

COMPARISON OF SPECIAL EDUCATION PRESCHOOL PROGRAM AND INCLUSIVE PRESCHOOL PROGRAM FOR MATH ACHIEVEMENT

Marija Slavkovic

Elementary School "Sava Jovanović Sirogojno", Serbia

E-mail: marija.mmd@gmail.com

Haris Memisevic

University of Sarajevo, Bosnia and Herzegovina

E-mail: hmemisevic@gmail.com

Abstract

Transition period from preschool years to school years is a time of rapid changes in children's development. Children with intellectual disability lag behind their peers without disabilities in their school readiness skills, especially in math skills. Thus, there is a great importance of school preparation programs for children with intellectual disability in improving their math abilities. The aim of the present research was to compare the effectiveness of two preschool programs in improving math abilities of children prior to their enrollment in elementary schools. The sample for this research comprised 90 children aged 60-72 months. Of those, there were 60 children with intellectual disability and 30 typically developing children. Math abilities were assessed with a subscale from Peabody Individual Achievement Test. The results of this research indicated that children with intellectual disability attending special education preschool program achieved significantly better math results than children with intellectual disability attending inclusive preschool program. Some suggestions to preschool teachers on how to improve the effectiveness of their work with children with intellectual disability were given.

Keywords: children with intellectual disability, inclusive education preschool programs, math abilities, quasi-experimental design, school readiness, special education preschool programs.

Introduction

Prior to enrollment in elementary schools, children in Serbia need to attend a mandatory preschool preparation program. Duration of this program is 9 months. The mandatory preschool program is for children aged 5 to 6.5 years old, a year prior to their enrollment into elementary school. Although the program is mandatory and free, not all children attend it. The statistical data from 2010 indicated that 88% of 6-year-old children attended the preschool preparation program (Bankovic, 2014). The goal of the program is to increase children's readiness for school and to facilitate child's transition from preschool to school environment. However, defining *school readiness* is not an easy task due to different conceptualizations on what skills and dimensions *readiness* consists of (Crnic & Lamberty, 1994). There are several domains of children's development important for the school success and they include motor development, social and emotional development, language development, and cognition (Kagan, Moore, & Bredekamp, 1998). One part of school readiness is the academic prowess or specific child's abilities. The preschool preparation programs are especially useful to children from disadvantaged families of low socio-economic status (Heckman, 2006) and for children with

disabilities or at-risk for disabilities (Dettre, 1983). There is a wide scientific consensus that investing in high quality early education programs will lead to better child's outcomes in health, human capital, and wellbeing throughout the life (Richter et al., 2017).

Transition period from preschool to school years is a time of rapid changes in children's life and thus the need for their adequate preparation (Margetts, 2000). A successful adaptation to schools depends on many factors including academic, social, cognitive, emotional and behavioral abilities (McIntyre, Blacher, & Baker, 2006). In the first four years of life, most children make significant progress in learning language (Conti-Ramsden & Durkin, 2012). In addition to language skills, preschool period is important for the development of basic mathematical concepts. Preschool children vary greatly in their math abilities and it appears that individual differences in math knowledge appear early in the development (Klibanoff et al., 2006).

The topic of early math achievement has received much scientific attention recently and one of the reasons for that is that early math skills are highly predictive of later academic achievement (Hardy & Hemmeter, 2019; Sarama & Clements, 2009). Early math competencies are also highly predictive of later math achievement (Jordan, Kaplan, Ramineni, & Locuniak, 2009). Many factors during the early childhood affect child's mathematic performance. One of the major demographic factors contributing greatly to math achievement is the socioeconomic status (Heckman, 2006). A plethora of research indicated the strong link between working memory and math achievement (Alloway & Alloway, 2010; Ashcraft & Krause, 2007; Raghubar, Barnes, & Hecht, 2010). Other factors predicting math achievement include verbal fluency, selective attention, visual motor integration, and inhibitory control (Memisevic, Biscevic, & Pasalic, 2018).

By definition, children with developmental disabilities lag behind their peers on school entry, especially in the area of academic competences (Morgan, Farkas, & Wu, 2011). Children with intellectual disability have much poorer math performance than children without disabilities. In fact, in comparison with all other disability categories, children with intellectual disability are at the highest risk of having math difficulties (Wei, Lenz, & Blackorby, 2013). Thus, early childhood and preschool programs aimed at increasing math abilities are of special importance to children with intellectual disability.

Given the importance of the knowledge of math concepts and skills, the effectiveness of two different preschool preparation programs on math achievement was examined. One is a special education preschool preparation program aimed at providing educational services to children with intellectual disability. The other one is inclusive (or regular) preschool preparation program serving all children, typically developing children as well as children with developmental disabilities. Preschool program assessments might provide useful indicators of their effectiveness for school preparation (Maxwell & Clifford, 2004) and can thus serve as a useful guide in improving the programs. Research on the comparison of different preschool programs has not received much scientific attention in Serbia. However, this information is of critical importance in order to select best programs for children with intellectual disability.

At the outset, three working hypotheses were set:

1. Children in all three groups improve on the math skills tasks;
2. There are no differences in math improvement between three groups of children;
3. There are no gender differences in math improvement.

Methodology of Research

General Background

This research employed a pre-test/post-test quasi-experimental design with three groups of children. Children were not randomly assigned to the groups. This type of design is very useful in evaluating the effects of a preschool program on math achievement. Children were tested on a math task at the beginning of the school year (pre-test), then after 8 months, they were tested again (post-test). This design has practical advantages because it deals with intact groups and does not disrupt the existing research setting. One caution about this design is if there are post-test differences between groups, they may not be clearly and without doubt be attributed to the intervention setting (Dimitrov & Rumrill, 2003).

Participants

The sample for this research was a convenient one and consisted 90 children (54 boys and 36 girls) aged 60 to 72 months old (mean age at pre-test = 67.0; $SD = 4.6$ years) who were attending mandatory preschool program. Children were classified in three groups: 1. Children with intellectual disability attending special education preschool program ($n=30$); 2. Children with intellectual disability attending inclusive preschool program ($n=30$); and 3. Children without disabilities attending inclusive preschool program ($n=30$). Inclusion criteria for selecting children with intellectual disability were: standardized IQ scores in the range of mild intellectual disability (IQ range 50-69); chronological age of 5 to 6.5 years at the time of pre-test and absence of any other sensory and/or neurological conditions.

Procedure and Instrument

Children were recruited from the 18 convenient kindergartens in five cities in Serbia (Belgrade, Novi Sad, Kragujevac, Sombor and Subotica). This large number of kindergartens was necessary in order to recruit children with mild intellectual disability who were attending inclusive program. For the assessment of math skills, a revised version of Peabody Individual Achievement Test was used (PIAT-R; Markwardt, 1997). PIAT-R consists of 6 subscales: General information, Reading Recognition, Reading Comprehension, Mathematics, Spelling, and Written Expression. Mathematics subscale is aimed at assessing basic math knowledge and application of mathematical concepts. According to the manual, the PIAT-R has excellent psychometric properties. Split-half reliability was between .95-.98. Test-retest reliability ranged from .84 - .96. Construct validity was established through its correlation with Peabody Picture Vocabulary Scale, and the correlation was .72. The main purpose of the test was to evaluate scholastic achievement in educational setting. The test was intended for children and adolescents aged 5-0 to 18-11 years. Children were individually administered the test in the morning hours at the available space in their kindergartens. Preschool administrators approved the research and testing was done in accordance to Helsinki declaration. Only children with written parental consents were tested.

Special Education Preschool Preparation Program

Special education preschool preparation programs serve children with developmental disabilities, including children with intellectual disability and children with autism spectrum disorder. This program (implemented in 3 kindergartens, 7 groups) was attended by 30 children with intellectual disability in our sample. The professional working at these kindergartens are

special education teachers (formerly known as *defectologists*), who received specialized training on the evidence-based practices and methods of working with children with developmental disabilities, such as differentiated instruction, applied behavior analysis, systematic instruction, repeated practices, etc. Also, in comparison with inclusive preschool education program, the ratio teacher- children is usually smaller and is not typically exceeding 5 children per 1 teacher. Children attended this preschool program for at least 4 hours daily for 8 months.

Inclusive Preschool Education Program

Inclusive preschool education program serves all children, regardless of disability status, prior to enrolling in elementary school. However, majority of children attending these programs were children without disabilities. This program was attended by 60 children in our sample (30 without disabilities and 30 children with intellectual disability). Children with intellectual disability were recruited from 15 kindergartens (30 groups), and children without disabilities were recruited from 2 kindergartens (3 groups). It is important to note that not all inclusive groups had children with intellectual disability. If there was a child with intellectual disability in the group, then the child – teacher ratio in these groups was approximately 10 children per 1 preschool teacher. Otherwise, the child – teacher ratio was up to 20 children per one teacher. Children attended this preschool program for at least 4 hours daily for 8 months. The personnel working in these kindergartens are preschool teachers who were not trained, in their pre-service training, on how to implement specific special education methods in their everyday work. It is important to note that both programs, special and inclusive, work under the state-regulated school preparation curricula.

Statistical Analysis

For all data, descriptive statistics with means and standard deviations were presented. The first hypothesis was tested by using a paired sample t-test. Along the t-test and level of significance, a Cohen’s *d* measure of an effect size was presented. For the second hypothesis a one-way ANOVA followed by Games-Howell post hoc test was performed. The third hypothesis was tested with an independent samples t test. An alpha level of .05 was used for all the tests. The analysis was performed with the computer program SPSS v.13 for Windows.

Results of Research

The first task was to test whether math scores differed significantly from pre-test to post-test assessment. The results of paired t test are shown in Table 1.

Table 1. Pre-test post-test mean differences in math achievement.

Group	Pre-test math scores		Post-test math scores		<i>t</i> (<i>df</i>)	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Intellectual disability (special preschool)	6.6	1.8	12.0	4.1	10.0 (29)*	1.7
Intellectual disability (regular preschool)	6.0	2.0	8.3	3.4	5.3 (29)*	0.8
Control group (without intellectual disability)	17.1	3.2	22.7	4.4	15.8 (29)*	1.4

Note. * $p < .001$

As can be seen from the table 1, all groups achieved significantly better results in math scores on post-test. However, according to the Cohen’s *d* measure of the effect size, the largest improvement was for the group of children with intellectual disability attending special program, followed by the control group and group of children with ID attending regular program.

A one-way ANOVA was performed to determine the mean differences in pre-test and post-test math scores between groups. These results are shown in Table 2.

Table 2. One-way ANOVA for pre-test and post-test math scores according to child’s group.

Variable	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
<i>Math pre-test scores</i>				
Between groups	2	2346.0	1173.0	203.1*
Within groups	87	502.4	5.8	
<i>Math post-test scores</i>				
Between groups	2	3362.9	1681.4	106.5*
Within groups	87	1373.1	15.8	

Note. * $p < .001$

The results of one-way ANOVA revealed statistically significant differences in mean pre-test and post-test math scores between groups. A post-hoc test was performed to determine what groups were significantly different. Games-Howell post hoc test was chosen as the variances were not homogeneous across groups. These results are shown in Table 3.

Table 3. Mean pre-test and post-test math differences between the groups.

Group	MATH Pre-test		MATH post-test	
	Mean	<i>SE</i>	Mean	<i>SE</i>
ID (sped) vs control group	-10.5***	0.67	-10.7***	1.1
ID (reged) vs control group	-11.1***	0.68	-14.4***	1.0
ID (sped) vs ID (reged)	0.63*	0.49	3.8**	0.97

Note. *** $p < .001$; ** $p < .01$; * $p = .41$. sped- special education group, reged- regular education group, *SE*- standard error.

Control group of children without ID performed significantly better on both pre-test and post-test math scores in comparison with both groups of students with intellectual disability. However, on post-test, the mean difference remained almost the same between them and children with intellectual disability attending special education program. On the other hand, the mean difference increased between children without ID and children with ID attending regular preschool program. As for the difference between children with ID attending special and regular preschool program, the mean difference in math achievement increased significantly in favor of children attending special education program. Next, an ANOVA was performed to examine whether the mean improvement score (post-test math scores – pre-test math scores) varied between the groups. There were statistically significant differences between the groups $F(2,87)=17.3, p < .001$. Posthoc Games-Howell test indicated no difference in math improvement between children with intellectual disability attending special education program and children without disabilities ($p = .96$). However, both these groups improved their math scores significantly higher than the group of children with intellectual disability attending regular preschool program (both p 's $< .001$).

Lastly, the potential gender effect was examined in the mean improvement in math scores. There were no significant differences in relation to gender on improvement in scores from pre-test scores to post-test scores; $t(88) = 0.21$; $p = .84$.

Discussion

The aim of the present research was to determine the effectiveness of two different preschool preparation programs on math achievement in children with intellectual disability and children without intellectual disability. The results of this research clearly indicate that both preschool preparation programs, special education preschool program and inclusive preschool program, were very effective in improving the math abilities in children prior to their enrollment in elementary school. However, the largest improvement was in the special education preschool program, in which children with intellectual disability improved their math scores for approximately 1.7 standard deviations. It is also evident that inclusive preschool program had a larger effect on children without disabilities than on children with intellectual disability, with both of these groups improving significantly. There are several potential explanations for the obtained results. First, special education preschool groups are led by special education teachers who are specialized in providing evidence-based methods for improving children's academic skills. Special education teachers need to have a wide knowledge base and need to master a complex repertoire of instructional methods (Brownell, Sindelar, Kiely, & Danielson, 2010). Another potential explanation regards the group sizes in these programs. Special education preschool groups are smaller in size and have a more favorable child – teacher ratio and thus the better math achievement. It is widely established that smaller group sizes have a positive effect on learning math, at least in older students (Springer, Stanne, & Donovan, 1999). The findings in this research are in line with a conclusion that small classes in early grades have many benefits (Nye, Hedges, & Konstantopoulos, 1999). A possible, but unlikely explanation is that special education preschool programs are better equipped to support students with intellectual disability. It is important to note that special education preschool program was not superior to the regular education program for children without disabilities. However, this finding is still in favor of the quality of special education preschool program as the earlier studies have found different developmental trajectories in math achievement between children with and without disabilities, with children without disabilities having higher gains over the course of six months (Hojnoski, Caskie, & Miller Young, 2018). Regular preschool programs, although somewhat inferior to the special education program for children with intellectual disability, have also resulted in large and significant improvements. Given the size of the improvement, it is evident that preschool programs play a huge role in increasing children's academic competencies. Preschool benefits have been widely reported in the scientific literature and there should be wider public campaigns to enroll more children in Serbia in preschool institutions. The age of start of mandatory program should probably be lowered so even children as young as 4 years could attend free preschool programs, as the evidence suggests that starting preschool at that age can produce benefits decades later (Melhuish, 2011).

In this research the gender differences in the math improvement were not found, meaning that girls and boys math abilities followed the similar trajectory. This finding is in line with other research in which there were no gender differences at an early school age (Memisevic, Biscevic, & Pasalic, 2018).

A thing one needs to bear in mind is that math scores are not all that counts regarding the success and adjustment of children with intellectual disability. As other areas of child's development such as emotional and social development were not assessed, it is hard to tell whether regular/inclusive preschool programs might be more useful to children with intellectual disability in the area of social skills.

This research has some limitations worth mentioning. First, there was no control for the duration of the preschool program. Although the minimum daily time is 4 hours, maybe children in special education group spent, on average, more time in the kindergartens. In line with this, it was not examined whether the children attended the kindergartens prior to mandatory preschool program. However, this is of lesser importance, as the children with intellectual disability achieved similar math results on the pre-test. Another limitation regards the recruitment procedure (convenient sample) which might have led to a potential bias in these results. It might be that children of parents who gave the consent to participate were in some way different from children for whom there was no parental consent. Lastly, it is possible that some extraneous variable might have contributed to the obtained results, for example that children with intellectual disability in special education preschool program attended some extracurricular education programs to a larger extent than children with intellectual disability in regular preschool program.

It is important that all teachers working with preschool children (special teachers and preschool teachers) are well prepared for the transition of a child from preschool to elementary school setting. Professional development of the teachers is a useful step in that direction. This strategy will result in the reduction of stress of a child during the transition period and will also result in better academic and social outcomes of all children.

Conclusions

Special education preschool program was superior to regular preschool program in improving the math abilities of children with intellectual disability. Special education teachers have a broad set of skills in implementing evidence-based methods in working with children with intellectual disability. Current research indicates that children with intellectual disability have more academic gains in specialized settings in which they receive more individualized attention. In order to close this gap in the achievement, it is advised that all preschool institutions, not just special preschools, engage special education teachers who will support children with intellectual disability as well as preschool teachers. In addition to this, preschool teachers working in regular preschool institutions should have more pre-service classes regarding children with intellectual disability and evidence-based methods. Another advice that would probably result in better academic outcomes is that mandatory preschool programs in Serbia should start at younger age of children. Besides academic benefits, the earlier age of enrollment into the preschool program would also have many societal benefits as well.

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<i>Marija Slavkovic</i>	Elementary school "Sava Jovanović Sirogojno", Belgrade, Serbia. E-mail: marija.mmd@gmail.com
<i>Haris Memisevic</i>	PhD, Assistant Professor, Faculty of Educational Sciences, University of Sarajevo, Skenderija 72, 71000 Sarajevo, Bosnia and Herzegovina. E-mail: hmemisevic@gmail.com Website: https://www.researchgate.net/profile/Haris_Memisevic