Available online at www.sciencedirect.com

ScienceDirect

Procedia Social and Behavioral Sciences 15 (2011) 2753–2757

Procedia Social and Behavioral Sciences

WCES-2011

Usage of Non-routine Problem Solving Strategies: Semi-Structured Interviews with First Grade Students

Burcu Celebioglu[a]*, Rıdvan Ezentaş[b]

[a]*Uludag University Institute of Education Sciences, Uludag Universitesi Egitim Bilimleri Ensitusu , Bursa 16059, Turkey*
burcucelebioglu@gmail.com

[b]*Uludag University Faculty of Education, Uludag Universitesi Egitim Fakultesi Ilkogretim Bolumu, Bursa 16059, Turkey*

Received date here; revised date here; accepted date here

Abstract

The aim of this study is to search how the first graders solve problems including problem solving strategies and what they wonder about in this period. For this aim, 6 non - routine problems including problem solving strategies were prepared to test students. Problem solving strategies named look for a pattern, make a drawing, work backwards, systematic list were chosen. Also non routine division problem was chosen for the test. The test was examined in research as a pilot study to 40 first grade students. Following redesigning of the test, it was put into practice with 12 first grade students in Bursa. Problem solving behaviors of students were observed with video camera in the interviews and images are recorded to be printed out. The findings of the study show that first graders apply look for a pattern strategy successfully and there is a significant relationship in scores of students and their achievements in mathematics. Furthermore, relationship between the scores of the students and their gender is insignificant.

Keywords: Mathematics, non-routine problem, problem solving, problem solving in first grade, semi-structured interview

1. Introduction

In recent reform documents, mathematical problem solving receives a special emphasis. Problem solving constitutes an important part of mathematics studies. The main aim of problem solving is to learn and to teach how to acquire various capabilities for improved problem solving in mathematics (Baykul, 1999). According to Altun (2005), problem is a situation in which the individual wants to do something, but does not know what to do yet, and problem solving is "to learn what to do in cases in which one does not know what to do".

In the literature, it is stated that solution methods which are used for non-routine problems can be classified and named based on their common properties. The most outstanding strategies among them are as follows: Look for a pattern, make a systematic list, work backwards, guess and check, draw a diagram, simplify the problem, make a table, eliminate the possibilities, reasoning, estimation (Altun, Bintas, Yazgan & Arslan, 2004). In the solving process of some problems, only one strategy is used, while more strategies can be used for other problems. For example, look for a pattern, draw a diagram, and simplify the problem strategies are often used together (Celebioglu, Yazgan & Ezentas 2010).

doi:10.1016/j.sbspro.2011.04.183

Previous studies on problem solving include those by Carpenter, Ansell, Franke, Fennema, & Weisbeck, (1993), who examined the way pre-school students solved various problems involving four operations and found that with few exceptions, the strategy used by students can be characterized as modeling or representing the relationships or actions defined in the problem; Verschaffel, De Corte, Lasure,Van Vaerenbergh, Bogaerts, &. Ratinckx, (1999), who examined the efficiency of an experimental learning environment designed for teaching mathematical application problems to fifth graders, and Karataş and Güven (2004), who conducted a case study with eighth graders to assess their competencies in problem solving processes.

In the literature, semi-structured interview is used to examine problem solving behaviors of students from various age groups in depth. However, to the best of our knowledge, there are no such studies concerning first graders. This study aims to observe and analyze problem solving strategies used by first graders in depth. If the first graders are able to solve the non-routine problems used in this study, a suggestion will be made for more diversity in problems currently used in textbooks. Thus, the study has a potentially significant contribution to make to the literature.

2. Method

The method used in this study, semi-structured interview, is employed by researchers to present individual questions and problems so that the thoughts of the interviewee are identified correctly. In this context, the researcher needs to monitor variables like the motivation and interest of the student (Ginsburg, 1997: 48). This is why the responses the researcher gets and the observations he or she makes are important. Interviews with the students were video and audio recorded using a camera. Interview durations were different for each student, but on average, they took about 75 minutes.

2.1 Participants

12 first graders participated in the study. Equal numbers of male and female students were included. All the participants had math scores of 5 out of 5.

2.2 Instruments

Students were given a math test consisting of 6 questions involving non-routine problem solving strategies and non-routine division with remainder operations, and solved the problems during the interview. Following a pilot study conducted with 40 students, the test was re-designed. Below are examples from the test, concerning the strategies of systematic list and drawing a diagram.

Problem 1 (Make a systematic list strategy): We can buy one chocolate from a vending machine if we insert coins worth 7 liras. Individual coins are worth 1, 3, and 5 liras. To buy a chocolate, you could, for example, insert two 1-lira coins, and one 5-lira coin. In how many different ways can you insert coins to buy chocolates?

Problem 2 (Draw a diagram strategy): A frog is trying to climb up a pit 10 steps deep. Each time she jumps, she climbs up 4 steps and slides back 2 steps. How many jumps does she need to make to be able to leave the pit?

2.3 Data Analysis

Data were analyzed using descriptive analysis. In descriptive analysis, direct quotes are frequently used to better express the views of the individuals interviewed or observed. This type of an analysis aims to present the findings of the study in an orderly and easy to interpret manner (Yıldırım and Şimşek, 2008). In addition, success rates of the students were calculated as percentages. To analyze the relationship between problem solving success rates of the students and their genders, chi square test was used.

2.4 Procedure

The test was conducted by the first author in the middle of the school year, during regular school hours. During the interviews, materials that students may need in solving the problems (bottle caps, chickpeas, plastic plates, paint pens, straws, coins worth 1, 3 and 5 liras) were placed on the table at which the student and the researcher worked on problems.

3. Findings

3.1 Strategy use

In the present study, frequencies and percentages concerning students' problems solving behaviors and correct answers found using the strategies were calculated for each question. Correct answers for the problems were as follows: Strategy of finding a pattern 100 %, strategy of making a systematic list 70.8 %, problem involving non-routine division operation with a remainder 85.7 %, strategy of making a drawing 83.4 %, strategy of working backwards 62.5 %, and the problem involving the strategies of making a drawing and finding a pattern 80 %.

3.1.1 Analysis of the Process

The study contains responses of the students all the questions, and the interviews made. Below is a reproduction of dialogues concerning two students' responses to two different questions.

Problem 1: (Making a systematic list)

The student solved this problem correctly and in full.

Nursena: (Showing her fingers to the researcher) *If I add 3 and 4, that makes 7.*

Nursena: *Was I supposed to get to 4 liras? No.* (Re-reads the question). *It asks in how many ways can I get to 7 liras. 5 plus 2 makes 7.*

Interviewer: *Are there any 2s among these coins?* (Interviewer asks pointing to the coins on the table)

Nursena: *No.*

Interviewer: *How would you solve then?*

Nursena: *3 plus 4 makes 7, Sir. Do we have 4? (Asks herself) Do we have 2? No. We don't have 2, and we don't have 4.*

Interviewer: (Points to 1-lira coins as a cue.) Can you do what you want using these coins? (The student thinks for a while, and then responds.)

Nursena: *3 plus 3 plus 1 makes 7.*

Interviewer: *Can you make any other?*

Nursena:*3 plus 1.....*

Interviewer: *You can use all the 1s here. (pointing to the materials)*

Nursena: *3, if I were to add two 1s, it would make 5. But we don't have 2. If I were to use 1s... 3,1,1,1,1. Four 1s make a 4. Two 1s make 2, and we get 6. One more 1, and we get 7. Again… 3, plus two 1s, plus two 1s. 3,1,1,1,1. We already got that. Five more 1s, and we get 7.*

Problem 2: (Draw a diagram strategy)

Elif: *What's a pit like, Sir?*

As a cue, the shape of a pit was explained to the student. The student makes a diagram based upon the explanation, and first divides the diagram into 10 pieces. Then, she picks up an object from the table, and jumps the object upon the diagram, starting from the bottom of the pit, and makes explanations as she goes up.

Figure 1. Student Drawing for the Solution of the Problem Involving the Strategy of Drawing a Diagram

Elif: *She went up four steps, slid back 2 steps. Went up another 4 steps, and slid back 2 steps again. With each jump, she actually moves 2 steps.*

The student figures out that the frog moves 2 steps with each jump, and counts 2 by 2.

Elif: *5.*

Interviewer: *5 what?*

Elif: *It can go out with the 5th jump.*

The student reaches the correct answer by using the initial cue and the later information.

Elif: *I am going to count from 4 to 10.*

Interviewer: *Why?*

Elif: *Because she slides 2 steps, it makes 6.*

Interviewer: *Can you explain this a little more?*

Elif: *She goes 4 steps. Then jumps, and when she slides, it makes 2 more steps, making a total of 6 steps. She jumps once more, which makes 8, another jump, and it makes 10.*

Interviewer*: How many jumps did it take?*

Elif: *3.*

Interviewer: *Does the frog start from the bottom of the pit by walking?*

Elif: *Yes, she walks first.*

Interviewer*: Does this information come from the question?* The student reads the question again.

Elif: No.

Interviewer: *Why would you think it walks first?*

Elif: *Because she cannot jump without walking at first.*

Interviewer: *Why?*

Elif: *To go to the jumping place.*

Interviewer: *Why would you think there is such a place?*

Elif: *She needs to walk first so that she can jump.*

The student did not make a drawing, nor did she use any materials or the cue. She tried to understand the question in her mind only, but was not able to reach the correct answer because she did not use the information given in the question.

3.2 Strategy use and gender

A chi square test was conducted to examine the relationship between problem solving and gender. Because correct answers made up 100 % of all questions solved by the strategy of finding a pattern, this strategy was left out of the analysis. No significant relationship was found between problem solving strategies included in the test and gender ($\chi^2_p < \chi^2_{(df,\alpha)}$ $\alpha = 0{,}05$)

Table 1 χ^2 test results about relationship between strategy use and gender

Questions	χ^2_p	df	$\chi^2(df;\alpha)$
Look for a pattern	-	-	-
Make a systematic list	1.33	2	5.99
Non-routine division	0.44	1	3.84
Draw a diagram	1 .11	2	5.99
Work backward	2.5	2	5.99
Look for a pattern- draw a diagram	3.24	1	3.84

4. Conclusions

In the qualitative part of the study, students worked with the researcher one on one in the problem solving process, and had the opportunity to solve the problems using the materials provided. In addition, high observed rates of problem solving in the study group might be attributed to the fact that participants already had high math grades. It was also probably the case that the success rate for the problem involving the strategy of finding a pattern was 100 % because students solved similar problems in class. It is an obvious conclusion that if textbooks contained material specifically designed for different problem solving strategies, success rates for these strategies would also improve.

In conclusion, teachers should take different problem solving strategies into account when preparing for math classes and aim to have the students think in depth. For this purpose, they should systematically use problem solving strategies in different examples, and help the students find out the correct solutions. Primary school math curricula should be improved and re-designed based upon the findings of this study and other similar studies. They should include activities on problem types and problem solving strategies. Ages and levels that are appropriate for each problem solving strategy needs to be identified and proper timing should be achieved in education.

References

Altun, M., Bintaş, J., Yazgan, Y., Arslan, Ç.(2004), İlköğretim Çağındaki Çocuklarda Problem Çözme Gelişiminin İncelenmesi (An Examination of the Development of Problem Solving Ability among Primary School Students), Uludağ Üniversitesi Bilimsel Araştırma Projeler Birimi, (Ref. Nu.E2001/37), Bursa.

Altun, M. (2005), Eğitim Fakülteleri ve İlköğretim Öğretmenleri İçin Matematik Öğretimi (Math Teaching for Faculties of Education and Primary School Math Teachers), Aktüel Yayınları, Bursa.

Baykul, Y., (1999), İlköğretim Birinci Kademede Matematik Öğretimi (Math Teaching in First Level of Primary Education), Öğretmen Kitapları Dizisi, İstanbul.

Carpenter, T., A.- E.- Franke, M-Fennema, E., & Weisbeck, L., (1993) Models of problem solving: A study of kindergarten children's problem solving processes., Journal for Research in Mathematics Education," 24 (5)., pp .428-441. www.eric.ed.gov 12.10.2008.

Celebioglu, B. Yazgan, Y., Ezentaş, R, (2010) Usage of Non-routine Problem Solving Strategies at First Grade Level,2.World conferences on educational scienes, İstanbul.

Gingsburg, H. P.(1997), Entering the Child's Mind: The Clinical Interview in Pyschological Research and Practice, Cambridge University Pres, pp., 48-50

Karataş, İ.– Güven, B. (2004), 8. Sınıf Öğrencilerinin Problem Çözme Becerilerinin Belirlenmesi: Özel Bir Durum Çalışması (Identifying the Problem Solving Abilities of 8th Graders: A Special Case Study), Milli Eğitim Dergisi, Sayı,163.

Verschaffel, L., De Corte, E., Lasure, S.,Van Vaerenbergh, G., Bogaerts, H.&. Ratinckx, E., (1999), Learning to Solve Mathematical Application Problems: A Design Experiment with Fifth Graders, Mathematical Thinking & Learning, Vol 1, 195, (Çevrimci) http/epnet.com/ehost, 2 Kasım 2001

Yıldırım, A. & Şimşek, H. (2008). Sosyal Bilimlerde Nitel Araştırma Yöntemleri (Qualitative Research Methods in Social Sciences), (7th Edition), Ankara: Seçkin Yayıncılık.