Partial cognitive functions affecting reading method of pupils with mild intellectual disabilities

(scientific paper)

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Abstract: *This paper deals with the analysis of reading method (syllables reading and fluent reading) and the level of partial cognitive functions of pupils with mild intellectual disabilities educated in terms of school integration in elementary school. To identify pupils' performance in reading competence (reading method) we used pedagogical diagnostics of reading of younger students as a research tool (*Čižmarovič, *Kalná 1991). For detecting the level of partial cognitive functions we applied a research tool called T-254 deficits of partial functions (Sindelarová, adapted* Černý *2008). Moreover, 46 four-grade students (20 girls, 26 boys) aged 10–12 years attending the elementary school in the Prešov region, were involved in testing. Monitored dependent variables were: partial cognitive functions and independent variables included: methods of reading – reading syllables, fluent reading. Through the analysis of the collected data, we found out that pupils, who read syllables, made significantly more mistakes in individual cognitive functions – auditory classification, auditory differentiation, auditory memory, visual classification, two-dimensional spatial orientation, visual and auditory perception of chronology and time, according to statistics. As noted above, one can assume that targeted stimulation of a reading method requires developing purposely the introduced areas of partial functions in the cognitive processes in the educational process.*

Keywords: *pupil with a mild intellectual disability, reading method, partial cognitive function, school integration, primary education*

1 Introductions

The intention of the study arises from the current problem, which is the centre of discussion of experts at various scientific conferences and seminars. It is the issue of a full-valued and functional school integration of pupils with mild intellectual disabilities in elementary schools. We focus our attention on the issue of a reading competence development – a way of reading (reading method) and partial cognitive functions, which is a part of the teaching subject Slovak language and literature in elementary schools (ISCED 1, 2009).

It is essential in this discourse that in the process of school integration a teacher should develop a key reading competence of the pupils with mild intellectual disabilities in school integration. It must be the most targeted and also considering the pupils' current state of cognitive-developmental processes. This is important for a teacher to be able to assume their strengths in education on which he/she can build (he/she should know the rules of the pupil's mental development; interdependencies and correlation relationships between cognition functions; and should respect the individual pace of the pupil's development).

A teacher cannot expect that the development of cognitive functions will be equal for each pupil, or more precisely, that all partial cognitive functions will be equally developed. They predetermine the level of pupils' educational skills, i.e. the reading skill (Blachman, 1991; Siegel 2003 Leeber 2006, Sindelarová 2007, Hlebová 2009; Pokorná 2010; Zezulková 2011; Doidge 2012; Liptáková 2012; Krejčová 2013; Žovinec 2014) to a great extent.

Therefore, our aim is to analyse the relationship between detected level of reading competence – a way of reading and a level of partial cognitive functions of pupils with mild intellectual disabilities, what is also a partial aim of a project APVV-0851-12 called *Personal and social factors of school success of pupils with special educational needs in terms of inclusion* (OSFA).

2 Theoretical background

The end of the 20th and the beginning of the 21st Century brings a multidisciplinary approach to special education which results in the discourse of an inclusive approach to persons with special educational needs. Worldwide, professionals profile a new discipline called inclusive education, they innovate international disease classification systems (ICD-10 2013, DSM-V 2013) and accept new commitments, but mainly, they try to implement these new approaches into practice. These efforts have even appeared in our environment. In the context of international documents (particularly the Convention on the Rights of Persons with Disabilities**,** article 24, published in Coll. No. 317/2010, member of the European Agency for Special Needs and Inclusive

Education since 2012) Slovakia committed to meet the model of a fully or partially integrated and inclusive education of persons with less severe degrees of disabilities. This idea was also conceived in the document called the National Program for the Development of living conditions of persons with disabilities for the period 2014–2020 (2014). It suggests that the commitment of creating inclusive terms also applies to pupils with mild intellectual disabilities, who are in the centre of our attention.

Currently, the Institute of Information and Prognoses of Education in Slovakia records (to date 19 September 2013) 1,139 pupils with mild intellectual disabilities educated in the Prešov Region in the 4th grade in primary schools and special schools, while only 13.6 % of pupils (155 pupils) are educated in the form of school integration, 32.3 % of pupils (368 pupils) are educated in special classes in primary schools and up to 54.1 % of pupils (616 pupils) continue to be educated in special schools. It can be deduced from the above that the current situation is far different from the state that we pledged as a Member State of the European Union. From the information above it can be concluded that a current state of education of pupils with mild intellectual disabilities in the mainstream of education has the character of the school integration with the aim of a gradual transition to the models of inclusion.

The act No. 245/2008 Coll. on Upbringing and Education (Act on Education) (p. 1915), however, defines only the term of school integration as "the education of children and pupils with special educational needs in the classrooms of schools and school facilities for children or pupils without special educational needs." Tekelová (2012) states that this concept was legislatively embedded in the mainstream of school and learning settings with the rights and obligations of participants by the act No. 29/1984 Coll. on the system of primary and secondary education (Act on Education) as amended by Act No. 365/2004 Coll. in 2004. Lechta (2010) adds that the integration, in the right sense, should be understood as an individual integration of a pupil into the regular classroom in elementary school. It usually takes place in the form of integration of a pupil with a disability in a regular classroom in the elementary school, closest to his/her home address and it is essential to provide professional educational support for these pupils (and their parents).

According to § 94 Chapter 2 of Act No. 245/2008 Coll., on Upbringing and Education (Act on Education), it is necessary to adapt content and form of education in teaching subjects, in which pupils with mild intellectual disabilities are educated by educational program for pupils with intellectual disabilities ISCED 1 – primary education (2009) and the resulting **Educational program for students with mild degree of mental disabilities ISCED 1 – primary education (2009),** following an A **version for pupils with mild intellectual disabilities.**

This educational program (2009) considers the teaching subject Slovak language and literature as a crucial subject in the educational process for pupils with mild intel-

lectual disabilities. The importance of the teaching subject is emphasised in legislative documents, in which it is considered as a basis for entire upbringing and education.

Mastering educational tasks of the teaching subject is a prerequisite for fulfilling tasks of other teaching subjects, and for developing the (large) majority of core competencies, such as Social Communication; Information and Communication Technology (ICT) Competencies; Learning to Learn; Problem-solving Competency; Perception and Understanding of the Culture as well as Communication Tools for Understanding Cultural Differences, as stated by Pavlis (In: Vančová et al. 2010). One of the teaching goals of the teaching subject Slovak language and literature is "to form a habit of reading aloud correctly for all pupils, to teach them to understand the reading text and to educate as many readers and listeners as possible with a positive attitude to literature" (Educational program for pupils with mild intellectual disabilities ISCED 1 – primary education 2009:19). It is the skill to read that becomes a prerequisite for learning in other subjects.

International research studies organized by PIRLS (The Progress in International Reading Literacy Study) and PISA (Programme for International Student Assessment) work with a term **reading literacy**, which they rank among the main components of **functional literacy**. For a research study of PIRLS is **reading literacy** defined as "understanding, using and reflecting on written texts, in order to achieve individual's goals, to develop individual's knowledge and potential on the purpose of an active participation in society" (In: Metelková Svobodová, Švrčková 2010:8). The PISA research describes reading literacy as the ability to process information in the text and to use the gathered data for solving a practical problem (Kašiarová 2011).

Jarmarová (In: Valenta, Michalík, Lečbych et al. 2012:295) defines the concept of reading competence as «a gradual acquisition of letters, syllables, words and sentences leading to the development of reading skills, perception of the content of a reading text, its reproduction and reading comprehension.» According to Obert (2009:23) reading competence expresses «the knowledge base, habits and value relations existing in an individual›s memory and age defined group», which is, in addition to the individual peculiarity of a mentally disabled pupil, also bounded by the degree of literary education, repertoire of reading models asserted by literary education, as well as school education in its broadest sense. In school education, is the concept of **reading** used in several basic meanings, such as 1. an activity applied when communicating with a text; 2. a name of one component of the teaching subject of Slovak language and literature; 3. a text, literature (e.g. home reading). Gavora (2008:27) defines the first meaning of reading as "an intellectual skill that is applied in all teaching subjects for the 1st and the 2nd grade in elementary and secondary schools. It becomes an important tool for self-development of language expression, speech culture and aesthetic feelings." Thus, reading represents an extracurricular skill to be primarily developed in the mother-tongue teaching and adequately in the

educational process within each teaching subject of cognitive orientation in a school environment (Metelková Svobodová, Švrčková 2010). It is, undoubtedly, the most important skill which a pupil acquires at school.

A pupil has to be able to notice different structures of a text to be able to learn to read, he/she must learn to concentrate and remember what he/she has read, to organise it in spatial and temporal sequences including verbal statements of read graphemes/words. That is why it is necessary, in relation to the reading competence, to develop targeted cognitive functions. Dispositions to the development of cognitive functions are genetically determined, but as Vágnerová (2002) states, only assumptions are inherited but further development of these functions depends on the way the child or the pupil is stimulated, that is on quality, frequency and adequacy of incentives.

A pupil with a mild intellectual disability learns, thinks and explores the world by means of **cognitive processes** (used for learning, thinking and exploring the world) which develop unevenly, but mainly with limits due to functional weakness of the central nervous system (CNS). However, Krejčová states (2013) that current neuro-scientific research shows that particular characteristics of the CNS can affect the way of learning of pupils with mild intellectual disabilities, as well as educational processes form the activity of the CNS. Feuerstein (2002; 2008) emphasises that cognitive functions, such as the structure of the brain are affected by the intervention, i.e. they are able to modify and change. Therefore, teacher's duty is to believe in a possibility of development of a pupil with a mild intellectual disability and to think about specific performance of individual cognitive processes, which are trained, fostered and developed by the pupil.

Individual cognitive processes do not support process isolation but they are strongly linked. Moreover, they can be apparently seen as **partial functions** (basal, basic functions) **in the cognitive area**. Sindelarová (2007:8) defines them as "basic skills that enable differentiation and development of higher mental functions, such as speech and thinking. In further development they become requirements for skills of reading, writing and also appropriate behaviour." If their development runs unevenly – i.e. they are immature and less developed than others, so **deficits in subfunctions** (in German Teilleistungsschwächen) come into existence. Graichen (1973, In: Pokorná 2010:95) defines them as "reduced performance of individual factors or elements within a larger functional system, which is essential in mastering a certain complex of adaptation processes." Sindelarová (2007:8) describes them as "weakening of basic skills which can lead to problems in learning and behaviour."

These demonstrations of an uneven development of pupils with mild intellectual disabilities can be observed in early and pre-school age in the sphere of late talking, graphomotoric clumsiness, sociability (Zezulková 2011) and later as problems in school skills (Bednářová, Šmardová 2007; Sindelarová 2008) which arise as a conse-

quence of different variants of deficits in partial cognitive functions of these pupils. Moreover, they can be reflected in the following areas:

1. visual and auditory classification (figure-ground differentiation),
2. visual and auditory differentiation,
3. intermodal relations,
4. visual and auditory memory,
5. perception of chronology and time (seriality),
6. tactile-kinaesthetic perception, body scheme and orientation in space.

Referring to the authors Siegel (2003); Roloff (1989, In: Sindelarová 2008); Stanovich (1986), Perfetti, Lesgold (1977, In: Blachman 1991), Zezulková (2011), who investigated the effect of partial cognitive functions on school skills, we define a **research question** in this context and we want to find *the correlation between the observed level of reading competence (way of reading), and the level (or deficits) in partial cognitive functions of pupils with mild intellectual disabilities educated in individual integration in the 4th grade in elementary schools.*

3 Research methodology

The aim of the research was to analyse the relationship between the determined levels of reading competence (way of reading) and the levels (or more precisely deficits) in partial cognitive functions of pupils with mild intellectual disabilities.

Due to the above mentioned issue of concern and the objective of the research with respect to the analysis of the relationship of the selected variables (reading competence and partial cognitive functions) we assume:

Hypothesis*: The level of reading competence in the section – the way of reading of pupils with mild intellectual disabilities educated in terms of individual school integration in the 4th grade in elementary schools is significantly influenced by the level of sub-cognitive functions, according to statistics.*

When evaluating the **independent variable**, which is the way of reading, we observed indicant categories, namely *reading syllables and fluent reading*. When evaluating the **dependent variable**, we monitored the number of mistakes in sub-cognitive functions, i.e. visual classification (figure-ground differentiation), visual classification of shapes, visual memory, auditory classification (figure-ground differentiation), auditory differentiation of speech, auditory memory, intermodal relationship, perception of chronology and time, tactile-kinaesthetic perception and spatial orientation.

The research sample comprised forth-grade pupils at the age of 10–12 with mild intellectual disabilities educated in terms of individual school integration in the elementary school in the Prešov Self-Governing Region. The average age of pupils was 10,739 years. Regarding to the nature of data we used the median, which was 11 years

of age, in statistical processing of the age of pupils. The largest group – modus was formed by pupils who reached the age of 10. All pupils (100 %) were fourth graders in the elementary school, 26 of them (78.26 %) were currently in the 4th year of their compulsory school attendance and 10 pupils (21.74 %) were in the 5th year of their compulsory school attendance.

To obtain representative data, we used *pedagogical reading diagnostic assessment of young students* (Čižmarovič, Kalná 1991) as a research tool. It is a testing tool for evaluating the quality of reading performance and analysis of the pupil's mistakes in reading. For the needs of this paper, we focus only on one observed area, namely the way of reading where we analyse recorded fields – reading syllables and fluent reading. For our assessment we used the text no. 8* with a title *Hare and Doe* (*Zajac a srnka*) (by Kopáňová) (In: Čižmarovič, Kalná 1991:2) with a total number of 81 words. The choice was based on comparison of its level with the curriculum defined in the International Standard Classification of Education for pupils with mild intellectual disabilities – ISCED 1 – primary education (2009).

To obtain data about the level of sub-cognitive functions, we used a research tool *T-254 Deficits of partial functions* (Sindelarová, adapted by Černý 2008). This test includes not only testing in the form of an oral or written response, but also practical testing. It consists of individual subtests designed to assess the level of isolated sub-cognitive functions.

4 Findings

According to International Standard Classification of Education for pupils with mild intellectual disabilities – ISCED 1 – primary education (2009) the pupils in 4th grade in elementary schools should be able to read a short text with accuracy and understanding, even to practice the correct verb accent and natural intonation in terms of *reading techniques*. However, we found out that only 54.35 % of pupils read with fluency and up to 41.30 % of pupils read syllables.

Based on data from the Table 1 and the calculated p-values, we can conclude that pupils who **read syllables** (41.3 % of pupils) made significantly more mistakes in the areas of tactile-kinaesthetic perception ($p < 0.001$), auditory classification (figure-ground differentiation) ($p < 0.000$), acoustic differentiation of speech ($p < 0.038$), auditory memory ($p < 0.001$), visual classification (figure-ground differentiation) ($p < 0.032$), visual differentiation of shapes ($p < 0.008$), two-dimensional spatial orientation ($p < 0.007$), visual perception of chronology and time ($p < 0.013$), auditory perception of chronology and time ($p < 0.000$) than the pupils who did not read syllables (58.7 % of pupils).

Based on the results it can be concluded that this area does not have a direct relationship with the visual memory ($p < 0.631$), but it depends more on its previous

levels in visual perception (visual classification, visual differentiation). At the same time, significant difference between spatial orientation, namely the body scheme ($p<0.188$) and the area of auditory visual intermodal relationship ($p < 0.174$), as well as the field of visual auditory intermodal relationship ($p < 0.070$), was not confirmed, according to statistics.

Table 1: The analysis of relationships between the way of reading – reading syllables and the partial cognitive function

Independent variable	Read syllables – number of pupils – 19						Do not read syllables – number of pupils – 27							
Dependent variable	**Mean**	**Standard deviation**	**Minimum**	**Median**	**Maximum**	**Normality test**	**Mean**	**Standard deviation**	**Minimum**	**Median**	**Maximum**	**Normality test**	**Used test***	**P-value**
I. Tactile-kinaesthetic perception	5,368	1,892	0	6	6	<0,005	2,37	2,871	0	0	6	<0,005	1	0,001
II.A Auditory classification	7,89	6,07	0	7	18	0,171	0,926	2,586	0	0	13	<0,005	1	0,000
V. Visual differentiation of shapes	8,368	1,95	4	9	10	<0,005	6,111	2,979	2	7	10	0,010	1	0,008
VII. Visual perception of chronology and time	12,74	5,61	5	10	25	0,204	7,78	6,88	0	7	25	0,080	2	0,013
VIII.A Auditory memory	1,789	0,976	0	2	3	<0,005	0,815	0,786	0	1	2	<0,005	1	0,001
IX.B Visual differentiation	12,89	5,36	5	12	21	0,467	9,22	5,65	1	9	22	0,788	2	0,032
IX.C Two-dimensional spatial orientation	17,89	5,17	5	18	25	0,703	13,37	5,51	2	15	21	0,100	2	0,007
X.A Acoustic differentiation of speech	4	4,23	0	3	15	0,023	1,63	2,306	0	0	8	<0,005	1	0,038
XII. Auditory perception of chronology and time	13,63	5,67	2	13	25	0,010	8,222	3,309	0	10	15	<0,005	1	0,000

Notes: *Used Test: 1 – Mann-Whitney U-test, 2 – T-test.

It is obvious from the Table 1 that if a pupil read syllables, he/she makes significantly more mistakes at the basic levels, namely in visual classification (figure-ground differentiation) as well as in auditory classification (figure-ground differentiation), including tactile-kinaesthetic perception. Based on literature it can be concluded that if a pupil has weakened basic levels of sub-cognitive functions; subsequently, they affect other functions which are built on them.

This was also confirmed in our research study, while a significant difference was afterwards recorded in the levels of visual differentiation of shapes, acoustic differentiation of speech, auditory memory, spatial orientation, including two-dimensional time perception and intermodal relations, according to statistics. **The hypothesis was confirmed** in the variables with p-values marked in red (Table 1). In each of these marked cases, pupils who read syllables also made significantly more mistakes than pupils, who did not read syllables in the assessment test, according to statistics.

The above facts were confirmed in the recorded dependent variable – **fluent reading** and, therefore, pupils who read fluently (45.65 % of pupils) also made, according to statistics, significantly fewer mistakes in the areas of auditory classification ($p < 0.000$), acoustic differentiation of speech ($p < 0.005$), auditory memory ($p < 0.005$), visual classification ($p < 0.011$), spatial orientation ($p < 0.001$), auditory perception of chronology and time ($p < 0.001$) and visual auditory intermodal relationship ($p < 0.008$) than the pupils, who did not read fluently (54.35 % of pupils) (Table 2).

Table 2: The analysis of relationships between the way of reading – fluent reading and the partial cognitive functions

Independent variable	Read fluently – number of pupils – 25						Do not read fluently – number of pupils – 21							
Dependent variable	**Mean**	**Standard deviation**	**Minimum**	**Median**	**Maximum**	**Test normality**	**Mean**	**Standard deviation**	**Minimum**	**Median**	**Maximum**	**Normality test**	**Used test***	**P-value**
I. Tactile- kinaesthetic perception	0,576	2,88	0	0	6	<0,005	0,445	2,04	0	6	6	<0,005	1	0,000
II.A Auditory classification	0,611	3,054	0	0	15	<0,005	1,34	6,12	0	7	18	0,082	1	0,000
VIII.A Auditory memory	0,16	0,8	0	1	2	<0,005	0,222	1,017	0	2	3	<0,005	1	0,005

IX.B Visual classification	1,16	5,78	1	8	22	0,454	1,08	4,95	5	12	21	0,450	2	0,011
IX.C Spatial orientation	1,09	5,44	2	12	21	0,338	1,05	4,81	5	18	25	0,377	2	0,001
X.A Acoustic differentiation of speech	0,411	2,056	0	0	8	<0,005	0,887	4,066	0	3	15	0,047	1	0,005
XII. Auditory perception of chronology and time	0,734	3,671	0	10	15	<0,005	1,21	5,55	2	10	25	<0,005	1	0,001
XIV.A Visual auditory intermodal relationship	0,584	2,922	0	2	11	0,028	1,28	5,86	0	7	20	0,016	1	0,008

Notes: *Used test: 1 – Mann-Whitney U-test, 2 – T-test.

It is obvious from the Table 2 that pupils who read fluently also made significantly fewer mistakes at basic levels, namely in visual classification (figure-ground differentiation), auditory classification (figure-ground differentiation) as well as at the second level of auditory perception – acoustic differentiation of speech, including auditory memory, according to statistics. At the same time, significantly fewer mistakes were made in the tactile-kinaesthetic perception followed by two-dimensional spatial orientation, including auditory perception of chronology and time, and auditory-visual intermodal relationship, according to statistics. **The hypothesis was confirmed** in the variables with p-values marked in red (Table 2). In each of the marked cases it was shown that pupils who read fluently made significantly fewer mistakes in comparison to the pupils who did not read fluently, according to statistics.

Conclusions

Data and findings, which we have obtained, are the basis for creating a stimulating program as a complement of the curriculum of the teaching subject Slovak language and literature for pupils with mild intellectual disabilities in 4th grade educated in terms of school integration in elementary schools. We did not expect that the sample would contain pupils who read syllables in the number of 41.3 % pupils, based on the content of education in the educational program for pupils with mild intellectual disabilities (2009). Based on the obtained data, it is obvious that especially these pupils necessarily need special education and care (intervention) aimed at the basic sub-cognitive functions in which pupils make significantly more errors than pupils who did not read syllables, according to statistics. That included the area of visual classification (figure-ground differentiation) ($p < 0.032$) as well as auditory classification (figure-ground differentiation) ($p < 0.000$) including tactile-kinaesthetic perception ($p < 0.001$). These areas also affect the observed weakened levels, such as acoustic differentiation of speech ($p < 0.038$), auditory memory ($p < 0.001$), visual

differentiation of shapes ($p < 0.008$), two-dimensional spatial orientation ($p < 0.007$), visual perception of chronology and time ($p < 0.013$) as well as auditory perception of chronology and time ($p < 0.000$).

We need to emphasise that these findings relate to the research sample in the Prešov Self-Governing Region, thus our conclusion refers to the research sample of 155 pupils. Based on these findings, we can assume that if we intentionally stimulate primarily detected deficit areas of sub-cognitive functions, the function of these areas will be improved. Moreover, we suppose that it could make the process of reading (reading technique and reading comprehension) more effective. This intention will become the aim of our research in the next phase of the planned research. Finally, these findings can help the effective education of pupils with mild intellectual disabilities in terms of school integration in elementary schools.

It is also necessary to consider other variables that affect the level of reading competence of these pupils, especially social factors (family, school, educational approach, methods of teachers, etc.), whereby we must not forget the spontaneous development of these pupils, though it is delayed and partially limited. Therefore, not only pupils need to make more effort, but also teachers in order to support the pupils' optimal development.

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