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Comparing The Arithmetic Skills in Problem-Solving Among Primary and Secondary School Age Children

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Abstract

Basic arithmetics skills, which are necessary for mathematical problem-solving, are expected to develop faster after starting school. These basic skills help to improve the level of mathematical operations during the classes. When this development is insufficient, there may occur learning difficulties in mathematics or dyscalculia. This research has been conducted to examine these basic calculating skills in problem situations from a developmental perspective. The Cognitive Developmental aRithmetics (CDR) tests, was used for this aim. These tests have 3 different levels based on the grade level. In this research, the problems section in the tests was compared in terms of different grade levels. For this purpose, the CDR1 test was applied to the 2nd and 3rd grade, the CDR2 test to the 4th and 5th grade, and the CDR3 test to the 6th and 7th-grade levels. There are 1203 participants in total. In the statistical analysis, a significant difference was found regarding the classes in the CDR1 test concerning the development of arithmetics in short problem situations. There is not any significant difference in other grade levels for CDR2 and CDR3.

Keywords: arithmetic skills, arithmetic development, problem-solving, mathematics, calculating skills.

Introduction

It is important to plan activities that form the basis of mathematical thinking and have a very important effect on the development of mathematics success and arithmetic skills in the following years, including problem situations in which counting will be used [1]. In order to develop calculating skills, starting from the preschool period, it is aimed to develop skills such as verbal counting, recognition, mental calculation, and problem-solving [2]. Students' meaningful learning is closely related to their ability to apply knowledge in different environments, to establish relationships between concepts, to associate conceptual and operational knowledge, to establish relationships between learning areas, and to transform knowledge into various forms of representation [3]. In cases where meaningful learning is not achieved, students cannot go beyond the patterns they memorize. Soylu and Soylu [4] attributed the students to fail in problem-solving requiring operational and conceptual knowledge and learning difficulties which has the main reason for the students' inability to learn meaningfully the concepts of addition, subtraction, and multiplication with learning processes based on rote. Knowing that numbers represent multiplicities and deciding what to do accordingly, students become able to do basic operations consciously by controlling certain dimensions of their thinking processes. In the study conducted by Olkun et al. [1] on the acquisition of counting principles starting in pre-school, the development of students' skills related to the concept of numbers was examined and it was found that all skills developed with age. For example; Okamato et al.[6], who developed the scale that measures the size comparison between numbers and calculating skills of kindergarten students, applied this scale to children at the end of the first grade, and found the correlation between the tests strong and significant. Various studies have determined that children who do not develop the concept of the number will have difficulties in certain areas of mathematics (arithmetic operations, flexible mental calculations, prediction skills, etc.) and their academic success will be significantly affected [7]. Because students who lack basic calculating skills cannot be successful problem solvers, and those who fail to solve problems cannot be successful problem-makers [4]. Considering that the basis of problem-solving is basic calculating skills and calculation ability, it is necessary to determine in advance the slowness or difficulties in the development of these skills. Calculation difficulty in arithmetics has been found to be the result of a neurological condition that is either innate or subsequently developed in the brain by researchers [8]. It would be wrong to expect students with these situations to be at the same level as their peers in mathematics class. The difficulty or deficiency in calculating skills is also a sign of mathematics learning difficulties [9]. The results in the achievement and intelligence tests are not sufficient to conclude that the student has difficulty in mathematics [10]. Therefore, this study was carried out to determine the developmental differences in problem-solving that require the use of four basic operations and at the same time to determine whether problem-solving were made whether consciously or unconsciously. For this aim, The Cognitive Developmental aRithmetics test (CDR) [11] which is developed for the assessment of arithmetics, was used.

Materials and Participants

A total of 1203 students from different public schools participated in this study. There are 334 students from the 2nd and 3rd grades, 411 from the 4th and 5th grades, and 458 from the 6th and 7th grades. The tests applied at three different levels based on the grades.

In the CDR tests, it is aimed to measure the use of four basic operations (addition, subtraction, multiplication, division) and cognitive sub-skills related to them. In the problems section of CDR tests, there are 2 parts and 20 questions in total. In the first part of the problems (P1), the students were asked 10 questions such that they could reach a result by doing only one of the four basic operations. In the second part of the problems (P2), the students were given extra information and 10 problem situations were asked to measure their attention whether they did the problem consciously or unconsciously.

Results

P1 Section

CDR1 test, P1 part’s t-test results are shown in Table1 ($t = 3.27$ and $p < .05$). A statistically significant difference was found between the mean at the second grade ($M = 5.71$ $SD = 2.98$) and the third grade level ($M = 6.75$ $SD = 3.35$). Third grades were 10% more successful than the second graders regarding the mean.

Table 1

t-test results of the CDR1 test in P1

	N	M	SS	SD	t	p
2. grade	162	5.71	2.98	332	3.27	.001
3. grade	172	6.75	3.35			

According to Table2 in which P1 part's t-test results ($t = .65$ $p > .05$) of the CDR2 test, are given. There is not any significant differences between the fourth grade ($M = 6.63$ $SD = 2.37$) and the fifth grade levels results ($M = 6.80$ $SD = 2.82$).

Table2

t-test results of the CDR2 Test in P1

	N	M	SS	SD	t	p
4. grade	222	6.63	2.37	409	.65	.51
5. grade	189	6.80	2.82			

P1 t-test results ($t = .20$ $p > .05$) of the CDR3 test are given at the Table3 and according to the results there is not any significant difference between two grades regarding the mean.

Table 3

t-test results of the CDR2 Test in P1

	N	M	SS	SD	t	p
6. grade	234	6.85	2.34	456	.20	.83
7. grade	224	6.89	2.55			

Problems P2 Section

According to Table4 just like in the P1 t-test results, P2 t-test ($t = 0.20$; $p > .05$) results have a significant difference between the mean of the second grades ($M = 5.71$ $SD = 2.98$) and the third grades ($M = 6.75$; $SD = 3.35$). The percentage of correct answers in both grades is 57% in the second grade and 67% in the third grade.

Table 4

t-test results of the CDR1 Test in P2

	N	M	SS	SD	t	p
2. grade	162	5.71	2.98	332	3.27	.001
3. grade	172	6.75	3.35			

In the Table 5 in which the P2 part t-test results ($t = .67$; $p > .05$) are given, no statistically significant difference was found between the fourth ($M = 4.65$; $SD = 3.03$) and the fifth ($M = 4.77$; $SD = 2.97$) grades regarding the means.

Table 5

t-test results of the CDR2 Test in P2

	N	M	SS	SD	t	p
4. grade	222	4.65	3.03	409	.67	.41
5. grade	189	4.77	2.97			

The t-test results (t = 1.63; p> .05) for the CDR3 test P2 is presented in Table 6 and there was not found any statistically significant difference between the sixth (M = 4.72 and SD = 2.70) and the seventh grade results (M= 5.14 and SD = 2.87).

Table 6

t-test Results of the CDR3 Test in P2

	N	M	SS	SD	t	p
6. grade	234	4.72	2.70	456	1.63	.10
7. grade	224	5.14	2.87			

Conclusion

Basic calculating skills are very important for the development of arithmetic success during academic life and so on. This development's first steps start at a primary school. Based on the results in this research, at 2nd and 3rd-grade students have significant differences regarding the mean. One of the reasons for this result can be the slower arithmetic development in the early grades compared to others. The results of the other grades demonstrate there are not any significant differences regarding the means. Therefore, it can be said that the development of calculating skills becomes faster after learning the basic four operations (addition, subtraction, division, and multiplication) in primary school. Based on the results in this research, the P1 parts, ' mean was significantly higher for all students, but this means decreased significantly in problem P2 where extra information was given. Most of the students used the extra information in the solution, and this situation affected the result of the total mean. This indicates that meaningfully learning, and the ability to use arithmetic to consciously solving problems is weaker just as the Floyd et al.'s [5] research; where the students performed more memorization on basic calculating skills, and in problem situations, there were no significant differences between a primary school student and a secondary school student regarding strategies used. Considering the differences in the mean between the grades, it indicates there is a significant difference between the 2nd and 3rd grades of the primary school where arithmetic is started and that these skills are developing. At other grade levels, it is seen that the mean of two grades in which a test is applied are close to each other. Accordingly, these comparisons are useful at the individual level, concerning showing students who are behind their peers or their grade level in arithmetic terms. It cannot be expected for students with these situations to have the same level of success in math as their peers. In cases where calculation skills cannot be provided, problems will arise especially in mental or estimation calculations. Such inadequacies and problem situations are considered under the name of calculation difficulties.

The difficulty or deficiency in calculating skills is also a sign of mathematics learning difficulties (Jordan, 2007). Therefore, these tests which are applied at three different levels were important to identify students who have calculating difficulties regarding problem-solving or who are cognitively behind their peers by solving short problems that require basic four operations.

References

[1]. Akkan, Yasar, Adnan Baki, and Unal Cakıroglu. "5-8. grade öğrencilerinin aritmetikten cebire geçiş süreçlerinin problem çözme bağlamında incelenmesi." *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi* 2012.43 (2012): 1-13.

[2]. Griffin, Sharon. "The development of math competence in the preschool and early school years: Cognitive foundations and instructional strategies." *Mathematical cognition* (2002): 1-32.

[3]. Olkun, Sinan, Esra Fidan, and Ayşe Babacan Özer. "5-7 yaş aralığındaki çocuklarda sayı kavramının gelişimi ve saymanın problem çözmede kullanımı." *Eğitim ve Bilim* 38.169 (2013).

[4]. Soylu, Yasin, and Cevat Soylu. "Matematik derslerinde başariya giden yolda problem çözmenin rolü." *İnönü Üniversitesi Eğitim Fakültesi Dergisi* 7.11 (2006): 97-111.

[5]. Floyd, Randy G., Jeffrey J. Evans, and KEVIN S. McGREW. "Relations between measures of Cattell‐Horn‐Carroll (CHC) cognitive abilities and mathematics achievement across the school‐age years." *Psychology in the Schools* 40.2 (2003): 155-171.

[6]. Case, Robbie, et al. "The role of central conceptual structures in the development of children's thought." *Monographs of the society for research in child development* (1996): i-295.

[7]. Lee, Dianne, and N. E. Papillion. "The Implications of Number Sense on the Mastery of Addition and Subtraction Concepts." *Department of Mathematics* 48 (2011).

[8]. Ardila, Alfredo, and Mónica Rosselli. "Acalculia and dyscalculia." *Neuropsychology review* 12.4 (2002): 179-231.

[9]. Jordan, Nancy C. "Do words count? Connections between mathematics and reading difficulties." (2007).

[10]. Durmus, Soner. "Matematikte öğrenme güçlüğü gösteren öğrencilere yönelik öğretim yaklaşımları." *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi* 13 (2007): 76-83.

[11]. Desoete, Annemie, and Herbert Roeyers. "Metacognitive macroevaluations in mathematical problem solving." *Learning and Instruction* 16.1 (2006): 12-25.