RESEARCH ARTICLE

ACTA Vol. 15, No. 3, 2017, 241-256
NEUROPSYCHOLOGICA

Received: 11.12.2016
Accepted: 28.09.2017

A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

INTEGRATION EXERCISE PROGRAMME FOR CHILDREN WITH LEARNING DIFFICULTIES WHO HAVE PRESERVED VESTIGIAL PRIMITIVE REFLEXES

Celestyna Grzywniak
Pedagogical University of Krakow, Krakow, Poland

SUMMARY

Background: The main goal of the research was to determine the usefulness of the *Integration exercise programme* stimulating development in children with learning difficulties who have preserved vestigial primitive reflexes. Their symptoms included weak motor and visual-motor coordination, lowered visual and auditory analysis and synthesis which resulted in difficulties in reading and writing, disrupted emotional development, psychomotor hyperactivity, weak concentration and other symptoms.

Material/ Methods: 104 children with learning difficulties and other accompanying symptoms took part in the experiment. The children were trained in the shape of the *Integration exercise programme* at school under a therapist's supervision and additionally at home under parental supervision. The children who went through the whole programme were qualified to the experimental group and those who resigned from the programme after a short period of time – to the control group. A pre-test and a post-test, before and after completion of the *Integration exercise programme,* was used to evaluate the results.

Results: It was found that the *Integration exercise programme* is useful in therapy involving facilitation of development in children with learning difficulties, who exhibit various symptoms. Almost all the obtained results were statistically significant. The *Integration exercise programme* is particularly effective in the case of children exhibiting a whole set of symptoms along with learning difficulties, problems with concentration, weak emotion control, weak motor development, abnormal muscle tension, weak motor coordination.

Conclusions: The *Integration exercise programme* widens the range of methods stimulating development and the range of possibilities to apply the therapy practiced in psychology, pedagogy and physiotherapy.

Key words: learning difficulties, preserved vestigial reflexes, physical activities, neural pathways

INTRODUCTION

Pedagogists, psychologists and physiotherapists are still looking for new methods for stimulating development in children, particularly those exhibiting a variety of symptoms (see: Lipowska 2011). A set of multiple symptoms affects various psychomotor functions and causes varied problems, particularly at school. Due to the fact that work on those symptoms is highly specialized, such a child should attend therapy with a psychologist and a physiotherapist and possibly a pedagogist.

Waclaw Vojta (Banaszek, 2004) referred to such a set of symptoms as a nervous coordination disorder with various degrees of intensity: severe, moderate, mild and very mild. The last two are exhibited by children who were seemingly healthy but suffered from various deficiencies. The reason for such a state was sought by Vojta in the preserved primitive reflexes with a moderate degree of intensity and an insufficient degree of development of postural reflexes. The idea was developed first by Dr Peter Blythe and subsequently his wife – Dr S. Goddard-Blythe (see: Goddard – Blythe 2013, 2006), creating a therapy programme for such children called the *Integration exercise programme for physical activities dedicated to children with special needs*.

The exercises are dedicated to children aged at least seven exhibiting preserved vestigial reflexes which result in a great variety of symptoms. It consists of 24 exercises assembled in accordance with the cephalocaudal development (motor development progresses from the head downwards) and proximal development (from the inside to the outside of the body – to the palm), so the child starts exercises by strengthening its neck muscles. All exercises involve physical activity and are adequately selected and assembled in accordance with the motor patterns occurring during a child's development.

\According to the definition formulated by Jagna Czohańska (1985), reflexes shape a child's motor development and make it possible to assume correct lying, sitting and standing positions and then balance while walking. Other researchers, along with Goddard-Blythe, claim that each primitive and postural reflex also shapes certain mental areas. The reflexes open neural pathways and through the multiple repetition of movements, strengthen them. If a child skips certain movement patterns, e.g., crawling or rolling sideways, at the early stage of development or does not repeat them multiple times, the neural connections will not fully perform their functions due to their weakness. The *Integration exercise programme* aims at facilitating the performance of simple physical exercises, which form a basis of the whole motor development. Through those exercises a child starts with strengthening the neck muscles which allow the head to be kept still. That, as a result, is a condition for image stabilization in the eye's retina, which is necessary for reading and writing. Slow, multiple repetition of those exercises strengthens not only the muscles, but also neural connections, which, at the early stages of life, are too weak, and that positively affects the development of mental functions.

It can manifest itself as weak motor and visual-motor coordination, difficulties in following moving objects with the eyes, emotional immaturity, weak concentration and other symptoms. Therefore, going back to the movement patterns from the period of infancy makes it possible to strengthen the neural connections again. Such exercises should be performed 5 times a week, preferably at the same time of the day, not too late, in order for the child not to be tired. They are approximately 15 to 20 minutes long and should last for at least 9 months. Each exercise shall be performed slowly and repeated 5 to 6 times at most. The programme ends with important exercises involving crawling, since alternate movements develop lateralization and release the integration of all sensory systems (Grzywniak 2015; 2016).

MATERIAL AND METHOD

104 children between the ages of 6,10 and 11 attending primary schools and a Psychological-Pedagogical Clinic in Cracow with learning difficulties and other accompanying symptoms took part in the experiment. The program started in 2012 anad was finished in 2014. Exercises were demonstrated, taught and later performed individually and in small groups, for the duration of 12 to 14 months. The children were trained at school under a therapist's supervision and additionally at home under parental supervision.

All the children were subject to a pre-test and a post-test as well as an independent variable in the shape of the *Integration exercise programme*. The children who went through the whole programme were qualified to the experimental group and those who resigned from the programme after a short period of time – to the control group.

The aim of the study was to find answers to the following questions:

- What, if any, improvement was there in the performance during tests taken before and after implementing the *Integration exercise programme* in the experimental group?
- Which test results exhibited the most and the least improvement after implementing the *Integration exercise programme* in the experimental group?
- What, if any, improvement was there in the performance during tests taken after approximately one year in the control group?
- Which test results exhibited the most and the least improvement for children in the control group?

Did the greatest improvement occur in the control or the experimental group?

In order to answer the research questions above, the experiment involved a pre-test introducing 21 tests assessing the coordination level of large muscles and balance, vestigial form of primitive reflexes, the development of visual and auditory perception. The tests were evaluated in a five-grade scale where the result of 0 points denotes correct task completion, 1 point – a 75% completion, 2 points – only a 50% completion, 3 points – only a 25% completion and 4 points – the lack of task completion. A detailed description of the research tool can be

found in the works of Goddard Blythe (2002, 2013) and Grzywniak (2013, 2015). Some of the described tests are used in child neurology. A questionnaire for the 21 implemented tests is presented below:

No.	The diagnostic test used in the experiment	Grade before	Grade after
1.	Walking a straight line forwards		
2.	Walking a straight line backwards		
3.	Walking on the feet's side edges forwards		
4.	Walking on the feet's side edges backwards		
5.	The Ayres Test left side		
6.	The Ayres Test right side		
7.	The Schildera Test left side		
8.	The Schildera Test right side		
9.	STNR- flexing		
10.	STNR- extending		
11.	TLR- flexing		
12.	TLR- extending		
13.	Following with eyes		
14.	Integration (star-symbols)		
15.	Integration (letter H symbols)		
16.	Integration (finding hidden words)		
17.	differentiation of sounds		
18.	Tansley's Test –visual differentiation		
19.	Tansley's Test –visual-motor integration		
20.	Bender Test –visual differentiation		
21.	Bender Test - visual-motor integration		

Descriptions of the implemented tests:

Walking a straight line (tip top)

This test evaluates the ability to keep one's own body balance, motor and visual-motor coordination, and also, to some degree, concentration and muscular tension. In order to perform this test, a child must be able to look forward and perform certain body movements. During the test there may occur: a vestigial form of the tonic labyrinthine reflex, as well as a vestigial form of the sucking reflex in the shape of facial grimaces and the plantar reflex by flexing toes.

Walking forward and backwards on the edge of one's feet sides

This test makes it possible to determine the motor coordination of the whole body, visual-motor coordination, the ability to balance and muscular tension. The success in completing the task may be affected by vestigial form of the tonic labyrinthine, plantar, sucking and palmar grasp reflexes. A child's palm may also assume the position of a *monkey grasp*.

The Ayres Test

A test by A. J. Ayres, which determines the occurrence of a vestigial form of the asymmetrical tonic neck reflex. If a vestigial form of that reflex occurs, it denotes the incorrect development of lateralization, hand-eye coordination, whole body coordination, the ability to follow with the eyes, and in correct flexing distribution on the right and left side. Children exhibit reading and writing difficulties,

incorrect lateralization and motor coordination of the whole body as well as visual-motor coordination. The test determines a vestigial form of that reflex occurring on the left and the right side of the body in an all-fours position.

The Shilder Test

This test also determines the occurrence of a vestigial form of the asymmetrical tonic neck reflex. It is performed in a standing position.

The Symmetrical Tonic Neck Reflex (STNR) Test

This test determines the occurrence of a vestigial form of the symmetrical tonic neck reflex while extending and flexing the head. This preserved reflex causes incorrect motor coordination of the whole body, a weak ability to focus sight on near and far objects and the ability to shift sight between near and far objects. It affects the ability to write down from a board, distance evaluation, evaluation of closing-in objects, e. g., a car approaching a pedestrian crossing as well as the ability to focus on an object for a longer period of time, e. g., reading. The test is performed in an all-four position.

The TLR Test

The test is also performed by flexing and extending the head in a standing position. It determines the occurrence of a vestigial form of the tonic labyrinthine reflex and the functioning of the vestibular system. The vestibular system, through numerous connections with sensory systems, affects many functions, including the visual and auditory systems.

Eyes following test

It evaluates the ability to follow with the eyes and the correctness of saccades, which is necessary for learning how to read. There are letters or numbers arranged in four rows. The child's task is to read every second character without using their fingers as an aid.

Integration Tests (14, 15, 16)

The test involves counting the number of elements in a set without using fingers as an aid. The elements are scattered. The test evaluates the development of visual perception, the ability to perform visual analyses and syntheses, the ability to group graphical signs, to perceive the whole and its parts at the same time. The development of visual analysis and synthesis is affected by the following reflexes: TLR, STNR, Moro and ATNR.

Sound differentiation test (Test 17)

This test evaluates the development of auditory analysis and synthesis and auditory memory. This function is affected by the TLR and Moro reflexes.

The Tansley's test and the Bender Test (18 to 21).

The test involves redrawing shapes with a pencil from the Tansley's test and the Bender test on an A-4 sheet. These tests evaluate the level of graphic-motor development, visual perception, visual-motor coordination, arrangement of the shapes on the sheet which is related to space management and visual differentiation. Visual differentiation is an ability to differentiate one object from another. The development of those functions is mainly affected by ATNR, the palmar grasp reflex, TLR and STNR as well as the Moro reflex.

Interviews with children and parents were also conducted. The meetings took place every week or every two weeks or more often if necessary, particularly after the introduction of new exercises. When exercises became easy to perform, new ones were proposed and demonstrated.

Statistical analysis

Ad 1. In order to find an answer to the first research question, the particular results of the experimental group obtained before introducing the Programme and after it was finished were compared. The statistical analysis utilized the Wilcoxon test for matched pairs. The analysis of quantity variables (overall results) was conducted by calculating the average, standard variation, median, quartile, minimum and maximum. These methods were also used in further parts of the statistical analysis. The obtained results clearly indicate that the percentage of results rated 3 and 4 points was significantly lower and those rated 0 and 1 higher, which is undoubtedly beneficial. The attained change is statistically highly significant reaching $p<0.001$. The discussed data is presented in Table 1.

Then, the average sum of points obtained in 21 tests before and after the introduction of the Integration exercise programme was calculated using the paired t-Student test for matched pairs. The obtained results indicate a high statistical significance, $p<0.001$, which confirms the effectiveness of the implemented programme. The relevant data is presented in Table 2.

On the basis of the statistical analysis above, it can be said that there was a highly significant improvement in the performance during tests, and the interviews with parents and teachers as well as observing children indicate that there was improvement in the children's functioning at school and at home.

Ad 2. In the experimental group, the greatest improvement (on average by 1.33 points) was noted in the results of tests: 2 (walking straight backwards) and 4 (walking backwards on one's feet edges). It indicates that there was improvement in the children's body balance, motor and visual-motor coordination, and on the basis of observations – also concentration.

The development of those functions is affected by the symmetrical tonic neck reflex, tonic labyrinthine reflex and also the plantar reflex. The lowest (on average by 0.52 points) improvement was noted in the results of tests: 14 (star symbols) and 16 (integration – finding hidden words). Therefore, the lowest improvement occurred in the development of visual perception, sign assembling, distinguishing

Table 1. A comparison of the initial and final results of the diagnostic tests in the experimental group

Test number	Measurement	Percentage of results					p *
		0	1	2	3	4	
1	Before the Programme	14.81%	27.78%	40.74%	14.81%	1.85%	p<0.001
	After the Programme	51.85%	44.44%	3.70%	0.00%	0.00%	
2	Before the Programme	0.00%	22.22%	33.33%	18.52%	25.93%	p<0,001
	After the Programme	18.52%	48.15%	33.33%	0.00%	0.00%	
3	Before the Programme	5.56%	20.37%	50.00%	24.07%	0.00%	p<0.001
	After the Programme	24.07%	61.11%	14.81%	0.00%	0.00%	
4	Before the Programme	0.00%	7.41%	25.93%	40.74%	25.93%	p<0.001
	After the Programme	11.11%	29.63%	55.56%	3.70%	0.00%	
5	Before the Programme	24.07%	38.89%	29.63%	7.41%	0.00%	p<0,001
	After the Programme	46.30%	46.30%	7.41%	0.00%	0.00%	
6	Before the Programme	22.22%	38.89%	24.07%	14.81%	0.00%	p<0.001
	After the Programme	38.89%	51.85%	9.26%	0.00%	0.00%	
7	Before the Programme	7.41%	22.22%	46.30%	20.37%	3.70%	p<0.001
	After the Programme	16.67%	68.52%	14.81%	0.00%	0.00%	
8	Before the Programme	14.81%	20.37%	29.63%	33.33%	1.85%	p<0.001
	After the Programme	25.93%	55.56%	16.67%	1.85%	0.00%	
9	Before the Programme	18.52%	29.63%	35.19%	14.81%	1.85%	p<0.001
	After the Programme	33.33%	57.41%	9.26%	0.00%	0.00%	
10	Before the Programme	35.19%	20.37%	35.19%	9.26%	0.00%	p=0.002
	After the Programme	40.74%	53.70%	5.56%	0.00%	0.00%	
11	Before the Programme	5.56%	25.93%	50.00%	16.67%	1.85%	p<0.001
	After the Programme	12.96%	72.22%	12.96%	1.85%	0.00%	

12	Before the Programme	1.85%	24.07%	31.48%	31.48%	11.11%	p<0.001
	After the Programme	12.96%	53.70%	29.63%	3.70%	0.00%	
13	Before the Programme	7.41%	20.37%	38.89%	29.63%	3.70%	p<0.001
	After the Programme	27.78%	46.30%	24.07%	1.85%	0.00%	
14	Before the Programme	35.19%	33.33%	27.78%	3.70%	0.00%	p<0.001
	After the Programme	55.56%	40.74%	3.70%	0.00%	0.00%	
15	Before the Programme	27.78%	37.04%	31.48%	3.70%	0.00%	p<0.001
	After the Programme	59.26%	31.48%	9.26%	0.00%	0.00%	
16	Before the Programme	25.93%	48.15%	25.93%	0.00%	0.00%	p<0.001
	After the Programme	53.70%	44.44%	1.85%	0.00%	0.00%	
17	Before the Programme	22.22%	33.33%	29.63%	14.81%	0.00%	p<0.001
	After the Programme	44.44%	51.85%	3.70%	0.00%	0.00%	
18	Before the Programme	22.22%	35.19%	42.59%	0.00%	0.00%	p<0.001
	After the Programme	42.59%	50.00%	7.41%	0.00%	0.00%	
19	Before the Programme	16.67%	50.00%	29.63%	3.70%	0.00%	p<0.001
	After the Programme	48.15%	44.44%	5.56%	1.85%	0.00%	
20	Before the Programme	0.00%	27.78%	51.85%	20.37%	0.00%	p<0,001
	After the Programme	18.52%	70.37%	11.11%	0.00%	0.00%	
21	Before the Programme	0.00%	37.04%	40.74%	22.22%	0.00%	p<0.001
	After the Programme	22.22%	57.41%	20.37%	0.00%	0.00%	

part from the whole and perceiving the whole as a sum of parts. The relevant data can be found in Table 3.

Ad 3. The experimental group was comprised of children who initially performed the exercises from the programme, but after a short time, up to a month, quit the programme. After 12 months the 21 tests were conducted again and

then compared with the tests conducted earlier. The Wilcoxon test for matched pairs was used for this purpose. A comparison of the obtained results demonstrated that in as many as 12 tests (1, 3, 4, 7, 8, 11, 12, 14, 16, 17, 19 and 21)

Table 2. A comparison of the average result sums from the tests conducted before and after the application of the programme in the experimental group

Measurement	Sum of points								p *
	N	Average	SD	Median	Min	Max	1. quartile	3. quartile	
Before the Programme	54	34.65	5.87	34	25	47	30	39	p<0.001
After the programme	54	17.24	4.33	15.5	8	26	15	20.75	

Table 3. A comparison of 21 tests in the experimental group

Test number	N	Result change						
		Average	SD	Median	Min	Max	1. quartile	3. quartile
1	54	1.09	0.73	1	0	3	1	2
2	54	1.33	1.1	1	-1	4	1	2
3	54	1.02	0.69	1	0	3	1	1
4	54	1.33	1.03	1	-1	4	1	2
5	54	0.59	0.77	1	-1	2	0	1
6	54	0.61	0,71	1	-1	2	0	1
7	54	0.93	0.95	1	-2	4	1	1
8	54	0.93	1.04	1	-1	4	0	1,75
9	54	0.76	0.95	1	-2	2	0	1
10	54	0.54	1.11	0,5	-2	3	0	1
11	54	0.8	0.98	1	-1	3	0	1
12	54	1.02	0.92	1	-1	4	0	1
13	54	1.02	0.88	1	0	3	0	1
14	54	0.52	0.84	0	-1	2	0	1
15	54	0.61	0.63	1	0	2	0	1
16	54	0.52	0.67	0,5	-1	2	0	1
17	54	0.78	1.14	1	-2	3	0	1,75
18	54	0.56	0.92	1	-1	2	0	1
19	54	0.59	0.86	1	-2	2	0	1
20	54	1	0.75	1	-1	3	1	1
21	54	0.87	0.73	1	-1	3	0	1

Table 4. A comparison of the initial and final results of the diagnostic tests in the control group.

Test number	Measurement	Percentage of results					p *
		0	1	2	3	4	
1	Before the Programme	20.00%	36.00%	28.00%	16.00%	0.00%	p=0.004
	After the Programme	24.00%	40.00%	28.00%	8.00%	0.00%	
2	Before the Programme	8.00%	30.00%	28.00%	22.00%	12.00%	p=0.11
	After the Programme	6.00%	34,00%	30.00%	24.00%	6.00%	
3	Before the Programme	6.00%	30.00%	46.00%	18.00%	0.00%	p=0.001
	After the Programme	8.00%	42.00%	42.00%	8.00%	0.00%	
4	Before the Programme	0.00%	12.00%	26.00%	40.00%	22.00%	p=0.002
	After the Programme	0.00%	18.00%	32.00%	34.00%	16.00%	
5	Before the Programme	28.00%	42.00%	22.00%	8.00%	0.00%	p=0.073
	After the Programme	32.00%	40.00%	24.00%	4.00%	0.00%	
6	Before the Programme	16,00%	48.00%	28.00%	8.00%	0.00%	p=0.66
	After the Programme	12.00%	46.00%	38.00%	4.00%	0.00%	
7	Before the Programme	16.00%	32.00%	38.00%	14.00%	0.00%	p=0,022
	After the Programme	18.00%	36.00%	42.00%	4.00%	0.00%	
8	Before the Programme	6.00%	30.00%	46.00%	18.00%	0.00%	p=0,02
	After the Programme	6.00%	42.00%	42.00%	10.00%	0.00%	
9	Before the Programme	22.00%	52.00%	22.00%	4.00%	0.00%	p=0,267
	After the Programme	28.00%	48.00%	20.00%	4.00%	0.00%	
10	Before the Programme	30.00%	32.00%	30.00%	8.00%	0.00%	p=0,458
	After the Programme	28.00%	38.00%	30.00%	4.00%	0.00%	
11	Before the Programme	2.00%	28.00%	48.00%	22.00%	0.00%	p=0,003
	After the Programme	2.00%	44.00%	40.00%	14.00%	0.00%	

12	Before the Programme	1.85%	24.07%	31.48%	31.48%	11.11%	p<0.001
	After the Programme	12.96%	53.70%	29.63%	3.70%	0.00%	
13	Before the Programme	7.41%	20.37%	38.89%	29.63%	3.70%	p<0.001
	After the Programme	27.78%	46.30%	24.07%	1.85%	0.00%	
14	Before the Programme	35.19%	33.33%	27.78%	3.70%	0.00%	p<0.001
	After the Programme	55.56%	40.74%	3.70%	0.00%	0.00%	
15	Before the Programme	27.78%	37.04%	31.48%	3.70%	0.00%	p<0.001
	After the Programme	59.26%	31.48%	9.26%	0.00%	0.00%	
16	Before the Programme	25.93%	48.15%	25.93%	0.00%	0.00%	p<0.001
	After the Programme	53.70%	44.44%	1.85%	0.00%	0.00%	
17	Before the Programme	22.22%	33.33%	29.63%	14.81%	0.00%	p<0.001
	After the Programme	44.44%	51.85%	3.70%	0.00%	0.00%	
18	Before the Programme	22.22%	35.19%	42.59%	0.00%	0.00%	p<0.001
	After the Programme	42.59%	50.00%	7.41%	0.00%	0.00%	
19	Before the Programme	16.67%	50.00%	29.63%	3.70%	0.00%	p<0.001
	After the Programme	48.15%	44.44%	5.56%	1.85%	0.00%	
20	Before the Programme	0.00%	27.78%	51.85%	20.37%	0.00%	p<0,001
	After the Programme	18.52%	70.37%	11.11%	0.00%	0.00%	
21	Before the Programme	0.00%	37.04%	40.74%	22.22%	0.00%	p<0.001
	After the Programme	22.22%	57.41%	20.37%	0.00%	0.00%	

children from the control group noted a considerable improvement on the level of statistical significance $p<0.05$. A detailed analysis indicated that the percentage of grades of 3 and 4 points was lower, and the number of grades 0 and 1 was higher. For the remaining tests (tests 2, 5, 6, 9, 10, 13, 15, 18 and 20) the p values are higher than 0.05, and therefore are not statistically significant. The relevant data is presented in the table 4.

Afterwards, the average sums of the points from the 21 tests introduced at the beginning and at the end of the experiment were calculated and then compared. These results can be found in Table 5. A statistical analysis indicated a high statistical significance p <0.001. This can be explained by the positive influence of school and family environment on a child's development, the influence

Table 5. A comparison of the average sums of the results from tests conducted at the beginning and at the end in the control group

Measurement	Sum of points								p *
	N	Average	SD	Median	Min	Max	1. quartile	3. quartile	
Before the Programme	50	32.7	6.86	32.5	19	45	28.25	38	p<0.001
After the Programme	50	29.5	6.18	28.5	19	41	25.5	33.75	

Table 6. A comparison of 21 test results in the control group

Test number	N	Result change						
		Average	SD	Median	Min	Max	1. quartile	3. quartile
1	54	1.09	0.73	1	0	3	1	2
2	54	1.33	1.1	1	-1	4	1	2
3	54	1.02	0.69	1	0	3	1	1
4	54	1.33	1.03	1	-1	4	1	2
5	54	0.59	0.77	1	-1	2	0	1
6	54	0.61	0.71	1	-1	2	0	1
7	54	0.93	0.95	1	-2	4	1	1
8	54	0.93	1.04	1	-1	4	0	1.75
9	54	0.76	0.95	1	-2	2	0	1
10	54	0.54	1.11	0.5	-2	3	0	1
11	54	0.8	0.98	1	-1	3	0	1
12	54	1.02	0.92	1	-1	4	0	1
13	54	1.02	0.88	1	0	3	0	1
14	54	0.52	0.84	0	-1	2	0	1
15	54	0.61	0.63	1	0	2	0	1
16	54	0.52	0.67	0.5	-1	2	0	1
17	54	0.78	1.14	1	-2	3	0	1.75
18	54	0.56	0.92	1	-1	2	0	1
19	54	0.59	0.86	1	-2	2	0	1
20	54	1	0.75	1	-1	3	1	1
21	54	0.87	0.73	1	-1	3	0	1

of school education, physical education classes, physical activity and a child's autonomous development.

The control group did not exhibit the same improvement in results from different tests. The results of some tests noted a high statistical significance, while some of them did not note such a significance. However, a comparison of the average sums of all the tests before and after the introduction of the programme indicated a very high improvement on the level of $p<0.001$.

Ad 4. The control group noted the highest improvement, on average by 0.52 points, in the results of Test 17. However, it was lower than in the experimental group. The lowest improvement was noted in the results of Test 19. Test 17 evaluates the ability to differentiate between sounds, distinguishing sounds in a word, meaning auditory analysis and synthesis as well as auditory memory. This func-

Table 7. A comparison of the average results of the control and the experimental group

Test number	Group	N	Change in test results							p *
			Average	SD	Median	Min	Max	Q1	Q3	
1	Experimental	54	1.09	0.73	1	0	3	1	2	p<0.001
	Control	50	0.2	0.45	0	-1	1	0	0	
3	Experimental	54	1.02	0.69	1	0	3	1	1	p<0.001
	Control	50	0.26	0.49	0	0	2	0	0	
4	Experimental	54	1.33	1.03	1	-1	4	1	2	p<0.001
	Control	50	0.24	0.48	0	-1	1	0	0.75	
7	Experimental	54	0.93	0.95	1	-2	4	1	1	p<0.001
	Control	50	0.18	0.52	0	-1	1	0	0	
8	Experimental	54	0.93	1.04	1	-1	4	0	1.75	p<0.001
	Control	50	0.2	0.57	0	-1	2	0	0	
11	Experimental	54	0.8	0.98	1	-1	3	0	1	p<0.001
	Control	50	0.24	0.52	0	-1	2	0	0	
12	Experimental	54	1.02	0.92	1	-1	4	0	1	p<0.001
	Control	50	0.2	0.64	0	-2	1	0	1	
14	Experimental	54	0.52	0.84	0	-1	2	0	1	p=0.032
	Control	50	0.18	0.6	0	-2	1	0	0.75	
16	Experimental	54	0.52	0.67	0.5	-1	2	0	1	p<0.001
	Control	50	0.14	0.35	0	0	1	0	0	
17	Experimental	54	0.78	1.14	1	-2	3	0	1.75	p=0.132
	Control	50	0.52	0.81	0	-1	3	0	1	
19	Experimental	54	0.59	0.86	1	-2	2	0	1	p<0.001
	Control	50	0.12	0.33	0	0	1	0	0	
21	Experimental	54	0.87	0.73	1	-1	3	0	1	p<0.001
	Control	50	0.18	0.48	0	-1	1	0	0	

tion develops intensively in the process of learning how to write, so during the early years of school education. The intensive practicing of that function at school was probably the reason for obtaining high results in this test. Test 19 determines the level of visual-motor integration, meaning visual perception, visual-motor coordination, graphomotorics, distinguishing and finding small objects on a sheet of paper. These functions are developed by inter alia the asymmetrical tonic neck reflex, the labyrinthine reflex and the palmar grasp reflex. This test exhibited only a small improvement, by 0.12 points. The relevant results are presented in Table 6.

Ad 5. In order to find an answer to this question, The Mann-Whitney test was used. The obtained data indicates a much more positive change on the level of high statistical significance in the experimental group than in the control group. Better results were noted in all of the tests with the exception of Test 17. The relevant results are presented in Table 7. Only the tests from the control group which noted a statistically significant change were used for the comparison.

Statistically significant changes in Tests 2, 5, 6, 9, 10, 13, 15, 18 and 20 of the control group did not occur, but they did in the experimental group. Therefore, a conclusion can be drawn that the experimental group obtained better results in these tests. Hence, the final comparison of the results obtained by the experimental and the control group indicates that much better results were obtained by the former.

DISCUSSION

Studies of the influence of the *Integration exercise programme* on the psychomotor development of children with learning difficulties and on the improvement of school-related abilities were undertaken by Goddard-Blyte (2005; 2006), and Grzywniak (2016).

Goddard (2005), in her research projects, posed questions related to the influence of the programme on the improvement of the maturity of primitive reflexes, the ability to draw a human shape as well as reading, writing and orthography. One of the research projects, conducted in Ireland, was related to the application of the *Integration exercise programme* for children at the age of 8 and 9 having difficulties with writing, reading and spelling. The project was introduced in primary schools; one class acted as the control group, another as the experimental group. A total of 324 children were tested. The experiment indicated that children having difficulties with reading and writing exhibited a vestigial form of preserved primitive reflexes and that under the influence of the performed exercises, the children made significant progress related to their education. Reading and writing assessment was performed using the English SAT test, similar to the Polish test by T. Śliwińska and T. Straburzyńska (*A series of reading and writing tests for grades 1-3 of primary school*). Goddard's research indicates that a heightened degree of occurrence of preserved primitive reflexes is related to lower performance in reading, writing and the drawing of human shapes, and the application of the *Integration exercise programme* positively affects the integration of prim-

itive reflexes in the central nervous system, which as a result improves performance in reading, writing and the drawing of human shapes.

To sum up, it can be said that the application of the *Integration exercise programme* positively influenced the performance of the children from the experimental group during tests, and therefore improved the integration of primitive reflexes facilitating psychomotor development in various aspects as well as learning abilities. The children from the control group also noted a considerable improvement on the level of statistical significance in performance in the following tests: 1, 3, 4, 7, 8, 11, 12, 14, 16, 17, 19 and 21. However, a comparison of that data with the test results obtained by the children from the experimental group indicates that much better results on the level of high statistical significance were obtained by the children from the experimental group. The study results presented in this article confirm the effectiveness of the discussed Programme.

The research results obtained by the author presented in this article confirm the effectiveness of the discussed programme. It indicate improvement at a high significance level in the range of performed tests, and the interviews with parents and teachers provide information on the improvement in school-related abilities and functioning at school and at home. The results might be explained on the basis of microgenetic theory of symptom formation (Brown & Pachalska 2003; Pąchalska, Góral-Półrola & Jastrzębowska 2015).

CONCLUSIONS

The application of the *Integration exercise programme* positively influenced the performance of the children from the experimental group during tests, and therefore improved the integration of primitive reflexes facilitating psychomotor development in various aspects as well as learning abilities. The children from the control group also noted a considerable improvement on the level of statistical significance in performance. Therefore the *Integration exercise programme* widens the range of methods stimulating development and the range of possibilities to apply the therapy practiced in psychology, pedagogy and physiotherapy in Poland.

REFERENCES

Banaszek G. (2004) Rozwój niemowląt i jego zaburzenia a rehabilitacja metodą Vojty. Bielsko-Biała: A-medicapress.

Brown J.W., Pąchalska M. (2003) The symptom and its significance in neuropsychology. *Acta Neuropsychologica.* 1(1):1-11.

Czochańska J. (1985) Neurologia dziecięca. Warszawa: PZWL.

Goddard-Blythe S. (2002) Reflexes, learning and behavior, a window to the chid's mind. Fern Ridge Press, Eugene, Oregon.

Goddard-Blythe S. (2005) Releasing educational potential through movement: A summary of individual studies carried out using the INPP Test Battery and Developmental Exercise Programme for use in schools with children with special needs. Child Care in Practice.11/4:415-432.

Goddard -Blythe S. (2006) Program ćwiczeń integrujących do zajęć ze specjalnymi potrzebami, Materiały z kursu Rozpoznawanie i terapia opóźnień neurorozwojowych u dzieci ze specyficz-

nymi trudnościami w nauce oraz trudnościami z utrzymaniem koordynacji ruchowej występującymi w warunkach szkolnych. Warszawa: INPP.

Goddard-Blythe S., (2013). Jak ocenić dojrzałość dziecka do nauki? Warszawa:Wydawnictwo Naukowe PWN.

Grzywniak C. (2015). Stymulacja rozwoju dzieci z trudnościami w uczeniu się – nowe tendencje. Kraków : Wydawnictwo Naukowe Uniwersytetu Pedagogicznego.

Grzywniak C. (2013). Dbałość o prawidłowy rozwój psychomotoryczny dziecka. Kraków: Scriptum.

Grzywniak C. (2015). Dojrzałość neuropsychologiczna do szkolnego uczenia się dzieci sześcio- i siedmioletnich. Kraków: Scriptum.

Grzywniak C. (2016) *Role of early-childhood reflexes in the psychomotor development of a child, and in learning.* Acta Neuropsychologica. 14 (2): 113-129.

Lipowska M. (2011). *Dysleksja i ADHD. Współwystępujące zaburzenia rozwoju. Neuropsychologiczna analiza deficytów pamięci*. Warszawa: Wydawnictwo Naukowe Scholar.

Pąchalska M., Góral-Półrola J., Jastrzębowska G., Rasmus A., Kaczmarek B., MacQueen B.D., Małek A. (2015) The neurolinguistic of the US/Them structure in aphasia. Acta Neuropsychologica 13(4): 309-329. DOI: 10.5604/17307503.1184047.

Address for correspondence:
Celestyna Grzywniak
Pedagogical University of Cracow,
Ingardena 4, 30-060 Kraków
e-mail: gcel@poczta.onet.pl