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Effectiveness of the Big Math for Little Kids Program on the Early Mathematics Skills of Children with Risk Group

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The aim of this study is to determine the effect of Big Math for Little Kids (BMLK) Program on the early mathematics skills of children with lower socioeconomic level. The participants of the study consist of between 60-72 months of aged children with lower socioeconomic level recruited to kindergartens of Ministry of National Education from Turkey in Diyarbakır in the 2018-2019 academic year. The sample of the study consists of 40 children with above mentioned characteristics. Of these, 20 were assigned to the experimental group and 20 to the control group. Two schools were selected for experimental and control group, and the study was conducted after selecting ten children in a class of each school. In the study pretest-posttest with control group experimental model was used. The data of the study were collected through the Tests of Early Language Development Test (TELD-3) to determine children with adequate language skills of their own age group, and Test of Early Mathematical Ability (TEMA-3) to assess early mathematical development of children. As a result, BMLK program was determined to be effective in the mathematics development of children with lower socioeconomic level.

Keywords: early mathematics, early intervention, preschool period, big maths for little kids.

Introduction

Human development starts the moment when one is born and continues through lifetime. However, the early childhood period, which covers the ages of 0 to 8, is when the development is at its fastest and when humans are most open to the influence by their environment. The early childhood period has an important impact on a child's life in the future and children are ready to learn many skills during this period (Birkan, 2002). For this reason, early childhood is an important period in which foundations of many mathematical concepts are laid down, as in all areas of development, and in which children are open to develop mathematical skills (Clement & Sarama, 2007). Before school, concepts such as number, counting, measuring, shape, time and space come to mind when mathematics are considered. Such concepts contribute to the cognitive development of children and lay the foundation of early mathematical skills (Güven, 2005). From the moment he/she is born, the goal of a child is to explore the world.

During the early childhood period, children learn and start to use countless math-related concepts. This acquisition happens naturally as the child interacts with his/her surroundings and people around. During the pre-school period, children gain a lot of experience on numbers and quantity. They compare quantities, perceive the concepts of few and many and come up with various

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solutions to balance a tall building made of blocks. A few examples would be counting how many olives he/she ate, matching the number of plates to the number of napkins, sharing cookies equally among friends and counting fingers. Mathematical skills acquired during the early childhood period serve as the foundation of more complex mathematical information to be learned throughout school by supporting abilities to solve problems, making analyses and hypotheses, which form the basis of children's scientific thinking skills. In addition, children's early math skills are directly related to their future academic success, possibility to graduate high school with higher grades, higher employment rates, and professional achievement (Kroesbergen et al., 2009). In addition, a child's experience with pre-school math has a direct influence on that child to not develop a fear of math throughout school life, feeling excited for learning math and to develop a positive attitude towards math (Starkey & Klein, 2008; Williams & Coles, 2007). For this reason, early mathematical skills are a part of pre-school education programs in many developed countries.

Early mathematics skills need to be developed in pre-school period and children may exhibit different developmental characteristics in these skills. Some children lag, unable to develop their skills as good as their peers. The most important group among such are children of low socioeconomic status (Brooks-Gunn & Duncan, 1997; Ginsburg, Lee & Boyd, 2008; Schreier & Chen, 2013). Research shows that children of low SES families lag one development year behind children of high SES families when pre-school math performance is considered (Hughes, 1986; Klein, Shim, Scales & DeFlorio, 2002). This SES gap presents itself as early as age 3 and continues to widen during the school year if not intervened (Klein et al., 2008). Starkey et al. (2004) identified a significant gap against low SES between math performances of low SES and mid SES pre-school students despite similar ethnic backgrounds. In their study, Griffin et al. (1994) observed that 5 to 6-year-old children of low SES families exhibit similar level of math skills compared to 4 to 5 year-old children of mid SES families. In their study in the US, Denton and West (2002) indicated that children with low SES scored half a standard deviation less than the average compared to other SES groups in a nation-wide standard math exam. In another study, pre-school students of low SES scored less in math than their peers of other SES groups and this score gap kept widening up until the 8th grade (Schoenfeld & Stipek, 2011). In summary, it appears that SES is an important factor in children's mathematical success.

Another factor affecting children's early math skills is the type of school the children attend. The effect of the school factor is that teachers in public and private schools have different expectations about the child (Sparkes, 1999). Teachers and families in disadvantaged schools often have low expectations about children (Sparkes, 1999). Research shows that when teachers' expectations are low, students are less motivated and, as a result, perform less in math skills (Eamon 2005). Another factor in children's math skills is the low participation of families in the school. Regardless of income groups, it is known that the participation of families in children's school activities increases the academic performance of their children (Galindo & Sheldon, 2012). Another reason for having difficulties in math skills is

cultural differences and bilingualism (Keels & Raver, 2009). Studies show that the difference between children's mother tongue and school language negatively affects the academic achievement of children, and the level of school readiness of bilingual and immigrant children is lower than other children (Fuligni & Yoshikawa, 2004; Magnuson, Lahaie & Waldfoger, 2006).

Even though the family's income is the most important factor influencing the socioeconomic status, it also includes variables such as the educational level of the family, resources at hand (a studying room, a computer), and the professional status of the family (Bradley & Corwyn, 2002). The fact that children with low SES are less exposed to or deprived of care, rich learning environments and stimulating environments such as friends and school causes them to display a poorer performance than children of other income groups (Case, Lubotsky & Paxson, 2002; Ginsburg et al., 2008; Schreier & Chen, 2013).When socioeconomic status is considered in Turkey, it is safe to say that there is a significant population with low income status in the Southeastern Anatolia Region. In this region, development levels of all provinces are lower than the country average, except for Gaziantep (TUİK, 2015). There are no intervention programs or additional support in Turkey's educational system targeting low SES children. This results in an opportunity gap in education and the gap between academic performances of children at different socioeconomic levels widens (Myers, 1992). Children of low SES scored less than their peers in all academic fields in mathematics in particular at the Trends in International Mathematics and Science Study carried out by the International Association for the Evaluation of Educational Achievement on students in fourth and eighth grades and at the Program for International Student Assessment carried out on 15-year-old students. According to the PISA 2015 report, children of low SES lag one school year behind children of high SES (OECD, 2017). The average score of students of low SES was 376 while this figure was 480 among students of high SES (OECD, 2017). According to quantitative research on primary school attendance, primary school attendance of children of low SES is lower than those of other SES groups (ACEV, 2006).

In Turkey, it is highly important to support children of low SES on all fields of development on mathematics. Children living in low SES regions are unable reach their cognitive potential because they are not stimulated enough by their environment. Early and long-lasting interventions can prevent the adverse impacts of a negative environment on a child's potential (Thompson & Nelson, 2001). Studies also suggest that early interventions improve children's early mathematical success and impacts of such interventions are felt for years (Watts et al., 2016).

There are many studies suggesting that early intervention programs ensure school readiness and eliminate socio-economic based gaps (DeLoach 2012; Opel, Zaman, Khanom & Aboud 2012; Presser, Clements, Ginsburg & Ertle 2012; Starkey, Klein & Wakaley, 2004). High quality early childhood programs that consider the individual characteristics of a child, his/her needs and social and cultural environment are of importance in the education of children of the low SES (Griffin et al., 1994). Children of the low SES, who attend pre-school institutions that do not offer such an education, often experience persistent failure since they

are unable to benefit from an intervention on pre-school math skills (National Council of Teachers of Mathematics [NCTM], 2006; National Research Council, 2009). In line with this need, many countries developed and included pre-school intervention programs targeting disadvantaged children into their mathematical curricula.

It is noted that children, who complete this education, are academically more successful, work in higher quality jobs and benefit more efficiently from healthcare services. For the long term, a higher quality labor force also contributes to the economic development of the society (Coble & Allen, 2005). Mathematical skills are vital for training employable citizens and approximately 90% of all professions require a certain level of math skills (House 2006; Mikulski, 2001; Steen, 2001). For this reason, it is highly important to support children in the early period with necessary mathematical skills and design programs accordingly.

The BMLK Educational Program to be covered in this study is used in many countries especially with children of the low-income group and has been proven to be effective. Therefore, implementing the BMLK program in Turkey would be instrumental in developing the mathematical skills of children of the low SES, helping them to start school prepared and preventing academic failures in the future. This program is also thought to be important in terms of addressing the lack of intervention programs on pre-school mathematical skills.

As a result of the study, it is believed that information on the BMLK's effectiveness will not only serve to improve the future academic success of children of the low SES but also of children with developmental disabilities. The study is also significant in terms of setting out the mathematical training needs of pre-school children of the low SES. Finally, the study is thought to shed light on other studies on children's mathematical development and contribute to the introduction of early intervention programs.

Method

Research Design

This study adopted the experimental model with pretest/posttest/control test design with a control group. In experimental designs with pretest and posttest control group, experimental and control groups are formed and these groups undergo pre-experiment and post-experiment measurements (Büyüköztürk, 2012).

In the study, children in the experimental group were administered the BMLK program, while children in the control group continued receiving their regular education curriculum. For this study, the dependent variable is the "mathematical development" of children in the study, while the independent variable is the "Big Math for Little Kids Educational Program", the impact of which on children's mathematical development is being analyzed.

Study Group

The study group comprised children who attend kindergartens that are affiliated to the Ministry of National Education in Diyarbakır city center in the educational year of 2018-2019. A list of central district kindergartens was received from Diyarbakır Provincial Directorate of National Education to create the sample group. The lists were reviewed, another list of schools of the low socio-economic status at the same district was drawn up and four schools were randomly selected. Then, information on the schools' SESs was verified through interviews held with administrators and teachers of the listed schools and the researcher identified 4 classes in 4 schools, in which the study will be carried out, after providing information on the educational program to be administered. This study included children of the low socioeconomic status with average recipient language skills according to the TELD scores, without any medical diagnosis and are reported to have an average success level by teachers. There are 11 girls and 9 boys in both test and control groups. The mean age of children in test and control groups is 64 months.

Data Collection Tools

In the study, the Test of Early Mathematics Ability (TEMA-3) and the Test of Early Turkish Language Development (TELD) were performed to evaluate children's early mathematical development and level of Turkish recipient language skills, respectively. After the application, the researcher asked questions about the educational program to hear the views of children, families, and teachers by making use of the social validity questionnaire developed by the researcher.

Test of Early Mathematics Ability (TEMA-3; Ginsburg & Broody, 2003)

TEMA-3 was developed to evaluate the mathematical abilities of children between the ages of 3-0 through 8-11. TEMA-3 consists of 72 questions measuring early mathematical skills such as numbering, numeral literacy, and number comparison.

Each question is marked as correct or incorrect and the number of correct answers gives raw scores. The raw score obtained from the test can be converted into age equivalents, percentile ranks and a standard score (Math Ability Score). The increase in math ability score points to an improvement in a child's math skills (Ginsburg & Baroody 2003). An increase of at least 4 points suggests that the increase in Math Ability Score is statistically significant. In the original form of the test, a standard score of 69 and below is considered very poor, 70 to 84 below average, 85 to 92 average, 93 to 107 above average, 108 to 115 superior and 161 and above very superior mathematical skills. A normed study for this test has yet to be conducted in Turkey.

Test of Early Turkish Language Development (TELD; Topbaş & Güven, 2013)

TELD is the Turkish adaptation of the language development test titled the Test of Early Language Development (TELD-3). The test was developed to assess the language development of children between the ages of 2-0 through 7-11. TELD is used to identify children with language development problems, to come up with an intervention program for such a problem and to ensure early identification of children at risk of academic failure (Topbaş & Güven, 2013). The test contains a total of 76 questions assessing semantics and grammar.

The internal consistency coefficient for the recipient language test used in this study was found to be .93. The test is administered individually to each child. For each question, the score is 1 for correct or 0 for incorrect. Raw scores are converted into standard scores based on age. For the TELD, a standard score of 131 to 165 is considered very good, 121 to 130 good, 111 to 120 above average, 90 to 110 average, 80 to 89 below average, 70 to 70 poor and 35 to 69 very poor language skills.

The Social Validity Questionnaire

Social validity data that is required to demonstrate the effectiveness and functionality of the BMLK program were acquired from answers of Social Validity Data Collection Questionnaires developed for children, families, and teachers. For this purpose, three questionnaires have been developed and presented below.

Social Validity Questionnaire for Families has 5 questions. In this questionnaire, families were asked if they were content with the fact that early mathematical skills were being taught, if there was anything they would like to change in the program, if the program had a contribution in developing children's early mathematical skills, if home activities had a contribution in developing children's mathematical skills and if they see any change in their children in terms of their interest in and motivation for mathematics.

Social Validity Questionnaire for Teachers has 5 questions. In this questionnaire, teachers were asked if they were content with the fact that early mathematical skills were being taught, if there was anything they would like to change in the program, if the program had a contribution in developing children's early mathematical skills, if they would like to implement this program in their classrooms and if they see any change in children in terms of their interest in and motivation for mathematics.

Social Validity Questionnaire for Children has 3 questions. In this questionnaire, children were asked if the program was fun, if they would like these activities to be implemented in their own classrooms and what they liked and disliked in the program.

Families and teachers were asked to answer "yes, no, or partially" to the questions and then to elaborate on their answers. Face-to-face interviews were held with all participants to collect social validity data. In addition to questions in the

questionnaire, all participants were asked whether they would like to add anything else.

Data Collection

Implementation Process

Big Math for Little Kids Educational Program to be Implemented. The BMLK Educational Program is based on supporting the mathematical development of pre-school children aged 48 to 72 months. It is a research-based developmental program funded by the National Science Foundation and developed by Ginsburg et al. in 2003 as a kindergarten and pre-school program to prepare children to primary school. The activities in the program were developed in six fields namely, number, shape, pattern, logical reasoning, measurement, operations on numbers, and space.

The materials/activities in the program were designed specifically for the needs of children at a specific level of development. The program consists of a teacher resource binder, a general program overview and teacher guide booklets for each 6 unit. Units included in the program are: "What Are Numbers?", "The Shape of Things", "Patterns Plus", "Measure Up!", "Working With Numbers" and "Getting Around". Program that was designed for each development level also includes 6 colored storybooks for each unit. Homework storybooks, which are black and white versions of classroom storybooks, were prepared for children to fill out with their families at home (Ginsburg, Greenes & Balfanz, 2003). Materials in the program were designed to be low-cost, to meet the needs of all children and to be accessible for children of all economic levels. The program also includes teaching activities, evaluation materials and reproducible activity pages. The program that was designed for each development level also includes 6 colored storybooks for each unit. Homework story books are for children to use at home with their parents. The BMLK Educational Program has been used in Turkey since its adaptation.

Before implementing each activity in the BMLK, the educational environment was arranged. Based on the type of activity, either a roundtable setting was established or desks and chairs were moved aside to facilitate mobility. Before each activity, the researcher brings to class pre-copied activity sheets, assessment forms, and necessary materials. Before the implementation, the researcher has a little chat with students and informs them about the activities. At the end of every activity, what was learned that day was summarized and children were told what to do for the next activity. Four units in the Big Math for Little Kids Educational Program were administered over the course of 11 weeks.

After the implementation of the BMLK, TEMA-3 was administered to experimental and control groups as a post test. The test was read ministered to the experimental group to see if the effectiveness of the BMLK was permanent. After the implementation of the follow-up test, children, families, and teachers were asked their opinions about the program.

Data Analysis

Data collected within the framework of the study was analyzed using the IBM SPPS 22 package program. To serve the purposes of the study, first it was checked if data showed normal distribution. The coefficient of skewness was found to be between -3.4 and -4.5 and the coefficient of kurtosis to be between -8.0 and -9.3. According to the Kolmogorov-Smirnov test, not all measurements showed normal distribution (K-S(z)=0.00; p<.00) (Pallant, 2015).

Since TEMA-3 pretest/post test scores of experimental and control group children and TEMA-3 posttest and follow-up test score averages of experimental group children did not show a normal distribution, the *Wilcoxon Signed Rank Test (matched pair)* was use. The *Mann Whitney U Test* was used to compare TEMA-3 pretest and post test score averages of experimental and control group children.

The effect sizes were also measured during group comparisons. For the Mann Whitley U and Wilcoxon Signed Rank Tests, the effect size was calculated by dividing the *z* value by the square root of the sample size (Pallant, 2015). According to Cohen's criteria, .1 indicates small, .3 medium and .7 large effect size (Cohen, 1992).

Findings

The aim of this study was to examine the effectiveness of the BMLK Educational Program in developing the mathematical skills of kindergarten children of low socio-economic status. In line with this aim, findings came out from the study are presented below in relation to the research questions.

Any possible significant difference between the TEMA-3 pretest and posttest score averages of experiment and control groups was analyzed by making use of the *Mann Whitney U-Test*. The average scores, standard deviations, rank averages, rank sums, *U* and *p* values and effect sizes of groups are listed in Table 1 and 2.

Table 1. Pretest Results of TEMA-3 Scores of Children Participated in the Study

Group	**N.**	$\bar{X}$	***SD***	**Rank Average**	**Rank Sum**	***U***	***p***	**Effect**
Experimental	20	80.95	7.67	19.30	386	176	.51	.01
Control	20	81.25	8.12	21.70	434			

Table 1 shows that TEMA-3 pretest scores of experimental and control groups are close. *Mann Whitney U-Test* did not find a significant difference between average TEMA-3 pretest scores of control and experimental groups (U=176, p=.51). These results show that children are at a similar level in terms of their early mathematical skills.

Table 2. Posttest Results of TEMA-3 Scores of Children Participated in the Study

Group	N.	$\bar{X}$	*SD*	Rank Average	Rank Sum	*U*	*p*	*Effect*
Experimental	20	93.85	2.36	29.13	582.50	27.50	.000	.68
Control	20	81.35	6.72	11.88	237.50			

The analysis results presented in Table 2 showed significant differences between TEMA-3 scores (U=27.50, p<.001). TEMA-3 scores and equivalent ranks of the experimental group were higher than of the control group. It is striking that the effect size between groups was high (.68).

Any possible significant difference between the TEMA-3 pretest and posttest score averages of the control group was analyzed by making use of the Wilcoxon Signed Rank Test. Mean ranks, mean sums, effect sizes and z and p values of experimental and control groups for TEMA-3 are listed in Table 3 and Table 4.

Table 3. Comparison of TEMA-3 Pretest and Posttest Score Averages of the Control Group

Posttest - Pretest	N.	Rank Average	Rank Sum	*z*	*p*	*Effect*
Negative Rank	4	3.75	15			
Positive Rank	3	4.33	13	-.17	.86	.03
Equal	13					

According to the results obtained from the Wilcoxon signed rank test in Table 3, there was not a significant difference between TEMA-3 pretest and posttest scores of students of the control group (z= -.17, p> .86).

Table 4. Comparison of TEMA-3 Posttest and Control Test Score Averages of the Experimental Group

Posttest - Follow-Up Test	N.	Rank Average	Rank Sum	*z*	*p*	*Effect*
Negative Rank	3	3.5-1	14-1			
Positive Rank	2			-1.83	.08	.01
Equal	15					

According to Table 4, there is no significant difference between the posttest and control test scores of the experimental group children (z=-1.83, p>.05). However, there was a slight decrease in the mean ranks of children in the follow-up test. Fifteen students received the same scores from the post and follow-up tests while two students scored higher in the follow-up test and three scored less.

Social Validity Findings

After the completion of the study, the Social Validity Data Collection Questionnaire was used to evaluate the effectiveness and functionality of the program through the eyes of children, teachers and families.

Families were positive towards the program answering "yes" to all questions but "is there anything you would like to change with the program?". Families

pointed out that the program developed their children's mathematical skills. They also mentioned that games played, and storybooks read at home also attracted the attention of other children at home and improved their motivation towards school.

Teachers were positive towards the program answering "yes" to all questions but "is there anything you would like to change with the program?". After the application, teachers expressed that children wanted more math activities, were looking forward to activity time, were more interested in doing homework, worked more in harmony in groups, the activities improved the math skills of children and that they were surprised to see children liked these activities because they were bored with previous activities. Both teachers noted that they would like to use this program in their own classes if they were to receive a training on the program.

All the children in the experimental group stated that the activity was fun and that they would like to do a similar thing in their classrooms. All the children stated that there was not nothing they did not like with the administration.

Discussion

In this study, it was investigated whether the BMLK training program was effective in the development of math skills of children from lower socioeconomic level preschool child. In the findings obtained, the experimental group children participating in the training program were more successful in the tests evaluating their early mathematics development than the control group children who did not participate in the training program. As a result, the applied training program was found to be effective in the mathematics development of children from the lower SES. Findings for the research questions are discussed below,

Pre-intervention early mathematical skills of children were analyzed using the TEMA-3 and the pretest scores of children were found to be low and like one another. The average TEMA-3 score of the experimental group children and control group children were 80.95 and 81.25, respectively. Çakır's study (2019) found the average TEMA-3 score of 100 children, who attend kindergarten in Ankara and exhibit normal development, to be 98.5 while Çavdarcı (2016) found the average TEMA-3 score of 32 children between the ages of 48 and 72 months who attend kindergarten in Ankara to be 97.2. Even though there is no norm research on the test in Turkey, it can be concluded that children scored below average taken into consideration the scores in the original form (a score between 70 and 84 corresponds to below average) and recent studies. Bearing in mind the importance of early mathematical skills on children's future academic performance, the poor early math skills performance of children in this study of the low SES offers a justification for why this intervention program should be implemented.

As a result of the administration of the BMLK program, this poor performance of experimental group children considerably got better after the administration and when compared with the control group in the posttest. This result is consistent with the relevant literature (Aber, Jones, & Raver, 2007;

Jordan, Huttenlocher, & Levine, 1992; Starkey & Klein, 2008; Wakeley, 2002; Young & Loveridge, 2004). These studies also found quality mathematical intervention programs to be effective in the early mathematical skills of children of low SES.

It is thought that the effectiveness of the BMLK program on children's early mathematical skills is due to its content, methodology and administration. It is noted that early childhood programs aimed at improving the interest of children in mathematics and developing their experience and knowledge and that contains sequential activities and integrates math with other activities can teach children many mathematical skills (NCTM, 2006). According to Skwarchuk (2009), child-centered, interesting, systematic, sequential and play-based math activities are effective in improving the mathematical skills of economically disadvantaged children. Research suggests that play-based learning improves children's academic and social skills (Katz, 2019). Through play, children can explore, experiment and solve problems through creative and fun ways (Skwarchuk, 2009). Since the BMLK program is a child-centered and play-based program encompassing all these features, it was effective in the development of children. Another proof that the program was effective is the fact that the experimental group children found the BMLK program to be fun and that they would like to do the same activities in the BMLK in their classrooms.

The social validity questionnaire and notes taken throughout the study show that teachers opt for teacher-centered teaching methods rather than play-based ones for teaching early math and literacy skills. In many countries, there has been a shift from a play-based experiential approach to more academic ones and from hands-on activities to worksheets and teacher leadership in kindergarten education. TEDMEM (2016) report found in Turkey that "pre-school education concentrates on teacher-centered practices and teaching methods thus leading to kindergartens that look like primary schools." In contrast, it is noted that pre-school children gain more out of play-based programs than academically oriented ones (Carlsson, McLaughlin & Almon, 2015). Children learn best when they are engaged in play-based activities targeting their development levels, previous experiences and current needs (Carlsson et al., 2015). Play-based education also enables children to engage in flexible and high-level thinking processes that are considered necessary for the 21st century student (Greenes, 2003). These processes are problem-solving, analyzing, assessment, social skills-gaining and knowledge and creativity application. For this reason, the early mathematical development of children, who took part in the child-centered BMLK educational program that involves play-based mathematical activities, was significantly greater than the ones.

One possible reason why BMLK has an impact on children's early mathematical skills is the involvement of families in the education process. It is inevitable for cognitive gains to remain short-term if families, who are capable of supporting children constantly, are not included in intervention efforts (Kağıtçıbaşı, 1998). It is thought that interventions that include families would not only benefit the child but also his/her immediate circle, especially in Turkey, where family ties are quite tight (Kağıtçıbaşı, 2010). In this study, parents stated that the administered program improved their children's mathematical skills. They

also mentioned that games played and storybooks read at home also attracted the attention of other children at home and improved their motivation towards school. For the reasons explained above, it will be particularly important for teachers, working in low SES regions, to get informed on how families can contribute to their children's mathematical development at home through in-service training.

There are some limitations to take into consideration when evaluating the outcomes of this study. First, this study was conducted with 40 children. This limits the generalizability of the findings. Therefore, similar studies should be conducted with larger groups. Secondly, study findings are limited to data collected from children studying in kindergartens affiliated to Diyarbakır Provincial Directorate of National Education. Therefore, it is important to support the results by conducting studies in different regions.

Even though it seems unnatural to re-apply scientific-based intervention programs developed in developed countries in developing countries, there are no alternatives to such programs (Woodhead, 1985). Proving the effectiveness of early intervention programs is costly and requires at least 20 years of effort (Kağıtçıbaşı, 2010). Therefore, it is of importance to take a closer look at the results of intervention programs, which are adapted to Turkey from other countries, and try to evaluate their wider applicability. There seems to be no comprehensive study aiming to develop early mathematical skills of pre-school children with low income level. This study is significant since it is the first comprehensive intervention effort in Turkey to develop early mathematical skills of children of the low-income level. Administering the BMLK program to a larger sample group and conducting new studies that show the long-term effects of the achieved results can offer policymakers a more attractive set of findings to introduce the necessary changes and can lead the way for amendments to the pre-school curriculum.

Conclusion

In the study pretest-posttest with control group experimental model was used. The data of the study were collected through the Tests of Early Language Development Test (TELD-3) to determine children with adequate language skills of their own age group, Continuing Assessment and Checking Up Forms to evaluate the implementation process of the implemented program and Test of Early Mathematical Ability (TEMA-3) to assess early mathematical development of children. After applying the TEMA-3 test and the Continuing Assessment Form as a pre-test, four units of BMLK program were applied to the experimental group for 11 weeks by the researcher. The main themes of the four units are numbers, shapes, patterns and measurement skills. After the experiment, TEMA-3 vii test and Continuing Assessment Form were applied to the experimental and control groups as post-test. The obtained data were analyzed by using Mann-Whitney U and Wilcoxon tests. The results of analysis showed that the children in the experimental group scored better in the tests evaluating the early math skills when compared the control group children. As for the assessment of the implementation

process of BMLK, the children in the experimental group were determined to have gained most of the program's goals. As a result, BMLK program was determined to be effective in the mathematics development of children with lower socioeconomic level.

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