

# Gross Motor Skills of Children with Mild Intellectual Disabilities

Pavel Zíkl, Nikola Holoubková, Hana Karásková, Tereza B. Veselíková

**Abstract**—The article presents the research results focused on comparing the level of gross motor skills in children with mild intellectual disabilities and intact children. The data collection used the standard test (Test of Gross Motor Development). The research sample consisted of a total of 114 students with an average age of 10 years. The results present the differences between the two groups of students in locomotor skills and object control skills. The presented results can serve as a basis for better targeting of special-pedagogical support for children with mild intellectual disabilities and as a basis for innovation of the curriculum for this group of children, as well as a basis for further research activities in this area.

**Keywords**—Gross motor, mild intellectual disability, Test of Gross Motor Development.

## I. INTRODUCTION

THIS paper contains the research results focused on comparing the level of gross motor skills of children with mild intellectual disabilities and intact children at the end of attendance to primary school. This research follows on from our previous activities, where we focused on the comparison of upper limb motor skills and manual skills in the same groups of children.

The impact of intellectual disability on normal school activities, such as reading, writing and arithmetic, is relatively well known and due to the nature of intellectual disability we expect differences. Similarly, we observe delays in dealing with the activities of daily living in a group of children with mild intellectual disabilities, while there is a gradual leveling and children with this disability learn to cope with basic activities, although usually a little later (dressing, hygiene, food intake, etc.).

Delays of motor development is well described in people with moderate and especially severe and profound intellectual disability, where delay in this area is one of the typical symptoms. These groups usually show the deficit in motor skills also in adulthood, which can result in the worst case to total immobility and severe restrictions in momentum (profound and severe intellectual disabilities). People with moderate disabilities have milder deficits, they often manifest in articulation (pronunciation defects), co-ordination of

movements, vision-motoric co-ordination or balance. People with mild disabilities show only slight delay in motor skills, especially in childhood, or it is not mentioned at all. This slight delay occurs in locomotion, balance, dexterity and in performing common practical activities (activities of daily living, game, work) [1]–[3].

Our goal was to refine our understanding of the development of children with mild intellectual disabilities in this area in the period at the end of attendance to primary school, when we expect a flattening of the differences purely in motor, intellectually undemanding activities. Coping with simple motor activities is one of the prerequisites for integration into normal life, not only during school-life but also in adulthood. This is not only a prerequisite for typical school activities (such as writing, geometry, art), but also leisure (sport, game, self-serving). They are also essential for professional training and labor integration, because most people with mild intellectual disabilities work in manual occupations. Improving motor skills is thus one of the areas that can help to better the inclusion of people with mild intellectual disabilities and is one of the prerequisites for having a normal life.

In school practice the factual knowledge of development level of gross motor skills can help us in planning suitable teaching approaches, use appropriate work methods and determination of adequate educational goals.

### A. Previous Researches

We also focused on the comparison of motor skills of children at the end of attendance to primary school in our two previous studies.

In the first, we compared the performance of children with mild intellectual disabilities with intact children in manual activities based on the school curriculum. We chose activities which were the same in the curriculum for both groups of children – assembly and disassembly work [4], [5]. We included tasks with increasing intellectual difficulty. These were:

- Task 1: focused on mechanical manual work (simple disassembly lasting 1-2 minutes),
- Task 2: focused on the work according to a model (a surface product composed of several parts, which assembly required only a simple analysis of the model, selection of necessary parts and assembly; duration of 1-3 minutes),
- Task 3: focused on the work according to a manual (a spatial product where it was necessary to follow the instructions comprised of series of photographs placed on

P. Zíkl is with the Institute of primary and pre-primary education, Faculty of Education, University of Hradec Králové, Rokitského 62, 500 03 Hradec Králové, Czech Republic (e-mail: pavel.zikl@uhk.cz).

N. Holoubková, H. Karásková, and T. B. Veselíková are students in the field of Primary School Teaching, Faculty of Education, University of Hradec Králové (e-mail: nikola.holoubkova@uhk.cz, hana.karaskova@uhk.cz, Tereza.veselikova@uhk.cz).

a single sheet of paper; duration of 2-7 minutes).

To cope with simple manual tasks the children with mild intellectual disabilities needed approximately 25% more time. For intellectually demanding tasks, the difference between the two groups was roughly two-thirds. Much larger differences were found in the incidence of errors. Children with intellectual disabilities erred in intellectually demanding tasks 30% - 60%, while the error rate for intact children was 10% [6], [7].

The goal of the second research was the comparison of the functional abilities of the upper extremities using a standard ergo-diagnostic test for detecting hand functionality (Jebsen Taylor Hand Function Test) [8]. All observed sub-tests showed differences between the group of intact children and the group of children with mild intellectual disabilities. Children with this disability needed 10% to 34% more time to manage the task. The smallest difference was in the tasks designed to simulate page turning, lifting small objects and lifting large objects. The largest difference was at the tasks which were more demanding for co-ordination (simulation feeding - scooping beans with a spoon and stacking objects on each other). The children with intellectual disabilities also had more dispersed values than the intact population [9].

#### *B. Basis for Our Research*

In the presented research, we focused on the level of gross motor skills. Here, we also wanted to compare the two groups of children at the end of attendance to primary school.

The educational programs for both groups of children (Framework Educational Programme for Basic Education and the Annex of this programme designed for education of pupils with mild intellectual disabilities) have practically the same objectives in the development of gross motor skills and expect very similar activities to influence the level of motor skills. Their illustrative comparison is shown in Table I.

We can see that both groups of children are expected to cope with almost the same motion activities. The difference is in the minimum time allocation to the subject of Physical Education during attendance to primary school. Among the general population, the minimum number of hours is 10 (i.e. each of the five grades have 2 hours a week), while children with mild intellectual disabilities have at least 15 hours (i.e. 3 hours a week) [4], [5].

## II. OBJECTIVES AND METHODOLOGY

### *A. Objectives*

The basic objective was to compare the level of gross motor skills in students with mild intellectual disabilities and intact students at the end of attendance to primary school.

### *B. Sub-Objectives*

To verify theoretical assumptions about the differences between the performances of intact pupils and pupils with mild intellectual disabilities in gross motor skills.

TABLE I  
ACTIVITIES AFFECTING THE LEVEL OF MOTOR SKILLS  
(FRAMEWORK EDUCATIONAL PROGRAMS)

FEP for basic education	FEP for BE – annex for the education of pupils with MID
motion games - with various objectives; non-traditional movement games and activities; using toys and non-traditional equipment in exercises; motion creativity	motion games - motion activities of individuals, couples and groups; motion games with different focus and using traditional and non-traditional equipment, no tools; motivational, creative and imitating games, creating of own modifications of acquired motion games
basics of gymnastics - preparatory exercises, acrobatics, exercising with equipment and tools of appropriate size and weight	basics of gymnastics - training exercises; simple acrobatic exercises, exercising with equipment and tools
rhythmic and conditioning forms of exercises for kids - fitness exercises with music or rhythmic accompaniment, basic aesthetic motions, expression of melody and rhythm in motion, simple dances	rhythmic and fitness exercise - expression of rhythm in motion, alignment of simple movement with music, simple dances
preparatory martial arts - towing and pressures	preparatory martial exercises - towing, pressures, resistances
basics of athletics - sprints, motivated long-distance running, long jump or high jump, ball throwing	basis of athletics - athletic preparatory activities; running – sprint over short distances, motivated endurance run (according to the abilities of pupils), long jump, ball throwing
basis of sport games - using balls, bats and other equipment of appropriate size and weight, individual sporting activities, co-operation in game, training games, matches under simplified rules of mini-sports	basis of sport games - training games; basic handling of the ball, bats and other equipment of appropriate size and weight; basic individual sporting activities and games with simplified rules

Note: The list is not comprehensive, but includes typical activities to develop gross motor skills.

FEP for basic education has been modified, while the Annex for the education of pupils with MID hasn't yet, which explains some of the reformulations.

To obtain data to complement the results of the previous researches focused on motor function of upper limbs.

To check the possible use of TGMD in education research focused on children with mild intellectual disabilities.

To gain data for future researches aimed at a different age group (for example, comparing the input level at the beginning of school attendance with the level at the end of primary school).

### *C. Hypotheses*

To meet the research objectives we have set the following hypotheses:

- H1. Children with mild intellectual disabilities will achieve worse results (lower scores) than the intact population in the sub-test focused on locomotor skills.
- H2. Children with mild intellectual disabilities will achieve worse results (lower scores) than the intact population in the sub-test focused on object control skills.
- H3. Statistically significant difference in the level of gross motor skills (assessed using the Test of Gross Motor Development) will be achieved among children with mild

intellectual disabilities and intact children

#### *D. Methodology*

A standardized test of gross motor development was used for the data collection. It is a test that has been used for a long time, it is intended for age group from 3 to 10 years, it does not require intensive tools for implementation, the evaluation does not reflect the condition of the monitored pupils and its tasks are not intellectually challenging and long. It was an important aspect to choose from with regard to the target group of pupils, because of the need to avoid the tasks where worse results of a pupil is not due to the level of motor skills, but for example misunderstanding the task, faster loss of attention or fatigue. (compare for example [10]). The test also includes activities that are included in the FEP for both observed groups of children.

The entire test consists of two sub-tests - locomotor skills (sub-test 1) and in object control skills (sub-test 2). Each contains sub-activities for which there are precise criteria for their implementation, which are recorded in the answer sheet (for each motion activity - three to four individual criteria). Each test was repeated twice for each child in accordance with the instructions in the manual.

Sub-test 1 (Locomotor skills) contains:

- run,
- gallop,
- hop,
- leap,
- horizontal jump,
- skip,
- slide

Sub-test 2 (Object control skills) contains:

- two-hand strike,
- stationary bounce,
- catch,
- kick,
- overhand throw.[11]

For a comparison of the results we did not use the standards listed in the test, since they are not fully consistent with the population of the Czech Republic, as showed for example in its use in researches aimed at the pre-school population in our country [12]. For this reason, we chose the comparison to control group of intact children.

The data collection was implemented by three administrators. They were familiar with the test and uniformly trained. Each of them first conducted testing in children with mild intellectual disabilities and then at the same large group of intact children. Identical sets of tools were used for administering the test.

Statistical calculations were carried out in the NCSS2000 program. The Student's t-test and the non-parametric Mann-Whitney test were selected for the hypothesis testing (files did not clearly show a normal distribution). Significance level  $\alpha = 0.05$  was chosen for the testing.

#### *E. Description of the Research Sample*

The description of the research sample is shown in Table II. A total of 114 children - 57 children with mild intellectual disabilities (dg. F70, [13]) and 57 intact children were tested. Each child was tested twice consecutively, according to the test method (i.e. a total of 228 tests). Boys accounted for 60% of the entire sample, which corresponds to the proportion of boys in the population of children with intellectual disabilities in our schools [14], [15].

Children with mild intellectual disabilities were tested first and intact children were selected according to the file structure (sex, age). Both groups were always tested in schools within the same region. Children with mild intellectual disabilities were attending 3rd - 6th class of practical primary school, which is a special school for pupils with mild intellectual disabilities. It would be more suitable to test pupils with mild intellectual disabilities who are integrated into mainstream schools (school selection/form of education is in the hands of parents), but in the Czech Republic only 6.3% of pupils with mild intellectual disabilities are integrated [14] and so it would not be possible to obtain a sufficiently large sample of children for testing. In mainstream schools, pupils from 3rd - 5th classes were tested. The average age of the pupils with mild intellectual disabilities was 11 years (standard deviation 1.15) and of intact pupils 10.5 years (standard deviation 0.93). Greater variance in age, and also in the attended classes of pupils with mild intellectual disabilities is due to the frequent postponement of schooling for this group of children, which is possible to defer until the age of 8 years (the regular beginning of compulsory school attendance in the Czech Republic is 6 years, but at the latest a pupil must start the school in the year during which they turn eight years of age) [16]. Another reason for the greater variability is more frequent repeat of school year for children with mild intellectual disabilities, which is possible only once during the attendance to primary school. Our intention was to test the children at the end of their attendance to primary schools, i.e. at the age of around 10 to 11 years. In order to obtain a sufficiently large file, however, we had to include children not only from the 5th class, because it is relatively difficult to obtain the co-operation of schools and find a sufficiently large number of children (it is usual in the Czech Republic that practical primary school has dozens of children in all nine grades from the region and often around five children in one grade).

Under current legislation [16] it is prohibited to include children without intellectual disability in practical primary school, which is found by a standardized psychological test in school guidance facilities. For children with profound disabilities there is a different type of special school determined (or integration, according to the parents' choice) and so in practical primary schools there are only children with mild intellectual disabilities. This fact was also verified by asking the class teacher, who has access to the documentation of children.

TABLE II  
DESCRIPTION OF THE RESEARCH SAMPLE

	children with mild intellectual disabilities	intact population
number of children	57	57
boys	34	35
girls	23	22
average age	11.05	10.46

### III. RESEARCH RESULTS

The tables show the points results of each sub-test (Tables III, V) and the overall test results (Table VII). The points are always the sum of the results of the first and second test. The results of the first and repeated tests were statistically tested separately and also the statistically significant difference was confirmed in the results of both groups.

Table III shows the results of the first sub-test.

TABLE III  
RESULTS OF SUB-TEST 1 (LOCOMOTOR SKILLS)

	children with mild intellectual disabilities	intact population
average	42.7	47
difference between the averages		+4.3 points (10.1 %)
standard deviation	5.6	4.4
minimum	29	31
maximum	52	52
median	44	48
difference between the medians		+4 points (9.1 %)
t-test (t-value)	-4.5240*	
Mann-Whitney test (Z-value)	-4.2801*	

\* indicates that the difference between the results is statistically significant.

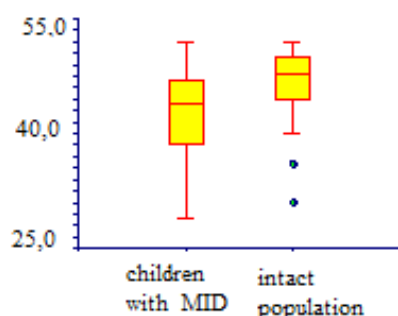


Fig. 1 Results of sub-test 1 (locomotor skills)

In locomotor skills the children without disability achieved 10% better result (the difference is statistically significant). More significant, however, is the information about the distribution of values (Fig. 1). Dispersion of values in children with mild intellectual disabilities is significantly higher (SD 5.6 versus 4.4 in the intact population). While the result of intact children virtually did not drop below 40 points (with the exception of two cases), so in children with mild intellectual disabilities this outcome occurred in 28% of children. In contrast, the upper limit (best performance) is the same for

both groups, but only a few children with mild intellectual disabilities reach this limit, as shown in Table IV (the result of 25% of intact pupils and the same point boundary reached by the pupils with mild intellectual disabilities).

TABLE IV  
COMPARISON OF THE NUMBER OF THE BEST AND WORST OF RESULTS  
(LOCOMOTOR SKILLS)

	children with mild intellectual disabilities	intact population
25% worst results	34 (60 %)	14 (25 %)
25% best results	5 (9 %)	22 (39 %)

Note: 25% = 14 children; the higher number in the best is determined by the same result in 12 - 22 children

We can see the results of the second sub-test in Table V, which focuses on the assessment of object control skills (it is not about object manipulation, i.e. fine motor skills, but mainly the evaluation of the whole hand movements and possibly the torso).

TABLE V  
RESULTS OF SUB-TEST 2 (OBJECT CONTROL SKILLS)

	children with mild intellectual disabilities	intact population
average	30	33.8
difference between the averages		+3.8 points (12.7 %)
standard deviation	5,1	3,6
minimum	16	23
maximum	40	38
median	31	35
difference between the medians		+4points (12.9 %)
t-test (t-value)	-4.4980*	
Mann-Whitney test (Z-value)	-4.3035*	

\* indicates that the difference between the results is statistically significant

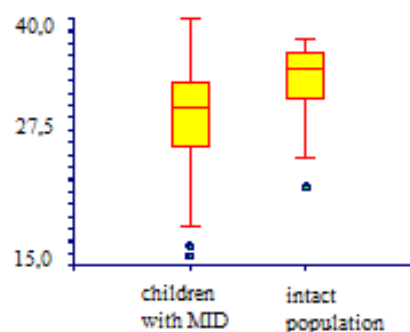


Fig. 2 The results of sub-test 2 (object control skills)

The results are very similar to those in the sub-test 1, only the difference between the average results is slightly lower (better result by 9.8% in the intact population). Range of values for both groups is slightly larger than in the first sub-test, but it is significantly higher in children with intellectual disabilities. The upper limit in this case is even slightly higher in children with mild intellectual disabilities (but it is given by the results of only one child). The results 25% of the best and

worst performances are shown in Table VI (outcome 25% of intact pupils and the same point boundary reached by the pupils with mild intellectual disabilities).

TABLE VI  
COMPARISON OF THE NUMBER OF THE BEST AND WORST OF RESULTS  
(OBJECT CONTROL SKILLS)

	children with mild intellectual disabilities	intact population
25% worst results	37 (60 %)	17 (30 %)
25% best results	3 (5 %)	14 (25 %)

Note: 25% = 14 children; the higher number of the worst is given by the same results 13 - 17 children.

TGMD overall results (Table VII) correspond to the sub-tests and we can state similar conclusions. The average result of intact children is better by 9.8% and at a significantly narrower dispersion of values, as shown in Fig. 3. A small proportion of children with MID reach the same values as the intact population, but significantly larger portion of the sample has significantly worse results.

TABLE VII  
OVERALL TEST RESULTS

	children with mild intellectual disabilities	intact population
Average	72.8	80.7
difference between the averages		+7.9 points (9.8 %)
standard deviation	8.2	6.1
minimum	51	66
maximum	87	89
median	73	83
difference between the medians		+10 points (13.7 %)
t-test (t-value)	-5.8956*	
Mann-Whitney test (Z-value)	-5.3765*	

\* indicates that the difference between the results is statistically significant

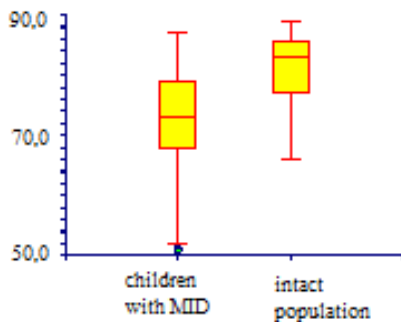


Fig. 3 Overall test results

Figs. 4 and 5 show another noticeable difference between the two groups. While the intact population had the results of both tests virtually the same (Fig. 5), the children with MID slightly improved in repeat testing (Fig. 4). However, this improvement is not statistically significant (3.3% in the sub-test 1 and 6.1% in the sub-test 2). The statistically significant difference remained between the two groups even when only the second tests were compared.

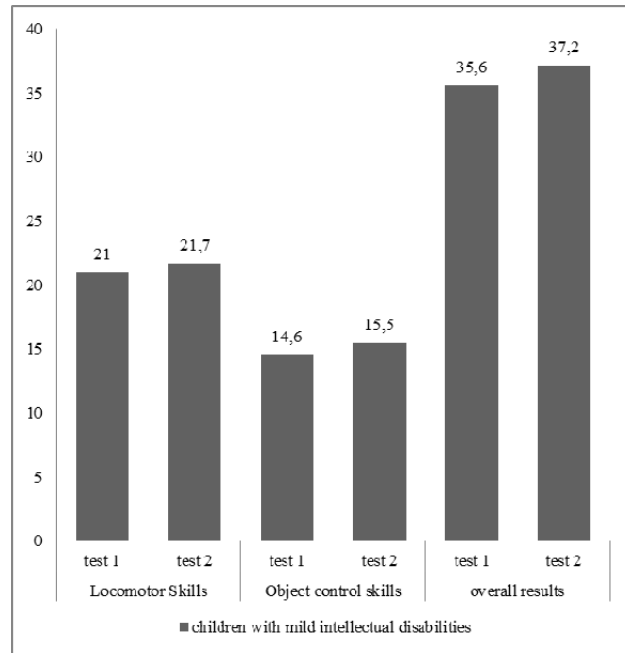


Fig. 4 The difference between the first and second testing (children with mild intellectual disabilities)

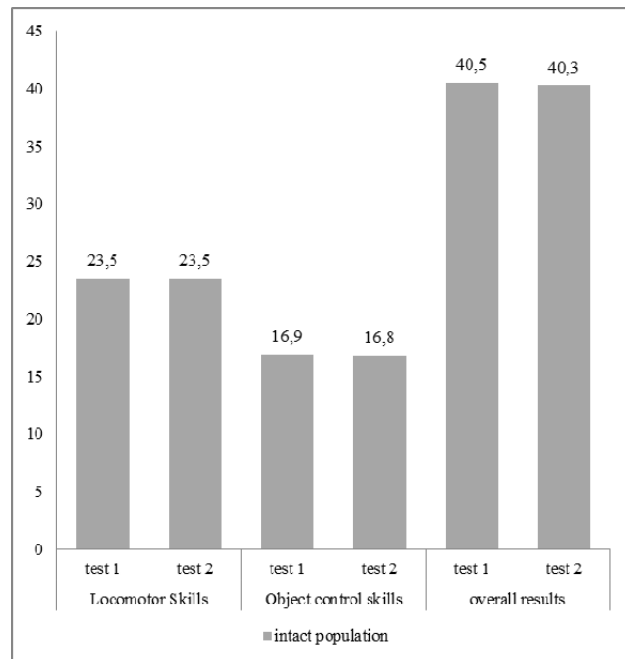


Fig. 5 The difference between the first and second testing (intact population)

#### A. Summary of the Results

H1. Children with mild intellectual disabilities will achieve worse results (lower scores) than the intact population in the sub-test focused on locomotor skills.

The hypothesis was confirmed.

H2. Children with mild intellectual disabilities will achieve worse results (lower scores) than the intact population in

the sub-test focused on object control skills.

The hypothesis was confirmed.

H3. The statistically significant difference in the level of gross motor skills (assessed using the Test of Gross Motor Development) will be among the children with mild intellectual disabilities and intact children.

The hypothesis was confirmed.

We can say that among the children with mild intellectual disabilities and the intact population was a difference in the level of gross motor skills in both the locomotor area as well as in object control skills. The differences are statistically significant and amounts to about 10%, but at a significantly higher scatter of results for children with intellectual disabilities.

The theoretical assumption that in children between the two groups around the age of 10 years show differences was confirmed and there was not a balance in the performance in gross motor skills between them, although its development is given more time than for intact children (see time allocation mentioned earlier).

The children with intellectual disabilities also had a greater dispersion of values in both sub-tests. It corresponds to the general assumption of greater individual differences among children with disabilities than the differences between the intact population. The intellect dispersion is narrower in children with mild intellectual disabilities, the children are "closer" to each other in this area than the intact population (mild intellectual disability IQ from 50-69, which is 19 points; a wider standard 70 – approx. 130, which is 60 points; ICD-10, [13]). Individual differences within a relatively narrow group of children with mild intellectual disabilities are therefore more significant.

#### B. Discussion

The differences between the groups are small.

The differences are not great, but are statistically significant. For more accurate results it would be appropriate to obtain additional data, which is now in planning.

- A difference between the 1st and 2nd tests appeared in children with mild intellectual disabilities.

This difference was not statistically significant, and if only the second test results were compared, the overall result would not change too much. The children are trained at the beginning of the testing and their understanding of the tasks is checked. This should minimize the impact of intellectual disability on the result (misunderstanding of the tasks). However, a small shift appeared there and further data collection will serve to refine the results.

#### IV. CONCLUSION

The obtained results are supplemented by information resulting from our previous studies. In comparison with the results of the test of fine motor skills (functional abilities of the upper limbs), the differences between the observed groups of children is a little smaller. The values dispersion and imbalance in the results are very similar.

Even in very simple and intellectually undemanding school activities (running, throwing, jumping) it is necessary to reckon with slightly worse results, slower processing and in particular with relatively large differences between individual children. A series of recommendations often suggest that a student with intellectual disabilities can achieve the same results as their classmates, at least in some subjects. It can certainly be true for many children, because among children with mild intellectual disabilities there are considerable individual differences and some even achieve the same results in motor activities, as a part of intact pupils. But generally the results point out that it may not be true, and differences mostly appear even in the simplest activities. This is particularly important in children individually integrated, who are usually asked to do the same in the motor activities as the intact children.

We cannot rely on the fact that in mild disability the differences will appear only in intellectually demanding activities, with some deficits to be reckoned with even in elementary motor skills and even after several years of schooling, not just in the beginning. If we want to enable children with mild intellectual disabilities to participate in all activities and support their inclusion in society, then supporting the development of motor skills should be a part of comprehensive care, because they also need a higher level of support in this area.

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**Pavel Zíkl** was born in Hradec Králové, Czech Republic in 1971. He earned Master degree in a field of Education at the Faculty of Education, University of Hradec Králové in 1993, Special Education at the Faculty of Education, Charles University, Prague in 2000 and Doctoral degree (Ph.D.) in a field of Special Education in 2009 (Charles University, Prague).

He works at the Institute of Primary and Preprimary Education, Faculty of Education, University of Hradec Králové in the Czech Republic since 2003. At the present time (since 2009), he is a director of the Institute. He is also solver and co-solver of many research and development projects. He wrote a books and articles focused on intellectual, physical and multiple disabilities, e.g. Zíkl, P., Manžonová, M., Kalusová, D. Manual abilities of children with mild mental disabilities as a prerequisite for the use of modern technology. In *Recent researches in educational technologies (EDUCATION '11)*. Athens : World scientific and engineering academy and society, 2011, s. 111-115, ISBN 978-1-61804-021-3; Zíkl, P., Tomášková, M., Zajíčková, B. Functional motor abilities of the upper extremities in children with mild intellectual disabilities. In *Education and educational psychology (EDU 2012): 3rd international conference*. Istanbul: Cognitive Counselling & Conference Services (C-crcs), 2012, ISSN 1986-3020; books: Zíkl, P. *Dítě s tělesným a kombinovaným postižením ve škole/Child with physical or multiple disabilities at school*. Praha: Grada, 2011, ISBN 978-80-247-3856-7; Zíkl, P. et al. *Využití ICT u žáků se speciálními potřebami/ICT applications for children with special needs*. Praha: Grada, 2011, ISBN 978-80-247-3852-9 and many others.