

Analysis of early childhood occupational therapy intervention in a group of clients with low graphomotor skills

(scientific paper)

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Abstract: *Early childhood occupational therapy is considered a comprehensive form of help, which is provided for children with risk development, children with potentially risk development and children with specific disabilities within the systems of their families. The presented paper comprises of the analysis of an occupational therapy intervention, a specifically constructed programme of occupational therapy that was designed for clients at the age of 5 to 6 with low graphomotor skills. In the methodological part of the article, the authors present statistically significant differences in data before and after the realization of the occupational therapy programme. As part of the verification we chose two standardized tests: the first one used was F-test, then Student's t-test comparing the means of two samples during pre- and post- assessment testing. Drawing from the analysis of the results of the long-term occupational therapy intervention, it can be stated that the conducted programme is useful and meaningful as it was proven by the factors of comparison in the test and re-test.*

Keywords: *Research, developmentally oriented occupational therapy; graphomotor skills*

1 Occupational therapy in early intervention

the primary goal of occupational therapy is supporting the clients' development, their independence and quality of life, as well as their emotionality with the focus on early age, up to their school enrolment, based on the requirements stemming from their current health conditions. The actual means of assessment, intervention and counselling used as parts of early childhood occupational therapy facilitate coping with the particular tasks of the child and family, overcoming barriers and feelings of limitation (Mojžíšek, Zátopková, 1982; Havigeová et al., 2013, 2014). In the context

of early childhood occupational therapy, the whole process runs in the following steps (see Table 1, Kováčová, 2014).

Table 1 Tasks of occupational therapy

Early childhood occupational therapy (Tasks)	Description of particular tasks
Identify significant contexts for activating mobility	It is necessary for the professional to be able to select the context and the situations that act as activators for the child and that create opportunities for social interactions with the focus on the complex development of child personality. For children at early age it is suitable to choose situations that include simple activities such as tearing and sticking paper, or assembling simple puzzles. For children at preschool age, it is appropriate to play innovative games with a partner, for example creating a picture from waste materials, or creating objects by sewing.
Provide effective means for mobility	Each client in occupational therapy intervention has a specific problem connected with their mobility. By selecting appropriate means, it is possible to help the child integrate in everyday life.
Prepare environment for accepting a child with particular difficulties in the area of motor skills	It is helpful to create a situation for the child in which visual, auditory and motor skills are maximized. It is also good to find professionals and gain practical recommendations from them. Full interaction with the environment and the society is important. Children should be seated in front of the therapist, situated on the same eye level. The therapist holds the material in their hands in a way that it is visible for the child. It is necessary to use appropriate expression and voice intonation, suitable communication in every interaction with the child. It must be used at all times including all activities of daily living.
Use appropriate strategies	During the intervention, it is necessary to use appropriate approaches in all activities that are directed towards higher efficiency of mobility and the independence connected with it. During these activities it is necessary to provide children with time and space in order to give them time to think about how they are going to work. The professional needs to react to all the attempts of the child regardless of the results of the activity. Children learn best in a playful environment, in positive and pleasant atmosphere.

Source: Kováčová (2014)

Within parent counselling (Tichá, 2008), it is important to emphasise that motor activity does not develop instinctively but rather based on imitating. In case of delayed development in the area of motor skills, it is necessary to provide a goal oriented intervention (Kováčová, 2014).

Regarding dyspraxia, it is possible to assume that a child suffers from it if the movement coordination of a child in fine or gross motor skill tasks is significantly lower compared to their age norm. Based on research findings it is assumed that 5-8% of school age children suffer from dyspraxia (Golubovič, Slavkovič, 2014).

2 Activity training and evaluation of children in the area of motor skills

When occupational therapists focus on the assessment of hand movements in the area of motor skills, they must be able to assess the stages of grasp development (see Kováčová, 2014). In occupational therapy, the assessment of the stage of grasp is used from early age up to preschool age, when occupational therapy focuses less on manipulation with toys and more on manipulation with materials (Hadraba, 2007).

Regarding early childhood stimulation it is necessary to focus on the area of gross motor skills first and after that on the area of fine motor skills, improving dexterity of small muscle groups and the eye-hand coordination (Valachová, 2009, Fábry Lucká, 2014). After managing these partial areas, occupational therapists will focus on the development of graphomotor skills. As part of the (grapho-)motor exercises, it is necessary to differentiate particular appropriate exercises based on the age and disability of a child or children in a group. Based on that, there are three types of graphomotor exercises: manipulation, preparation and graphomotor exercises (see Table 3).

Table 2 Categorisation of exercises focused on the area of graphomotor skills

Graphomotor exercises	Description of exercises	Examples of particular exercises in early childhood occupational therapy
Manipulation exercises	Manipulation exercises are designated for children up to two years of age. The exercises include stimulation of motor and manipulation abilities (support of gross and fine motor skills) through the means of pre-artistic materials described.	These materials allow children to: – manipulate with water – pour, spill, mix, dissolve, and observe (development of the awareness of cause and effect, means and goals); – manipulate with sand, clay, or flour – sift, dig, kick, bury, make mud, and get dirty; – and manipulate with various natural materials such as stones, sticks, or beans (development of tactile perception).

Preparation exercises	Preparation exercises in the development of graphomotor skills are typical in groups of children from three to four years old.	They are performed on large sheets of paper or cardboard using a pencil. Also, sidewalk is used as a space without strictly set borders for drawing. The preparation exercises include relaxation exercises of the whole arm and body (gross motor skills). Further on, the relaxation exercises are focused on finger and palm coordination.
Graphomotor exercises	Graphomotor exercises focused on supporting the development in the graphomotor expression are not only mechanical training of certain graphic components.	The stimulation of graphomotor skills through the graphomotor exercises is performed based on these aspects: – verbal support (as a motivation a short story, an open sentence, riddle, rhyme or a poem is used); it is not recommended to use descriptive instruction such as “connect these two points” or “connect these four curves”; – tactile support (based on tactile perception of a particular object that has the same outline/shape as the component being practiced); – motor support (based on imaginary movement in the air similar to the component being practiced), and – visual support (based on colourful or highlighted beginning and ending of a shape).

The training of creating and drawing shapes is usually applied by the occupational therapist in directions: left-to-right, bottom-to-top, and top-to-bottom. If a child has problems manipulating the pencil it is helpful to use a board with sand surface. Sand, flour or other fine materials stuck on a board put pressure against the fingers and slow them down. Children can therefore observe the movements of their own hands, experiment with lines or create shapes.

3 Occupational therapy programme

occupational therapy includes rehabilitation as part of supporting under-developed body functions regarding gross motor skills of children. In occupational therapy intervention, play activities must fulfil a certain therapeutic intention, based on which children with disabilities become active. They select from a range of certain activities offered by the adult/therapist. The core principle is activating and enhancing children's engagement in meaningful activities. In the programme of occupational therapy described in detail in the research part of the article, the occupational therapist focuses on various tasks in the individual topics, e.g.: naming and matching body parts, correct attribution of objects to the body, perception of the human body when looking from the front or from the back, specific body parts used when walking,

climbing over barriers or catching a ball. Children are supposed to match individual body parts correctly (e.g. in a puzzle) – which creates foundations for drawing the human body. The actual development of motor skills happens gradually and it is fluid. Therefore, it is important to modify, supplement and extend the tasks in the occupational therapy programme. It is useful to repeat some activities more often and by doing so, lead children with disabilities towards the opportunity of strengthening and fixating the newly gained knowledge correctly – e.g.: recognizing and drawing a graphic shape or remembering and performing the order of partial tasks in an activity. Children learn to see themselves, feel their body and use it in a way appropriate for the situation that they happen to be in or often act in.

4 Methodology

4.1 Methodological indicators

The goal of the presented research was the verification of a long-term support-oriented occupational therapy programme for clients with disabilities with the focus on the area of graphomotor skills.

Research Tasks

To perform and to evaluate the supportive occupational therapy programme as a long-term (lasting during a full school year), regular intervention in the occupational therapy office (a group session once a week and an individual session once a week).

Research Sample

The research sample included eight children with disabilities at the age from 5 to 6.8 years, regarding gender it was a heterogeneous group. It was a closed group consisting of clients with disabilities who live in complete families and each client has at least one sibling (Table 3). They are of Roman-Catholic denomination and they meet in a parish in the western part of Slovakia.

Table 3 Research sample description*

Gender Female (Age of the client)	Health conditions of the client	Gender Male (Age of the client)	Health conditions of the client
C1 (5)	dyspraxia, obesity	C3/5,5	behavioural disorder (aggressive symptoms), attention deficit disorder, scoliosis, astigmatism, eating disorders

C2 (5,5)	delayed speech development, scoliosis, symptoms of dyspraxia	C4/ 6	cerebral palsy, hyperopia, epilepsy, symptoms of dyspraxia
C5 (5,7)	communication disorder, onychophagy, neurosis with neurasthenic symptoms obesity	C7 (6)	dyspraxia, suspected dyscalculia, attention deficit disorder, scoliosis, astigmatism, dyslalia in producing "r"
C6 (5,9)	symptoms of dyspraxia	C8 (6,8)	attention deficit disorder, scoliosis, astigmatism, myopia, dyslalia in producing "r" and "s"

*The names of the clients are not stated in order to secure their privacy.

Research sample selection was based on these criteria (Table 4).

Table 4 Criteria for including the client in the occupational therapy programme

1.	Regular professional care of special or therapeutic educator in a public or private centre.
2.	Diagnosed dyspraxia or symptoms of dyspraxia stated by a professional based on observation.
3.	The opportunity to participate in regular occupational therapy sessions (time and mobility possibilities of the parent).
4.	Expected to enter the first grade.
5.	Attending a regular or a special-education kindergarten.
6.	Disability (excluding intellectual disability).

Hypothesis

The values in the area of graphomotor skills in the pre-tests will be statistically less significant in comparison with the post-tests after the occupational therapy programme.

4.2 Used research methods and their evaluation

For the purposes of gaining the data at the beginning and at the end of the programme these methods were used:

1. Nottingham developmental assessment (CEECA, 2007) – Motor development – Fine motor skills – assessment of 28 items in child development (Gazarková, Kováčová, 2015).

In order to gather the data, individual items of CEECA (2007) were assessed on a numeric bipolar scale with a 5-point rating. Number 1 assessed the observed phenomenon as unmanaged, number 2 as managed with difficulties and substantial help of another person, number 3 as managed with a high error rate,

- number 4 as managed with rare smaller errors and number 5 as fully managed. The assessment consists of three parts – for the purposes of this research the part for motor development was used (Gazarková, Kováčová, 2015). The evaluation of pre- and post-test values was conducted by standard mathematic methods including statistical testing for the purposes of confirming the statistical significance.
2. K-ABC-Kaufman Assessment Battery for Children (Kaufman et al., 1983, issued by Psychodiagnostika, Bratislava, 1999). From this testing battery, two sub-tests were used for the evaluation: Hand Movements and Triangles. In the subtest of hand movements, a child must see and perceive a sequence of movements in space and time and needs to remember them for a short time in order to repeat them using their hand. In the subtest of Triangles, the task of the child is to assemble several identical triangles (yellow on one side and blue on the other side) to match an abstract form. The evaluation of pre- and post-test values was conducted by standard mathematic methods including statistical testing for the purposes of confirming the statistical significance.
 3. Non-standardised observation sheet for occupational therapy assessment evaluating general readiness for the process of writing from the perspective of occupational therapy. It assesses the stage of grasp, the level of working stamina, concentration of attention, muscular strength of the fingers, muscle tone, laterality and spontaneous drawings. Individual tasks are assessed based on a five-point scale (Kováčová, 2014). This observation sheet was not evaluated in this study considering the fact that there is a large amount of analysis of individual tasks.

4.3 Occupational Therapy Intervention

The occupational therapy programme consisted of 11 blocks. The activities were divided into group activities (Table 4) and individual occupations (Table 5). The group activities were conducted before the individual sessions. The individual sessions were not focused on training or repeating the tasks that were not managed in the group sessions. The goal of the group sessions was to prepare for the communication with the educator in the context of tasks that are connected with the process of writing and reading in the school environment. The total of 86 sessions was conducted from September to August (excluding holidays). The attendance of the clients at the group sessions was 85 % and the attendance of individual sessions was 94 %.

Table 5 Content of the occupational therapy programme – group form

Block	Content of the group occupational therapy sessions
1.	Introductions. Space orientation in the office (naming and getting to know the material). Body work in macro- and micro-space.

2.	Occupations using hands. Prints. Creating group collages of a fishing pool and the life in it.
3.	Occupations using paper – tearing and rolling. Group activity.
4.	Occupations using paper – cutting, sticking. Working in small groups.
5.	Occupations using paper – cutting, sticking, puzzle from pieces. Group activity.
6.	Occupations using paper – cutting, drawing, and folding paper. Working in small groups.
7.	Occupations using wire. Creating shapes according to a model. Working in small groups.
8.	Occupations using wood. Assemblage. Working in small groups.
9.	Occupations using plastic. Using different types of scissors. Working in small groups.
10.	Occupations using glass. Experimenting with glass paint. Group work.
11.	Post-intervention assessment of the level of fine motor skills and graphomotor skills according to the described research methods. Final evaluations. Portfolios and works exhibition.

Table 6 Content of the occupational therapy programme – individual form

Block	Content of the individual occupational therapy sessions	
1.	Informing the client about the goals and content of the programme. Pre-intervention assessment of the level of graphomotor skills in specific standardised and non-standardised tests (maximum of three sessions).	
2.	Each further individual session was focused on one topic and the therapist assessed the level of performance based on a 5-point assessment scale ** Each individual session was focused on supporting graphomotor skills supplemented by manual occupations.	Movement. Fast and slow movements. Recognizing objects. Planning of movements.
3.		Gestures based on verbal instruction. Movement alphabet (e.g.: copy me or make a movement based on instruction). Movements and ideas.
4.		Intentional action based on instruction (in the area of independence – e.g.: combing hair, closing a zipper, grabbing a pencil).
5.		Working with templates. Tracing shapes.
6.		Working with templates. Finishing shapes.
7.		Working with graphic shapes – full straight line. Collage from circles. Using scissors.
8.		Working with graphic shapes – lines in various directions. Working with templates. Creating a picture.
9.		Working with graphic shapes. Combination of curved line in horizontal and vertical direction. Sewing.
10.		Working with graphic shapes – experimenting with lines rising diagonally, heart-shaped lines, upper and lower snip and upper and lower loop. Turning. Scrolling.
11.	Post-intervention assessment of the level of graphomotor skills in specific standardised and non-standardised test (maximum of three sessions).	

** Number 1 assessed the observed phenomenon as unmanaged, number 2 as managed with difficulties and substantial help of another person, number 3 as managed with a high error rate, number 4 as managed with rare smaller errors and number 5 as fully managed. The assessment sheet is divided into three parts – for the purposes of this research the part for motor development was used (Gazarková, Kováčová, 2015).

The occupational therapy intervention was conducted in the period of one school year as part of supporting children during preparation for entering the first grade of regular school in the following school year. Since the primary diagnoses of the children varied (table 3), the therapist used a combined form of intervention – a group form as well as individual form of occupational therapy.

5 Research results and analysis

results gained from the pre-test and post-test data were verified using statistical significance (F-test and Student's t-test) before and after conducting the support-orientated occupational therapy programme.

Data Evaluation and Interpretation

Research Task : To perform and to evaluate support-oriented occupational therapy programme as a long-term (lasting during a full school year), regular intervention in the occupational therapy office (a group session once a week and an individual session once a week).

a) Nottingham Developmental Assessment

The comparison of pre- and post-intervention values of the whole group is processed in the tables (Table 5). The distribution of individual evaluations was 0.51 in the category of writing skills and 0.85 in the category of work skills.

Table 7 Total scores in the area of fine motor skills

Area of development	Category	Average value in the group		
		pre-intervention	during intervention	post-intervention
Motor development	Writing skills	3.08	3.64	4.22
	Work skills	3.15	4.00	4.51

Both group and individual evaluation points out a positive change in both categories – in the category of writing skills it is +1.14 and in the category of work skills it is +1.36. The table evaluation is valid for the evaluation of the group with an average count for each client. Despite these values, the testing did not prove a statistically

significant change in the group; however, the progress of two clients was statistically significant.

a) K-ABC-Kaufman Assessment Battery for Children

Processed in the tables (Tables 6-11) we present the comparison of pre- and post-intervention values in the group of clients – for each of the above described subjects individually.

The Subtest of Hand Movements

Table 8 Total score in the subtest of Hand Movements in K-ABC

	Median	Minimum	Maximum	Modus	Average	Std**	Variance
Test	9	0	20	9	9.188	5.344	28.563
Re-test	16	0	25	16	14.125	8.007	64.117

Table 7 Statistical values for a two-tailed F-test for variance in the subtest of Hand Movements in K-ABC

	Test	Re-test
Mean	9.2	14
Variance	30.6	68.4286
Observations	15	15
Difference	14	14
F	0.4472	
P(F <= f) (1)	0.0721	
F crit (1)	0.4026	

Table 9 Statistical values for two-tailed paired t-test for the means in the subtest of Hand Movements in K-ABC

	Test	Re-test
Mean	9.2	14
Variance	30.6	68.4286
Observations	15	15

Pears. correlation	0.8538	
Hyp. difference of mean values	0	
Difference	14	
t stat	-4.0678	
P(T <= t) (1)	0.0006	
t crit (1)	1.7613	
P(T <= t) (2)	0.0012	
t crit (2)	2.1448	

On the set level of statistical significance of $\alpha = 0.05$ (in case of two tailed test $\alpha/2$, in case of one tailed test α) we found out again that $F < F_{crit}$ and $p > \alpha/2$, which means that two samples dependent on the input and the output have the same variances. Student's t-test for the mean value in case of two tailed as well as in case of one tailed test showed that $t > t_{crit}$ and $p < 0.05$. The results point out to the fact that differences in means in two dependent samples are statistically significant.

The Subtest of Triangles

Table 10 Total score in the subtest of Triangles in K-ABC

	Median	Minimum	Maximum	Modus	Average	Std**	Variance
Test	1	0	2	1	0.8125	0.75	0.5625
Re-test	0	0	1	0	0.25	0.44721	0.2

Table 11 Statistical values for two tailored F-test for variance in the subtest of Triangles in K-ABC

	test	Re-test
Mean	0.25	0.8125
Variance	0.2	0.5625
Observations	16	16
Difference	15	15
F	0.3555556	
P(F <= f) (1)	0.0268845	
F crit (1)	0.4160691	

Table 12 Statistical values for two tailored paired t-test for the mean values in the subtest of Triangles in K-ABC

	Test	Re-test
Mean	0.25	0.8125
Variance	0.2	0.5625
Observations	16	16
Pears. correlation	0.5465944	
Hyp. difference of mean values	0	
Difference	15	
t stat	-3.576237	
P(T<= t) (1)	0.0013784	
t crit (1)	1.7530503	
P(T<= t) (2)	0.0027568	
t crit (2)	2.1314495	

With the statistical significance set on the level of $\alpha = 0.05$ (in case of two tailed test $\alpha/2$, in case of one tailed test α) we found out that $F < F_{crit}$ and a $p > \alpha/2$, which means that two samples dependent on the input and the output have the same variances. Student's t-test for the mean value in case of two tailed as well as in case of one tailed test showed that $t > t_{crit}$ and $p < 0.05$. The results are statistically significant.

3) Non-standardised observation sheet for occupational therapy assessment

This observation sheet was not evaluated considering the fact that there is a large amount of analysis of individual tasks. With the statistical significance set on the level of $\alpha = 0.05$ (in case of two tailed test $\alpha/2$, in case of one tailed test α) we found out that $F < F_{crit}$ and a $p > \alpha/2$, which means that two samples dependent on the input and the output have the same variances. It can be stated that there is a statistical difference in the group in the category of writing skills. Student's t-test for the mean value in case of two tailed test as well as in case of one tailed test showed that $t < t_{crit}$ and $p < 0.05$. The results are statistically significant.

The effectiveness of the supportive occupational therapy programme focused on the development of graphomotor skills was observed in achieving statistically

significant differences in all evaluated categories. Based on the hypothesis worded as – *The values in the area of graphomotor skills in the pre-tests will be statistically less significant in comparison with the post-tests after the occupational therapy programme* – is confirmed.

6 SUMMARY

The theoretical background of early childhood occupational therapy draws from the knowledge of developmental psychology, early childhood intervention in education and therapy (specifically from the transaction developmental model described by Tichá, 2008), and from counselling focused on families (on the support of parent competencies; on the support of the quality of life of children with disabilities in the area of life competencies as described by Havigeová et al., 2013; Truhlářová et al., 2015), and from the generally perceived occupational therapy (Krivošíková, 2011).

Children and their development through offered occupations become the centre of attention. Meaningful occupations are considered main means of help in early childhood occupational therapy. In this system of help, the needs of children and their parents are fulfilled system-wise with the focus on future successful continuation. The presented occupational therapy programme is suitable as an inspiration; and based on its proven success and achieved progress, it may serve as a model for further occupational therapy interventions focused on the stimulation in the graphomotor area.

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