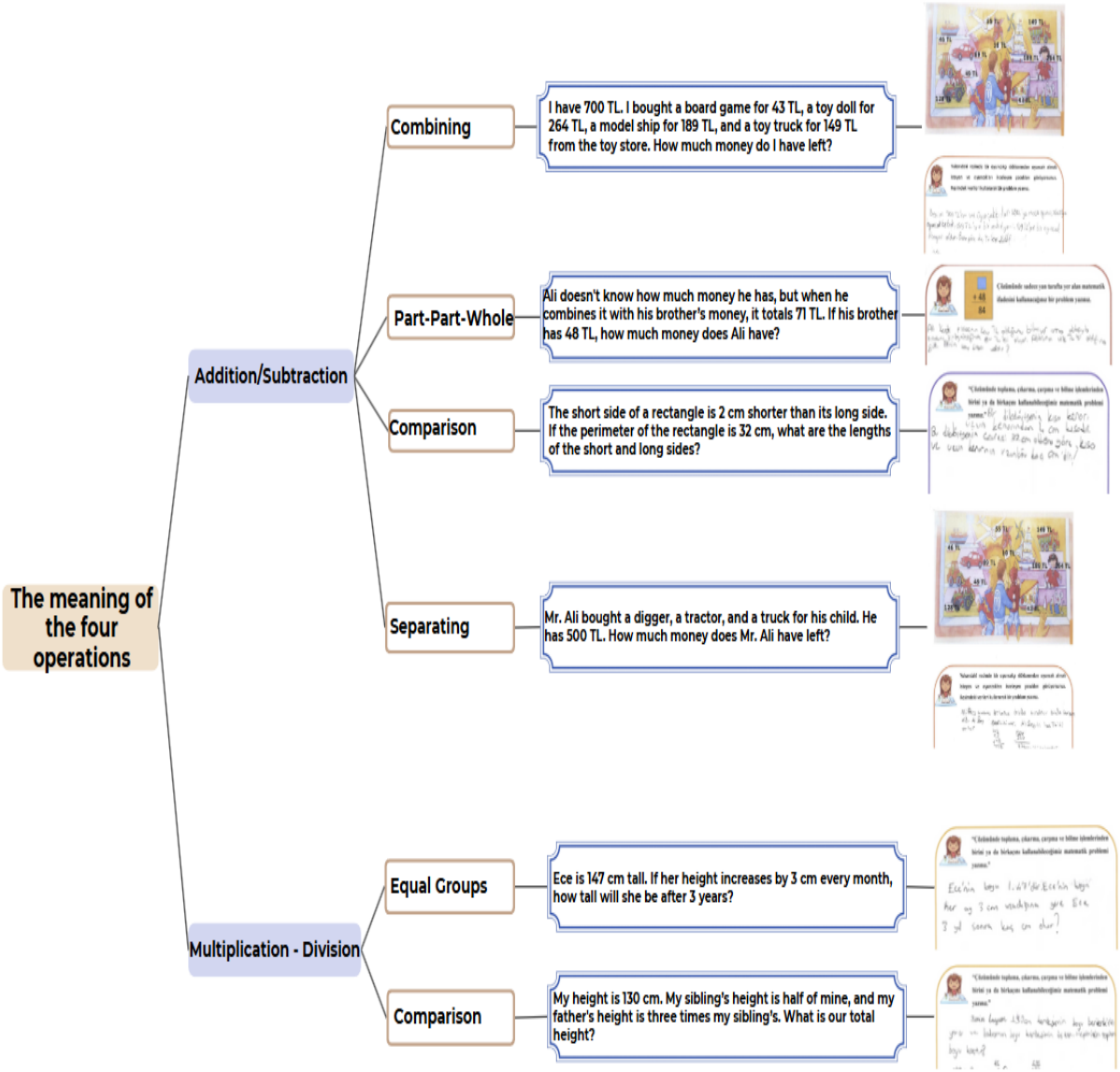

Figure 5. *Mathematical Problem Types Categorized by The Meaning of the Four Operations with Examples.*

Figure 5 presents the classification of mathematical problems according to the meaning of the four operations (addition, subtraction, multiplication, and division). The figure distinguishes different conceptual structures, such as combining, part-whole, comparison, and separating for addition and subtraction, as well as equal groups and comparison for multiplication and division. Students provided examples of problems for each category. This classification illustrates how the fundamental meanings of operations influence the context and structure of problems, providing valuable insights into students' processes of understanding and constructing various types of problems.

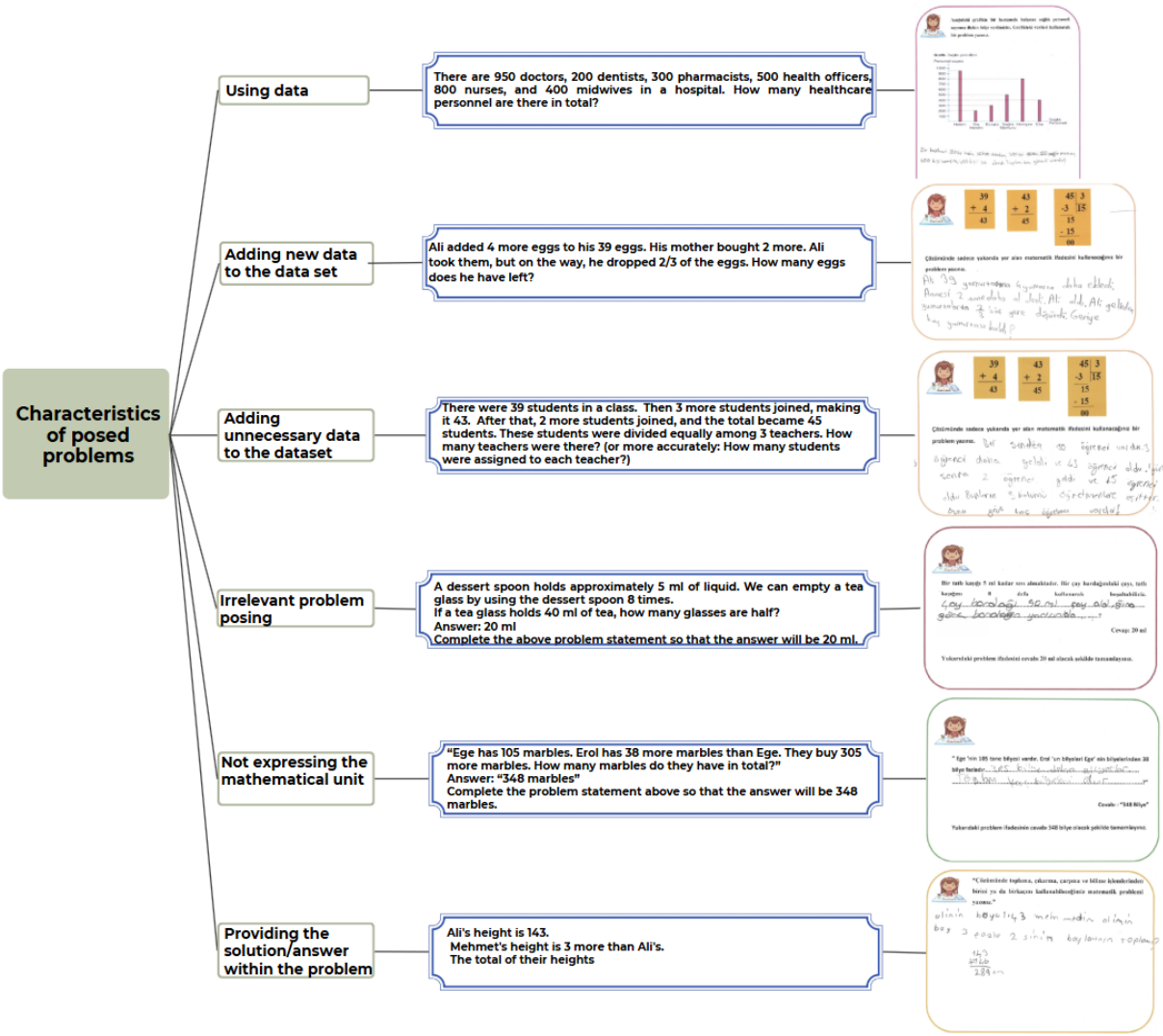

Figure 6. *Mathematical Problem Types Categorized by Characteristics of Posed Problems with Examples.*

Figure 6 presents the characteristics of problems posed by students under different subcategories. It includes examples such as using data, adding new data to the dataset, adding unnecessary data, posing an irrelevant problem, not specifying the mathematical unit, and providing the solution or answer within the problem. This classification reveals the main difficulties and common tendencies that students encounter in their problem-posing processes.

2.6. Validity and reliability

To enhance the reliability of qualitative research, researchers consider member checking the most effective method (McMillan, 2000; Miles & Huberman, 1994; Glesne, 2013). In this study, researchers tasked a second researcher with coding the data and reviewing these codes to ensure the reliability of content analysis. The data coding process was repeated independently by the second researcher, regardless of the actions of the first researcher, resulting in a consistency rate of 91.33% for the codes. Throughout the analysis process, researchers established various categories and codes to evaluate the problem-posing situations, and they quantified the collected data and presented it in tables. Finally, external auditors, without any connection to the research, reviewed all data from the study and attempted to provide an objective evaluation.

The study's internal validity, and thus its integrity, stems from accurately interpreting the data (Creswell & Miller, 2000). The researchers supported the study's conclusions with direct quotations to enhance its integrity. Bowen (2009) identifies Confirmability as a critical measure of objectivity and

clarity, requiring that a researcher's decisions be verifiable by others. For this study, researchers digitized the data analysis and made it clearly and openly accessible, providing a detailed account of how they arrived at their findings. The study's external validity or applicability depends on whether its results are valid in different contexts (Shenton, 2004). By describing the context in detail through convenient sampling, the researchers ensured that their findings applied to similar research settings. Merriam (1998) emphasizes that a study's coherence comes from thoroughly explaining the processes of data collection, utilization, analysis, and interpretation. The study achieved consistency by adhering to these methods, and using a data analysis table for coding further enhanced this consistency.

3. Findings

The study presents the findings obtained from the data under the following subheadings.

3.1. Findings Related to Free Problem Posing Situation

3.1.1. Type of Problems Posed by Students about Free Problem Posing Situation

In the sub-dimensions of the free problem-posing situation, the researchers asked students to pose two types of problems: one without a given topic that they found challenging and another related to four operations skills—addition, subtraction, multiplication, and division—with a specified topic. Among the problems related to four operations skills, students correctly posed 53 problems in the "without topic" category and 63 problems in the "with topic" category. Table 1 presents the analysis of the problem statements students posed regarding four operations skills in the free problem-posing situation.

Table 1. *Analysis of problem statements created by students in the context of free structured situations.*

Free Structured Situations	**Problem Statements**	Non- Routine Problem	Verbal Story Problem	Verbal Exercises Problems	Mathematical Sentences	**Non- Problem Statements**	No Answer	Invalid Case	Incomplete Expression	**Total**
	f	**f**	**f**	**f**	**f**	**f**	**f**	**f**	**f**	**f**
Without Giving a Topic	**53**	3	23	27		**12**	8		4	**65**
By Giving a Topic	**63**		54	6	3	**2**	1	1		**65**

As Table 1 reveals, 53 problems were accepted as correct statements in the Without Giving a Topic category, while 12 were judged incorrect. Conversely, in the With Giving a Topic category, 63 problems received approval as correct statements, with only two considered incorrect.

Reviewing the "Without Giving a Topic" category, 23 students crafted "Verbal story" problems, 27 formulated "Verbal exercise" problems, three developed "Non-routine problems," eight failed to answer, and four produced statements that were too weak to qualify as problems.

In the "With Giving a Topic" category, the analysis revealed that 54 students created "Verbal story" problems, six offered "Verbal exercise" problems, two abstained from answering, and one provided an invalid statement.

The study highlights notable distinctions between problems posed without and with a topic. The correctness of problem statements under the With Giving a Topic scenario surpasses those in the

Without Giving a Topic category. Focusing on a specific subject helps students pose more accurate and well-structured problem statements, thereby improving the overall quality and effectiveness of their problem-posing performance.

Exploring the Without Giving a Topic category, most students favored composing "Verbal story" and "Verbal exercise" problems. Nonetheless, this category saw eight students not responding and four presenting inadequately formulated problems. Meanwhile, the With Giving a Topic category witnessed a pronounced rise in "Verbal story" problems, suggesting that contemplating a specific subject allows for more comprehensive and narrative-driven problems. However, the presence of non-responding students and one invalid problem statement in this category implies that a specified subject does not universally simplify problem-posing for all students.

3.1.2. The Meanings of the Four Operations Used by Students in Correctly Posed Problems in the Free Problem Posing Situation

In examining the Free Problem Posing Situation, the study scrutinized the problems students formulated correctly, focusing on the meanings conveyed by the four operations they utilized to craft the problems. It assessed the expressions within these problems strictly by the type of operation required—addition, subtraction, multiplication, or division—ignoring instances where multiple expressions necessitated the same operation. For instance, if a problem incorporated one or several instances of addition and subtraction, it was accounted for as employing each of these operations once, based on the type of operation involved. Table 2 delineates the meanings attributed to the four operations by students in their effectively constructed problems.

Table 2. *Meanings carried by the four operations used in problems created by students in the context of free structured situations.*

Free Structured Situations			Mathematical Sentences	Verbal Exercises Problems	Verbal Story Problem	**Total**
			f	**f**	**f**	**f**
The Meanings of the Four Operations	Without Giving a Topic	Part-part-whole (Addition/Subtraction)			2	**2**
		Separation (Subtraction)			7	**7**
		Comparison (Multiplication- Division)		1	41	**42**
	By Giving a Topic	Combination (Addition)	3	2	15	**20**
		Part-part-whole (Addition/Subtraction)		1	19	**20**
		Comparison (Subtraction)		1	5	**6**
		Separation (Subtraction)	3	2	25	**30**
		Equal Groups (Multiplication/Division)	3	3	34	**40**
		Comparison (Multiplication/Division)		1	7	**8**

Table 2 shows that students predominantly framed their problems around the concept of equal groups (multiplication/division) in the *"Without Giving a Topic*" category, producing 42 such instances. They followed this with seven problems based on separation (subtraction) and two problems based on part-part-whole (addition and subtraction). A high frequency of verbal story problems also characterizes this category.

In the *With Giving a Topic* category, students most frequently conveyed the concept of equal groups (multiplication/division), generating 40 related problems. They then posed 30 problems reflecting

separation (subtraction), followed by 20 problems for combination (addition), another 20 for part-part-whole (addition and subtraction), eight for comparison (multiplication and division), and six for comparison (subtraction). These results demonstrate that students intentionally emphasized expressions aligned with the four fundamental meanings of mathematical operations in this category.

3.1.3. The Number of Operation Steps Used by Students in Correctly Posed Problems Related to the Free Problem Posing Situation

The study examined the correctly posed problems by students in the Free Problem Posing Situation, with an explicit focus on the number of operation steps students utilized while posing these problems. Table 3 presents the number of operation steps students employed in their correctly posed problems for the Free Problem Posing Situation.

Table 3. *Number of operation steps used in problems created by students in the context of free structured situations.*

Free Structured Situations			Mathematical Sentences	Verbal Exercises Problems	Verbal Story Problem	**Total**
			f	**f**	**f**	**f**
The Number of Operation Steps	Without Giving a Topic	One-Step		8	4	**12**
		Two- Step		9	10	**19**
		Three or More Steps		10	9	**19**
	By Giving a Topic	One-Step		3	10	**13**
		Two- Step		2	19	**21**
		Three or More Steps	3	1	25	**29**

The analysis of the *'Without Giving a Topic*' sub-dimension reveals that students primarily composed two-step problems (f = 19) and three or more steps (f = 19), followed by one-step problems (f = 12). They classified most one-step problems as verbal exercises (f = 8) and identified the rest as verbal story problems (f = 4). When analyzing the two-step and three-or-more-step problems, students distributed their problem types almost equally between verbal exercises (f = 9, f = 10) and verbal stories (f = 10, f = 19).

These results show that students preferred to design problems with two or more steps when they worked without a given topic. Although some students posed one-step problems, they typically wrote them in the verbal exercise format. In contrast, they showed an equal preference for verbal story and verbal exercise formats when posing two-step and multi-step problems.

In the *With Giving a Topic* sub-dimension, students most frequently posed problems with three or more steps (f = 29), followed by two-step problems (f = 21) and one-step problems (f = 13). They designed most one-step problems as verbal stories (f = 8) and fewer as verbal exercises (f = 3). For two-step problems, students mainly used the verbal story format (f = 19), with a small number using verbal exercises (f = 2). In problems with three or more steps, students overwhelmingly favored the verbal story format (f = 25), while some also used mathematical sentences (f = 3) and verbal exercise formats (f = 3).

These findings from the *With Giving a Topic* sub-dimension clearly show that students tend to construct more complex, multi-step problems when they receive a specific topic. They generally posed one-step problems as verbal stories and relied heavily on the verbal story format for both two-step and

multi-step problems. Some students also chose to pose their multi-step problems using the mathematical sentence format.

3.1.4. Exploring the Characteristics of Correctly Posed Problems by Students in the Free Problem-Posing Situation

The study examined how students structured their correctly posed problems in the Free Problem Posing Situation. Table 4 presents the characteristics of the problems that students correctly posed in this context.

Table 4. *Characteristics of correctly formed problems by students in the context of free structured situations*.

Free Structured Situations			Mathematical Sentences	Verbal Exercises Problems	Verbal Story Problem	**Total**
			f	**f**	**f**	**f**
Characteristics of Correctly Formed Problems	Without Giving a Topic	Adding New Data to the New Data Set*		27	23	**50**
	By Giving a Topic	Adding New Data to the New Data Set*	3	6	53	**62**

* Since the problem situation provided no data to students, this category evaluates the data students wrote.

The analysis of correctly posed problems in the Free Problem-Posing Situation reveals that researchers provided students with scenarios either with or without a given topic. They evaluated the student-generated problems based on whether students added new data to existing information. The results show that in both sub-dimensions, students consistently incorporated new data into their problem constructions.

In the sub-dimension where students posed problems without a specific topic, they predominantly added new data (f = 50), focusing on verbal exercises (f = 27) and verbal stories (f = 23). This preference for verbal exercises when asked to create a challenging problem suggests that students may perceive this type of problem as more difficult based on their educational experiences.

The findings confirm that when students created problems without a given topic, they primarily used verbal exercises (f = 27) and verbal stories (f = 23). Their tendency to choose verbal exercises for challenging problem tasks may indicate that they find this format more cognitively demanding.

In the sub-dimension involving problems related to a given topic, students mostly added new data while posing their problems (f = 62). They showed a strong preference for verbal stories (f = 53), followed by verbal exercises (f = 6) and mathematical sentences (f = 3). When asked to pose a problem solvable through one or more of the four operations, students overwhelmingly favored the verbal story format.

These findings demonstrate that when students pose problems based on a specific topic, they primarily rely on verbal story structures (f = 53) while integrating new data. This result suggests that students prefer verbal stories as a natural and familiar way to apply mathematical operations in posing problems.

Overall, the study highlights that both the presence of a specific topic and the perceived difficulty level significantly influence how students pose problems. Students tend to favor verbal exercises and verbal stories when posing mathematical problems, especially when incorporating new contextual information.

3.2. Findings Related to the Semi-Structured Problem Posing Situation

3.2.1. Types of Problems Posed by Students in the Semi-Structured Problem Posing Situation

In the semi-structured problem-posing situation, under the "Editing" sub-dimension, students received instructions to create problems freely based on a provided story scenario. For the "Translating" sub-dimension, the task involved formulating problems that aligned with a given graph. Within this semi-structured problem-posing context, evaluators deemed 63 of the problems created under the "Editing" sub-dimension correct, and 60 problems under the "Translating" sub-dimension also received approval. Table 5 presents the analysis of problem statements formulated by students, focusing on their application of four operations skills in the semi-structured problem-posing scenario.

Table 5. *Analysis of problem statements created by students in the context of semi-structured situations.*

Semi- Structured Situations	**Problem Statements**	Non- Routine Problem	Verbal Story Problem	Verbal Exercises Problems	Mathematical Sentences	**Non- Problem Statements**	No Answer	Invalid Case	Incomplete Expression	**Total**
	f	**f**	**f**	**f**	**f**	**f**	**f**	**f**	**f**	**f**
Editing	**63**		63			**2**	1		1	**65**
Translating	**60**	1	55	4		**5**	2	1	2	**65**

Table 5 reveals that evaluators accepted 63 problems as correctly posed in the arrangement sub-dimension while identifying two as incorrectly posed. Similarly, the transfer sub-dimension recognized 60 problems as correct and classified five as incorrect.

When the study analyzed problem statements that students wrote for the "Editing" sub-dimension, 63 students generated "Verbal story" problems, and one did not answer the question. Another statement needed to have the necessary components to qualify as a problem. Writing a problem corresponding to a picture story led exclusively to the creation of verbal story problems by students, a notable outcome. "Furthermore, the analysis confirmed that students posed most of these problems correctly.

For the "Editing" sub-dimension, the findings highlight that most students (63) chose to create "Verbal story" problems in response to being asked to develop a problem fitting a pictorial story. Their preference for responding to such requests with verbal story-type problems suggests a favored approach to engaging with specific visual or narrative contexts for problem construction.

The study's review of problem statements within the "Translating" sub-dimension revealed that 55 students formulated "Verbal story" problems, four generated "Verbal exercise" problems, one created a non-routine problem, two did not respond, and one submitted a statement that proved either insufficient or invalid for problem formation. When tasked with creating a problem that matches a specific graph, students predominantly opted for verbal story problems, with a smaller portion selecting verbal exercise-type problems.

The outcomes from the "Translating" sub-dimension demonstrate that most students opted for "Verbal story" problems, with a notable minority exploring "Verbal exercise" problems. This pattern, mainly observed among students tasked with devising problems suited to a given graph, highlights their ability to convert visual information into text-based problems. Additionally, creating verbal exercise-type problems showcases students' ability to articulate problems in diverse formats.

3.2.2. The Meanings of the Four Operations Used by Students in Correctly Posed Problems in the Semi-Structured Problem Posing Situation

The study examined the correctly posed problems by students within the semi-structured problem-posing scenario by focusing on the meanings conveyed through the four operations used during problem formulation. The researchers assessed the expressions in each problem based solely on the type of operation required (addition, subtraction, multiplication, and division) without counting repeated occurrences of the same operation. For example, if a problem included multiple instances of addition or subtraction, the analysis counted each operation type only once. Table 6 presents the meanings students assigned to the four operations in their accurately posed problems.

Table 6. *Meanings carried by the four operations used in problems created by students in the context of semi-structured situations.*

Semi- Structured Situations			Mathematical Sentences	Verbal Exercises Problems	Verbal Story Problem	**Total**
			f	**f**	**f**	**f**
The Meanings of the Four Operations	Editing	Combination (Addition)		1	3	**4**
		Part-part-whole (Addition/Subtraction)			59	**59**
		Comparison (Subtraction)			1	**1**
		Separation (Subtraction)			31	**31**
		Equal Groups (Multiplication/Division)			20	**20**
	Translating	Combination (Addition)		3	13	**16**
		Part-part-whole (Addition/Subtraction)			39	**39**
		Comparison (Subtraction)		1	6	**7**
		Separation (Subtraction)		1	17	**18**
		Equal Groups (Multiplication/Division)			5	**5**
		Comparison (Multiplication/Division)			1	**1**

As Table 6 shows, students most frequently posed problems in the "Editing" sub-dimension to express the concept of part-part-whole (addition/subtraction) (f = 59). They followed this with separation (subtraction) (f = 31), equal groups (multiplication/division) (f = 20), combination (addition) (f = 4), and comparison (subtraction) (f = 1). Verbal story problems dominated the problems posed, marking a significant trend.

In the "Translating" sub-dimension, students most commonly posed problems that reflected part-part-whole meanings (addition/subtraction) (f = 39). They also addressed separation (subtraction) (f = 18), combination (addition) (f = 16), comparison (subtraction) (f = 7), equal groups (multiplication/division) (f = 5), and comparison (multiplication/division) (f = 1). Their problem statements mainly conveyed the meanings of part-part-whole and separation within the context of the four operations.

To analyze these patterns, the researchers focused on the meanings conveyed by each operation in the correctly posed problems. They considered only the required types of operations—addition, subtraction, multiplication, and division—and did not count repeated occurrences of the same operation within a single problem. For instance, if a student used addition or subtraction multiple times, the researchers counted that operation type only once in the analysis. Table 6 summarizes the meanings students assigned to the four operations in their accurately posed problems.

3.2.3. Number of Operation Steps Used by Students in Correctly Posed Problems in the Semi-Structured Problem Posing Situation

The study examined the number of operation steps that students employed while correctly posing problems in the semi-structured problem-posing situation. Table 7 displays the distribution of operation steps used by students in the problems they accurately posed within this context.

Table 7. *Number of operation steps used in problems created by students in the context of semi-structured situations.*

Semi- Structured Situations			Mathematical Sentences	Verbal Exercises Problems	Verbal Story Problem	**Total**
			f	**f**	**f**	**f**
The Number of Operation Steps	Editing	One-Step			7	**7**
		Two- Step			20	**20**
		Three or More Steps			36	**36**
	Translating	One-Step		3	23	**26**
		Two- Step		1	24	**25**
		Three or More Steps			9	**9**

Analyzing the operation steps students utilized in crafting problems for the "Editing" sub-dimension of the semi-structured problem-posing scenario revealed a preference for developing problems with three or more steps (f = 36), followed by two-step (f = 20) and one-step (f = 7) problems. Notably, all problems posed fell into the verbal story category.

Further scrutiny of the operation steps employed by students in posing problems for the "Translating" sub-dimension of the semi-structured problem-posing scenario revealed a higher frequency of one-step (f = 26) and two-step (f = 25) problems. Students posed fewer problems involving three or more steps (f = 9) compared to one- and two-step problems, indicating a lower preference for more complex structures. Additionally, the analysis identified that, beyond verbal story problems, students ventured into posing verbal exercise-type problems.

3.2.4. Exploring the Characteristics of Correctly Posed Problems by Students in the Semi-Structured Problem-Posing Situation

The study examined the characteristics of correctly posed problems by students within the semi-structured problem-posing context. Table 8 details the characteristics of these accurately formulated problems, showcasing students' approach to problem construction within this specific scenario.

Table 8. *Characteristics of correctly formed problems by students in the context of semi-structured situations.*

Semi- Structured Situations			Mathematical Sentences	Verbal Exercises Problems	Verbal Story Problem	**Total**
			f	**f**	**f**	**f**
Characteristics of Correctly Formed Problems	Editing	Using Data			13	**13**
		Adding New Data to the Data Set			50	**50**
		Adding Unnecessary Data to the Data Set			1	**1**
		Irrelevant Problem Posing			1	**1**
	Translating	Using Data		3	19	**22**
		Adding New Data to the Data Set		1	26	**27**
		Irrelevant Problem Posing			1	**1**

In the conclusion section of this study, the researchers evaluated students' abilities to construct semi-structured problems across two main sub-dimensions: Organization and Transfer. In the Organization category, 65 students demonstrated success in various skills—13 students effectively used given data, while 50 students successfully added new information to the data. However, only one student managed to perform more complex tasks, such as adding unnecessary information to the data and posing contextually appropriate problems.

In the Transfer category, three students were successful at a basic level and 19 at an advanced level in posing problems using data, totaling 22 students who demonstrated success in this skill. One student succeeded at a basic level in adding new data to information. In contrast, 26 students succeeded at an advanced level, resulting in 27 students succeeding in this category. Only one student was found successful in posing problems related to specific situations.

These findings suggest that students possess a well-developed ability to interact with data and incorporate new information during the mathematical problem posing process. However, students need to develop more complex skills, such as posing problems specific to situations and filtering out unnecessary information.

3.3. Findings Related to the Structured Problem Posing Situation

3.3.1. Types of Problems Posed by Students in the Structured Problem Posing Situation

In this assessment, researchers evaluated how students posed structured mathematical problems across two distinct sub-dimensions. In the "Comprehending" sub-dimension, students posed problems that matched a given mathematical equation or operation. In the "Selecting" sub-dimension, they formulated question sentences that accurately corresponded to a provided answer. Students posed 53 correct problems in the Comprehending sub-dimension and 45 correct problems in the Selecting sub-dimension. Table 9 displays the analysis of the problem statements students posed using the four operations within the structured problem-posing context.

Table 9. *Analysis of problem statements created by students in the context of structured situations*.

Structured Situations	**Problem Statements**	Non- Routine Problem	Verbal Story Problem	Verbal Exercises Problems	Mathematical Sentences	**Non- Problem Statements**	No Answer	Invalid Case	Incomplete Expression	**Total**
	f	**f**	**f**	**f**	**f**	**f**	**f**	**f**	**f**	**f**
Comprehending	**53**		23	30		**12**	9	1	2	**65**
Selecting	**45**		44	1		**20**	10	2	8	**65**

In the "Comprehending" category, 53 students successfully posed problem statements, 23 addressed non-routine problems, 30 dealt with story problems, 12 with mathematical expressions, and 9 made errors while posing problem statements. Additionally, one student did not provide an answer, and two posed invalid statements, while researchers assessed a total of 65 students.

In the "Selecting" category, 45 students correctly selected problem statements, 44 tackled routine problems, 1 addressed a story problem, 20 made errors with mathematical expressions, and 10 formed problem statements. Furthermore, two students did not respond, and eight created invalid statements, totaling 65 students evaluated in this category.

In conclusion, most students in both categories have demonstrated success in problem-posing and selection skills. Particularly in the "Selecting" category, there is a notable high success rate in choosing non-routine problems. The low number of students creating invalid statements in both categories suggests that students generally understand the given mathematical situations and can pose appropriate problems. However, the presence of students who posed incorrect problem statements or have yet to respond indicates a need for educators to provide more support and guidance in these areas.

3.3.2. The Meanings of the Four Operations Used by Students in Correctly Posed Problems in the Structured Problem Posing Situation

The study examined the correctly posed problems by students within a structured problem-posing scenario, focusing on the meanings conveyed by the four operations used during problem-posing. It assessed the expressions contained in the problems strictly based on the required type of operation (addition, subtraction, multiplication, and division), disregarding instances of multiple expressions necessitating the same operation. For instance, if a problem incorporates one or more instances of addition and subtraction regarding operation type, the analysis treats the problem as employing each operation type once for this examination. Table 10 displays the meanings behind students' four operations in their accurately posed problems.

Table 10. *Meanings carried by the four operations used in problems created by students in the context of structured situations.*

Structured Situations			Mathematical Sentences	Verbal Exercises Problems	Verbal Story Problem	**Total**
			f	**f**	**f**	**f**
The Meanings of the Four Operations	Comprehending	Combination (Addition)		26	13	**39**
		Part-part-whole (Addition/Subtraction)			1	**1**
		Separation (Subtraction)		4	9	**13**
		Equal Groups (Multiplication/Division)		1		**1**
	Selecting	Part-part-whole (Addition/Subtraction)			2	**2**
		Separation (Subtraction)			7	**7**
		Equal Groups (Multiplication/Division)			44	**44**

Table 10 presents how students posed problems using the four operations in structured situations, organized under the sub-dimensions of "Comprehending" and "Selecting." In the "Comprehending" category, students posed 26 correct problems reflecting the concept of combination (addition), one problem for part-part-whole (addition/subtraction), nine problems for separation (subtraction), and one problem for equal groups (multiplication/division), resulting in a total of 37 correct problem statements.

In the "Selecting" sub-dimension, students posed two correct problems for part-part-whole (addition/subtraction), 7 for separation (subtraction), and a notable 44 for equal groups (multiplication/division), yielding a total of 53 correct problem statements in this sub-dimension.

Overall, it is evident that students have a better grasp of the concept of equal groups within the "Selecting" category, as evidenced by the significant number of correct problems. Students have successfully posed problems related to addition and subtraction across both sub-dimensions, with a particularly deeper understanding displayed in the "Selecting" sub-dimension regarding multiplication and division operations. These findings demonstrate the students' proficiency in understanding mathematical operations and their application in the problem-posing processes while providing valuable insights into the effectiveness of educational curricula and teaching approaches.

3.3.3. Number of Operation Steps Used by Students in Correctly Posed Problems in the Structured Problem Posing Situation

The study analyzed the correctly posed problems that students generated in the structured problem-posing situation, focusing on the number of operation steps they used while posing these problems. Table 11 presents the number of operation steps students applied in their correctly posed problems within the structured problem-posing scenario.

Table 11. *Number of operation steps used in problems created by students in the context of structured situations.*

Structured Situations			Mathematical Sentences	Verbal Exercises Problems	Verbal Story Problem	**Total**
			f	**f**	**f**	**f**
The Number of Operation Steps	Comprehending	One-Step				
		Two- Step				
		Three or More Steps		23	30	**53**
	Selecting	One-Step			34	**34**
		Two- Step			9	**9**
		Three or More Steps			2	**2**

Table 11 highlights the complexity of problems that students created in structured scenarios, organized under the "Comprehending" and "Selecting" sub-dimensions. In the "Comprehending" sub-dimension, 53 students posed problems that required three or more steps to solve, demonstrating their proficiency in constructing complex problem structures. The lack of data for one-step or two-step problems suggests that the assessment may not have included simpler problems or that students chose not to pose problems of lower complexity.

In contrast, in the "Selecting" sub-dimension, students predominantly posed one-step problems (34 instances), followed by two-step (9) and three-or-more-step problems (2). This pattern indicates a preference for more straightforward problem structures, reflecting students' confidence in simpler formats or instructional emphasis on such tasks.

This analysis reveals a contrast in the problem-posing approaches of students. While they exhibit strong skills in posing complex problems under the "Comprehending" sub-dimension, they tend to favor simpler, more accessible problems in the "Selecting" sub-dimension. This contrast provides educators with valuable insights into the range of cognitive demands students are prepared to meet and highlights the need for instructional strategies that support problem-posing across varying levels of complexity.

3.3.4. Exploring the Characteristics of Correctly Posed Problems by Students in the Semi-Structured Problem-Posing Situation

The study examined the characteristics of correctly posed problems by students within the structured problem-posing context. Table 12 details the characteristics of these accurately formulated problems, showcasing students' approach to problem construction within this specific scenario.

Table 12. *Characteristics of correctly formed problems by students in the context of structured situations.*

Structured Situations			Mathematical Sentences	Verbal Exercises Problems	Verbal Story Problem	**Total**
			f	**f**	**f**	**f**
Characteristics of Correctly Formed Problems	Comprehending	Using Data		28	17	**45**
		Adding Unnecessary Data to the Data Set		1		**1**
		Irrelevant Problem Posing		3	11	**14**
	Selecting	Adding New Data to the Data Set			42	**42**
		Adding Unnecessary Data to the Data Set			1	**1**
		Irrelevant Problem Posing			3	**3**
		Providing the Answer within the Problem			1	**1**

Table 12 outlines the attributes of correctly posed problems that students posed in structured scenarios, organized under the "Comprehending" and "Selecting" sub-dimensions.

In the "Comprehending" sub-dimension, 45 students effectively used the provided data to pose their problems. One student added unnecessary information, while 14 students posed problems that were deemed irrelevant. These findings suggest that although most students appropriately incorporated the given data, some failed to align their problems with the intended context or precision.

In the "Selecting" sub-dimension, 42 students successfully enhanced their problems by adding new data, demonstrating a strong preference for this approach. Only one student added superfluous data, and three students posed problems that did not align with the given answer. Additionally, one student mistakenly included the solution within the problem statement—an error not observed elsewhere.

Overall, students showed a strong understanding of how to use data when posing problems in the "Comprehending" sub-dimension, and they tended to enrich their problems with additional information in the "Selecting" sub-dimension. While errors such as irrelevance or unintended inclusion of answers did occur, they remained infrequent. These findings offer important insights into students' problem-posing strengths and limitations, providing valuable guidance for educators seeking to develop targeted instructional strategies.

4. Discussion and Conclusion

In this study, the problems posed by fourth-grade elementary students in free, semi-structured, and structured problem-posing situations were examined based on the type of problem, the meaning carried by the four operations, the number of steps in the operation, and its characteristics. Students primarily formulated their problems correctly; however, some invalid or erroneous problems also emerged. The study drew the following conclusions from the findings obtained:

Analyzing the problems that students posed in free problem-posing situations revealed that without a given topic, students equally created verbal exercises, story problems, and non-routine problems. Story problems became more prevalent with a topic provided, followed by verbal exercises and mathematical sentences. Without a specific topic, students often formulated problems involving three or more steps, whereas with a topic, they typically formulated problems with one or two steps. Moreover, without a given topic, the problems frequently featured meanings related to equal groups, separation, and part-whole. In contrast, providing a topic led students to explore a broader range of meanings in their posed problems, including equal groups, separation, part-whole, combination, and

comparison, in that order of frequency. In both cases, students posed their problems by incorporating new data.

Analyzing the problems that students posed in semi-structured problem-posing situations revealed that most problems fell into both the transfer and modification dimensions, with a minority being verbal exercise problems. The problems in both dimensions shared similar characteristics in the meanings they conveyed, with part-whole meanings dominating, followed by separation, combination, equal groups, and comparison. Students in both dimensions tended to incorporate new data into their problems. Regarding step count, the modification dimension frequently featured problems requiring three or more steps, whereas two-step problems were more prevalent in the transfer dimension.

In structured problem-posing situations, verbal exercise and story problems occurred in nearly equal numbers in the comprehension dimension, but story problems were the majority in the selection dimension. Students primarily imbued problems with meanings involving combination, separation, and equal groups within the comprehension dimension. In contrast, in the selection dimension, equal groups, separation, and part-whole were more commonly the focus. Problems in the comprehension dimension generally required three or more steps to solve, while in the selection dimension, one or two-step problems were more common. Additionally, while problems in the comprehension dimension aligned with given data, in the selection dimension, students frequently added new data to their problems.

Reviewing the study's overall results, students formulated correct problems for the given problem situations, predominantly posing story problems. Verbal exercise problems came next, followed by mathematical sentences and non-routine problems to a lesser extent. Tertemiz (2017) found similar results in her study on elementary school children. Balantekin and Oksal (2014) highlighted the influential role of motivation in problem-posing activities among elementary school children. They discovered that interactive reading has a positive effect on problem-posing abilities and measures of intrinsic and extrinsic motivation. This finding suggests that the children in the classes participating in the current study were motivated to undertake problem-posing activities. In a similar vein, Dölek and Çalışkan (2018) noted, in their research with fourth-grade elementary students, that students performed well in free, semi-structured, and structured problem-posing situations, echoing the current study's findings. However, Can and Yıldız (2021) pointed out that fourth-grade students predominantly struggled with posing verbal problems, expressing problems clearly, and posing mathematically correct problems suitable for the specified operations, which contrasts with the current study's findings. Moreover, the observation that students in the structured problem-posing dimension, especially in the comprehension sub-dimension, produced verbal exercise and story problems in nearly equal quantities implies, according to Can and Yıldız (2021), that elementary students find it challenging to pose verbal problems that match mathematical expressions.

The meanings attached to the four operations-based problems posed by students vary, which is a positive outcome. Erdoğan and Erben (2018) found in their study on gifted elementary students that the students predominantly posed problems involving combination, separation, and equal group meanings, similar to the findings of this study. However, in this study, students could imbue their problems with broader meanings. Similarly, Kılıç (2013) found that primary school students could pose problems representing various meanings of arithmetic operations performed with natural numbers, which aligns with the results of this study. Tertemiz (2017) showed that at all grade levels in elementary school, most students were more successful in posing problems using mathematical sentences related to addition and subtraction than those related to multiplication and division. However, this study determined that students successfully posed equal group problems involving multiplication and division.

Semi-structured and structured problem-posing situations require children to understand different mathematics representations and pose problems accordingly. Children are competent in these two main dimensions and can transform different representations. Similarly, a part of Cai's (2003) study on students in Singapore from schools with varying levels of achievement determined that most students could pose problems that adhered to the given shape pattern in a problem-posing task. Acquiring mathematical concepts is different from acquiring everyday concepts. Everyday concepts like "photo"

or "graph" are based on perceptual similarity and can be obtained with less effort through concept examples. When examining the research results, in semi-structured problem-posing situations, students prefer to pose problems that involve more steps and are of the story problem type in the modification sub-dimension. In the transfer sub-dimension, students focused more on one and two-step problems and posed problems in both story problem and verbal exercise types. These findings demonstrate that students can employ various strategies and types during the problem-posing process and adapt these abilities according to the number of steps in the operation and the type of problem.

Students often prefer story-type problems in semi-structured problem-posing activities, likely due to the contextual elements, such as graphs, real-life photographs, and other similar representations, included in these tasks. Students often prefer story-type problems in semi-structured problem-posing activities, likely due to the contextual elements, such as graphs, real-life photographs, and other similar representations, included in these tasks. These types of visual and contextual supports facilitate the problem-posing process by helping students to concretize mathematical ideas. However, this supportive effect may not apply equally to problem-solving processes. In line with this, Çimen and Kartal (2021) reported that students tended to experience greater difficulty when solving problems presented in narrative form. Similarly, the present study also revealed that some students shifted away from story-based representations and instead employed direct mathematical expressions, particularly when dealing with more complex problem-posing tasks. These findings suggest that students employ different cognitive approaches to problem-posing and problem-solving, depending on the contextual features and representational formats of the tasks.

Baykul (2014) states that problems involving the four operations can be associated with verbal, written, symbolic, and model representations, emphasizing the circular nature of this relationship. Transitions between representations directly relate to problem-posing activities. Within this circular structure, students may sometimes solve problems presented in verbal form. At the same time, educators may also ask them to pose problems based on visually or mathematically represented situations. When students struggle to transition between representations, they often demonstrate a lack of conceptual understanding (Lesh & Doerr, 2003).

In semi-structured problem-posing situations, students often associate mathematical symbols with familiar real-life contexts—such as marketplace or shop visuals, graphs, and tables—which aligns with the principle of direct, concrete experience and environmental interaction that characterizes the concrete operational stage in elementary-aged children. When educators utilize real-world situations in problem-posing tasks, they not only stimulate children's generation of new ideas but also support them in refining and organizing these ideas into interconnected conceptual networks. This process, in turn, strengthens students' relational understanding of mathematical symbols (Van de Walle, Karp, & Bay-Williams, 2014).

The findings of the present study indirectly align with those of Tertemiz, Özkan, Sural, and Akçakın (2015), who found that primary school textbooks often include four-operation problems with unknown results. Bal and Dinç-Artut (2022) also concluded that students generally succeed in solving such problems. These observations support the finding that children tend to pose problems with unknown results in free problem-posing situations. Additionally, Tarım (2017) discovered that students achieve significant success with problem types that frequently appear in textbooks. These results suggest that children typically base their self-constructed problems on the structures and meanings they encounter in primary school mathematics materials.

5. Recommendations

- The instruction on problem-posing across various scenarios (free, semi-structured, structured) focuses on the "Natural Numbers and the Four Operations Learning Areas." Therefore, designing this instruction for different learning domains and investigating its impact on students' problem-posing skills is possible.
- This research concentrates on fourth-grade students. Thus, conducting studies on problem-posing instruction encompassing various age groups would assist in comprehensively understanding the impact of instructional interventions related to age.

- Researchers can develop measurement tools to effectively assess the problem-posing process and measure the impact of problem-posing skills on student achievement. The development of such measurement tools can enable future research to gain deeper insights and make more effective use of problem-posing strategies.
- Teachers must receive training and ongoing support to utilize problem-solving methods effectively. Researchers can assist in enhancing teachers' skills by focusing on problem-posing strategies in the design of teacher training programs.

References

Ada, K., Demir, F., & Öztürk, M. (2020). Examination of Sixth Grade Students' Problem-Posing Skills: A Case study. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*. *11*(1), 210-240.

Ayvaz, Ü., & Durmuş, S. (2021). Fostering mathematical creativity with problem posing activities: An action research with gifted students. *Thinking Skills and Creativity*, *40*, 100846.

Bal, A. P., & Artut, P. D. (2022). Investigation of primary school students solving arithmetic verbal problems. *Journal of Education & Learning (EduLearn)*, *16*(1).

Balantekin, Y., Oksal, A. (2014). İlkokul 3. ve 4. sınıf öğrencileri için matematik dersi motivasyon ölçeği. *Cumhuriyet International Journal of Education (CIJE),* 3(2), 102-113. https://doi.org/10.30703/cije.321344

Baykul, Y. (2014). *İlkokulda matematik öğretimi.* Pegem Akademi.

Bevan, D., & Capraro, M. M. (2021). Posing creative problems: A study of elementary students' mathematics understanding. *International Electronic Journal of Mathematics Education*, *16*(3), em0654.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27-40. https://doi.org/10.3316/QRJ0902027

Brown, S.I., & Walter, M.I. (1990). *The art of problem posing* (2nd ed.). Lawrence Erlbaum Associates, Inc.

Cai, J. (2003). Singaporean students' mathematical thinking in problem solving and problem posing: an exploratory study. *International journal of mathematical education in science and technology*, *34*(5), 719-737.

Cai, J., & Hwang, S. (2002). Generalized and generative thinking in U.S. and Chinese students' mathematical problem solving and problem posing. *Journal of Mathematical Behavior*, 21, 401-421.

Cai, J., Moyer, J. C., Wang, N., Hwang, S., Nie, B., & Garber, T. (2013). Mathematical problem posing as a measure of curricular effect on students' learning. *Educational Studies in Mathematics*, *83*(1), 57-69.

Can, D., & Yıldız, H. N. (2021). An analysis of primary school students' problem-posing skills ınvolving addition and subtraction operations. *Bolu Abant İzzet Baysal University Journal of Faculty of Education, 21*(2), 416–433.

Cankoy, O., & Darbaz, S. (2010). Effect of a problem posing based problem solving instruction on understanding problem. *Hacettepe University Journal of Education*, *38*(1), 11-24.

Çetinkaya, A., & Soybaş, D. (2018). An investigation of problem posing skills of elementary scholl 8th grade students. *Journal of Theoretical Educational Science*, *11*(1), 169-200.

Christou, C., Mousoulides, N., Pittalis, M., Pitta-Pantazi, D., & Sriraman, B. (2005). An empirical taxonomy of problem posing processes. *Zdm*, *37*, 149-158.

Cifarelli, V. V., & Cai, J. (2006, July). The role of self-generated problem posing in mathematics exploration. In *Proceedings 30th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 2, pp. 321-328).

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Sage Publications, Inc.

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into Practice, 39*(3), 124-130.

Çarkcı, İ. (2016). *İlkokul 4. sınıf öğrencilerinin farklı problem kurma durumlarına yönelik ortaya koydukları problemlerin incelenmesi.* Gazi Üniversitesi / Eğitim Bilimleri Enstitüsü / Sınıf Eğitimi Ana Bilim Dalı.

Dölek, S., & Çalışkan, M. (2018). Investigation of problem solving and posing activities of primary school fourth grade students. TAY Journal, 2(2), 130-147.

Ellerton, N. F. (1986). Children's made-up mathematics problems — A new perspective on talented mathematicians. *Educational Studies in Mathematics 17*, 261–271.

Ellerton, N.F. (2013). Engaging pre-service middle-school teacher-education students in mathematical problem posing development of an active learning framework. *Educational Studies in Mathematics,* 83, 87-101.

English, L. D. (1997a). Promoting a problem-posing classroom. *Teaching children mathematics*, *4*(3), 172-179.

English, L. D. (1997b). The development of fifth-grade children's problem-posing abilities. *Educational Studies in Mathematics,* 34, 183-217.

Erdoğan, F., & Erben, T. (2018). Investigation of gifted students' problem posing abilities requiring arithmetical operations with natural numbers. Inonu University Journal of the Faculty of Education, 19(3), 531–546.

Erdoğan, F., & Gül, N. (2020). An investigation of mathematical problem posing skills of gifted students. *Pegem Journal of Education and Instruction*, *10*(3), 655-696.

Ergene, Ö. (2022). Posing probability problems related to continuous and discrete sample space. *International journal of mathematical education in science and technology*, *53*(2), 311-336.

Ev Çimen, E., & Kartal, E. (2021). An investigation of 4th grade students' abilities of solving problems given in symbolic, numerical and story formats. *Acta Didactica Napocensia,* 14(2), 143-159.

Glesne, C. (2013). Nitel araştırmaya giriş. A. Ersoy & P. Yalçınoğlu (Trans. Edt.). Anı Publication.

Gonzales, N. A. (1998). A blueprint for problem posing. *School Science and Mathematics*, *98*(8), 448-456.

Kar, T., & Işık, C. (2014). Analyzing problems posed by seventh grade middle school students for subtraction operation with fractions. *Elementary Education Online*, *13*(4), 1223-1239.

Katrancı, Y., & Şengül, S. (2019). The relationship between middle school students' attitudes towards mathematical problem-posing, attitudes towards mathematical problem-solving, and attitudes towards mathematics. *Education and Science*, 44(197), 1-24. https://doi.org/10.15390/EB.2019.7315.

Kılıç, Ç. (2013). Turkish primary school teachers' opinions about problem posing applications: students, the mathematics curriculum and mathematics textbooks. *Australian Journal of Teacher Education*, *38*(5), 144-155.

Kılıç, Ç. (2017). A new problem-posing approach based on problem-solving strategy: Analyzing pre-service primary school teachers' performance. *Educational Sciences: Theory & Practice*, *17*(3).

Kilpatrick, J. (1987). Problem formulating: Where do good problems come from? In A. H. Schoenfeld (Ed.), *Cognitive science and mathematics education* (pp. 123-147). Hillsdale, NJ: Erlbaum.

Kontorovich, I., & Koichu, B. (2016). A case study of an expert problem poser for mathematics competitions. *International Journal of Science and Mathematics Education*, *14*, 81-99.

Leikin, R., & Elgrably, H. (2020). Problem posing through investigations for the development and evaluation of proof-related skills and creativity skills of prospective high school mathematics teachers. *International Journal of Educational Research*, *102*, 101424.

Lesh, R. ve Doerr, H. (2003). *Foundations of a models and modeling perspective on mathematics teaching, learning, and problem solving.* R. Lesh & H. Doerr (Eds.) Beyond contructivism (pp.3-34). Hillsdale, NJ: Erlbaum.

McMillan, J.H. (2000). Educational research: Fundamentals for the consumer, USA: Longman.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. Jossey-Bass.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook*. Sage Publications.

Polya, G. (1973). How To Solve It. Princeton: Princeton University Press.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information, 22*(2), 63-75.

Silber, S., & Cai, J. (2021). Exploring underprepared undergraduate students' mathematical problem posing. *ZDM–Mathematics Education*, *53*(4), 877-889.

Silver, E. A. (1994). On mathematical problem posing. *For the Learning of Mathematics*, 14(1), 19-28.

Silver, E. A., & Cai, J. (1996). An analysis of arithmetic problem posing by middle school students. *Journal for Research in Mathematics Education*, *27*(5), 521-539.

Silver, E.A., Mamona–Downs, J., Leung, S., Kenny, P. A. (1996). Posing mathematical problems: an exploratory study. *Journal for Research in Mathematics Education*, 27(3), 293 – 309.

Stoyanova, E. (1998). Problem posing in mathematics classrooms. *Research in mathematics education: A contemporary perspective*, 164-185.

Stoyanova, E., & Ellerton, N. F. (1996). A framework for research into students' problem posing in school mathematics. *Technology in mathematics education, 4*(7), 518-525.

Tarım, K. (2017). Primary school students' levels of solving mathematical word problems and the distribution of these problems in textbooks. *Çukurova University Faculty of Education Journal, 46*(2), 639–648.

Tertemiz-Işık, N. (2017). Investigation of problems posed by primary school students based on four operations skills. *Turkish Journal of Educational Sciences, 15*(1), 1–25.

Tertemiz, N., Özkan, T., Çoban Sural, Ü., Ünlütürk Akçakın, H. (2015). An analysis of problem structures based on four operations of natural numbers in primary math textbooks. *International Journal of Turkish Education Sciences,* 2015(5), 119-137.

Tichá, M., & Hošpesová, A. (2013). Developing teachers' subject didactic competence through problem posing. *Educational Studies in Mathematics*, *83*, 133-14

Van De Walle, J. A., Karp, K. S., ve Bay-Williams, J. M. (2014). *İlkokul ve ortaokul matematiği: gelişimsel yaklaşımla öğretim*. Nobel Akademik Yayıncılık. ISBN: 978-605-133-423-3.

Van Harpen, X. Y., & Sriraman, B. (2013). Creativity and mathematical problem posing: an analysis of high school students' mathematical problem posing in China and the USA. *Educational Studies in Mathematics*, *82*, 201-221.

Xu, B., Cai, J., Liu, Q., & Hwang, S. (2020). Teachers' predictions of students' mathematical thinking related to problem posing. *International Journal of Educational Research*, *102*, 101427.

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