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## **COMPARATIVE EVALUATION OF PASS THEORY BASED COMPUTER GAMES AND BRAIN MOTOR AND BALANCE STIMULATIONS ON VISUAL-SPATIAL PROCESSING AND READING PERFORMANCE IN DYSLEXIC STUDENTS**

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### **ABSTRACT**

The aim of this research was to compare evaluation of PASS theory based computer games and brain motor and balance Stimulations on visual-spatial processing and reading performance in dyslexic students. Research method was pre-test post-test semi-experimental type with control group. Independent variables were PASS theory based computer games and brain motor and balance Stimulations; dependent variables were visual-spatial processing and reading performance. Statistical population was third, Fourth and fifth grade elementary students in Esfahan. For this purpose 30 dyslexic students were chosen through cluster sampling. Tools of research were clinical interview form, Wechsler IQ test IV, NEPSY neuropsychological test and Reading and dyslexia test. Data was analyzed by multivariate Co- variance. Results showed, there was a meaningful difference between control and experimental groups in visual-spatial processing and interventions increased this domain in experimental groups. Also, there was no significant difference between experimental groups in visual-spatial processing except in plan copying subscale. Computer games interventions were more effective than brain motor and balance Stimulations on this subscale. In addition to, there was significant difference between experimental and control groups in reading word, word comprehension, phoneme omission, rhymes and naming subscales and these subscales improved. In rhymes and naming subscales computer games group had better performance than another experimental group. In words chain and semi-words reading, computer games group showed meaningfully the highest performance. In letter symbol subscale, only brain motor and balance Stimulations group had increased meaningfully. There was no significant difference between triple groups in type symbol subscale.

**Keywords:** *PASS Theory, Computer Games, Brain Motor and Balance Stimulations, Visual-Spatial Processing, Dyslexia*

### **INTRODUCTION**

In recent decades one area which, has been studied by the researchers, is learning disorders. People who have learning disabilities are challenging one of the common beliefs about human beings. A person who is not mental retard, doesn't have mental disorder, visual or auditory deficiency and is not poor and not suffering from social deprivation logically should be successful at school but why this is not so? (Ganji, 2013).

In special learning disabilities, severe disorder in reading proficiency is termed dyslexia. Before the diagnostic statistical manual of mental disorder fifth edition, dyslexia was considered one of the learning disabilities but it has changed into a specifier, which is a disorder that specifies the special kind of learning disability. The original characteristic of dyslexia is that a person has a problem in reading correctly or quickly and in reading comprehension and this ability doesn't disappear with the chronological age and the intelligence quotient and the learning conditions (Ganji, 2013).

Cognitive functions such as attention, executive function, language and motor function and visual and spatial processing, learning and memory are complicated abilities. Those are combinations of flexible and interactional subscales that are planned by the natural network, which is flexible in itself (Luria, 1963, 1973, 1980). Visual-spatial processing is a complicated process and involves many related parts. It

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contains mental object incarnations, ability to discriminate between objects, orientation, to determine right and left direction, the ability of spatial relation between objects, plan copying and producing and making plan by blocks, and the ability of landscape adaptation subjectively and interpreting map symbols and the ability of solving non- verbal problems. These skills developed in childhood and increased in adolescent by developing attention, memory, experience and education (Cronin *et al.*, 1977; cited Abedi, 2008).

### **Statement of Problem**

Dyslexia is defined by Kaplanas learning disorder for words recognition, slow reading and poor reading comprehension when there is not a considerable low IQ or mental disorder. This learning deficiency, which is seen a lot in primary school students, has family background and is accompanied by disorder in reading abilities or mathematics skills or one of the communication skills (Kaplan and Sadok, 2008).

In order to treat this problem, many methods were used, for example Fernald multi-sensory method, Davis method, motor and balance stimulations and PASS theory based computer games.

PASS theory based computer games are those games that increased four brain processing: planning, attention, simultaneous and successive processing (Flanagan and Alfonso, 2011).

Other treatment method is brain motor and balance stimulations, which include reinforcement and teaching neuropsychological functions. Motor and balance stimulation neuropsychological reinforcements means to use the interventions to empower attention span, executive functions, language, visual-spatial processing and working memory which are designed and performed based on combinations of teaching programs of Korkman *et al.*, (1998), Baily *et al.*, (2010).

In literature, there are some studies, which probe the effect of digital games on neuropsychological functions. Baily *et al.*, (2013) found that digital games are effective to empower spatial processing. Sandro *et al.*, (2013) showed that computer games have positive effects on reading speed of dyslexic students. Ooi *et al.*, (2010) found that there was a relation between PASS cognitive performance with reading performance. Clickman (2005) and Geary (2006) showed that students with learning disabilities, had many problems in visual-spatial processing.

The other studies show the effect of computer games on developing the reading proficiency. Eehel and Jamet (2013) showed that computer games have positive effect on learning and motivation. Yihua *et al.*, (2013) found that students learning were improved by the use of computer in Chinese rural areas. Sandro *et al.*, (2013) indicated that computer games can develop reading ability and reading speed. Mc-Closkey *et al.*, (2004), Pennington (2009), Jordan *et al.*, (2010), George (2010), Mazzacco and Hanich (2010) confirmed that neuropsychological intervention can improve the educational performance of children suffered from learning disorders, Same Siahkalroodi (2009) concluded that visual perception has positive effect on reading proficiency and reading comprehension.

So, in the present study PASS theory based computer games and sensory motor balance stimulations are used for dyslexic children treatment. Computer games method concludes games that have brain processing factors as planning, attention, simultaneous processing and successive processing (Flanagan and Alfonso, 2011). Sensory motor balance stimulations includes reinforcement and teaching neuropsychological functions reinforcements to empower attention span, executive functions, language, visual-spatial processing and working memory which are designed and performed based on combinations of teaching programs of Korkman *et al.*, (1998), Bale *et al.*, (2010).

### **Purpose of Study**

Specialists believe that the number of dyslexia sufferers are high and is approximately more than 15 or 20 percent of children and adults in the world are suffering from it (Halahan, 2005).

The present study had two main aims. One of the main purpose of the study was to define the evaluation of PASS theory based computer games and brain motor and balance stimulations on visual spatial processing of dyslexia students. The other important aim was to define the evaluation of PASS theory based computer games and brain motor and balance stimulations on reading performance of dyslexia students.

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**MATERIALS AND METHODS**

**Method**

The research method was pre-tested, post-test semi- experimental type with control groups. In this study, independent variables were PASS theory based computer game and brain motor and balance stimulations and dependent variables were reading performance and visual-spatial processing of dyslexia students.

**Participants**

Population in this study included students of third, fourth, and fifth of primary school in Isfahan city which were studying at educational year 2014 and were referred to learning disorders centers by their teachers because of their reading disabilities. The sample was chosen by cluster sampling.

**Instruments**

The research tools were clinical interview form, Wechsler IQ test IV with reliability coefficient of 0.70 to 0.91 and Nepsy neuropsychological test with reliability coefficient of 0.75 to 0.89 and reading and dyslexia Moradi and KormiNoori test (2005) with reliability coefficient of 0.43 to 0.98.

**Procedure**

Before intervention, students were given a reading performance and Nepsy neuropsychological test as a pretest and after all treatment sessions each participant was taken a post test. After pretest and recognition of student weakness, the treatment protocol was designed for 24 sessions at each person and each teaching table was educated in 3 weeks. Therefore each student was under treatment for 4 month.

**Data Analysis**

The data of each group was analyzed by descriptive statistics (medium, standard deviation) and inferential statistics multivariate (co-variation). To analyze the data in this study the SPSS software was used.

**RESULTS AND DISCUSSION**

**Findings**

The first hypothesis of the study was to define the evaluation of PASS theory based computer games and brain motor and balance stimulations on visual-spatial processing of dyslexic students. The table 1 shows the median and standard deviation of pre-test and post-test students' scores in visual-spatial processing subscale of NEPSY test.

**Table1: Median and standard deviation of pretest and posttest students' scores in visual-spatial processing subscale of NEPSY test**

Statistical indicator				
standard deviation	Median	groups	stages	variable
1/33	11/00	1. PASS theory based computer games	Pre test	Plan copying
1/50	11/60	2. Motor and balance stimulations		
1/07	9/40	3.control group		
1/32	10/33	Total		
0/99	13/10	1. PASS theory based computer games	Post test	
1/50	11/60	2. Motor and balance stimulations		
0/82	9/30	3.control group		
1/93	11/33	Total		
1/19	10/10	1. PASS theory based computer games	Pre test	Arrows
1/57	9/70	2. Motor and balance stimulations		
0/97	9/50	3.control group		
1/25	9/77	Total		
1/15	11/70	1. PASS theory based computer games	Post test	
1/18	11/50	2. Motor and balance stimulations		
0/97	9/50	3.control group		
1/47	10/90	Total		

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**Table 2: Results of Bonferroni test for comparison of median minus of neuropsychological subscales of NEPSY test in triple groups**

Variables	Groups	Median	1	2	3
Executive functions/attention	1. PASS theory based computer games	97.983	-	1.640	4.009
	2. Motor and balance stimulations	96.343	-1.640	-	2.369
	3.control group	93.9774	-4.009	-2.369	-
Language	1. PASS theory based computer games	115.39	-	4.225	19.463*
	2. Motor and balance stimulations	111.17	-4.225	-	15.238*
	3.control group	95.933	-19.463*	15.238*	-
Sensory motor functions	1. PASS theory based computer games	115.15	-	8.305*	10.559*
	2. Motor and balance stimulations	106.84	-8.305*	-	2.254
	3.control group	104.59	-10.559*	-2.254	-
Visual spatial processing	1. PASS theory based computer games	112.12	-	3.534	13.027*
	2. Motor and balance stimulations	108.58	-3.534	-	9.493*
	3.control group	99.093	-13.027*	-9.493*	-
Memory and Learning	1. PASS theory based computer games	112.84	-	0.334	12.200*
	2. Motor and balance stimulations	112.51	0.334	-	11.866*
	3.control group	100.64	-12.200*	11.866*	-

\* : P<0.05

**Table 3: Results of Bonferroni test for comparison of median minus of visual spatial processing subscales test in triple groups**

Variables	Groups	Median	1	2	3
Plan copying	1. PASS theory based computer games	12/608	-	1/253*	1/570*
	2. Motor and balance stimulations	11/355	-1.253*	-	1/318*
	3.control group	10.037	-2.570*	-1.318	-
Arrows	1. PASS theory based computer games	11.394	-	0.078	1.561*
	2. Motor and balance stimulations	11.473	0.078	-	1.639*
	3.control group	9.833	-1.561*	-1.639*	-

\* : P<0.05

The second hypothesis of the study was to define the evaluation of PASS theory based computer games and brain motor and balance stimulations on reading performance of dyslexia students. Table 4 shows the results of Bonferroni test for comparison of median minus of reading and dyslexia subscales test in triple groups.

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**Table 4: Results of Bonferonni test for comparison of median minus of reading and dyslexia subscales test in triple groups (\*: P<0.05)**

Variables	Groups	Median	1	2	3
Words reading	1. PASS theory based computer games	85.742	-	0.297	4.530*
	2. Motor and balance stimulations	85.446	-0.297	-	4.233*
	3.control group	81.212	-4.530*	-4.233*	-
Chain of words	1. PASS theory based computer games	68.376	-	0.810	6.617
	2. Motor and balance stimulations	67.566	-0.810	-	5.807*
	3.control group	61.759	-6.617*	-5.807*	-
Rhymes of words	1. PASS theory based computer games	65.706	-	1.969	4.350*
	2. Motor and balance stimulations	63.737	-1.969	-	2.381
	3.control group	61.356	-4.350*	-2.381	-
Naming	1. PASS theory based computer games	81.532	-	-2.939	1.137
	2. Motor and balance stimulations	84.472	2.939	-	4.076*
	3.control group	80.396	-1.137	-4.076*	-
Comprehension	1. PASS theory based computer games	86.912	-	1.496	4.940
	2. Motor and balance stimulations	85.416	-1.496	-	3.444
	3.control group	81.972	-4.940	-3.444	-
Word comprehension	1. PASS theory based computer games	85.742	-	0.297	4.530*
	2. Motor and balance stimulations	85.446	-0.297	-	4.233*
	3.control group	81.212	-4.530*	-4.233*	-
Phones omission	1. PASS theory based computer games	68.376	-	0.810	6.617*
	2. Motor and balance stimulations	67.566	-0.810	-	5.807*
	3.control group	61.759	-6.617*	-5.807*	-
Semi word reading	1. PASS theory based computer games	65.706	-	1.969	4.350*
	2. Motor and balance stimulations	63.737	-1.969	-	2.381
	3.control group	61.356	-4.350*	-2.381	-
Letter symbol	1. PASS theory based computer games	81.532	-	-2.939	1.137
	2. Motor and balance stimulations	84.472	2.939	-	4.076*
	3.control group	80.396	-1.137	-4.076*	-
Type symbol	1. PASS theory based computer games	86.912	-	1.496	4.940
	2. Motor and balance stimulations	85.416	-1.496	-	3.444
	3.control group	81.972	-4.940	-3.444	-

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### **Discussion**

The first hypothesis of the study was to define the evaluation of PASS theory based computer games and brain motor and balance stimulations on visual spatial processing of dyslexia students. Based on first third table, there was a meaningful difference between control and experimental groups in visual-spatial processing and interventions increased this domain in experimental groups. Also, there was no significant difference between experimental groups in visual-spatial processing except in plan copying subscale. Computer games interventions were more effective than brain motor and balance Stimulations on this subscale.

Based on second table there was significant difference in neuropsychological functions between control and experimental groups, except executive functions and attention subscales. Therefore, the first research hypothesis of the effectiveness of two intervention methods was confirmed.

Research of this study is congruent with some of previous studies in this area. Baily *et al.*, (2013) found that digital games are effective to empower spatial processing.

Also, the study results are incongruent with the work of Ingle and Wilms (2013) that showed digital games were helpful to develop short-term visual memory. In author's opinion, this may happen because of types of games or game time duration, or parent attitude to these games. Clickman (2005) and Geary (2006) and Mir *et al.*, (2009) showed that students with learning disabilities, have difficult in visual-spatial processing.

The second hypothesis of the study was to define the evaluation of PASS theory based computer game and brain motor and balance stimulations on reading performance of dyslexic students. Based on forth table, there was significant difference between control and experimental groups in reading performance test subscales except in type symbol. There was significant difference between experimental and control groups in reading word, word comprehension, phonem omission, rhymes and naming subscales and these subscales improved. In rhymes and naming subscales computer games group had better performance than another experimental group. In words chain and semi-words reading, computer games group showed meaningfully the highest performance. In letter symbol subscale, only brain motor and balance Stimulations group had increased meaningfully. There was no significant difference between triple groups in type symbol subscale. According to the above-mentioned results, the results of the study are congruent with some of the previous findings. Eehel and Jamet (2013) showed that computer games have positive effects on learning and motivation. Yihua *et al.*, (2013) found that students learning were improved by the use of computer in Chinese rural areas. Sandro *et al.*, (2013) indicated that computer games could develop reading ability and reading speed. Mc-Closkey *et al.*, (2004), Pennington (2004), Jordan *et al.*, (2010), Gerge *et al.*, (2013), Mazzocco and Hanich (2010) confirmed that neuropsychological interventions can improve the educational performance of children suffered from learning disorders. Same Siahkalroodi (2004) concluded that visual perception has positive effect on reading proficiency and reading comprehension. Regarding the above Results, it seems that one of the attractive and useful methods to improve reading performance of students suffering from dyslexia is using computer softwares and games based on PASS theory interventions for improving neuropsychological skills.

Based on the results of the study, dyslexic children, besides routine educational teachings, need extra work to develop neuropsychological skills and educational time should be allocated to improve these important skills.

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