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INVESTIGATION OF THE PROBLEM POSING SKILLS ABOUT TABLES AND GRAPHICS (*)

(Araştırma Makalesi)

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Abstract

The aim of this study was to examine the 5th grade students' problem-posing skills appropriate to the problem situations (unstructured, semi-structured and structured) about tables and graphs. The method of the present study was qualitative research method, because it enables to examine the problem-posing skills of the students in detail. In a public school, a total of 15 students, 5 of whom participated pilot study, were included to this study. In order to achieve the aim of the study, the students were given a scale of 9 problems, which was prepared in line with the pilot study and expert opinions. The students were asked to pose as much as problems related to scoreboard, frequency table and column graph. After the problems were posed, semi-structured interview form was applied to the students. Content analysis method was used for data analysis. When the findings gathered from the data collection tool were examined, it was seen that the students had difficulty in posing a problem sentence and a large part of the question sentences generated were related to the exercise category. With respect to data gathered, problem posing scale could be used in further studies that would study problem posing. Besides, instructional processes and including this topic in textbooks would be the suggestions of this study.

Keywords: *Exercise, Graph, Problem, Problem Posing, Table.*

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Tablo ve Grafiklere Yönelik Problem Kurma Becerilerinin İncelenmesi

Öz

Bu çalışmanın amacı 5.sınıf öğrencilerinin tablo ve grafikler ile ilgili problem durumlarına uygun problem kurma becerilerini incelemektir. Çalışma yöntemi, öğrencilerin problem kurma becerilerini ayrıntılı bir şekilde incelemeyi hedeflediği için nitel araştırma yöntemidir. Bir devlet okulunda 5. sınıflardan seçilen örneklemden toplam 15 öğrenci ile çalışılmıştır. Öğrencilere, çalışmanın hedefine ulaşmak için pilot uygulama ve uzman görüşleri doğrultusunda hazırlanan 9 problemden oluşan bir problem kurma ölçeği verilmiştir. Öğrencilerden veri işleme alanı ile ilgili problem kurma durumlarına uygun kurabilecekleri kadar problem kurmaları istenmiştir. Problemler kurulduktan sonra öğrencilere yarı yapılandırılmış görüşme formu uygulanmıştır. Veri analizinde içerik analiz yöntemi kullanılmıştır. Araştırmada elde edilen bulgular incelendiğinde öğrencilerin problem cümlesi kurmada zorlandıkları ve oluşturulan soru cümlelerin büyük bir kısmının alıştırma kategorisi ile ilgili olduğu görülmüştür. Elde edilen bulgulara göre çalışmada kullanılan ölçek farklı problem kurma çalışmalarında kullanılabilir ve öğrencilerin problem kurma becerilerini geliştirmek için öğretimde ve ders kaynaklarında daha fazla problem kurma çalışmalarına yer verilebilir.

Anahtar Kelimeler: *Alıştırma, Grafik, Problem, Problem Kurma, Tablo.*

1. Introduction

There has been a change in the education process; individuals are supposed to internalize information and use it whenever necessary instead of just receiving it as it is (National Council of Teachers of Mathematics [NCTM], 2000). The individual must be active in education process (Kazak, 2012). In an education system in which the learner is active, individuals aren't supposed to memorize the information as it is (Polat, 2016). It is important to internalize the information, to add some ideas from itself, and to put the information ready into memory. The main objectives of Mathematics Curriculum (Ministry of National Education [MoNE], 2017) are to acquire and develop reasoning, communication, problem solving and correlation skills. The individual who gains problem solving skill understands what s/he reads and establishes a relationship between the data (Altun, 2012; Kükey, Aslaner and Tutak, 2019). Curriculum do not only emphasize the importance of problem posing skills (MoNE, 2017) but also solving the problems in daily life, posing problems that are new, thinking and gaining different ideas are also important.

The problem concept simply conjures up mathematics lessons or skills in many people. However, people are compelled to deal with many problems that they encounter in daily lives. Therefore, they may need to come up with new ideas to solve these problems and use their mathematics knowledge. Problem solving enables analysing the data, progressing systematically, creating individual's unique methods and strategies for problem solving

(Onkun-Özgür, 2018). While problem solving, individuals can also gain the ability to pose correct problem sentence or derivatives of the problem they are trying to solve.

Problem posing is an important activity and it is at the heart of mathematical activities (Geçici and Türnüklü, 2020; Kojima and Miwa, 2008). This skill gives students creative and productive features. It is an important part of students' education (Kilpatrik, 1987) and enables students to think, produce critically, and develop creative and analytical thinking skills (Aydoğdu İskenderoğlu, 2018; Nixon-Ponder, 2005). In addition, the ability to read and compose graphics and tables also contribute problem posing. Using visual data in daily life and using graphical representations provide easy understanding of the message to be given. With the development of technology and science, the need for graphics and tables in daily activities has increased and its usage has spread (Glazer, 2011). The visual aspects of graphics facilitate the comparison of the data and the understanding of the relationship between them.

1.1. Problem posing

The problem posing skill means composing a new problem instead of solving a given problem (Dede and Yaman, 2005). The new problem is composed on an event or a situation. Problem posing has also been described in many studies. Leung (1993), for instance, stated that problem posing is about rearranging a given problem. According to Gonzales (1998), problem posing is the fifth stage of the Polya's four stages of problem solving. Stoyanova (2005) as cited from Duncer (1945) expressed that problem posing is a demonstration of a situation once again. It can also be defined as the mathematical process in which students use their mathematics experience (Nardone and Lee, 2011). NCTM (2000) expressed it as composing a new and specific problem from an existing situation. Moreover, Cai (2003) has defined that it is the key to discovering mathematics and is also more important process than problem solving. Problem posing is an inquiry process that shapes students' conversations in the classroom (Akay, 2006). Among definitions mentioned above, common issue they covered is that problem posing is the idea of introducing a new problem. It has many contributions to the development of students and teachers. Some of its contributions to student development are; helping students to realize the underlying causes of problems, understanding the relationship between the concepts and numbers (Dickerson, 1999), establishing a relationship between real life and mathematics, and developing ideas about mathematics (Abu-Elwan, 2002). In addition, understanding student's success in mathematical definitions and concepts, increasing his/her ability to express mathematical situations verbally or in writing (Akay, 2006), noticing misconceptions about the problem, increasing his creative thinking skills (Çetinkaya, 2017; Singer, Vocia, and Pelczer, 2017), and decreasing fear of mathematics (Albayrak, İpek, and Işık, 2006) are other contributions. It provides the development of teaching awareness by taking responsibility to ensure learning (English, 1997), the development of reasoning skills, the capacity of comprehending problems (Arıkan and

Ünal, 2015; Cankoy and Darbaz, 2010; Ünveren Bilgiç and Argün, 2018) and the capacity of comprehending the feature of independent learners (Silver, 1994). Problem posing activities form the desire to participate all kinds of activities (Albayrak et al., 2006). As well, these activities contribute children to be social and active learners (Brown and Walter, 1990), improve their problem solving skills (English, 1997), and besides they also contribute to being critical about problem (Nixson-Ponder, 1995) and to approach analytically to real life issues (Lavy and Bershadsky, 2002).

In addition to its contributions to students, it also benefits teachers from different perspectives. Contribution of the problem-posing process on teachers and teachers' professional development is as follows; a problem posed reflects students' mathematical skill, interest and beliefs. The teacher could understand his/her students' interests' by examining problems posed (Toluk-Uçar, 2009). Since the problem posed is the follow-up of the student's mathematical knowledge it provides teacher convenience and problem posed is a beneficial tool for evaluating student's mathematical knowledge (Silver, 1994). It contributes prospective teachers to develop mathematical literacy skill as well (Ticha and Hospesova, 2009).

Research results on problem posing indicate that there is a close link between problem solving and posing (Gencer, 2019; Kilpatrick, 1987; Silver, 1994; Stoyanova and Ellerton, 1996; Lowrie, 2002; Stoyanova, 2005; Kılıç, 2011). While a student is posing problem, s/he enters into a more complex process than the problem solving process. For this reason, an individual with low problem solving success cannot be expected to show high success in the problem posing process (Gür and Korkmaz, 2003).

In addition to problem posing, the topics which are investigated are also different. In this study tables and graphs are chosen and issues regarded these topics are covered in the following section.

1.2. Tables and graphs

The graphic is expressed as the display of events with pictures or lines (Mail-Pala, 2011). The graphic is defined as one of the ways that summarizes the data and makes it easier to understand (Köklü, 2000). Many problems faced in daily life can be illustrated with shapes. Graphics make it easier to understand the importance of the problems and find solutions (Arıcı, 1998). This emphasizes its significance in terms of developing problem solving skill. It allows students to think spatially and as Beyazıt (2011) stated it contributes to the development of problem-solving skills. Graphics also improves communication skills. Showing information in different ways is usable for understanding. Symbols and graphics are powerful tools for demonstrating mathematical relationships. Graphs are the visual way of communicating between mathematical thoughts and people, and they are powerful learning tools (Ildırı, 2009). As understood, effective mathematics teaching should engage students in making connections among mathematical representations to deepen understanding of mathematical concepts (NCTM,

2014). Mathematical representations help students to make sense of problems, to find out if there is any relationship among quantities, and to understand mathematical concepts and procedures (NCTM, 2014). Besides, these representations give ideas about students' discourse. About this, Fuson, Kalchman, and Bransford (2005) stated that they help teachers to understand students' mathematical understanding and also enhance students' problem solving abilities. In this study, therefore, students' problem posing skills related to graphics and table topics were examined.

1.3. Academic researches on problem solving in tables and graphics

In the present study, it was aimed to examine 5th grade students' problem posing skills based on scoreboard, frequency table and column chart. Problems posed are aimed to examine as semi-structured, structured and unstructured problem-posing situations as constituted by Stoyanova and Ellerton (1996). NCTM (2000) also mentioned that for developing students' problem posing skill children are supposed to develop their own problems. Due to the importance of problem-posing and its necessity in mathematics education, this study was conducted on problem posing about frequency table, score board, and column graph. Researches involving problem-posing activities about tables and graphs are also included. First of all, Abu-Elwan (2002) selected his sample from prospective mathematics teachers and its purpose was examining pre-service teachers' problem posing and problem solving skills. Results indicated that given problems were solved easily, but participants had difficulty in problem posing. Kılıç (2011) examined primary mathematics curriculum objectives and specifically ones related with problem posing from grade 1 to grade 5, and the researcher found that there were problem posing objectives under number and measurement learning areas, but there weren't any under data processing learning area. Işık (2011) studied with 127 pre-service teachers and its purpose was examining conceptually the problems related to multiplication and division in fractions. It was found that there were deficiencies in meaning making about fractions and doing multiplication with integer fractions. Tertemiz and Sulak (2013) asked 5th grade students to pose problems after doing activities. Besides, it was observed that the students made changes in the data in the problems. Onkun-Özgür (2018) studied with 7th grade students and stated that it was aimed to examine students' problem-posing skills according to their problem-posing situations. Results indicated that students had difficulties in problem posing with semi-structured questions, but they were successful in unstructured problem-posing activity questions. Geçici and Türnüklü (2020) examined theses and dissertations done till 2018, they found out that these studies were generally about numbers and operations learning area. Researchers mentioned that these theses and dissertations were investigated students' operation skills (Geçici and Türnüklü, 2020). Another interesting finding of their study was that there were less theses and dissertations about geometry and measurement, algebra and data processing subjects. When these studies are considered altogether, there are various researches. However,

there are few studies in the literature examining problem posing skills related to data processing learning domain. When samples of these studies are considered, pre-service teachers were participants in general. This study will contribute to the literature in terms of the low number of studies conducted with 5th graders and specifically problem posing skill on data processing.

2. Method

In this research, case study approach was used. It was aimed to determine 5th grade students' current problem-posing skills about graphics and tables, the difficulties they faced while problem-posing and how their problem-posing skills were. Case study approach was used because problems posed contain incomplete information about the data processing and there was a need to conduct a detailed examination, such as which strategy the problem posing question sentences were suitable.

2.1. Participants

It was carried out in a secondary school in the fall semester of the 2019-2020 academic year in a district centre in the east of Turkey.

Table 1. Distribution of Participants with Regard to Academic Success and Gender

Academic success			**Gender**	
Low	**Middle**	**High**	**Female**	**Male**
Gamze Gülcan Baki Eser	Fatma Yusuf Emir	Songül Elif Eymen	Gamze Gülcan Fatma Songül Elif	Baki Eser Yusuf Emir Eymen
Total	Total	Total	Total	Total
4	3	3	5	5

The number of participant students according to gender and the general mathematics course achievement levels are presented in Table 1. Academic achievement of students was determined with respect to the opinions of their mathematics teacher. As seen in Table 1, five students in the study were female and others were male students. Participants were chosen with criterion sampling method which is one of the purposeful sampling methods. Criteria were being 5th grade students and had learned about scoreboard, frequency table and column graph during 3rd and 4th grades. Academic success and gender criteria were chosen in order to represent the whole classroom the participants were chosen. Throughout the study pseudonyms in accordance with their gender were used.

2.2. Data gathering process

The data gathering process began after receiving necessary permissions from Provincial and District National Education Directorates (Appendix 1). First of all, a question pool was created for the problem posing scale (PPS). In order to organize questions prepared before the pilot study, the opinions of two experts who completed their doctorate on mathematics education and who had academic studies on the problem were consulted. PPS was applied to five students for pilot study and it was completed in 2 weeks. After content analysis, it was found that PPS was appropriate. In addition, semi-structured interviews were conducted with these students who took PPS.

Table 2. The Distribution of Questions in Problem Posing Scale (PPS)

Data Processing Area Subject	The type of problem posing strategies		
	Unstructured	Semi-structured	Structured
Scoreboard	1	1	1
Frequency Table	1	1	1
Column graph	1	1	1

2.3. Data gathering tools

Two data gathering tools were used in the research; problem posing scale and semi-structured interview form. While constituting PPS, the current literature, 5th grade mathematics curriculum and expert opinions were considered. Three types of Stoyanova and Ellerton's (1996) problem-posing strategies were taken into consideration; semi-structured, structured and unstructured. Experts were two different faculty members who studied in mathematics education. It was aimed to provide content and face validities by getting experts' opinion. In accordance with experts' opinions, changes were made according to the way the questions were expressed. For this purpose, the study was carried out with the participation of 10 5th grade students after PPS took its final form. The PPS was open-ended and students were asked to pose as many problems as they would like to establish for each question. It was planned to give students each question on separate papers and to apply one problem every week. The reason for this was preventing boredom and distraction in students in the main study. The implementation of PPS was completed in 9 weeks (1 question each week). While application of PPS, enough time was given in pilot practice for students to establish problems and wrote down their problems. After pilot study, the researcher determined that it was sufficient to give one lesson hour (40 minutes) for each PPS question in the main study.

Interviews were made with each student who participated in the implementation of PPS. According to Patton (1987), for getting same kind of information from different people could be done by focusing on similar issues in the semi-structured interview

form. In forming the semi-structured interview form, researches related to problem solving with tables and graphics and elementary mathematics curriculum were used. The semi-structured interview form was submitted to two different experts and afterwards the interview form took its final form. Experts had studies on elementary mathematics education and used qualitative research methods in their studies. By getting experts' opinion, validity and reliability were provided. While application of PPS and semi-structured interview form, audio and video recordings were carried out by the researcher. While the researcher was collecting the data, the student was found in a classroom environment that didn't disturb the attention, and placed the audio and video recorders in suitable places for the same purpose during the interview. The aim was not to spoil the natural environment and to reach useful data for research. In the data analysis process, the analysis of the audio and video documents was done appropriately. The researcher carried out the process of working impartially, collecting data, evaluating and analysing data, and avoiding prejudices.

2.4. Data analysis

In the content analysis method, similar and related expressions are collected under the same concept or the same themes. Thus, it can be easily understood by the reader (Yıldırım and Şimşek, 2018). In this study, content analysis method was used. The purpose of using content analysis is to facilitate the interpretation of data by combining similar concepts. The analysis of PPS was made in accordance with content analysis method as well.

While analysing problem-posing responses, many researchers (Işık, Kar, Yalçın, and Zehir, 2011; Aydoğdu-İskenderoğlu and Güneş, 2016; Şengül-Akdemir and Türnüklü, 2017) used problem, not problem and empty categories. The diagram that was deemed appropriate for the study is given below.

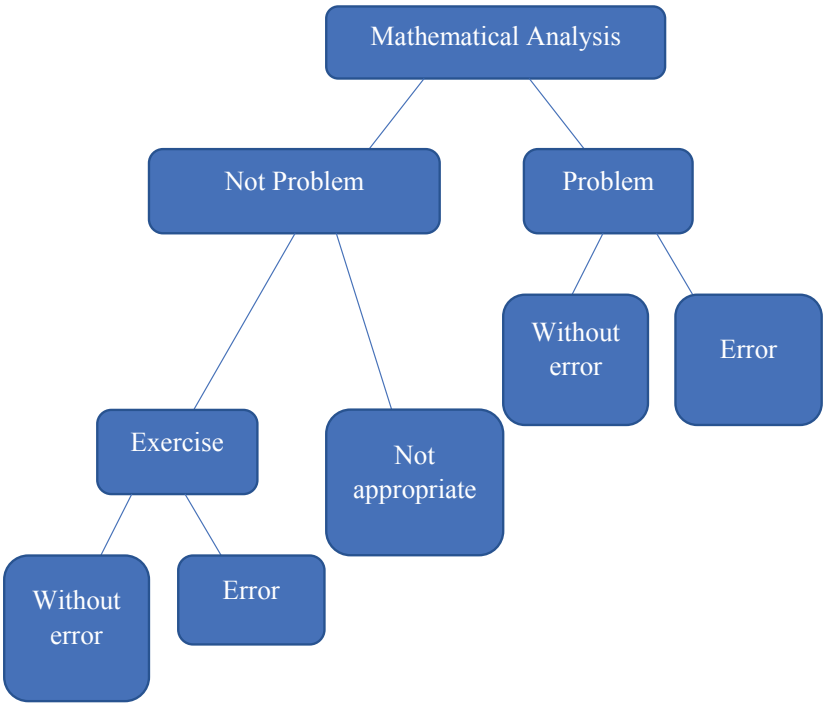

Figure 1. Mathematical analysis diagram (Onkun- Özgür, 2018).

Figure 1 was used for this study as a result of evaluations made in the field survey (Onkun-Özgür, 2018; Yenilmez and Ev-Çimen, 2014; Altun, 2015). In the mathematical analysis of the problems established by the students as in Figure 1, the question sentences are divided into two; problem and not problem. Problems are divided into two; false and error-free. Non-problematic statements are divided as exercises and not appropriate. Exercise questions are also grouped as incorrect and errorless. In this study, students' problems were first grouped as problem and not problem. In the definition of problems and exercises, the questions were divided into appropriate categories by making use of the definition of Yenilmez and Ev-Çimen (2014). According to Yenilmez and Ev-Çimen (2014), exercises are routine practices that involve easy operations with the aim of developing students' mathematical skills, and problems have uncertain result, power, and they require research. In this study, the reason for using the exercise and problem definition of Yenilmez and Ev-Çimen (2014) is the opinion that it will be useful for categorizing the questions with and without problems.

In the analysis of the research, the categories used by Onkun-Özgür (2018) for problem posing were used in this study. The Table 3 was used when forming categories according to the problems posed by the students in PPS.

Table 3. Categories Used After Analysis Process (Onkun- Özgür, 2018)

Problem		**Not Problem**		
With error	**Without Error**	**Exercise**		**Not appropriate**
		With error	**Without error**	
• Not solvable • Less / more information in problem story • Logical fallacy in problem story / question root • Error in unit • Multi stage operation • Conceptual error/ irrelevant to topic • Data written/ used wrongly	• Solvable • Appropriate to problem definition • Logical • Related to topic • No lack of statement / word • No incoherency • No irrelevant information • Understandable	• Not solvable • Less / more information in problem story • Logical fallacy in problem story / question root • Error in unit • Conceptual error/ irrelevant to topic • Data written/ used wrongly • Result is obvious	• Solvable • Appropriate to exercise definition • Logical/ consistent • Related to topic • No incoherency • No useless information • No deficiency in statement /word • Understandable	• Only descriptive information • No question root • Result is in problem statement • Empty

The diversity of data gathering tools is one of the factors that increase the validity and reliability of the study. In this study, more than one data gathering tool was used to increase reliability and validity. For credibility, these tools were presented to experts' opinions. For transferability, to Baştürk, Dönmez, and Dicle (2013), it can be generalized to other examples or situations. This study can be applied to similar problem-posing situations. In addition, the data gathered were transferred without adding comments (Yıldırım and Şimşek, 2018). For consistency, similar features of data gathering tool can be applied on the same individuals again (Dinç, 2018). The problems, audio and video recordings were interpreted by two experts and it was found out that there were similar comments with the researcher. According to Yıldırım and Şimşek (2018), confirmability depends on the expressiveness of the participants, the data gathering tool and the method. In this study, sampling, measurement tools and applied methods are clearly stated. Detailed explanations were supported with academic studies and reliability was tried to be increased.

The data gathered from the semi-structured interview form were analysed. The findings were coded by two other experts. Reliability among coders was calculated by "Consensus / (Consensus + Disagreement) x 100" (Miles and Huberman, 1994). Depending on the formula, the reliability was calculated as 92%. Since this result is more than 70%, the results are considered reliable. For instance, in the interview with Songül about column graph, Songül expressed that she experienced difficulty while she was filling the column

graph. Both coders coded this expression under "difficulty" code.

2.1. Ethical issues

Before beginning the study, data gathering tools were presented to University Ethical Board. When they approved the tools, researchers applied Provincial and District National Education Directorates for legal permissions for the study.

3. Results

3.1. Problem posing results with respect to scoreboard

In Table 4, the number of questions posed by the students regarding the scoreboard under structured, semi-structured and unstructured situations, and exercises are presented.

Table 4. Results with respect to Scoreboard

Problem posing situations	Problem		Not problem			Total
			Exercise		Not appropriate	
	Error	Without error	Error	Without error		
Structured	1*	0	12	25	7	45
Semi-structured	8	2	11	28	4	53
Unstructured	3	6	25	14	3	51
Total	12	8	48	67	14	149

*frequency

In Table 4, 149 questions about the scoreboard were posed. 12 of the problems posed had error and 8 were error-free problems. 48 of the questions are presented under exercise category and had errors, and 67 were error-free. 14 questions were under not appropriate category. About semi structured problem posing situation there were 53 questions, 51 for unstructured situations, and 45 for structured situations.

Figure 2 below presents an example of exercise without error question (scoreboard):

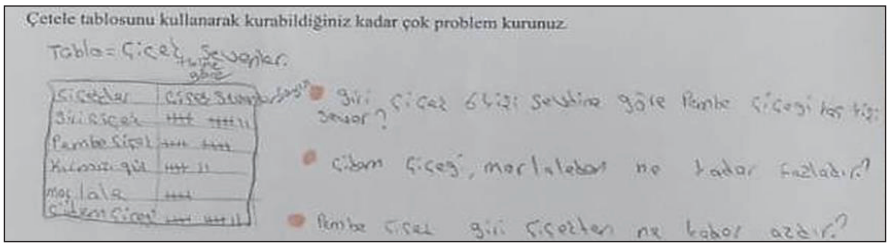

Figure 2. Exercise without Error Question - Gamze

Gamze posed a question appropriate to exercise without error category. Table and story of question were completed thoroughly. Gamze used understandable and single step expression. Dialogue between the researcher and Gamze was as follows:

R: What did you feel when you were asked to constitute your own question without any given tables or figures?

Gamze: I feel happy while I was constituting my own table and I feel relieved.

R: Where did you begin posing problem?

Gamze: First of all, I thought that what had to be on a scoreboard. And then, I love flowers so, I included names of flowers into the table.

R: Then, what did you do?

Gamze: What flower is more than the other? I wrote question statements about it.

R: About the first question you posed, did you want to ask those who loves pink flowers?

Gamze: Yes. I wanted to ask a simple question in which its answer could be answered easily.

R: Didn't you want to ask a difficult question?

Gamze: Actually, I wanted to ask. But I always thought of comparing them.

As seen in the interview with Gamze, she knew scoreboard but she only thought about comparison questions so she posed simple question.

3.2. Problem posing results with respect to frequency table

In Table 5, the number of questions related to the frequency table under structured, semi-structured and unstructured situations and as well exercises included in not problem category are presented.

Table 5. Results with respect to Frequency Table

Problem posing situations	Problem		Not Problem			Total
			Exercise		Not appropriate	
	Error	Without error	Error	Without error		
Structured	3*	2	20	12	7	44
Semi-structured	4	3	24	16	15	62
Unstructured	3	5	14	21	0	43
Total	10	10	58	49	22	149

*frequency

In Table 5, 149 questions related to the frequency table were presented. 10 of the problems had error and 10 problems were error-free. Under exercise category, 58 questions had error, 49 questions were error-free exercises and 22 questions were under not appropriate category. Most questions were posed when children were given semi-structured situations. 44 questions were posed under structured situations and 43 questions were posed under unstructured situations.

Figure 3 below presents an example of problem with error question (frequency table):

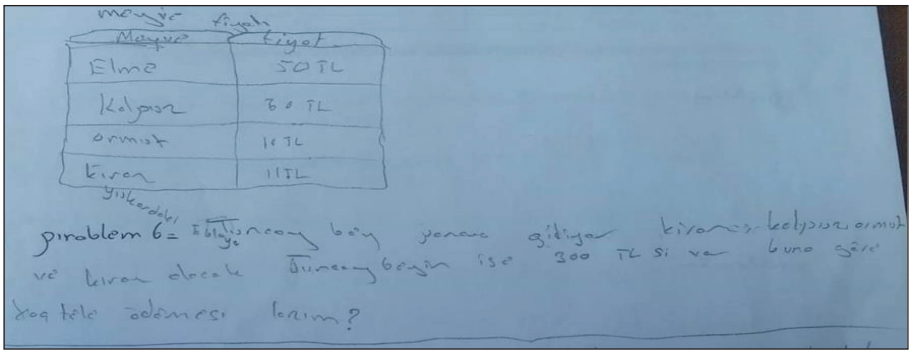

Figure 3. Problem with Error Question - Eymen

As seen in Figure 3, Eymen constituted a frequency table from his pre-knowledge. With the data he constituted, he posed a problem. However, due to lack of knowledge in his table's story his problem was not clear and understandable. Eymen didn't mention about the price of one kilo of the fruits. Therefore, he posed a problem with error. The interview between the researcher and Eymen was as follows:

R: (While showing the problem to the student) I guess you didn't want to adhere to given data. What was the reason behind this decision?

Eymen: At first, I wanted to draw a table.

R: What was the beginning point while you were posing the problem?

Eymen: I began with drawing a table.

R: Ok, when you read the question is there anything else that takes your attention?

Eymen: I wanted to mention about the types of fruits and their prices. So, I wanted to ask if someone had 300 TL and wanted to buy all fruits. As a result, I asked how much money s/he would spend.

R: Ok. But it seems like you didn't mention about how many kilos of fruits they would buy.

Eymen: Yes. Actually I was thinking to write. In fact I like pear a lot, I thought to write 5 kilos of pear. I should have mentioned about how many kilos of fruits, on the other hand how they would decide this. I rushed and forgot.

As seen from this interview, the reason behind the lack of data is forgetting problem story and the reason behind changing all things in table is posing his own question.

3.3. Problem posing results with respect to column graph

In Table 6, the problem posed appropriate to column graph under structured, semi-structured and unstructured situations, and the number of problems, exercise and not problem categories are presented.

Table 6. Results with respect to Column Graph

Problem posing situations	Problem		Not Problem			Total
			Exercise		Not appropriate	
	Error	Without error	Error	Without error		
Structured	5*	2	29	10	5	51
Semi-structured	1	4	6	35	6	52
Unstructured	0	1	17	25	2	45
Total	6	7	52	70	13	148

*frequency

In Table 6, 148 questions appropriate to the column graph were posed. 6 of problems had error and 7 problems were error-free. 52 questions were with error and 70 were error-free under exercise category and 13 questions were under not appropriate categories. 52 questions were posed when students were given semi-structured problem situations. 51 were posed when structured problem situations given and lastly 45 questions were posed when unstructured problem posing situations were given.

Figure 4 below presents an example of problem without error question (column chart):

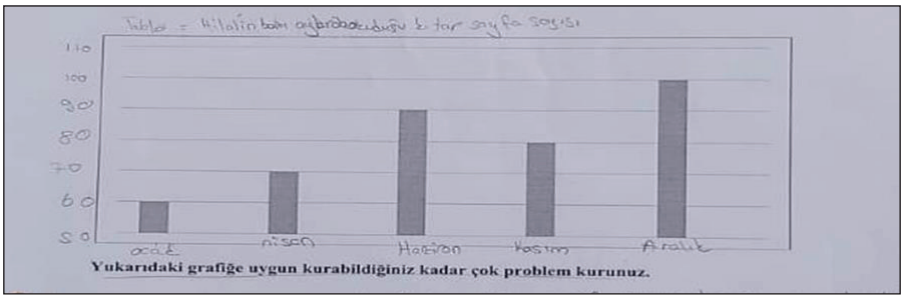

Figure 4. Problem without error question – Songül.

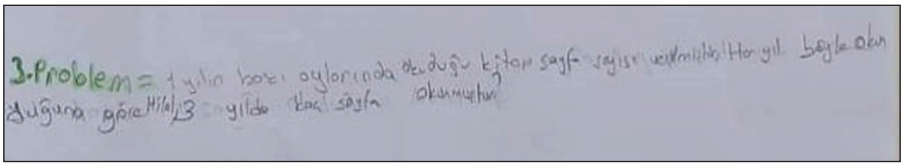

Figure 5. Problem without error question (continued) – Songül.

As seen in Figure 4 and 5, Songül posed a problem without error which doesn't include any missing or much data, solvable and needs multistep operations for solving it. The interview between Songül and researcher was as follows:

R: You completed all the missing things of the column graph. Which missing thing did you began with?

Songül: At first, I wrote the name of the graph. Then, I wrote months and the number of pages to its side.

R: What did you feel when you were posing the problem?

Songül: It was a little difficult to write the numbers both under and side the columns.

R: Compared to other questions, I mean, questions for tables, was it more difficult or easier?

Songül: Yes. They were easier. I could immediately fill them.

R: In your problem, you asked the number of pages read for 3 years. Could you explain your problem?

Songül: I thought that everyone could answer the number of pages read for a year. I wanted my problem a little difficult.

As understood from interview, she began with filling data of column graph. She experienced a little difficulty in this column graph with respect to other table questions. She thought about the result of the problem before posing the problem.

In Table 7, as a result of the analysis of students' scoreboard, frequency table and column graph under structured, semi-structured and unstructured problem-posing situations and how many questions they wrote for each category are presented.

Table 7. General Results with respect to PSP

Problem posing situations	**Problem**		**Not Problem**			**Total (f and %)**
			Exercise		**Not appropriate**	
	Error	**Without error**	**Error**	**Without error**		
Structured situation for scoreboard	1*	0	12	25	7	45 (10.1%)
Semi-structured situation for scoreboard	8	2	11	28	4	53 (11.9%)
Unstructured situation for scoreboard	3	6	25	14	3	51 (11.4%)
Structured situation for frequency table	3	2	20	12	7	44 (9.9%)
Semi-structured situation for frequency table	4	3	24	16	15	62 (13.9%)
Unstructured situation for frequency table	3	5	14	21	0	43 (9.7%)
Structured situation for column graph	5	2	29	10	5	51 (11.4%)
Semi-structured situation for column graph	1	4	6	35	6	52 (11.6%)
Unstructured situation for column graph	0	1	17	25	2	45 (10.1%)
Total (f and %)	28 (6.3%)	25 (5.6%)	158 (35.4%)	186 (41.7%)	49 (11%)	446 (100%)

*frequency

A total of 446 questions were posed. It was determined that an equal number of questions were posed about the scoreboard and frequency table, and about column chart only one missing number of questions was posed. According to the analysis, 11.9% of the questions posed by the students were problems (with and without error), 77.1% were exercises (with and without error), and 11% of the questions were under not appropriate category. Students posed the most questions under the exercise category. 31.4% of the questions were posed under structured problem situation, 37.4% of them were posed under semi-structured situations, and 31.2% of them were posed under unstructured situations. It was observed that the students posed most questions under semi-structured situations. The exercise category question distribution, which constituted 77.1% of the questions, indicated that students posed most questions under this category. According to the analysis, the distribution of questions was determined as 41.9% with error and 47.3% as without error questions. This data also showed that there were more without error questions.

4. Discussion, Conclusion and Implications

The aim of this research was to examine 5th grade students' problem posing skills about scoreboard, frequency table and column graph under data processing learning domain. In order to achieve this aim, students were given PPS and their questions were evaluated. In addition, semi-structured interview forms were conducted to get detailed information about the problems posed. In this research, it was found out that students posed most problems under semi-structured situations. Interviews with the students also indicated that they didn't have difficulty in semi-structured problem situations. Besides, it was seen that the least number of questions were posed under structured situations. However, the students said that they had difficulty in unstructured problem situations during the interviews. A similar result was found in Köken, Adıgüzel, Çubukluöz, and Gökkurt-Özdemir (2018) with 7th grade students. In their study, students had more difficulties when posing problems in structured problem-posing situations. Onkun-Özgür (2018), on the other hand, stated in his study on data processing that students had the most difficulty in posing under unstructured problem situations where the data were given the least. In problem situations where column and circle charts were given completely, it was determined that they had the least difficulty. In Çomarlı's (2018) study in the field of data processing, it was found that mathematics teacher had more difficulties in posing problems under unstructured problem situations. The same result was found in Çetinkaya's (2017) study. Contrary to these studies, Dinç's (2018) study with 7th grade students, the semi-structured problem-posing situation was the most difficult one that students had experienced. In the field survey (Onkun-Özgür, 2018; Çomarlı, 2018; Çetinkaya, 2017), it was observed that the students had difficulties in unstructured problem situations. Therefore, unlike these studies, in this and Dinç's (2018) studies, students posed more problems in the case of posing semi-structured problems. In interviews with students, it was observed

that they didn't have difficulty in semi-structured problem situations, but in unstructured problem situations, where they were released in all data, they had difficulty in placing the data in spite of the structured problem situation. Onkun-Özgür's (2018) and Çomarlı's (2018) studies were related to the data processing learning area. The students expressed that they had difficulty in posing under unstructured situations while interviews with students. However, unlike these studies, students posed questions in a smaller number of problem categories in the PPS related to the semi-structured problem situation in the data processing.

It was seen that some students couldn't pose a problem. In the interviews with the students, it was determined that they didn't read the problems they posed, they didn't check and the reasons for not being able to pose problems weren't lack of knowledge but might be due to attention. Similarly, Çomarlı (2018) stated that students' lack of attention and the reasons for the posing of problems were also lack of attention. Dinç (2018), on the other hand, found that students, who couldn't pose problems, focused on the problem related fiction and forgot to write question sentences. Therefore, there are various reasons behind not being able to pose problems.

In Çetinkaya's (2018) study with 8th grade students, she determined that the students were trying to make the questions difficult and for this reason, there were logic errors due to missing or unnecessary sentence in problem sentences. A similar situation was observed in this study. During the interview with the students, it was determined that they were worried about how to pose a difficult problem.

It is seen that the total number of questions posed by students about scoreboard, frequency table and column graph is 149, 149 and 148, respectively. The reason for the number of questions being equal and very close to each other might be due to the duration of one lesson (40 minutes) given to the students during the study process. Posing the same amount of problems on average might be due to this reason. The fact that students were taught at the same school and experience in the same environment might have also affected the number of story fiction related to problem posing. It was determined that the students posed problems and exercises with missing data. For this reason, it was observed that the numbers of incorrect problem and incorrect exercise category were high. Similar results were seen in the problem-posing studies of Onkun-Özgür (2018), Dinç (2018) and Kılıç (2013). Therefore, findings of this study are appropriate to current literature.

In accordance with the results of this study, the following suggestions can be presented:

- Students posed mostly exercise questions instead of problems. This is due to the fact that students encounter more exercise questions in textbooks and during instructional processes. It is necessary to include improvements for this in instructional processes. One of these improvements may be the increase in the number of acquisitions related to problem posing in the Mathematics curriculum.
- During semi-structured interviews, it was observed that many of the errors in

the problems were due to lack of attention. With the help of teacher, guidance on students' attention deficit can be enhanced.

- The research was a qualitative research and was limited to 10 students in actual study and 5 students in pilot study. Researchers who want to research on problem posing can be suggested to study with more samples including different factors (subject, environment, class, different measurement tools etc.).
- For another study, the errors that students made about problem posing can be identified and feedback can be provided, and it may be beneficial for teaching problem posing.

References

Abu-Elwan, R. (2002). Effectiveness of problem posing strategies on prospective mathematics teachers. Problem solving performance. *Journal of Science and Mathematics Education in S.E. Asia, 25*(1), 56-69.

Akay, H. (2006). *Problem kurma yaklaşımı ile yapılan matematik öğretiminin öğrencilerin akademik başarısı, problem çözme becerisi ve yaratıcılığı üzerindeki etkisinin incelenmesi*. Unpublished doctorate dissertation, Ankara: Gazi University Educational Sciences Institute.

Albayrak M., İpek, S., and Işık, C. (2006). Temel işlem becerilerinin öğretiminde problem kurma-çözme çalışmaları. *Erzincan Eğitim Fakültesi Dergisi, 8*(2), 1-11.

Altun, M. (2012). *İlköğretim ikinci kademede (6, 7 ve 8. sınıflarda) matematik öğretimi*. İstanbul: Alfa Aktüel Yayınları.

Altun, M. (2015). *Ortaokullarda (5, 6, 7 ve 8. sınıflarda) matematik öğretimi*. (10. Edition). Bursa: Aktüel Yayınları.

Arıcı, H. (1998). *İstatistik yöntemler ve uygulamalar*. Ankara: Metaksan Yayınları.

Arıkan, E. E. and Ünal, D. (2015). An investigation of eight grade students' problem psoing skills (Turkey sample). International *Journal of Resaerch in Education and Science, 1*(1), 23-30.

Aydoğdu İskenderoğlu, T. (2018). Fraction multiplication and division Word problems posed by different years of pre-service elementary mathematics teachers. *European Journal of Educational Research, 7*(2), 373-385.

Aydoğdu İskenderoğlu, T. and Güneş, G. (2016). Pedagojik formasyon eğitimi alan matematik bölümü öğrencilerinin problem kurma becerilerinin incelenmesi. *Sakarya University Journal of Education*, *6*, 26-45.

Baştürk, S., Dönmez, G., and Dicle, A. N. (2013). Geçerlik ve güvenilirlik. In S. Baştürk (Ed.). *Bilimsel Araştırma Yöntemleri*. Ankara: Vize Yayıncılık, s. 161-194'deki kitap bölümü.

Beyazıt, İ. (2011). Öğretmen adaylarının grafikler konusundaki bilgi düzeyleri. *Gaziantep Üniversitesi Sosyal Bilimler Dergisi*, *10*(4), 1325-1346.

Brown, S.I. and Walter, M. I. (1990). *The art of problem posing*. (2nd Ed.). New Jersey: Lawrence Erlbaum Associates, Inc. Publishers.

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.

Cankoy, O. and Darbaz S. (2010). Problem kurma temelli problem çözme öğretiminin problemi anlama başarısına etkisi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 38*, 11-24.

Çetinkaya, A. (2017). *İlköğretim 8. sınıf öğrencilerinin problem kurma becerilerinin incelenmesi*. Unpublished master's thesis, Kayseri: Erciyes University Educational Sciences Institute.

Çomarlı, S. K. (2018). *Ortaokul matematik öğretmenlerinin veri işleme öğrenme alanına ilişkin problem kurma becerilerinin incelenmesi*. Unpublished master's thesis, Bartın: Bartın University Educational Sciences Institute.

Dede, Y. and Yaman, S. (2005). Matematik öğretmen adaylarının matematiksel problem kurma ve problem çözme becerilerinin belirlenmesi. *Eğitim Araştırmaları Dergisi, 18,* 41-56.

Dickerson, V. M. (1999). *The impact of problem-posing instruction on the mathematical problem solving achievement of seventh graders*. Unpublished doctorate dissertation, Atlanta: University of Emory.

Dinç, B. (2018). *Yedinci sınıf öğrencilerinin gerçek yaşam durumlarına uygun problem kurma becerilerinin incelenmesi*. Unpublished master's thesis, Eskişehir: Eskişehir Osmangazi University Educational Sciences Institute.

English, L. D. (1997). Development of seventh-grade students' problem posing. In E. Pehkonen (Ed.), *21st Conference of the International Group for the Psychology of Mathematics Education,* (Volume 2, 241-248). Lahti, Finland.

Fuson, K. C., Kalchman, M., and Bransford, J. D. (2005). Mathematical understanding: An introduction. In S. Donovan and J. D. Bransford (Eds.), How students learn: History, mathematics, and science in the classroom (217-256). Washington, D. C.: National Academics Press.

Geçici, M. E. and Türnüklü, E. (2020). Türkiye'de problem kurma üzerine hazırlanan tezlerin tematik açıdan incelenmesi. *International e-Journal of Educational Studies (IEJES), 4*(7), 56-69.

Gencer, G. K. (2019). *Problem çözme strateji eğitimi ve matematiksel problem kurma becerisi arasındaki ilişkinin farklı değişkenler açıcından incelenmesi*. Unpublished master's thesis, Bursa: Uludağ University Educational Sciences

Institute.

Glazer, N. (2011). Challenges with graph interpretation: A review of the literature. *Studies in Science Education, 47*(2), 183-210.

Gonzales, N. A. (1998). A blueprint for problem posing. *School Science and Mathematics, 94*(2), 78- 85.

Gür, H. and Korkmaz, E. (2003). *İlköğretim 7. sınıf öğrencilerinin problem ortaya atma becerilerinin belirlenmesi*. Retrieved 10 January, 2020, from http://www.matder.org.tr/ilkogretim-7-sinif-ogrencilerinin-problem-ortaya-atma-becerilerinin-belirlenmesi/

Ildırı, A. (2009). *İlköğretim beşinci sınıf matematik ders kitabında ve öğrenci çalışma kitabında yer alan problemlerin incelenmesi ve bu problemlere ilişkin öğretmen görüşlerinin alınması*. Unpublished master's thesis, Adana: Çukurova University Social Sciences Institute.

Işık, C. (2011). İlköğretim matematik öğretmeni adaylarının kesirlerde çarpma ve bölmeye yönelik kurdukları problemlerin analizi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 41*, 231-243.

Işık, C., Kar, T., Yalçın, T., and Zehir, K. (2011). Prospective teachers' skills in problem posing with regard to different problem posing models. *Procedia Social and Behavioral Sciences, 15*, 485–489.

Kazak, V. (2012). *İlköğretim 6. sınıf öğrencilerinin kesirlerde toplama işlemine yönelik sözel problem kurma ve problem çözme becerilerinin incelenmesi*. Unpublished master's thesis, Erzurum: Atatürk University Educational Sciences Institute.

Kılıç, Ç. (2011). İlköğretim matematik dersi öğretim programında yer alan problem kurma çalışmalarının incelenmesi. *Mersin Üniversitesi Eğitim Fakültesi Dergisi, 7*(2), 54-65.

Kılıç, Ç. (2013). İlköğretim öğrencilerinin doğal sayılarla dört işlem gerektiren problem kurma etkinliklerindeki performanslarının belirlenmesi. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 20,* 256-274.

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

Kojima, K., and Miwa, K. (2008). A system that facilitates diverse thinking in problem posing. *International Journal of Artificial Intelligence in Education, 18*(3), 209-236.

Köken, C. B., Adıgüzel, T., Çubukluöz, Ö., and Gökkurt-Özdemir, B. (2018, April). *7. sınıf öğrencilerinin problem kurma süreçlerinin incelenmesi: birinci dereceden bir bilinmeyenli denklemler örneği.* Paper presented at the **II.** Uluslararası Sınırsız Eğitim ve Araştırma Sempozyumu, Bodrum, Muğla.

Köklü, N. (2000). *Sosyal bilimler için istatistiğe giriş*. Ankara: Pegem Akademi Yayıncılık.

Kükey, E., Aslaner, R., and Tutak, T. (2019). An investigation of the problem solving strategies used of middle school students for of the assumption component of mathematical thinking. *Journal of Computer and Education Research, 7*(13), 146-170.

Lavy, I. and Bershadsky, I. (2002). "What if not?" Problem Posing And Spatial Geometry –A Case Study. In A. D. Cockburn & E. Nardi (Eds.), *Proceedings of 29ht PME International Conference, 3,* 281-288.

Leung, S. (1993). *The relation of mathematical knowledge and creative things to the mathematical problems posing of prospective elementary school teachers on tasks differing in numerical information content*. Unpublished doctorate dissertation, Pittsburg: University of Pittsburg.

Lowrie, T. (2002). Designing a framework for problem posing: young children generating open-ended tasks. *Contemporary Issues in Early Childhood, 3*(3), 354-364.

Mail-Pala, Ş. (2011). *Matematik becerisinin sosyal bilgiler derslerindeki harita, grafik ve tablo okuma becerilerine etkisi*. Unpublished master's thesis, Erzincan: Erzincan University Social Sciences Institute.

Miles, M. B. and Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (3rd Ed.). Newbury Park, CA: Sage Publications.

Ministry of National Education [MoNE]. (2017). *İlköğretim matematik dersi 6-8. sınıflar öğretim programı ve kılavuzu*. Ankara: MEB Yayınları.

Nardone, C. F. and Lee, R. G. (2011). Critical inquiry across disciplines: Strategies for student-generated problem posing. *College Teaching, 59*(1), 13-22.

National Council of Teachers of Mathematics, [NCTM]. (2000). *Principles And Standards For School Mathematics*. Reston, VA: National Council of Teachers of Mathematics.

NCTM, (2014). Principles to actions: Ensuring mathematical success for all. Reston, VA: National Council of Teachers of Mathematics.

Nixon-Ponder, S. (1995). Using problem posing dialogue in adult literacy education: Teacher to teacher. *Adult Learning, 7*(2), 10-12.

Onkun-Özgür, E. (2018). *Yedinci sınıf öğrencilerin sütun ve daire grafiğine uygun problem kurma becerilerinin incelenmesi*. Unpublished master's thesis, Eskişehir: Eskişehir Osmangazi University Educational Sciences Institute.

Patton, M. Q. (1987). *How to use qualitative methods in evaluation*. Thousand Oaks, CA: Sage.

Polat, F. (2016). *Ortaokul öğrencilerinin fen derslerinde kullanılan grafikleri okuma*

becerileri ve grafiklere yönelik görüşleri. Unpublished master's thesis, Sivas: Cumhuriyet University Educational Sciences Institute.

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

Singer, F., M., Voica, C., and Pelczer, I. (2017). Cognitive styles in posing geometry problems: Implications for assessment of mathematical creativity. *ZDM Mathematics Education, 49*(1), 37-52.

Stoyanova, E. and Ellerton, N. F. (1996). A framework for research into students' problem posing. In P. Clarkson (Ed.), *Technology in Mathematics Education* (518-525). Melbourne: Mathematics Education Research Group of Australasia.

Stoyanova, E. (2005). Extending students' understanding of mathematics via problem-posing. *Australian Mathematics Teacher, 59*(2), 32-40.

Şengül-Akdemir, T. and Türnüklü, E. (2017). Ortaokul 6. sınıf öğrencilerinin açılar ile ilgili problem kurma süreçlerinin incelenmesi. *International Journal of New Trends in Arts, Sports & Science Education, 6*(2), 17-39.

Tertemiz, N. and Sulak, S. E. (2013). İlköğretim beşinci sınıf öğrencilerinin problem kurma becerilerinin incelenmesi. *İlköğretim Online, 12*(3), 713-729.

Tichá, M. and Hošpesová, A. (2009). Problem posing and development of pedagogical content knowledge in pre-service teacher training. In V. Durand-Guerrier, S. Soury-Lavergne, and F. Arzarello (Eds.), *Proceedings of the sixth congress of the european society for research in mathematics education* (1941-1950). Lyon: Institut National De Recherche Pédagogique.

Toluk-Uçar, Z. (2009). Developing pre-service teachers understanding of fractions through problem posing. *Teaching and Teacher Education, 25*, 166–175.

Ünveren Bilgi., E. N. and Argün, Z. (2018). Examining prospective proimary school mathematics teachers' algebraic habits of mind in the context of problem solving. *International e-Journal of Educational Studies, 2*(4), 64-80.

Yenilmez, K. and Ev-Çimen, E. (2014). Matematik öğretmeni adaylarının "örnek, alıştırma, problem" oluşturma çalışmalarının incelenmesi. *Eğitim ve Öğretim Araştırmaları Dergisi, 3*(3), 76-84.

Yıldırım, A. and Şimşek, H. (2018). *Sosyal bilimlerde nitel araştırma yöntemleri*. (11th Ed.). Ankara: Seçkin Yayıncılık.

Ek 1: Appendix (Research Permission)

T.C.
DOĞUBAYAZIT KAYMAKAMLIĞI
İlçe Milli Eğitim Müdürlüğü

Sayı : 92732475-903.01-E.22018380 07.11.2019
Konu : Ferice HAN'ın Yüksek Lisans Araştırma İzni

DOĞUBAYAZIT KAYMAKAMLIĞINA
İlçe Milli Eğitim Müdürlüğü

İlgi: [redacted] Müdürlüğünün 30.10.2019 Tarih ve 21192175 sayılı yazısı.

[redacted] Matematik Öğretmeni olup; Müdür Yardımcısı görevi yapmakta olan [redacted] T.C. Nolu Ferice HAN'ın "5. Sınıf Öğrencilerin Tablo Ve Grafiklere Yönelik Problem Durumlarına Uygun Problem Kurma Becerilerinin İncelenmesi " konulu yüksek lisans tezi için ilçemiz ortaokullarında araştırma yapması Müdürlüğümüzce uygun Görülse de;

Makamlarınızca da uygun görülmesi halinde olurlarınıza arz ederim.

Mehmet Emin ELNAZİK
Şube Müdürü

OLUR
07.11.2019

Bülent AYDEMİR
Kaymakam a.
İlçe Milli Eğitim Müdür V.

EK 1: Dilekçe
Ek 2: Yüksek lisans öğrenci belgesi
EK 3: Yüksek lisans Transkrip belgesi

Adres:
Elektronik Ağ:
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Bilgi için:
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