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Effects of Cooperative Group Work Activities on Pre-school Children's Pattern Recognition Skills

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Abstract
The aim of this research is twofold; to investigate the effects of cooperative group-based work activities on children's pattern recognition skills in pre-school and to examine the teachers' opinions about the implementation process. In line with this objective, for the study, 57 children (25 girls and 32 boys) were chosen from two private schools in the Adana city center. A pattern recognition test addressing pattern recognition skills, pre-test, and post-test were used as the data collection tools. Furthermore, semi-structured interviews were conducted at the beginning and end of the implementation to obtain the teachers' perspectives about the implementation process. During the implementation, 2 experimental groups followed a cooperative group work activities program, while a control group was taught individually. The data analysis indicated that the children in the experimental groups showed greater progress in terms of pattern recognition skills than their peers in the control group. The interview findings from teachers indicated that in addition to the pattern recognition skills, the children developed additional skills such as solidarity, sharing, active listening, and fulfilling their personal responsibilities in the group work activities. One of the significant findings of the study was that the teachers changed their negative attitudes toward the use of pre-school cooperative group work activities. Therefore, cooperative group work is recommended for use in pre-schools to reinforce children's pattern recognition skills and to develop important social skills.

Keywords: Cooperative learning • Group work • Pattern • Pre-school

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Patterns are structures based on the principle of arranging objects, figures, or numbers in a specific order. Patterns can be repeating groups of three growing–narrowing or relationship-based (Smith, 2001, p. 80). In a repeating pattern, a basic unit is continuously repeated (Olkun & Uçar, 2007); for example, ssszsssz. In a growing-narrowing pattern, there is a regular increase or decrease; for instance, ☺, ☺☺, ☺☺☺. In a relationship-based pattern, some operations are followed in a group. In such patterns, there is an order between the numbers such as 1, 3, 7, 15, ..., which is a pattern based on a calculation whereby the previous number is doubled and then 1 is added.

Revealing the order of a series is a form of mathematical modeling, and identifying the rules of a pattern is an important characteristic of mathematical thinking (Sovchik, 1989; Worth, 1990). Most studies have supported the idea that including pattern recognition in an early mathematics teaching/learning curriculum contributes to mathematical modeling, mathematical screening, and the abstraction of mathematical knowledge (Mulligan & Mitchelmore 2009; Papic & Mulligan 2005, 2007; Papic, Mulligan, & Bobis 2009). Papic and Mulligan (2005) pointed out that the mathematical patterns students encounter at school vary from numerical series to bi-dimensional and tri-dimensional object series, algebraic generalizations and geometrical theorems, and therefore, patterns lie at the heart of school mathematics.

Finding the rule in a pattern or knowing the principles for the formulation of the pattern requires the ability to recognize the similarities and differences through analysis. According to Worth (1990, p. 53), all these abilities are related to problem solving as searching for a pattern is a problem solving strategy. Tarım and Artut (2010) found that when children were exposed to pattern-related activities early, their problem solving skills developed accordingly. Therefore, it is important to provide children with active learning environments such as cooperative learning to support the development of pattern recognition skills and to reinforce peer-interaction. .

Cooperative learning is a method in which small groups work together with the aim of maximizing their own and each other's learning in the pursuit of a common objective (Johnson & Johnson, 1999). When children interact, they are exposed to different relationships such as giving and receiving help, expressing their point of view, learning about others' perspectives, looking for new ways to clarify differences, solving problems, and formulating renewed understanding and knowledge (Gillies, 2003). In other words, cooperative learning necessitates mutual group help, the sharing of materials, discussion on a topic, production of a common product, and the fulfillment of the tasks necessary to achieve the group aim (Johnson & Johnson, 1994, p. 96). The main tenet of cooperative group work is that students work together and are responsible for each other's learning (Slavin, 1990). This method has been used in different fields and at various educational levels. At pre-school, however, its application has been limited (Avcıoğlu, 2003; Artut, 2009; Ramani, 2005; Tarım, 2009; Tarım & Artut, 2005). One of the reasons for the limited number of studies addressing the pre-school period are the difficulties encountered during the implementation phase. In line with this, Curran (1998, pp. 3-5) pointed out that three social skills are required for cooperative learning implementation to be successful; active listening, happy talk, and the participation of each child; as these provide a comfortable and positive environment in which the children can work together and share their own opinions.

Research has shown that cooperative group work activities positively affect children's addition–subtraction skills (Tarım & Artut, 2005), problem solving skills (Tarım, 2009), and mathematical skills (Artut, 2009). Social skills such as sharing, mutual help and active participation have also been found to be enhanced.

With this background, this study investigated whether cooperative group work activities were effective in improving children's pattern recognition skills to determine whether such cooperative learning techniques should be increased in the pre-school education period. In line with this, teacher's views were also gathered on the implementation and conduct of cooperative group practice. Therefore, this study aims to determine the effects of cooperative group work activities on children's pattern recognition skills and to investigate the teachers' perspectives during the practice phase of these activities.

Method

The research used a mixed methods design. According to Creswell and Garret (2008), mixed methods are based on the use of both qualitative and quantitative research methods. The design of this research is a parallel mixed method in which qualitative and quantitative methods are used together in different phases and in different ways. In studies conducted using parallel mixed

methods, qualitative and quantitative data are equally important. The main motivation of using this method is to compensate for the weaknesses of one data collection method with the strengths of the other one (Creswell, 2008, as cited in Fırat, Yurdakul, & Ersoy, 2014). The study was conducted with two experimental groups and one control group so as to keep the teacher effect under control. Teachers' opinions were also gathered to determine the effectiveness of the implementation process.

Participants

The research was conducted during the 2013–2014 academic year in two private nursery schools located in the Adana city center, in the Mediterranean Region of Turkey. One school was selected for the experimental groups and the other for the control group. The purpose of conducting the study in two different nursery schools was to eliminate any interaction between the teachers and students in the experimental and control groups. The students in these selected schools came from middle to high-income groups.

57 children (25 girls and 32 boys) with an average age of 68 months were chosen for the experimental and control groups. No children in either the experimental or control groups were able to read and write. Most of the children's parents had university degrees and were at good levels in their careers.

Each experimental and control group class was attended by a female teacher and assistant teacher. For ethics purposes, the teachers were given codes, with the teacher in the first experimental group coded as T1, the teacher in the second experimental group coded as T2, and the teacher in the control group coded as T3. The teachers all had around 15 years' teaching experience.

Training Program

For a better cooperative learning atmosphere, it was necessary for the children to have some social skill standards such as active listening, happy talk and the participation of every child (Curran, 1998). The effective implementation of these standards has been found to contribute to an atmosphere which is comfortable, but challenging and where the children can interact freely with each other and exchange ideas.

Active Listening: The most important of the standards for the implementation of the cooperative learning method for preschoolers is active listening. Active listening means that the children are ready to listen to the teacher or the person speaking. In active listening, the children look at the person speaking, listen to what is being said and are not distracted by other things. The person speaking ensures that the listeners are looking and listening and are not distracted. In this kind of atmosphere, the children can feel free to express their ideas.

Happy Talk: Happy talk is related to the way the children cooperate with each other, and is encouraged through the use of positive sentences. At the same time, the children improve their vocabulary through consciously implementing this positive talk standard. Each individual contributes to the group's success using only happy positive talk, such as "You are very good," "Your help made me happy," "I believe in you," " You can achieve that" "Keep studying, it is going quite well," and "How nice you are painting."

Participation of Each Individual: One of the main problems in group work is that some group members become interested in other things instead of focusing on the given task. In cooperative group work activities, it is important that every group member try to complete the task given to them. The individual participation standard ensures that all group members fulfill their responsibilities to successfully complete their given task. The activities within each task are defined so as to ensure the completion and are distributed to the group members in various ways. Therefore, it is vital for the children to believe that there is a fair distribution of the task's activities. The easiest way of providing this feeling is for the teacher to separate the tasks into as many activities as there are group members and to give numbers to these tasks. The numbered tasks are distributed to the children in the groups randomly using various methods, such as asking the group members to select one of the numbered cards and then fulfilling the activities defined for that card.

Experimental Procedures

Before the implementation, six hours training was given to the teachers from the experimental groups, in which the collaborative learning method was introduced and information about the implementation of this method in the early childhood period was given. After the draft syllabus was introduced and discussed, it was re-designed with the teachers. The research took place for one hour a week over 8 weeks, including the preparatory studies. The implementation steps for the experimental groups were as follows:

I. In the first week, the students were met and greeted and an explanation about the planned

syllabus was given to the children. In this stage, some information about "active listening" and "happy talk" was explained to the children. Samples of the implementation were shown so as to ensure these standards were clearly understood.

II. In the following two weeks, group work, in which the groups were formed randomly, was implemented to assist the children in working together and following the standards. To raise awareness about working in groups, they were instructed to work together to choose a name for their group and draw a picture representing their group; for example, the Star Group (they drew a star), the Daisy Group (they drew a daisy), and the Dinosaur Group (they drew a dinosaur).

III. Implementation was based on the pattern activities developed by Tarım and Artut (2010:31-39) and was conducted over 4 weeks. The patterns used in the activities consisted of number systems, figure systems and three-dimensional figure systems. These patterns were formed in line with repetitive, growing-narrowing and relationship patterns. The general structure of the activities was as follows:

- Most tasks involved stories.

- There were some materials for cutting and pasting, as well as drawing activities related to the story.

- Each group made a picture suitable for the story using the materials.

- A pattern suitable for the picture was developed by the group members.

IV. In the last week, an evaluation was conducted and each child was given a certificate of achievement.

Control Group: In the control group, the pattern recognition studies were done individually. The teacher prepared a worksheet using the pattern questions used in the experimental group and went through it with the students individually.

Data Collection Tools

Pattern Test: The pattern test developed by Tarım (2012) was used to measure the pattern recognition skills of the children. This test was given as a pre-test and post-test in both the experimental and control groups. The pattern test consisted of 14 items. In her study, Tarım determined the items in the tests according to the pattern types and the children's developmental level. Considering the patterns types in the related literature, a draft version was prepared. Three mathematics education specialists and three pre-school teachers were given the draft version for feedback. In line with their feedback, the form was revised and administered to ten pre-school education department students. After this pilot-administration, some items were excluded and the form was finalized with 16 items. The internal consistency coefficient, the KR-20 value, was .86. Two items were thought to be repetitive and excluded, so the internal consistency coefficient, the KR-20 value for the 14-item pattern test was .89.

The items in the pattern test were distributed as repetitive patterns (9 items), growing patterns (2 items) and patterns based on relationships between numbers (2 items). In the presentation of the repetitive patterns, objects (7 items) and numbers (2 items) were used. Objects were used in one of the items in the presentation of the growing patterns and location change was added in the second item. In the patterns based on the relationship between numbers, two items were presented based on counting forward and one item was presented based on counting backward. A sample test item with repetitive pattern structure is shown in Figure 1. In this item, the children were asked to complete the empty boxes according to the pattern rule.

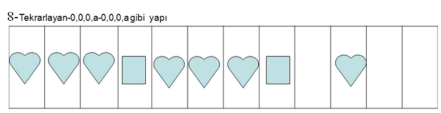

Figure 1: Sample test item.

Interview Form: For data collection from the teachers, a semi-structured interview form was developed for to extract their opinions regarding the implementation process. Interviews were conducted at the beginning and at the end of the implementation. The aim of the interviews was to examine the changes in the teachers' perspectives toward the implementation of the cooperative learning method in the pre-school period and to assess the contribution of this process to the teachers' teaching skills and the students' learning processes.

Data Collection

Data was obtained through individual interviews with the children before and after the implementation. The interviews were conducted in a quiet room at the school the students attended. Before starting the interviews with the children, there was a short preparation speech so they could understand the procedure. After that, the items in the pattern test were showed to the students one by one and they were asked with which object or number the gaps in the pattern must be filled. For

some items, the children were instructed to continue the pattern. The interviews took 20–25 minutes. The interview results were recorded on an interview form.

The 40–45 minute pre and post-interviews with the teachers were conducted in a suitable room at their respective schools and recorded on a voice recorder.

Data Analysis

The following data analyses from the pattern test were conducted:

- A one-way variance analysis to determine if there was a statistically significant difference between the pre-test scores of the groups.
- A one-way variance analysis to determine if there was a statistically significant difference between the post-test scores of the groups.
- A descriptive analysis method to analyze the qualitative data obtained from the teachers' interviews.

Findings

In this chapter, the findings are given under two sub-titles. First, the findings defining the effect of the cooperative learning method on the children's pattern recognition skills are presented. Then, the teachers' opinions about the process are discussed.

The Effect of the Cooperative Learning Method on the Children's Pattern Recognition Skills

The results of the variance analysis to determine if there was a statistically significant difference between the pre-test score averages of the groups showed no statistically significant difference ($F(2,54) = .149$, $p > .05$). Therefore, the groups were similar at the beginning in terms of their pattern recognition skills. The results of the variance analysis to determine if there was a statistically significant difference between the post-test score averages of the groups are given in Table 1.

When the pre-test score averages and post-test score averages of the groups were compared, it can be seen in Table 1 that all groups made progress. However, the post-test scores showed that there was a statistically significant difference between the post-test scores of the groups ($F(2,54) = 6.68$, $p < .05$). The paired comparison (Scheffe) conducted to examine the direction of the difference showed that the experimental groups were more successful than the control groups. In other words, the cooperative learning method was found to be more effective in developing the children's pattern recognition skills. These effect sizes were calculated, and it was found to be $d = 1.02$ for the comparison of the first experimental group and the control group and $d = .93$ for the comparison of the second experimental group and the control group. When the two experimental groups were compared, the effect size was found to be $d = .10$.

Findings Related to Teachers' Perspectives

At the beginning of the implementation, teachers were interviewed about their opinions toward the cooperative learning method and group work. Every teacher in the research group expressed some reservations as to the effectiveness of group work for preschoolers and felt there were drawbacks. They stated that they did not use group work in class except for game activities because they felt that the children in this age group preferred individual activities, that they might have some problems about sharing and solidarity, that they may become distracted quickly, and that there may be chaos, all of which would result in a failure to achieve the goal. Following are some of the opinions from the teachers about this issue:

> "In this period (pre-school), I only make the children play games in groups. I don't think it is suitable to use group work in bringing the children a mathematical concept." (T1)

> "I believe that there will be problems in group work that require sharing and cooperation as the children in this age group are still egocentric." (T3)

Table 1
Variance Analysis Results Based on the Post-test Scores of Experimental and Control Groups

	N	Pre-test $\bar{X}$ (SS)	Post-test $\bar{X}$ (SS)	*F*	*p*	Difference	Effect Size
Experiment1	19	6.10 (2.51)	10.00 (3.40)	6.68	.03	Control<Experimental1 Control<Experimental2	1.02 .3
Experiment2	18	6.61 (3.46)	9.66 (3.28)				
Control	20	6.10 (3.69)	6.70 (3.22)				

Post-implementation, the experimental group teachers and teaching assistants (T1, T2) were asked again about their opinions on the implementation of cooperative learning method in the pre-school period. Significant positive changes in the teachers' attitudes were found. Following are some of the opinions from the teachers about this issue:

"At first, I had some suspicions. However, the implementation showed me that the children can work effectively in groups based on cooperation in this age group. I noticed that the studies such as active listening and happy talk facilitated the working in groups…" (T1)

"I realized that I had some deficiencies about how I should structure the group work at first. The implementation provided me with the knowledge to eliminate these deficiencies." (T2).

The teachers were asked how the implementation process contributed to their teaching skills and the children's learning processes. Both teachers from the experimental groups said that the cooperative group work activities had positively contributed to their teaching skills. Similarly, they stated that they had observed improvements in the children's pattern recognition skills and also felt that the children's sharing and solidarity, listening skills and task concentration had also improved.

"At the beginning of the implementation, I felt worried as the group work took a lot of time. Later on, however, I observed that the waste of time decreased and even disappeared as the children comprehended the process. I spotted that the children could do the pattern studies in the activities easily." (T1)

"From now on, I can use group work not only in game activities but also in teaching them mathematical concepts and even other concepts." (T1)

"While thinking that the children would not be willing to share and cooperate, the implementation showed me how to overcome this. They helped me notice how happy talk really works." (T2)

"It made me feel surprised to see some of my students who are often interested in the other things rather than the lesson participated in the group work actively later on." (T2)

"Working in different groups each time made it possible for children with different skills to come together. This made them notice the structure existing in the pattern more easily and contributed to the children forming suitable patterns upon determining a rule." (T1)

"The interactions resulting from their working with different friends contributed to the children's skills of concentrating on the task, behaving to each other kindly, listening to each other and me in addition to their pattern recognition skills." (T2)

Discussion

In this study, it is important to mention the drawbacks: limited sample size, subject characteristics, research duration, task types, and the instructors' skills. Therefore, the findings are discussed accordingly.

Slavin (2015, p. 5) said that "… cooperative learning has been used and studied in every major subject, with students from pre-school to college, and in all types of schools." By saying so, he meant that cooperative learning has been in use from the pre-school period upwards. This study has shown that cooperative group work activities are effective for the learning of pattern recognition skills in the pre-school period. In other words; the experimental group children achieved better results than the control group children because of the cooperative group work. The findings of the study showed parallelism with the results of mathematics teaching cooperative learning studies (Artut, 2009; Slavin, Madden, & Leavey, 1984; Slavin & Karweit, 1985; Tarım, 2009; Tarım & Artut, 2005).

This research found that the cooperative learning method is effective for the learning of pattern recognition skills by pre-school children. The effect sizes from the comparison of the experimental and the control groups were calculated as $d = 1.02$ and $d = .93$, respectively, which are considered large according to the classification in Thalheimer and Cook (2002). In Çapar and Tarım's (2015) meta-analysis study, which investigated the effect of cooperative learning on academic achievement, they found that the common effect size was 1.01 in a very limited number of studies conducted at the pre-school level ($n = 2$). The effect sizes found in this study are in line with their study.

It can be deduced from this study that the cooperative learning method is quite effective for the development of children's pattern recognition skills. When the two experimental groups were compared, the effect size was $d = .10$, which indicates that the first and the second experimental groups were similarly structured.

Janzen Roth (2011) emphasized that pattern activities create an atmosphere for children in which they can think mathematically, communicate mathematically and can establish relationships between various mathematical concepts. Enriching these activities with group work can be one of the reasons for the observed progress.

During the research, the children did the pattern activities in groups with their peers, all of whom had different talents. In this way, the children had the opportunity to talk to each other about the pattern and get to know each other. This overlaps with Vygotsky's approach (1978) whereby the development is a product of the interaction with the environment and the more developed people in that environment. This interaction was realized through language, as the necessary cognitive processes start with the child's interaction with other children and adults. One of the best ways of providing this interaction in the classroom is creating a cooperative learning atmosphere. Piaget (1926) also held that peer interaction is also important in logical-mathematical thought in disequilibrating the child's egocentric conceptualizations and in providing feedback to the child about the validity of logical constructions (as cited in Slavin, 2015, p. 10). In the same way, Doise and Mugny (1984, p. 23) indicated a close and mutual relationship between social interaction and cognitive development. In line with this, it can be inferred that cooperative work activities support cognitive development, and the cognitive development progress observed in this study could be said to be the result of the cooperative learning syllabus. The interviews with the teachers further support this opinion, as the teachers observed that when the children worked with other children with different talents, it was effective in their development of pattern recognition skills, and appeared to contribute to the development of other talents, such as expressing themselves and concentrating on a task.

At the beginning of the study the teachers had some negative opinions about cooperative group work activities for the teaching of mathematical concepts as they felt this method was not suitable for this age group and took a long time to do. These feelings were similar to those in a study by Tarım and Tunç (2014) which examined elementary school mathematics teachers' and elementary school teachers' opinions about cooperative group work activities in mathematics classes. Although the teachers who participated in the research stated that this method developed the students' social, cognitive and affective skills, they added that they found it time-consuming and unproductive, especially in mathematics lesson.

In the interviews conducted at the end of the experiment, the teachers' opinions about the cooperative group work activities had changed positively. In other words, the teachers had noticed how effective group work could be during the implementation process. Similarly, in a study by Tarım (2009) which sought to examine the effect of cooperative group work on children's problem solving skills, the teachers also stated that they found cooperative group work activities useful when teaching a concept.

The cooperative learning method affected the children's pattern recognition skills positively. The findings of this research showed that the cooperative learning method is an effective method for developing children's pattern recognition skills in the early childhood period.

This research investigated the influence of the cooperative learning method on children's general pattern recognition skills. In addition to this, the efficacy of the method was investigated by taking the types of patterns (repetitive, growing, the patterns based on relationships between numbers) into consideration.

As it can be seen in the results of this research, the teachers found that the children showed development in skills such as solidarity, sharing, listening, group work and fulfilling personal responsibilities. In further studies, the children who have problems with these social skills could be focused on.

In this study, the teachers stated initially that they had a negative perception of cooperative group work activities for pre-school children, but this attitude positively changed through this study. As a result, cooperative group work activities in the pre-school period were approved by the teachers in this study. Therefore, it is recommended that workshops be organized for small groups of pre-school teachers to increase the implementation of cooperative group work activities.

It would be beneficial to hold in-service teacher training programs, seminars and conferences about this method for pre-school teachers. Moreover, some studies about the design of materials appropriate for teaching patterns through cooperative group work activities could be conducted. The number of the patterns which can be developed to provide a colorful class life can be increased for any pre-school period syllabus used.

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