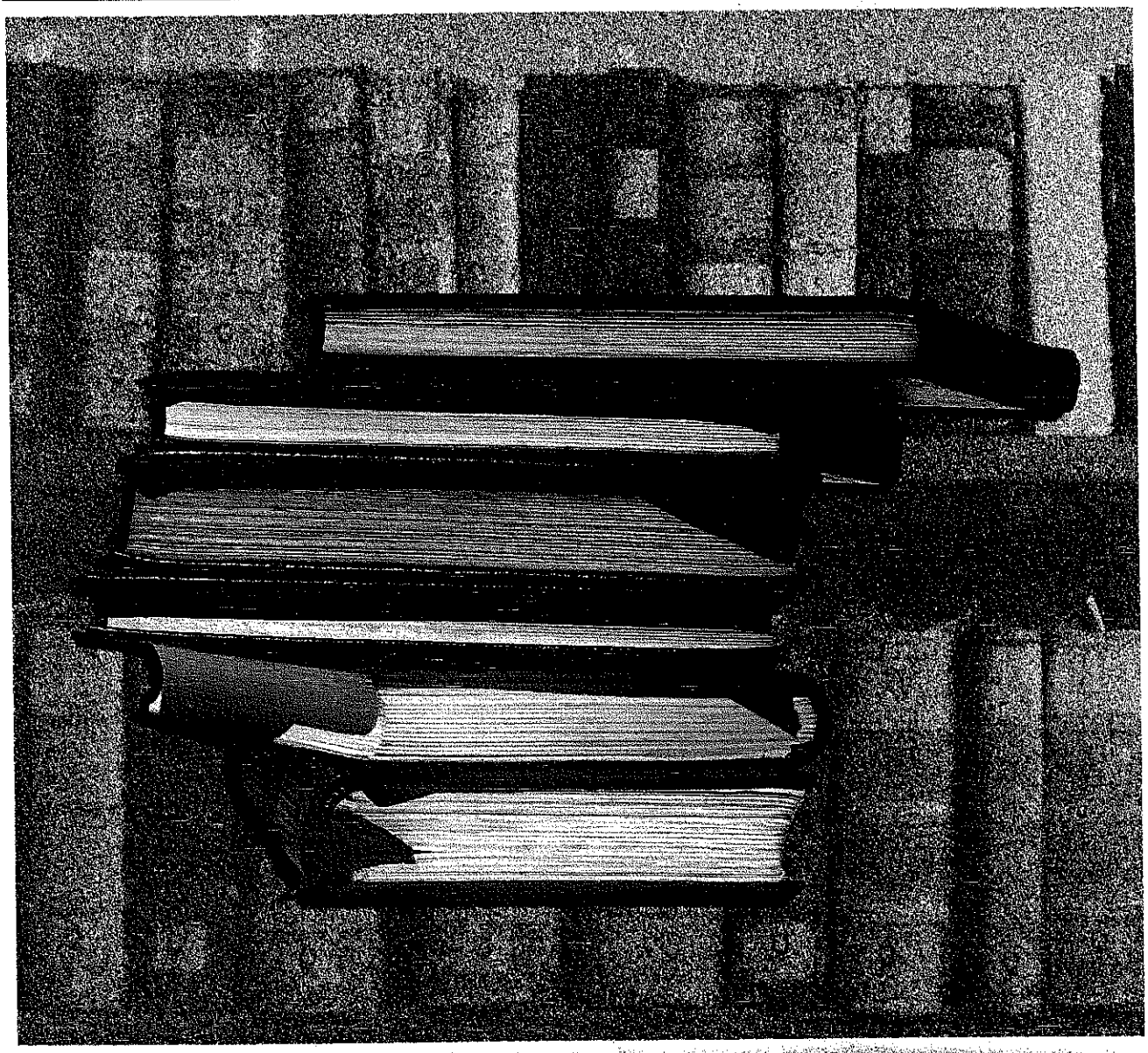
ISSN 1308-7711

ENERGY EDUCATION SCIENCE AND TECHNOLOGY, PART B

Social and Educational Studies



Volume 4. Issue 1
January 2012

SILA SCIENCE

Energy Education Science and Technology Part B: Social and Educational Studies
2012 Volume **(issue)** 4**(1):** 355-364

Comparison of 7th grade elementary school students' problem posing and problem solving achievements

Abdullah Kaplan[1,*], Ercan Ozdemir[2], Neslihan Kaplan[1]

[1]*Atatürk University, Department of Elementary School Mathematics Education, Erzurum, Turkey*
[2]*Rize University, Department of Elementary School Mathematics Education, Rize, Turkey*

Received: 30 January 2011; accepted: 09 March 2011

Abstract

In this study, the relation between 7th grade elementary school students' problem posing and problem solving achievements was investigated. Correlation method was used in this study. The study was conducted to 144 students who are 7th grade from 3 elementary schools in Erzurum city. To determine 7th grade elementary school students' problem posing and problem solving achievements, Mathematical Achievement Test (MAT), composed of 10 questions, was developed. The reliability coefficient (Cronbach's alpha) of MAT was found to be 0.87. According to the results of the study, students were successful in solving questions, while there was a decrease in their problem posing achievements. In addition, MAT results revealed that students were inadequate and they experienced crucial difficulties in posing problems.

Keywords: Problem Posing; Problem Solving; Visualization
© Sila Science. All rights reserved.

1. Introduction

The aim of mathematics education is not just developing human power who knows mathematics, instead, it is growing individuals who can use and apply the knowledge they have, think critically, do mathematics and solve problems [1]. Mathematics is a kind of mental activity that develops with individuals' curiosity of "knowing and understanding the truth" [2]. To know and understand the truth, problems that occupies individuals' mind are needed to be solved. Problem is mathematics' important constituent. Since it is one of mathematics' constituent, there were various studies conducted about it. The majority of them tried to explain the problem posing, problem solving and the relation between problem posing and solving.

*Corresponding author. Tel.: +90-442-231-4218; fax: +90-442-236-0955.
E-mail address: kaplan5866@hotmail.com (A. Kaplan).

Problem is a kind of obstacle that appears against reaching an individual's aim [3]. Problem posing, on the other hand, is to know what to do while not knowing what is needed to be done [2]. In addition, since it is a scientific method, problem solving necessitates critical thinking, creative and reflective thinking, abilities of analysis and synthesis [4]. The main aim of the problem solving education necessitates high level of thinking [5]. The process of problem solving is doing research with controlled activities in order to reach a goal which is not easy to reach and is designed clearly [2]. Understanding mathematical knowledge and constructing relation between such knowledge exist during the process of problem solving [6]. There are two important outcomes for problem solving in mathematics education. First one is the development of special strategies and rules for teaching subjects, while the second is the development of thinking ways and general approaches for realization and possible application of a mathematical rule or formula [7]. In addition, students' problem posing skills will be improved in line with the improvement in their problem solving skills [8].

In learning with concrete experience, understanding of experience and problem solving are important instead of reaching generalization [9]. Students are generally becoming experienced in problem solving in school environment. They solve questions in tests or books under mathematics teachers' guidance. They merely pose problem [10]. Students generally experience difficulty in posing their own problems [11]. However, problem posing should be in the center of learning mathematics [12, 13]. During the lessons, there is a need to give importance to problem posing activities as it is given to problem solving activities, because problem posing provide students with understanding mathematical cases and interpreting concepts given in the problem and mathematical symbols with special representations [4]. Problem posing is an ability to construct new problems with the help of previous knowledge and cases [14, 15]. Problem posing improves students' problem solving and creativity abilities [16]. Problem posing ability helps students to discover mathematical cases, to think critically and to gain experience about how to represent their learning and mathematical ideas verbally or in written form [17]. The effect of problem posing on students' critical thinking, on their dialog with others, on their questioning skills and collaboration, on analyzing the surrounding environment analytically and on student centered learning was proved [18, 19]. Problem posing activities improves students' conceptualization of the subjects with the abilities of their flexible thinking and thinking differently. In addition, it develops their problem solving skills [20]. Moreover, both the National Council of Teaching Mathematics [21] and National Ministry of Education [1] express the development of students' problem posing skills, because problem solving diminishes the fear and concerns against mathematics [22].

Problem posing and problem solving are two important elements that complete each other in mathematics education. Yaman and Dede [20] stated that students should not only be well problem solvers but also pose new problems with given situations. Therefore, there is a need to give importance to problem posing and problem solving in equal degree.

In this study, the relation between 7th grade elementary school students' problem solving and problem posing achievements was investigated. With this purpose, the sub-questions below guided this study.

1- Is there any relation between students' problem posing and problem solving achievements?
2- What are the difficulties that students experienced during problem solving process?
3- What are the strategies that students follow during problem solving process?

2. Method

In the study, the correlation design, one of the non-experimental methods, was used. Correlation method is a kind of method with the purpose of determining the existence and/or degree of two or more variables. The relations found with correlation method cannot be

interpreted as reason-result relations, but, it gives evidence to predict the situation in one variable if the situation of the other variable is known [23].The sample of the study was composed of 144 students from 7th grade in three public elementary schools. Students' socioeconomic status in one school was high while that in other schools were middle and low, respectively.

2. 1. Data Collection

To determine 7th grade students' problem solving and problem posing achievements, Mathematical Achievement Test (MAT), composed of 10 questions, was developed. The questions in MAT were open-ended. Four questions in MAT were related to problem posing while the rest was related to problem solving. Students were expected to solve 2 of the 6 questions related to problem solving by using visual figures. Time given to students in order to complete MAT was 40 minutes. The reliability coefficient (Cronbach alpha) was found to be 0, 87. For the validity of MAT, previous literature was reviewed, the course books were analyzed and MAT was subjected to two university teaching staffs who were expert in the area studied.

2. 2. Data Analysis

For each question in MAT, the correct answers were scored as 2 points, partial correct answers were scored as 1 point, and the wrong answers or unanswered questions were scored as 0 point. Therefore, the maximum score that students can get is 20 points while the minimum score is 0. The maximum score in problem solving part is 12, while the minimum score is 0. On the other hand, the maximum score in problem posing part is 8, while the minimum score in this part is 0. To determine the relation between students' problem posing and problem solving achievements, dependent t-test for paired samples. Each question was presented with the help of percentage, frequency and arithmetic mean tables. Descriptive statistics was used for analyzing some of students' responses in general.

3. Findings and discussion

In this part of the study, the results of MAT were analyzed. According to the scores that students gained from MAT, the results of dependent t-test scores for paired samples were presented in Table 1.

Table 1. Results of dependent t-test in line with students' MAT Scores

	N	M	S	t	p	r	P (correlation)
Problem Solving	144	8.84	3.936				
Problem Posing	144	2.22	2.342	23.636	0.000	0.524	0.000

The results of the dependent t-test with paired samples revealed that there is a significant relationship between students' problem solving and problem posing scores ($r_{144} = 0.524$ and $p = 0.000 < 0.05$). Therefore, students are more successful in problem solving part of the test. In addition, the average of students' scores was 8.84 points out of 12 points. On the other hand, their average score in problem posing questions was 2.22 points out of 8 points. The possible reason why students were successful in problem solving part of the test is to give sufficient number of problem solving activities in the lessons. In addition, the reason for low level of success in posing problem may be not giving enough attention to problem posing activities and applications in the lessons.

From the Table 2, students were very successful in first question in problem solving part of the test with the average score of 1, 60, while they had the least success in the third question

Table 2. The analysis of the students' responses related to problem solving in MAT

Question No	Average	Correct		Partially Correct		Incorrect or Not Answered	
		f	%	f	%	f	%
1	1.60	115	79.9	1	0.7	28	19.4
2	1.51	107	74.3	3	2.1	34	23.6
3	1.46	100	69.4	10	6.9	34	23.6
4	1.53	107	74.3	7	4.9	30	20.8

with the average score of 1.46. In addition, First question was the one that students had the greatest success in MAT. This question was as follows. (2/3)+(1/6)=? *islemini cozunuz*" (*solve this question*).

115 students solved this question correctly; and one student solved it partially. According to the analysis of students' responses, they equalized the denominator to 6, however, it was found that some of them equalized it to 18.

One of the students answer was shown below:

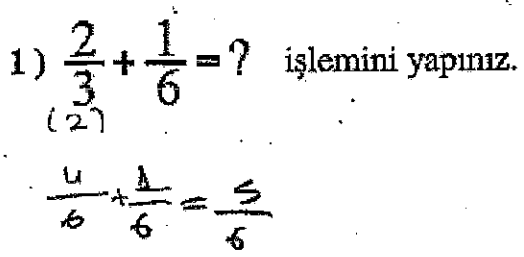
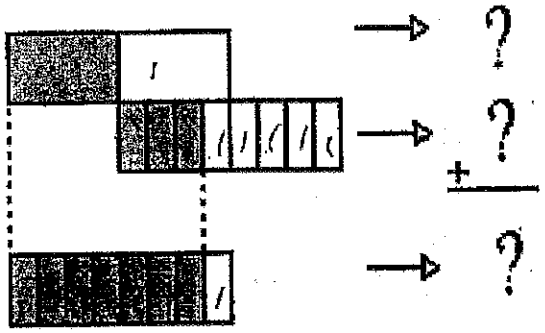


Fig.1. Response of a student.

Among this group (questions for problem solving), the frequency of correct answer was least for 3rd question with the arithmetic mean of 1.46. 100 students gave correct answer to this question, while 34 students solved it partially. In addition, 10 students gave incorrect answer to this question or kept it empty. This question and one of students' answers is given below as an example.



"Gorsel sekil üzerinde cozumu verilen ifadeyi yaziniz." (Write the expression of the solution given on visual image)

Fig. 2. Sample question asked to students.

Table 3. The analysis of students' answers to question on visual problem solving in MAT

Question No	Mean	Correct		Partially Correct		Incorrect or Empty	
		f	%	f	%	f	%
1	1.43	91	63.2	24	16.7	29	20.7
2	1.31	80	55.6	28	19.4	36	25

Table 3 indicates that students have most success for 1st question with the arithmetic mean of 1.43. 91 students' gave correct answer to this question, while 24 students gave partially correct answer to it. This question and one of the students' solutions is shown below." (2/3)+(1/6)=? *islemini gorsel sekil kullanarak cozunuz" (Write the expression of the solution given on visual image).*

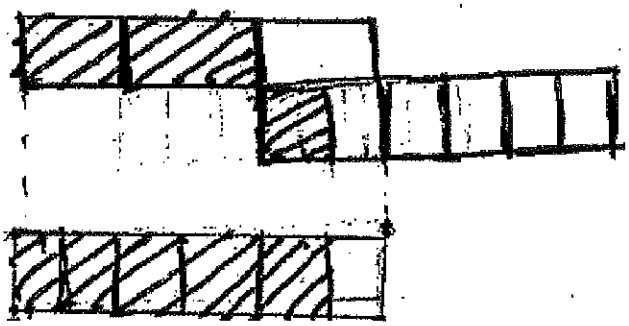


Fig. 3. Response of a student to this question.

The arithmetic mean for the other question was 1.31 and 6th question related to problem solving was the question that students showed the least success. To this question, 80 students gave correct answer, while 28 students solved it partially. This question is like "Given the expression, (5/8)-(2/4)=?, solve it by using visual representation." One of the students' solutions is shown in Fig. 4.

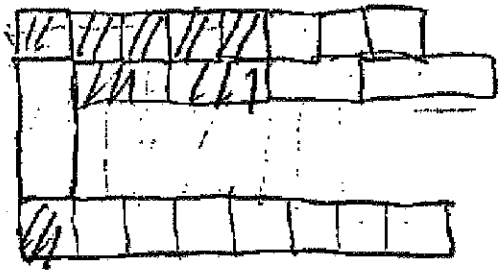


Fig. 4. Response of a student to this question.

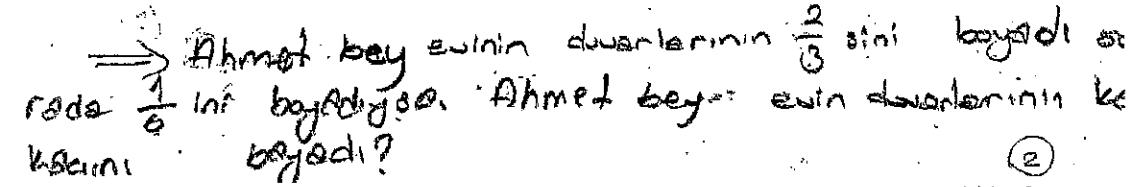
Table 4. The analysis of students' answers to question related to problem posing in MAT

Question No	Mean	Correct		Partially Correct		Incorrect or Empty	
		F	%	f	%	f	%
1	0.72	37	25.7	29	20.1	78	54.2
2	0.44	22	15.3	19	13.2	103	71.2
3	0.72	41	28.5	21	14.6	82	56.9
4	0.35	18	12.5	14	9.7	112	77.8

From Table 4, students were most successful in 1st and 3rd question with arithmetic mean of 0.72, while they were least successful in 4rd question with 0.35. 37 and 29 students gave correct and partially correct answer to first questions, respectively. Moreover, 41 students solved the 3rd question correctly, while 21 students solved it partially. For 4th question, 18 students solved it correctly and 14 students solved it partially. In addition, 4th question was the question that students solved with least frequency in MAT. Therefore, their success was least for this question. The frequency of students' responses among problem posing was the highest for 1st question, which was

"(2/3)+(1/6)=? = ? *islemine karsilikk gelebilecek bir problem kurunuz"(Pose a problem that is corresponding to the expression* (2/3)+(1/6)=?)

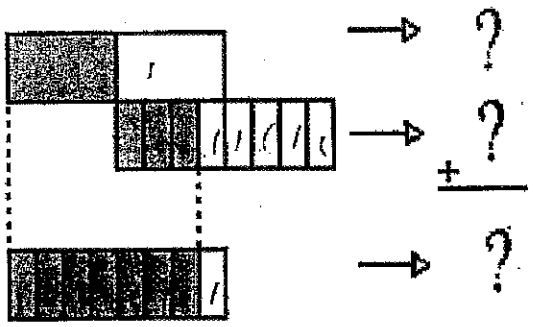
One student gave an answer to this question as shown in Fig. 5.



English Version: Mr Ahmet painted 2/3 of walls of this house. If he paints 1/6 of it later, what is overall proportion of his house's wall that he painted?

Fig. 5. Response of a student to this question.

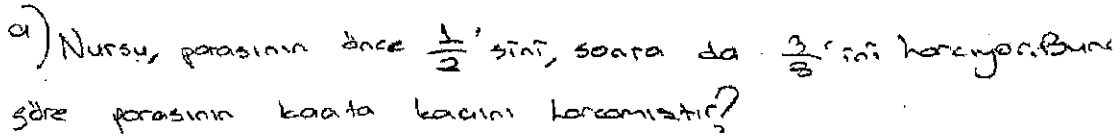
The other question that the frequency of students' correct answers related to problem posing is highest is shown in Fig. 6.



Yukarıdaki ifadeye karşılık gelebilecek bir problem kurunuz.
English Version: Pose a problem corresponding to the figure above.

Fig. 6. Sample question asked to students.

One of the students' answers to this question:



a) Nursu spent ½ of her money, then, she spent 3/8 of it. Accordingly, what is the proportion of her money she spent?

Fig. 7. Response of a student to this question.

The least frequency that students correctly answer for problem posing was 4rt question, which is:

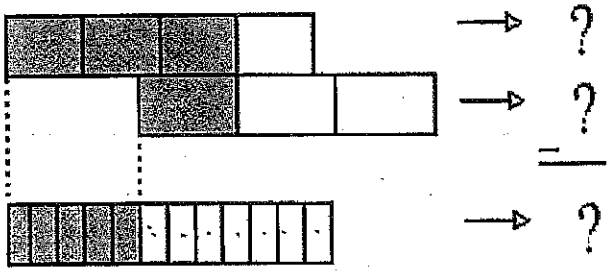
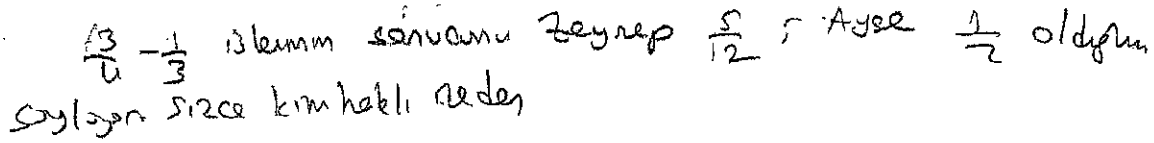


Fig. 8. Response of a student to this question.

A student gave an answer to this question as follows.



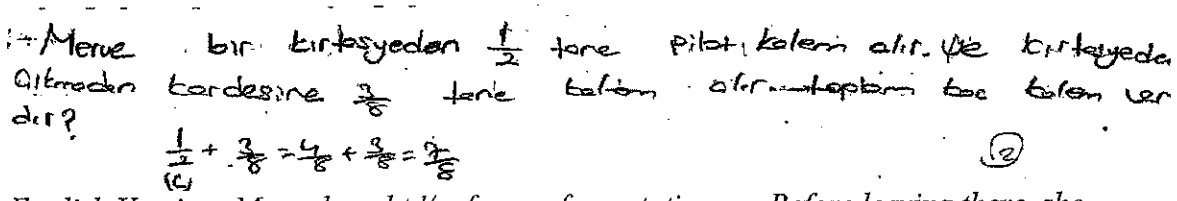
English version: Zeynep says that the result of the quesion 3/4-1/3 is equal to 5/12, while Ayşe says it is 1/2. Who is true and why?

Fig. 9. Response of a student to this question.

Tables 2-4 clearly showed the difference between students' achievements in problem solving and problem posing problems. The arithmetic mean of the question that students showed the highest achievement among problem solving questions was 1.31, while that among problem posing problem was 0.72. The question with students' highest achievement was one of the problem solving questions, while that with students' least achievement was one of the problem posing questions.

According to the analysis of the data from MAT, students were adequately successful in solving problems, because students' point average for the problem solving question was 8, 84 points out of the maximum 12 points. However, students' have serious difficulties in posing problem. Students' arithmetic mean for the problem posing questions was 2, 22 points out of maximum 8 points.

The greatest difficulty that students have in problem posing is that they could not correctly relate the real life context with mathematics. One of the problems posing example of a student who could not correctly relate the real life with mathematics is as shown in Fig. 10:

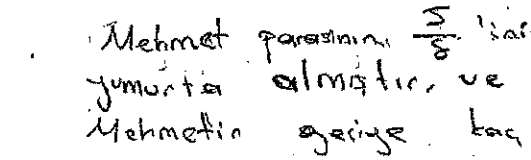


English Version: Merve bought ½ of a pen from stationery. Before leaving there, she bought 3/8 of pen for her daughter. What is the total ofthe pen she bought from stationery.

Fig. 10. Response of a student to this question.

However, everyone knows that ½ of a pen never exists. Since student is only focusing on the values given to him, he did not give attention whether his statement could be in daily life or not. The reason why students do such or similar mistakes can be that there is no or small number of activities related to problem posing in the lessons.

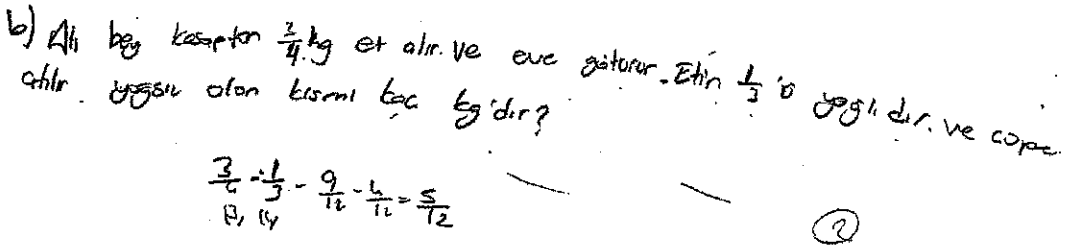
Another difficulty that students face in posing problem is to relate incorrectly the mathematical expressions with verbal expressions. An example for this situation from students' response is as shown in Fig. 11:



English Version: Mehmet bought an egg and bread by spending 5/8 and 2/4 of his money. How much money does Mehmet have at the end?

Fig. 11. Response of a student to this question.

Student tried to pose a problem corresponding to the expression of (5/8)-(2/4). However, they performed an incorrect solution. A student answer with similar mistake is as follows.



English Version: Mr. Ali bought ¾ kg meat from butcher and brought it to his house. Since 1/3 of meat is fatty, he dumped it to in the bin. How many kg of the meat is without fat?

Fig. 12. Response of a student to this question.

4. Conclusion and recommendations

There is a significant relationship between students' problem posing and problem solving achievements ($r_{144} = 0.524$ and $p = 0.000 < 0.05$). This result is parallel to the findings of Cai and Hwang's studies [8, 13].

According to the MAT results, students were successful in solving questions, while they are not that much successful in posing problem. This result also supports the results of Akkan et al.'s studies [24]. In addition, one of the possible reasons why students are successful in solving problem is that they develop positive attitude toward problem solving. The current education that focuses on problem solving strategies may results in developing positive attitude toward problem solving [25].

Students generally relied on the course books while posing problem and there is not many original problem found in these books. This finding is parallel to the findings of Korkmaz and Gur's studies [26]. In addition, MAT results indicated that students were unsatisfactory and they have serious difficulties in posing problems. This finding is parallel to Albayrak et al.'s studies [27].

Under the light of the results of this study, the recommendations below are stated in order to increase students' problem posing and problem solving achievements.

1. To make students acquire the abilities that they have difficulty in posing problem, appropriate activities should be designed and evaluated by applying such activities [17, 28-30].
2. There is a need to give importance to problem posing as given to problem solving, and if exists; the possible prejudices must be diminished or removed.
3. Students should be provided with the full comprehension of mathematical operations such as addition, subtraction and multiplication. So that students' difficulty in writing verbal sentences which correspond to mathematical statements can be diminished to the least degree.

References

[1] Milli Egitim Bakanligi Talim Terbiye Kurulu Baskanligi. Ortaogretim Matematik Programi ve Kilavuzu, MEB Print House, Ankara, Turkey, 2008 [in Turkish].
[2] Altun M. Liselerde Matematik Ogretimi. Erkam Print House, Bursa, Turkey, 2008 [in Turkish].
[3] Albayrak M. Ilkogretimde Matematik ve Ogretimi. (3rd Ed.). Mega Ofset Print House. Erzurum, Turkey, 2010 [in Turkish].
[4] Soylu Y, Soylu C. Matematik derslerinde basarıya giden yolda problem cozmenin rolu. Inonu Univ Egit Fak Derg 2006;7:97–111 [in Turkish].
[5] Azar A. A comparison of the effects of two physics laboratory applications with different approaches on student physics achievement. Energy Educ Sci Technol Part B 2010;2:161–185.
[6] Karatas I, Guven B. 8. Sınıf ogrencilerinin problem cozme becerilerinin belirlenmesi: Bir ozel durum calısması. Milli Egit Derg 2004;163:132–143 [in Turkish].
[7] Olkun S, Ucar-Toluk Z. Ilkogretimde Etkinlik Temelli Matematik Ogretimi. (3rd Ed.) Ani Print House, Ankara, Turkey, 2004 [in Turkish].
[8] Cai J, Hwang S. Generalized and generative thinking in US and Chinese students' mathematical problem solving and problem posing. J Math Behav 2002;21:401–421.
[9] Metin M, Yilmaz KG, Birisci S, Coskun K. The investigating high school students' learning styles with respect to the different variables: A sample from Turkey. Energy Educ Sci Technol Part B 2011;3:589–604.
[10] Lavy I, Walter MI. Problem posing via "what if not" strategy in solid geometry-a case study. J Math Behav 1993;22:369–387.
[11] Silver EA. On mathematical problem posing. Learn Math 1994;14:19–28.
[12] Brown SI, Walter MI. The Art of Problem Posing, NJ: Lawrence Erlbaum Associates, Hillsdale, 1983
[13] Cai J, Hwang S. A perspective for examining the link between problem posing and problem solving. International Group for Psychology of Mathematics Education 25th PME-NA Conference, Honolulu, 2003;103-110. [ERIC Document: ED501014].
[15] Silver EA. Fostering creativity through instruction rich in mathematical problem solving and problem posing. ZDM-Zentrall Blatt Didaktik Math 1997;29:75–80.
[16] Silver EA, Cai J. An analysis of arithmetic problem posing by middle school. J Res Math Educ 1996;27:521-539.
[17] Yigit N. Developing presentation skills of student teachers through micro-teaching method. Energy Educ Sci Technol Part B 2010;2:55–74.
[18] Kilpatrick A. Childhood sexual experiences: Problem and issues in studying long-range effects. J Sex Res 1987;23:173–196.
[19] Moses B, Bjork E, Goldenberg EP. Beyond problem solving: Problem posing, In T. J. Cooneyand C.R. Hirsch (Eds). Teaching and Learning Mathematics in the 1990s., 1990; 82-91 Reston VA: NCTM Publication.
[20] Yaman S, Dede Y. Matematik ve fen egitiminde problem kurma uygulamalari. Ondokuz Mayis Univ Egit Fak Derg 2005;20:1–11 [in Turkish].

[21] NCTM. Principles and standards for school mathematics, 2000; Reston VA: NCTM Publication.
[22] Brown SI, Walter MI. Problem posing in mathematics education, In: S. I. Brown & M. I. Walter (Eds.). Problem Posing: Reflection and Applications (pp.16–27). Lawrence Erlbaum Associates, Hillsdale, NJ, 1993.
[23] Karasar N. Bilimsel Arastirma Yontemi. (20th Ed.). Nobel Publication Distribution, Ankara, Turkey, 2009 [in Turkish].
[24] Akkan Y, Cakıroglu U, Güven B. Ilkogretim 6. ve 7. sınıf ogrencilerinin denklem olusturma ve problem kurma yeterlilikleri. Mehmet Akif Ersoy Univi Egit Fak Derg 2009;17:41–55 [in Turkish].
[25] Altun M, Arslan C. Ilkogretim ogrencilerinin problem cozme stratejilerini ogrenmeleri uzerine bir calisma. Uludag Univ Egit Fak Derg 2006;19:1-21 [in Turkish].
[26] Korkmaz E, Gur H. Ogretmen adaylarinin problem kurma becerilerinin belirlenmesi. BAU Fen Bil Ens Derg 2006;8:64–74 [in Turkish].
[27] Albayrak M, Ipek SA, Isik C. Temel işlem becerilerinin ogretiminde problem kurma-cozme calismalari. Erzincan Egit Fak Derg 2006;8:1–11 [in Turkish].
[28] Ceyhun I, Karagolge Z. Using algebraic and matrix method for balancing chemical equations. Energy Educ Sci Technol Part B 2009;1:127–137.
[29] Kurnaz MA, Calik M. A thematic review of energy' teaching studies: focuses, needs, methods, general knowledge claims and implications. Energy Educ Sci Technol Part B 2009;1:1–26.
[30] Karamustafaoglu S. Chemistry teachers' levels of using teaching materials. Energy Educ Sci Technol Part B 2010;2:255–268.