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Problem-Solving Instruction in the Context of Children's Literature and Problem Understanding

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Abstract

Problem Statement: De-contextualized teaching and learning in schools usually leads students to memorize definitions of concepts without having the opportunity to apply those concepts in real-world settings. NCTM's *Curriculum and Evaluation Standards for School Mathematics* proposes the use of meaningful problem-solving contexts for children. This document states that when mathematics evolves naturally from problem situations that have meaning to children and are regularly related to their environments, it becomes relevant and helps children link their knowledge to a variety of situations. The challenge for teachers, usually, is to find problem-solving activities that are authentic and important to learners. In this respect, children's literature can be used to provide real-world opportunities for children to explore mathematics by offering problem-solving contexts with which children are familiar. Although problem solving has been investigated for over 50 years, there is a lack of findings on problem understanding.

Purpose of Study: The purpose of the study is to explore the impact of contextual problem-solving instruction in the context of children's literature on students' problem understanding.

Methods: A two-way repeated measures experimental-control groups pretest-to posttest-to-delayed posttest design was used. Twenty-eight and 25 third–grade students from an urban elementary school formed the experimental and control groups, respectively. To explore mathematical

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problem understanding, a test consisting of 12 open-ended problems was used.

Findings and Results: According to the findings, students who received contextual problem-solving instruction performed better on visualization and qualitative reasoning, when it came to understanding mathematical problems, than did students who received traditional problem-solving instruction. The findings showed that the differences between the two groups were greater in qualitative reasoning.

Conclusions and Recommendations: The findings revealed that contextual problem-solving instruction is helpful, especially in improving the qualitative thought processes used in problem-understanding and problem-solving procedures, which are essential to expert problem solvers. The findings also revealed that contextual problem-solving instruction had long-term effects. Contextually-oriented materials and instructional programs are recommended in all educational settings, to foster the development of expert problem-solving attributes.

Keywords: Contextual problem-solving instruction, children's literature, problem understanding, problem-solving

In recent years, many educators have criticized the de-contextualized nature of teaching and learning in schools, which has prevailed since the beginning of the 20th century (e.g., Dewey, 1916; Hutchinson, 2002; Schoenfeld, 1985, 1998). Dewey (1916) has addressed both content and context by envisioning a type of schooling where real-world activities form settings for meaningful learning. For example, when numbers, operations and problems are embedded in meaningful real-world contexts, children have opportunities to make sense of mathematics and gain mathematical power (Griffin & Jitendra, 2009; NCTM, 2000).

Contextual teaching and learning is a conception of teaching and learning that helps teachers relate subject matter content to real world situations and motivates students to make connections between knowledge and its applications to their lives (Borko & Putnam, 1998). Contextual teaching and learning helps students connect the content they are learning to the life contexts in which that content could be used and to find meaning in the learning process (Schoenfeld, 1985, 1998).

NCTM's *Curriculum and Evaluation Standards for School Mathematics* suggests the use of meaningful problem-solving contexts for children. It states: "When mathematics evolves naturally from problem situations that have meaning to children and are regularly related to their environments, it becomes relevant and helps children link their knowledge to many kinds of situations" (National Council of Teachers of Mathematics, 1989, p. 23). The challenge for teachers, usually, is to find problem-solving activities that are authentic and important to learners (Brown, Collins & Duguid, 1989). In this respect, children's literature can be used to provide real-world opportunities for children to explore mathematics by offering problem-solving contexts with which children are familiar (Moyer, 2000). Thus, this study focused mainly on the contributions of contextualized problem-solving instruction to problem solving.

Many researchers specify *understanding of a problem* as one of the most important stages in problem solving (e.g., Cai, 2003; Karataş & Güven, 2004; Polya, 1957, 1973). In addition, Wiest (2002) has stated that problem context gives meaning to the mathematical content of problems and influences the problem-solving stages used to arrive at understanding of problems. On the other hand, with contextual problem-solving activities that are enriched with children's literature in story format, the development of mathematical topics occurs naturally, as part of a story, as opposed to a context in which mathematics is overlaid on a story where it would not normally arise (Moyer, 2000; NCTM, 1989; 2000). In light of related literature, in this study, understanding of mathematical problem performance is explored in two categories, namely: *visualization of a problem* (Garderen & Montague, 2003; Polya, 1957, 1973) and *qualitative reasoning about a problem* (Brown & Walter, 1990; Griffin & Jitendra, 2009; Schoenfeld, 1985). Many researchers believe that drawing diagrams or figures when understanding a problem is a helpful way of building a scaffold that organizes the information in the problem, thereby reducing the level of cognitive load associated with the problem-solving task (e.g., Pawley, Ayres, Cooper, & Sweller, 2005; Sweller & Low, 1992). Furthermore, Griffin and Jitendra (2009) have stated that providing classroom opportunities that emphasize reasoning is critical to successful problem solving. Kadijević (2002) has stated that qualitative reasoning significantly influences problem-solving performance. Briefly, in this study, the effects of contextual problem-solving instruction, in the context of children's literature, on problem-understanding performance is explored.

Many educators believe that problem solving is not only a key aspect of mathematics, but also the most important human skill, enabling us to live even better. With this in mind, some researchers have been looking for ways of enhancing problem solving. As mentioned, related literature emphasizes problem understanding as a good way of enhancing problem-solving performance. If a person cannot understand a problem, she cannot select an appropriate strategy to solve it. She cannot even attempt to solve the problem. If the problem and problem solving are discussed in a de-contextualized nature, children usually cannot give meaning to the mathematical content of the problem, and this may influence their understanding of the problem negatively. It seems that when problem solving evolves naturally from problem contexts that have meaning to children, it becomes relevant and helps them link their knowledge to many kinds of problem-solving situations. To this point, children's literature can be used as a knowledge scaffold, a meaningful context that supports problem understanding and, thus, in turn, problem solving. The use of children's literature to develop mathematical concepts and problem-solving skills is not a new idea. However, classroom practice often does not reflect this connection (Moyer, 2000; Schoenfeld, 1985). Lack of research on and classroom practice with problem-solving activities in story contexts makes this study important.

Method

Research Design

In this study, a two-way repeated measures experimental-control groups pretest-to posttest-to-delayed posttest design was used. Type of treatment and gender were the between-subject factors, and time was the within-subjects factor. The independent variable for the experimental group (EG) was contextual problem-solving instruction (CPSI), while the independent variable for the control group (CG) was traditional problem-solving instruction (TPSI). Two dependent variables were considered – namely, *visualization* and *qualitative reasoning*. The dependent variables were measured repeatedly before, after a short delay and after a long delay of the treatments.

Sample

Participants in pilot testing of the Understanding Problem test. The population included 144 third-grade classes across the 5 regions (strata) in Northern Cyprus – namely, Lefkoşa, Mağusa, Güzelyurt, İskele and Girne. Seven third-grade classes were chosen using a probability-based stratified random sampling method (Pedhazur & Schmelkin, 1991). The sample was composed of 196 third-grade students.

Participants in pilot testing of CPSI. For pilot testing of CPSI, a third-grade class of 26 students from the Lefkoşa region was selected using a purposive sampling method.

Participants of the EG and the CG. Twenty-eight and 25 third–grade students from an urban elementary school in Lefkoşa were randomly selected to form the EG and the CG, respectively. Ninety percent of these students were from a lower-middle class background.

Research Instruments

Understanding Problem (UP) test. To explore understanding of mathematical problem performance, the UP test was developed by the researcher. The test consists of 12 open-ended problems that can be solved, at most, in two steps. All the problems were story problems familiar to third-grade students, as seen in Table 1. Scoring of the UP test was as follows: performance was scored as "3" if the responses were *totally correct and original,* as "2" if the responses were *totally correct but not original,* as "1" if the responses were *partly correct* and as "0" if the responses were *totally wrong or there was no attempt*. The UP test was administered during a 30-minute period. The problems in pre-, post- and delayed post-UP tests were identical.

Visualization sub-test. The Visualization (VIS) sub-test is a sub-test of the UP test that consists of 6 problems. The aim of using this test was to explore the visualization performance of students, as assessed by drawings, as students arrived at understanding of a problem, as seen in Table 1.

Qualitative reasoning sub-test. The Qualitative Reasoning (QRES) sub-test is a sub-test of the UP test that consists of 6 problems. The aim of using this test was to explore the reasoning performance of students as they arrived at understanding of a problem. Six problems were geared towards covering the following dimensions: *(1) coping with incomplete information, (2) determining strategic information and (3) determining the reasonableness of a problem,* as seen in Table 1. These dimensions are

based on recommendations by Polya (1957, 1973) and Schoenfeld (1985) for understanding problems.

The problem of the study. In this study, data were collected to answer the following question: "Does contextual problem-solving instruction in the context of children's literature enhance problem understanding?"

Table 1
Sample Problems From UP Sub-Tests

Sub-Test	Dimension	Sample Problem
Visualization	Drawing a picture	Problem 1: *Damla's position in a line of students is third from the left and sixth from the right*. Draw a picture that depicts this situation.
Qualitative reasoning	Coping with incomplete information	Problem 7: To solve the following problem, we need additional information. What could this information be? *How much did Gretel pay for the chocolates? If each costs 3 TL?*
	Determining strategic information	Problem 9: To solve the following problem without carrying out an operation, secret information is given. What is that information? *Snow White has 48 books. What is half of twice the number of the books?*
	Determining the reasonableness of a problem	Problem 11: In the following problem, there is information that does not make sense. Find that information, and explain why the problem does not make sense. *Hansel is 3 years old. Her mother is twice as old as Hansel. How old is her mother?*

The net score for each problem was generated by taking the average of the three scores, and all analysis was done considering the net scores. The reliabilities of the UP test, VIS sub-test and QRES sub-test were.83, .67 and .65, respectively (Cronbach α). A mathematics educator and three experienced elementary school teachers were asked to judge the content validity of the UP test. All concluded that the content and format of the problems were consistent with the definitions of the variables and the participants in the study. They also concluded that the problems were non-routine, compared to actual classroom practices and textbook problems. Of the 12 problems, none were removed as a result of the pilot testing's findings.

Fidelity of the treatments. Several methods were used to ensure the fidelity of treatment implementation during the six weeks of instruction. For the EG, the following procedures were followed: First, the researcher provided the EG teacher with daily lesson plans for each instructional period. Before and after instruction, details of the plan, to clarify classroom procedures for the following day, were reviewed. Second, two trained in-service elementary school teachers observed class periods and checked off each procedure as it was completed. To check the contextual

aspect of treatments, the criteria in Figure 1 were used. Third, student work folders gave a clear account of what students did in class each day. The combination of lesson plans and student work provided a clear account of what happened in the experimental and the CG classes. Finally, three class sessions from each group were videotaped, to create a permanent record of class activities both for the control and the experimental groups.

Contextual Problem-Solving Instruction	Traditional Problem-Solving Instruction
Problem Type Two-step story problems Problem Context Problems were provided within the context of the stories *Snow White & the Seven Dwarfs* and *Hansel & Gretel*	Problem Type Two-step story problems Problem Context Textbook problems on measurement, geometry and natural numbers were used, as these topics were mostly preferred by the elementary school teachers in Northern Cyprus.
Relation of the Problems in Each Set The problems used in each set flowed in a sequential way that was connected to the story used.	Relation of the Problems in Each Set The problems used in each set had no specific relationship to one another.
Flow of Problem-Solving Instruction A four-step problem-solving procedure (organizing the information in the problem using a diagram or table, planning to solve the problem, solving the problem, checking) was introduced to the whole class.	Flow of Problem-Solving Instruction A four-step problem-solving procedure (organizing the information in the problem using a diagram or table, planning to solve the problem, solving the problem, checking) was introduced to the whole class.
The original story was read aloud to the whole class.	A set of textbook problems was distributed to students.
The original story was read again by each student silently.	Students were asked to solve problems individually using the four-step problem-solving procedure.
The problems developed in the context of the story were distributed to the students in written formats (at most four problems in each set.)	Whole class discussions were carried out on students' solutions.
Students were asked to solve the problems individually using the four-step problem-solving procedure.	Students were asked to write problems similar to the ones solved before.
Whole class discussions were carried out on students' solutions.	Whole class discussions were carried out on the solvability and reasonableness of the written problems, and corrections were made where needed.
Students were asked to write problems in the contexts of the stories.	
Whole class discussions were carried out on the solvability and reasonableness of the written problems, and corrections were made where needed.	

Figure 1. Comparison of Contextual Problem-Solving Instruction and Traditional Problem-Solving Instruction

Procedures

The following procedures were followed during this study:

1) Before conducting the study, permission was obtained from the Elementary School Education Division of the Ministry of Education to pilot test the UP test. The division also offered assistance in administering the UP test in 7 classes simultaneously. After training 7 pre-service elementary teachers for 2 hours to assist with the test, the UP test was administered.
2) To determine the children's stories to be used in the EG treatment, previously-selected 7 third-grade classes and 5 experienced elementary school teachers were interviewed. The students (n = 196) were asked to choose their two favorite stories from the following five: *The Frog Prince*, *The Little Mermaid, Alice's Adventures in Wonderland, Hansel & Gretel* and *Snow White & the Seven Dwarfs*. The same set of stories was rated by 5 experienced elementary school teachers, in terms of their familiarity with third-grade students. *Snow White & the Seven Dwarfs* and *Hansel & Gretel* were chosen by both teachers and students as the favorites.
3) The draft form of the CPSI to be used in the EG was developed in the following way: First, problems were developed in the context of the first phase of *Snow White & the Seven Dwarfs*. The problems developed flowed in a sequential manner and were embedded into the story, without distorting the original flow of the script. Some of the problems are seen in Figure 2. The draft form of the CPSI was pilot-tested for 160 minutes.
4) Pilot testing of the CPSI revealed that the treatment could be enriched by adding more dimensions – namely, by having students read the original story before asking them to solve the problems and by having whole class discussions on solutions to the problems. The final form of the CPSI and its comparison with TPSI are seen in Figure 1. All the stories and problems used throughout the study were in Turkish.

At last, dawn woke the forest to the song of the birds, and Snow White too, awoke. A whole world was stirring to life, and the little girl was glad to see how silly her fears had been. However, the thick trees were like a wall round her, and as she tried to find out where she was, she came upon a path.

Problem 6

Snow White should walk 45 meters to reach the path. How long will it take her if she spends 4 seconds for each 5 meters?

She walked along it, hopefully. On she walked, till she came to a clearing. There stood a strange cottage, with a tiny door, tiny windows and a tiny chimney pot. Everything about the cottage was much tinier than it ought to be. Snow White pushed the door open.

Problem 7

In the cottage, there were 7 small chairs around a table. The number of plates was s twice as much as the number of chairs. What was the total number of chairs and plates?

"I wonder who lives here?" she said to herself, peeping round the kitchen. "What tiny plates! And spoons! There must be seven of them, the table's laid for seven people." Upstairs was a bedroom with seven neat little beds. Going back to the kitchen, Snow White had an idea.

Figure 2. A sample set of problems used in the CPSI

5) The pre-UP test was administered.
6) The CPSI and TPSI were applied for 6 weeks (12 class periods, each 80 minutes). Each class period was observed, and the fidelity of the treatments was checked using the criteria seen in Figure 1.
7) The post-UP test was administered just after the treatments had been completed.
8) The delayed post-UP test was administered after a three-month recess.

Data Analysis

To detect any potential differences between the CG and the EG, regarding their problem understanding performance, two-way repeated measure MANOVA procedures were used. For post-hoc analysis, independent and paired sample *t*-test procedures were used. Bivarite correlation procedures were used to test the correlation, if any, between the dependent variables. Partial eta squared (η^2) measures were used to see how much variance was explained by the independent variables. In interpreting partial eta squared values, Cohen's (1977) measures were used. Cohen characterized $\eta^2 = .01$ as a small effect, $\eta^2 = .06$ as a medium effect and $\eta^2 = .14$ as a large effect. On the other hand, Cohen's *d* measures were used when

paired, and independent sample *t*-tests were performed. Cohen characterized $d = 0.2$ as a small effect, $d = 0.3$ as a medium effect and $d = 0.5$ as a large effect. The level of significance used throughout the study was .05.

Findings and Results

Bivariate correlation analysis revealed that VIS and QRES scores were correlated, Pearson's $r(53) = .819$, $p < .001$. This led us to use MANOVA procedures to analyze the data related to the sub-test scores. Independent sample *t* tests indicated no statistically significant differences between the EG and the CG, in regard to both VIS sub-test mean scores, $t(51) = 1.353$, $p > .05$, $d = 0.4$, and QRES sub-test mean scores, $t(51) = 0.969$, $p > .05$, $d = 0.3$, indicating group equivalency before the beginning of the study.

Multivariate tests, through two-way repeated MANOVA with gender and group as between-subjects and time as within-subjects factors, revealed significant main effects for group, $F(2, 48) = 34.357$, $p = .001$, $\eta_p^2 = .589$, and time, $F(4, 46) = 51.247$, $p = .001$, $\eta_p^2 = .817$, and interaction effects for group and time, $F(4, 46) = 24.46$, $p = .001$, $\eta_p^2 = .680$ on the linear combination of mean scores that resulted from VIS and QRES problems. All other main and interaction effects were non-significant, all $F \leq 1.382$, $p \geq .261$, $\eta_p^2 \leq .097$.

Mauchly's test indicated that the assumption of sphericity for the QRES variable was met ($\chi^2(2) = 4.897$, $p > .05$). However the assumption of sphericity for the VIS variable had been violated ($\chi^2(2) = 57.377$, $p < .001$). Therefore, degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = 0.632$).

Visualization

Two-way repeated MANOVA, with gender and group as between-subjects and time as within-subjects factors, revealed significant main effects for group, $F(1, 49) = 47.010$, $p = .001$, $\eta_p^2 = .490$, and time, $F(1.264, 61.938) = 74.698$, $p = .001$, $\eta_p^2 = .604$. Analysis also revealed a significant group x time interaction effect, $F(1.264, 61.938) = 8.506$, $p = .003$, $\eta_p^2 = .148$. The main effects of gender, $F(1, 49) = 2.210$, $p = .144$, $\eta_p^2 = .043$, and all other interactions were non-significant, all $F \leq 2.416$, $p \geq .127$, $\eta_p^2 \leq .047$. For the main effects of time, within-subjects contrasts showed that post- and delayed post-VIS sub-test mean scores did not differ significantly, $F(1, 49) = 3.382$, $p = .072$, $\eta_p^2 = .065$, but pre- and post-test mean scores differed significantly, $F(1, 49) = 82.938$, $p = .001$, $\eta_p^2 = .629$. For time x group interaction effect, within-subjects contrasts also showed that pre- and post-VIS sub-test mean scores differed significantly, $F(1, 49) = 8.842$, $p = .005$, $\eta_p^2 = .153$, but post- and delayed-post-VIS sub-test mean scores did not differ significantly, $F(1, 49) = 0.000$, $p = .999$, $\eta_p^2 = .001$.

Independent sample *t* tests indicated significant differences between the EG and the CG, in terms of VIS sub-test mean scores favoring the EG at both post-testing, $t(51) = 9.313$, $p < .05$, $d = 2.5$, and delayed post-testing stages, $t(51) = 9.062$, $p < .05$, $d = 2.4$ (see Fig. 3). Paired sample *t* tests indicated significant increases in the mean scores of both the EG, $t(27) = -10.831$, $p < .05$, $d = 2.04$, and the CG, $t(24) = -3.641$, $p <$

.05, d = 0.72, from pre-testing to post-testing, whereas there were no significant differences between the post-VIS sub-test and delayed-VIS sub-test mean scores of either the EG, $t(27) = 1.728$, $p > .05$, $d = 0.32$, or the CG, $t(24) = 1.013$, $p > .05$, $d = 0.22$ (see Table 2).

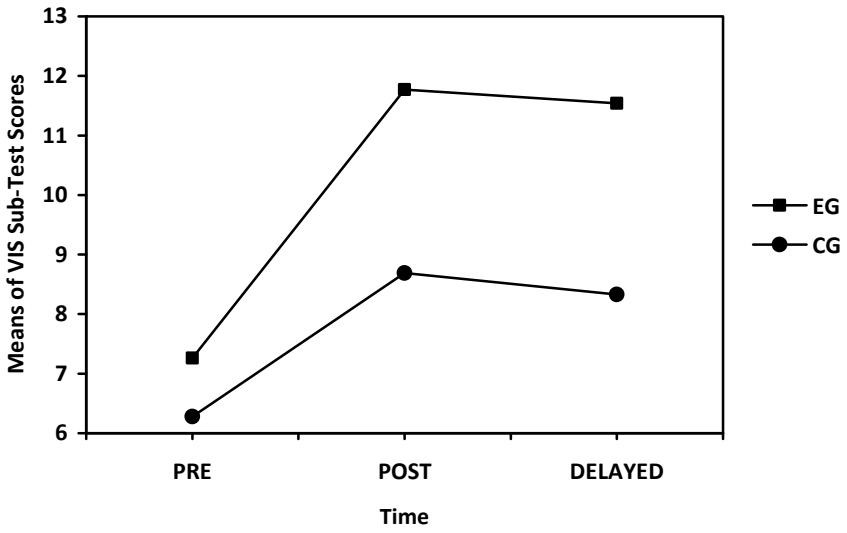


Figure 3. Pre-, post-, and delayed-post-test means of the VIS sub-test

Although not originally planned, after reviewing the qualitative aspects of the drawings and figures that the EG and CG students made while understanding problems, these visual images were analyzed to identify any potential differences between the two groups. Analysis revealed that 33.5% of the images used by the EG (53 of 168) and 71.3% of images used by the CG (107 of 150) were pictorial. However, 68.5% of the images used by the EG (115 of 168) and 28.7% of images used by the CG (43 of 150) were schematic (see Table 3). These proportions were statistically significantly different, $\chi^2(1, N = 318) = 50.177$, $p < .05$, $\phi = 0.4$.

Qualitative reasoning

Two-way repeated MANOVA, with gender and group as between-subjects factors and time as a within-subject factor, revealed significant main effects for group, $F(1, 49) = 59.943$, $p = .001$, $\eta_p^2 = .550$, and time, $F(2, 98) = 93.808$, $p = .001$, $\eta_p^2 = .657$. Analysis also revealed a significant group x time interaction effect, $F(2, 98) = 51.764$, $p = .001$, $\eta_p^2 = .514$. The main effects of gender, $F(1, 49) = 1.648$, $p = .205$, $\eta_p^2 = .033$, and all other interactions were non-significant, all $F \leq 0.174$, $p \geq .176$, $\eta_p^2 \leq .010$. For the main effects of time, within-subjects contrasts showed that post- and delayed

post-test mean scores did not differ significantly, $F(1, 49) = 0.155$, $p = .695$, $\eta_p^2 = .003$, but pre- and post-test mean scores differed significantly, $F(1, 49) = 138.633$, $p = .001$, $\eta_p^2 = .739$. For time x group interaction effect, within-subjects contrasts showed that both pre- and post -QRES sub-test mean scores, $F(1, 49) = 96.718$, $p = .001$, $\eta_p^2 = .664$, and post- and delayed-QRES sub-test mean scores differed significantly, $F(1, 49) = 7.849$, $p = .007$, $\eta_p^2 = .138$.

Independent sample *t* tests indicated significant differences between the EG and the CG, in terms of QRES sub-test mean scores favoring the EG at both post-testing, $t(51) = 11.803$, $p < .05$, $d = 3.18$, and delayed post-testing stages, $t(51) = 6.728$, $p < .05$, $d = 1.82$ (see Fig.4). Paired sample *t* tests indicated a significant increase from pre-testing to post-testing, $t(27) = -23.992$, $p < .05$, $d = 4.5$, in the mean scores of the EG, obtained from QRES sub-test problems, and a significant slight decrease from post-testing to delayed post-testing, $t(27) = 2.526$, $p < .05$, $d = 0.47$. However, there were no significant differences in the mean scores of the CG, neither from pre-testing to post-testing, $t(24) = -1.070$, $p > .05$, $d = 0.21$, nor from post-testing to delayed post-testing, $t(24) = -1.767$, $p > .05$, $d = 0.35$ (see Table 2).

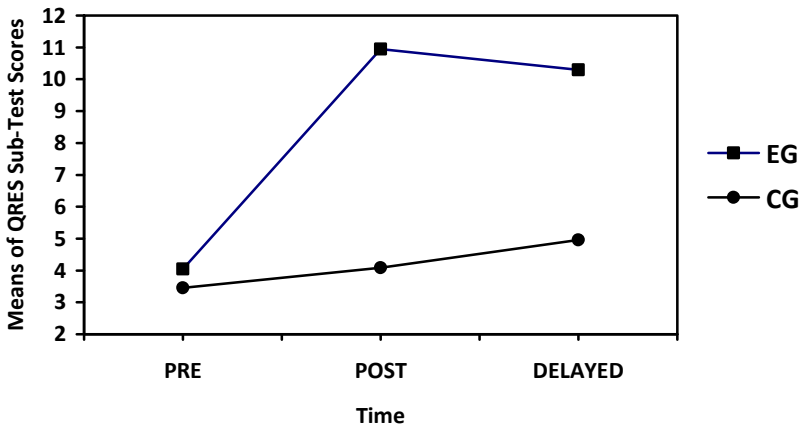


Figure 4. Pre-, post-, and delayed post-test means of the QRES sub-test

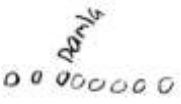
Table 2

Descriptive Statistics for Sub-Tests of the Understanding Problem Test

Group	Pre-Test		Post-Test		Delayed-Post Test		*n*
	M	*SD*	*M*	*SD*	*M*	*SD*	
			Visualization				
Control							
Boys	5.98	5.97	7.87	1.51	7.85	1.52	13
Girls	6.61	2.85	9.29	1.81	8.85	1.80	12
Total	6.28	3.08	8.55	1.78	8.33	1.70	25
Experimental							
Boys	7.41	2.62	11.74	0.42	11.36	0.93	14
Girls	7.12	1.69	11.79	0.39	11.71	0.47	14
Total	7.26	2.17	11.77	0.40	11.54	0.75	28
			Qualitative reasoning				
Control							
Boys	2.77	2.05	3.44	2.01	4.08	3.10	13
Girls	4.23	2.59	4.79	3.36	5.92	3.85	12
Total	3.47	2.39	4.09	2.77	4.96	3.53	25
Experimental							
Boys	4.26	2.42	10.96	1.43	10.29	2.30	14
Girls	3.84	1.46	10.94	1.16	10.29	2.05	14
Total	4.05	1.97	10.95	1.28	10.29	2.14	28

Table 3

Visual Images Used by EG and CG Students in Understanding Problem 1

Student Name	Pre-Test	Post-Test
	Experimental Group	
AG*		
SH*		
	Control Group	
KC*		
PR*		

*The capital letters stand for the students' initials.

Conclusions

The findings of the present study revealed that contextual problem-solving instruction had greater benefits than traditional problem-solving instruction, in regards to problem understanding. The very large effects of group (η_p^2 = .589) and group x time interaction (η_p^2 = .680) on the linear combination of the mean scores obtained for the VIS and QRES problems showed that contextual problem-solving activities might contribute to problem understanding. Similarly, some researchers have stated the importance of context in mathematics learning (e.g., Choi & Hannafin, 1997; Ross, Mccormick, & Krisak, 1986). For example, Wiest (2002) has stated that problem context gives meaning to the mathematical content of problems, which influences the problem-solving stages of problem understanding.

Although the contextual nature of problem-solving activities used in this study influenced the problem-understanding performance of students in a positive way, it seems that familiarity with the context used was also an important factor. Hembree (1992), in a meta-analysis of 44 studies, explored 6 pairs of problem contexts and concluded that familiar contexts strongly influenced students' problem-solving performance. Although the activities used in this study with the CG students had some context, the context was not as familiar as that used with the EG students. This might be an important reason why the EG students performed better than the CG students.

Since we used excerpts from children's literature as the context for the problems used in the EG, it seems that, besides familiarity with the context, the personalized nature of the context also had an important effect on EG students' problem-understanding performance. In many studies, it has been noted that personalized contexts enhance word problem solving by increasing the meaningfulness of contexts and stimulating students' intrinsic interest in solving problems (e.g., Cordova & Lepper, 1996; Lopez & Sullivan, 1992; Ku & Sullivan, 2002). Therefore, it can be concluded that contextual problem-solving instruction in familiar, personalized contexts, like children's literature, may enhance problem understanding.

In this study, two categories, visualization of a problem and qualitative reasoning about a problem, were considered indicators of problem understanding. Analysis revealed that the EG students performed better on both visualization and qualitative reasoning, compared to the CG students, at both the post-testing and delayed post-testing stages. Analysis also revealed that the differences between the EG and the CG were larger for qualitative reasoning (η_p^2 = .550) performance than for VIS (η_p^2 = .490) performance. Qualitative reasoning problems, naturally, were more complex than VIS problems. Thus, it can be concluded that CPSI might have more potential for improving complex tasks like qualitative reasoning, compared to TPSI. In line with this, Lopez and Sullivan (1992), for example, have also found that contextualization and personalization are more effective for more demanding cognitive tasks than for less demanding tasks.

The findings showed that the visualization performance of the EG students improved more from pre-test to post-test than did the visualization performance of the CG students. Some researchers have argued that students' problem-solving abilities might improve markedly if they could use working memory more efficiently (e.g., Silver, 1987; Sweller & Low, 1992; Sweller, Van Merrienboer, & Paas, 1998). In line with this, they have stated that visualization skills are important in problem solving. Therefore, it seems that CPSI is more effective than TPSI in improving problem-understanding and, thus, in turn, problem-solving with better visualization skills. Another notable finding related to the impact of CPSI over time is that the EG students maintained higher levels of visualization performance than the CG students 12 weeks later. Thus, it can be concluded that CPSI may have long-term effects on visualization performance.

One of the most important observations related to visualization performance was that the EG students made remarkably more schematic representations than the CG

students (see Table 3). According to many researchers, visualizing problems in schematic formats is usually preferred by expert problem solvers (e.g., Lowrie & Kay, 2001; Kaufmann, 1990; Kozhevnikov & Hagerty, 1999; Garderen, 2006). For example, Kozhevnikov & Hagerty (1999) have stated that the use of schematic representations is positively related to success in mathematical problem-solving, whereas the use of pictorial representations is negatively related to success in mathematical problem solving.

Unlike visualization, the findings of this study revealed that the CG group students showed no improvement in their qualitative reasoning performance from pre-test to post-test and from post-test to delayed post-test. Hence, it can be concluded that TPSI might be ineffective at improving higher-order skills like qualitative reasoning. On the other hand, the results showed that the EG students improved their qualitative reasoning performance from pre-test to post-test, compared to the CG students. The larger effects observed in relation to qualitative reasoning, compared to visualization, showed that CPSI is more effective, especially in improving qualitative reasoning skills. Many researchers have argued that qualitative reasoning is what expert problem solvers frequently use when problem solving (e.g., Carlson & Bloom, 2005; Chi, Glaser & Rees, 1982; Kadijević, 2002; Schoenfeld, 1985). Thus, it can be concluded that CPSI may lead to the development of expert problem solvers. The results showed that there was a decrease in QRES mean scores within the EG from post-testing to delayed post-testing. Since the decrease was so slight, it can be concluded that CPSI may have long-term effects on qualitative reasoning performance.

Some researchers have argued that *control* (e.g., Carlson & Bloom, 2005; Schoenfeld, 1985), *flexibility* (e.g., Geiger & Galbraith, 1998) and *metacognition* (e.g., Schoenfeld, 1985; Vinner, 1997) are thought processes used by expert problem solvers when problem solving. Since the problems in the qualitative reasoning category were meant to engage these thought processes and foster critical and strategic thinking, instead of the use of misleading key words, and considering the outstanding qualitative reasoning performance of the EG students , it can concluded that CPSI may also have the potential to improve the qualitative thought processes of students and their use of strategies important in problem understanding and problem solving.

Similar to the findings of many other studies (e.g., Hyde, et al., 1990; Caplan & Caplan, 2005; Duffy , Gunther & Walters, 1997), the findings of this study showed that gender had no significant effect on problem-understanding performance. For example, Hyde, et al. (1990) have suggested that there is a very small or null gender difference in the mathematics performance of students, especially at earlier grades. Caplan and Caplan (2005) have argued that the link between gender and mathematics performance is very weak. Duffy, Gunther & Walters (1997) have observed that there are no gender differences in problem solving related to the use of higher-order skills, as was investigated in this study. This study's finding of no gender differences was in agreement with literature in which it has been widely reported that gender differences do not emerge until early adolescence (e.g., Fennema & Carpenter, 1998).

Limitations

Several limitations of the study require cautious interpretations of the findings. First, the distribution of time in the study (i.e., 80-min session per week) did not reflect typical classroom practice. Second, although reading comprehension is an important factor, contributing to students' mathematical word problem-solving performance, students' initial reading levels were not controlled. Third, students' problem-understanding performance was limited to demonstrations of visualization and qualitative reasoning. Finally, the validity of the instruments was examined only by experts.

Recommendations

To summarize, the following recommendations can be offered for researchers, teachers, pre-service teachers, teacher trainers and curriculum experts, in light of the findings and current practice:

1) Pre-service and in-service teachers should have the opportunity to view and teach problem-solving in a more contextual way.
2) Students should be taught to visualize problems, to reduce the level of cognitive load associated with problem-solving tasks.
3) Qualitative reasoning should be considered more than other forms of reasoning in both understanding and solving problems.
4) The links between qualitative reasoning and problem understanding-solving should be considered in all teacher training programs.
5) More materials and programs should be developed, making especial use of contexts familiar to children, to improve problem solving.
6) Qualitative research should be conducted on these and other aspects of contextual problem solving.

Appendix

Problems Used in the Understanding Problems Test

Problem 1:
Damla's position in a line of students is third from the left and sixth from the right. Draw a picture that depicts this situation.

Problem 2:
In a classroom, the number of boys is 12, and the number of girls is 4 more than the number of boys. Draw a picture that depicts this situation.

Problem 3:
A box can hold 8 marbles. Hansel brought 4 boxes full of marbles. Draw a picture that depicts this situation.

Problem 4:
A mathematics book is 10 cm wide. Eight of the mathematics books are lined up on a shelf. Draw a picture that depicts this situation.

Problem 5:
In a classroom, there are 4 rows, and in each row, there are 8 desks. Draw a picture that depicts this situation.

Problem 6:
Gretel walked 20 meters after having a 2-minute rest and then walked 15 meters. Draw a picture that depicts this situation.

Problem 7:
To solve the following problem, we need additional information. What could this information be?
How much did Gretel pay for the chocolates? If each costs 3 TL?

Problem 8:
To solve the following problem, we need additional information. What could this information be?
Hansel walked twice as much as Gretel did. How much did Hansel walk?

Problem 9:
To solve the following problem without carrying out an operation, secret information is given. What is that information?
Snow White has 48 books. What is the half of twice the number of the books?

Problem 10:
To solve the following problem without carrying out an operation, secret information should be considered. Find that information.
The difference between the ages of Hansel and Snow White is 4. What will be the difference between their ages after 5 years?

Problem 11:
In the following problem, there is information that does not make sense. Find that information, and explain why the problem does not make sense.
Hansel is 3 years old. Her mother is twice as old as Hansel. How old is her mother?

Problem 12:
In the following problem, there is information that does not make sense. Find that information, and explain why the problem does not make sense.
A pencil weighs 3 kg. The weight of a book is 10 times the weight of the pencil. What is the weight of the book?

References

Borko, H., & Putnam, R. T. (1998). The role of context in teacher learning and teacher education. In *1998 Contextual teaching and learning design conference proceedings: Preparing teachers to enhance student success in and beyond school.* Columbus, OH: The Ohio State University, College of Education, Center on Education for Training and Employment. (ERIC Document Reproduction Service No. ED434095).

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, *17*(1), 32-41.

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

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.

Caplan, J. B. & Caplan, P. J. (2005) The perseverative search for sex differences in mathematics abilities. In A. M. Gallagher & J. C. Kaufman (eds.) *Gender Differences in Mathematics: An Integrative Psychological Approach*. Cambridge: Cambridge University Press.

Carlson, M. P., & Bloom, I. (2005). The cyclic nature problem solving: An emergent multidimensional problem-solving framework. *Educational Studies in Mathematics, 58*, 45-75.

Chi, M. T. H., Glaser, R., & Rees, E. (1982). Expertise in problem solving. In R. J. Sternberg (Ed.), Advances in the psychology of human intelligence, (Vol. 1). Hillsdale, NJ: Erlbaum.

Choi, J.I., & Hannafin, M. (1997). The Effects of Instructional Context and Reasoning Complexity on Mathematics Problem-Solving. *Educational Technology Research and Development*, *45*(3), 43-55.

Cohen, J. (1977). *Statistical power analysis for the behavioral sciences.* New York:Academic Press.

Cordova, D. I., & Lepper, M. R. (1996). Intrinsic Motivation and the Process of Learning: Beneficial Effects of Contextualization, Personalization, and Choice. *Journal of Education Psychology*, *88*(4), 715-730.

Dewey, J. (1916). *Democracy and education*. New York: Macmillan.

Duffy, J. , Gunther, G., & Walters, L. (1997). *Gender and mathematical problem solving.* Sex Roles, 37*(7), 477-494.*

Fennema, E., & Carpenter, T. P. (1998). *New perspectives on gender differences in mathematics: An introduction and a reprise.* Educational Researcher, 27*(5), 4-11, 19-22.*

Garderen, D. V. (2006). Spatial visualization, visual imagery, and mathematical problem solving of students with varying abilities. *Journal of Learning Disabilities, 39*(6), 496-506.

Garderen, D. V., & Montague, M. (2003). Visua-spatial representation, mathematical problem solving, and students of varying abilities. *Learning Disabilities Research & Practice, 18(4)*, 246-254.

Geiger, V. and Galbraith, P. (1998). Developing a diagnostic framework for evaluating student approaches to applied mathematics problems. *International Journal of Mathematics, Education, Science and Technology, 29*, 533–559.

Griffin, C. C., & Jitendra, A. K. (2009). Word problem-solving instruction in inclusive third-grade mathematics classrooms. *The Journal of Educational Research, 102* (3), 187-201.

Hembree, R. (1992). Experiments and relational studies in problem solving: a meta-analysis.*Journal for Research in Mathematics Education, 23,* 242-273.

Hutchinson, P. (2002). Children designing & engineering: contextual learning units in primary design and technology, *Journal of Industrial Teacher Education, 39*(3), 122-145.

Hyde, J. S., Fennema, E. & Lamon, S. J. (1990) Gender Differences in Mathematics Performance: A Meta-Analysis. *Psychological Bulletin*, *107*(2), 139-155.

Kadijević, D. (2002). Are qualitative and quantitative reasoning related? *The Teaching of Mathematics, 5*(2), 91-98.

Karataş, İ., & Güven, B. (2004). 8. sınıf öğrencilerinin problem çözme becerilerinin belirlenmesi: Bir özel durum çalışması. *Milli Eğitim Dergisi*, *163,* 132-143.

Kaufmann, G. (1990). Imagery effects on problem solving. In J. Hampson (Ed.), *Imagery: Current developments* (pp. 169-196). London: Routledge.

Kozhevnikov, M., & Hegarty, M. (1999). Types of visual-spatial representations and mathematical problem solving. *Journal Educational Psychology, 91*(4), 684-689.

Ku, H-Y., & Sullivan, H. J. (2002). Student Performance and Attitudes Using Personalized Mathematics Instruction. *Educational Technology Research and Development*, *50*(1), 21-33.

Lopez, C. L., & Sullivan, H. J. (1992). Effect of Personalization of Instruction Context on the Achievement and Attitudes of Hispanic Students. *Education Technology Research and Development*, 40(4), 5-13.

Lowrie, T., & Kay, R. (2001). Relationship between visual and nonvisual solution methods and difficulty in elementary mathematics. *The Journal of Educational Research, 94*(4), 248-255.

Moyer, P.S. (2000). Communicating mathematically: Children's literature as a natural connection. *The Reading Teacher, 54*(3), 246-255.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics,* Reston, VA: Author.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics,* Reston, VA: Author.

Pawley, D., Ayres, P., Cooper, M., & Sweller, J. (2005). Translating words into equations: A cognitive load theory approach. *Educational Psychology, 25,* 75-97.

Pedhazur, E., & Schmelkin, L. (1991). *Measurement design and analysis: An integrated approach*. New York: Psychology Press.

Polya, G. (1957). How to Solve It? (2nd ed.). Princeton, N.J.: Princeton University Press.

Polya, G. (1973). How to solve it: A new aspect of mathematical method (2nd ed.). Princeton, NJ: Princeton University Press.

Ross, S. M. Mccormick, D., & Krisak, N. (1986). Adapting the Thematic Context of Mathematical Problems to Student Interests: Individualized Versus Group-Based Strategies. *Journal of Educational Research*, 79(4), 245-252.

Schoenfeld, A. H. (1985). *Mathematical problem solving*. Orlando, FL: Academic Press.

Schoenfeld, A. H. (1998). Toward a theory of teaching-in-context. *Issues in*

Education, *4*(1), 1-94.
Silver, E. A. (1987). Foundations of cognitive theory and research for mathematics problem-solving instruction. In A. H. Schoenfeld (Ed.), *Cognitive Science and Mathematics Education.* Hillsdale, NJ: Erlbaum.
Sweller, J., & Low, R. (1992). Some cognitive factors relevant to mathematics instruction. *Mathematics Education Research Journal*, *4*, 83-94.
Sweller, J., Van Merrienboer, J. J. G., & Paas, F. G. W. C. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*, *10*, 251.
Vinner, S. (1997). The pseudo-conceptual and the pseudo-analytical thought processes in mathematics learning. *Educational Studies in Mathematics*, *34*, 97–129.
Wiest, L. R. (2002). Aspects of word-problem context that influence children's problem-solving performance. *FOCUS on Learning Problems in Mathematics*, *24*(2), 38-52.

Çocuk Edebiyatı Bağlamlı Problem Çözme Öğretimi ve Problemi Anlama (Özet)

Problem Durumu

Bağlamsal öğrenme ve öğretim, 50 yılı aşkın bir süredir eğitimci ve araştırmacıların eğitimde temel inceleme konularından biri olmuştur. Yapılan birçok araştırma, okullarda bağlamsal öğretimden çok az yararlanıldığını ortaya koymaktadır. Yapılan çalışmalar öğrencilerin genel anlamda kavram ve süreçleri kendi ilgi alanları ve dünyalarıyla birleştirme fırsatları bulamadıklarından söz etmektedir. Ağırlıklı olarak öğrencilerin anlamlı bağlamlar çerçevesinde kavram ve süreçleri kazanamadıkları için ezbere yöneldikleri işaret edilmektedir. Matematik öğretimi ile ilgili literatür gözden geçirildiği zaman, öğrencilerin özellikle aşina oldukları ve keyif alabilecekleri bağlamların kullanılması çerçevesinde gerçekleştirilen problem çözmeye dayalı etkinliklerle öğrencilerin daha etkin öğrenebilecekleri ve matematik ve problem çözmeye yönelik olumlu tutum geliştirebilecekleri anlaşılmaktadır. Bu anlamda, birçok araştırma, öğretimde çocuk edebiyatı bağlamından yararlanmanın önemini vurgulanmaktadır.

Problem çözme becerilerine yönelik çok sayıda çalışma olmasına rağmen, özellikle problem çözme aşamalarının en önemlilerinden biri olan "problemi anlama" ile ilgili çok az çalışmaya rastlanmaktadır. Halbuki, araştırmaların birçoğu matematik problemlerini çözmedeki zorlukların daha çok problemi anlama ile ilgili sorunlardan kaynaklanabileceğini, problemi anlamayan bireyin doğal olarak problemi çözmek için uygun bir strateji kullanamayacağını, hatta problemi çözmek için uğraşmayacağını ifade etmektedir. Bu anlamda çocuk edebiyatı bağlamından yararlanarak oluşturulmuş bir problem çözme öğretiminin problemi anlamaya olan etkisinin araştırılması önemlidir.

Araştırmanın Amacı

Bu araştırmanın amacı, çocuk edebiyatı bağlamlı problem çözme öğretiminin problemi anlama becerisini ne şekilde etkilediğini incelemektir. Problemi anlama becerisi, problemi görselleştirme ve problemle ilgili niteliksel akıl yürütme biçiminde

iki alt kategoride ele alınmış ve öğrencilerin bu kategorilerde gösterdikleri becerilerin irdelenmesi amaçlanmıştır.

Araştırmanın Yöntemi

Araştırmanın örneklemini, seçkisiz yöntemle belirlenen, 53 üçüncü sınıf ilkokul öğrencisi oluşturmaktadır. Bu çalışmada tekrarlı ölçümlere sahip iki faktörlü desen kullanılmıştır. Bu desende, bağımlı değişkenler üzerinde etkisi incelenen iki faktör (bağımsız değişken) yer almaktadır. Bağımsız değişkenlerden biri cinsiyet, diğeri ise deney grubu (n = 28) için Çocuk Edebiyatı Bağlamlı Problem Çözme Öğretimi (ÇEBPÖ) kontrol grubu (n = 25) için ise Geleneksel Problem Çözme Öğretimi (GPÖ) dir. Araştırmanın bağımlı değişkenleri ise; öğrencilerin matematik problemini görselleştirme ve problemle ilgili niteliksel akıl yürütme puanlarıdır. Altı haftalık bir süre boyunca deney grubunda ÇEBPÖ, kontrol grubunda ise GPÖ uygulanmıştır. Deney grubunda, *Pamuk Prenses ve Yedi Cüceler* ile *Hansel ve Gretel* hikayeleri içerisine, hikaye akışlarını bozmayacak şekilde problemler yerleştirilmiş ve öğrenciler, bunlar üzerinde çalışmalar yapmışlardır. Tekrarlı ölçümler, deneysel işlem öncesi, deneysel işlemden hemen sonra ve deneysel işlemden üç ay sonra olmak üzere üç farklı zamanda gerçekleştirilmiştir.

Araştırmanın Bulguları

Bulgulara göre, deney grubu öğrencilerinin gerek problemi görselleştirme, gerekse problemle ilgili niteliksel akıl yürütme kategorilerinde kontrol grubu öğrencilerine göre çok daha yüksek puanlar elde ettikleri ortaya çıkmıştır. Problemi görselleştirme kategorisinde, her iki öğrenci grubunun da sontest ve gecikmeli sontest ortalamalarında bir farklılık olmadığı gözlenirken gruplararası karşılaştırmalar, deney grubu öğrencilerinin her iki aşamada da kontrol grubu öğrencilerinden daha yüksek ortalamalar elde ettiğini göstermiştir. Problemi görselleştirme kategorisindeki en çarpıcı bulgulardan biri, deney grubu öğrencilerinin problemlerle ilgili çizdikleri şekillerin yaklaşık %34'ünün resimsel, %69'unun ise şematik olmasıdır. Diğer yandan kontrol grubu öğrencilerinin ise çizdikleri şekillerin yaklaşık %71'inin resimsel, % 29'unun ise şematik olmasıdır. Problemle ilgili niteliksel akıl yürütme boyutunda, problemi görselleştirme kategorisinde olduğundan farklı olarak deney grubunda öntestten sonteste kadar ilerleme kaydedilirken, kontrol grubu öğrencilerinde herhangi bir değişim ve ilerleme yaşanmamıştır.

Araştırmanın Sonuçları ve Önerileri

Araştırmanın bulguları genel anlamda ÇEBPÖ'nün problemi anlama becerisi üzerinde GPÖ'ye göre daha etkili olduğunu ortaya koymuştur. Etki büyüklüğü değerlerinin oldukça yüksek olması, ÇEBPÖ'nün bu bağlamda etkisinin oldukça yüksek olduğunu göstermektedir. ÇEBPÖ'de ele alınan problem bağlamlarının öğrencilerin kendi dünyalarına çok yakın olması ve bağlamları kişiselleştirebilmelerinin yöntemin etkilili olmasında önemli bir rol oynadığı büyük bir olasılıktır. Bu durum ilgili literatürde de yoğun olarak desteklenmektedir.

Problemi görselleştirme kategorisinde, özellikle deney grubu öğrencilerinin öntest puanlarına kıyasla sontestte çok yüksek puanlar almaları ve bu performansı üç ay

sonra uygulanan gecikmeli sontestte de korumaları, ÇEBPÖ'nün kazanılan görselleştirme becerilerini uzun vadede koruma üzerinde de oldukça etkili olduğunu göstermektedir. Öğrenmede kalıcı izli davranış değişikliğinin önemi göz önünde bulundurulduğunda ÇEBPÖ'nün bu bağlamda öğrenmede avantaj sağladığı da söylenebilir. Problemi görselleştirme kategorisinde deney grubu öğrencilerinin kontrol grubu öğrencilerine kıyasla problemlerle ilgili çizdikleri şekillerin büyük bir çoğunluğunun resimsel değil şematik olması, kontrol grubu öğrencilerinin uzman problem çözen konumuna geldikleri ile ilgili bir gösterge olabilir. Problemi anlamaya oldukça büyük katkısı olan problemi görselleştirmede böyle bir bulguya rastlanması, ÇEBPÖ'nün önemini artırmaktadır. İlgili literatür gözden geçirildiği zaman, bir problemi görselleştirmenin gerçekte problemle ilgili bilgi yükünü hafiflettiği öne sürülmektedir. Görselleştirme bu bağlamda ele alındığında, problemi anlamaya ve dolayısıyla problem çözmeye olan katkısı daha da önemli olmaktadır.

Özellikle ilkokul çağındaki çocukların problem çözerken işgörüsü olmayan yanıltıcı anahtar sözcük arayışında oldukları bir gerçektir. Hatta, bazı öğretmenlerin işi kolaylaştırma bağlamında çocukları bu yönde yetiştirdiklerine de rastlanmaktadır. Bu bağlamda, bu çalışmada özellikle anahtar sözcük arayanların işine yaramayacak, aksine stratejik bilgi ve kritik düşünmenin gerekli olduğu problemlerden oluşan *problemle ilgili niteliksel akıl yürütme* kategorisi ele alınmıştır. Etki büyüklüklerine bakıldığında bu ketagoride görselleştirmeye kıyasla deney grubu öğrencilerinin çok daha yüksek düzeyde performans gösterdikleri saptanmıştır. Bu duruma ÇEBPÖ'nün üst düzey beceriler olarak kabul edilebilecek problemle ilgili niteliksel akıl yürütme becerilerini geliştirmede daha etkili olduğu söyleyebilir. Bu kategoride kontrol grubu öğrencilerinin öntestten, gecikmeli sonteste kadar hiçbir ilerleme gösterememeleri geleneksel öğretim yöntemlerinin niteliksel akıl yürütmeye dayalı becerileri geliştirmede etkisiz olduğu biçiminde yorumlanabilir. Bu kategoride deney grubu öğrencilerinin çalışmadan üç ay sonra uygulanan gecikmeli sontestten elde edilen ortalamarında sonteste göre çok az bir düşüş göstermeleri, ÇEBPÖ'nün kazanılan akıl yürütme becerilerini de uzun vadede koruma üzerinde oldukça etkili olduğunu göstermektedir.

Görselleştirme ve niteliksel akıl yürütme kategorilerinin hiçbirinde cinsiyet faktörünün etkili olmadığı gözlenmiştir. İlgili literatür incelendiği zaman, ergenlik çağı öncesi erkek ve kızlarda matematiksel beceriler anlamında bir farkın gözlenemeyeceğinin yoğun olarak tartışıldığı göze çarpmaktadır. Bu bağlamda, bu çalışmadan elde edilen cinsiyete dayalı bulgular literatürle paralellik göstermektedir.

Çalışmadan elde edilen bulgular ışığında, öğrencilerin problemi anlama ve problem çözme becerilerinin geliştirilmesinde bağlamsal öğretimden büyük ölçüde yararlanılması gerektiği söylenebilir. Diğer yandan öğretmen yetiştirmede bağlamsal öğretim temelli yaklaşımlara ağırlık verilmelidir.

Anahtar Sözcükler: Bağlamsal problem çözme öğretimi, çocuk edebiyatı, problemi anlama, problem çözme