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PHD THESIS

PERSONALISED PSYCHO-PEDAGOGICAL PROGRAMMES FOR IMPROVING THE HANDWRITING SKILLS OF PRIMARY SCHOOL CHILDREN WITH ADHD

SUMMARY

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Key Words: ADHD, associated disorders, executive functions, learning difficulties, specific learning disorders, dysgraphia, dysorthographia, personalised psycho-pedagogical programmes, speech therapy, case study, handwriting skills, cursive writing.

INTRODUCTION

Hyperactivity with attention deficit (ADHD), found in approximately 5% of school children, represents a research topic that is currently arousing ever greater interest, due to the impact of this syndrome in the sphere of learning difficulties.

The vast majority of studies that focus on the difficulties of written language acquisition among school children with ADHD refer to dyslexia. There have been few research attempts to investigate the written language disabilities that affect school children with ADHD, in particular those with associated disorders (concerning the acquisition of eye-hand coordination skills; visual-motor or visual-spatial deficits; deficits of procedural visual-graphomotor memory and of the executive functions; and dyspraxia).

In light of the fact that ADHD is a syndrome which is frequently associated with other dysfunctions of the psychic processes involved in the activity of writing, we set out to demonstrate, through an empirical investigation, on the basis of a regression analysis, the predictive value of some psychological tests for the manifestation of dysgraphia.

Through an investigation based on pre-test and post-test assessments, as well as through several case studies, we checked the impact that personalised psycho-pedagogical and speech therapy programmes can have towards reducing dysgraphia and dysorthographia and towards improving the quality of writing in primary school children with ADHD.

There is a tendency, in some countries, to no longer teach handwriting skills to primary school children – including to those with ADHD. Instead, pupils are taught how to write on their tablets or laptops. However, neuropsychological studies have bought arguments in favour of teaching *cursive writing* to pupils, even if, due to technological advances, emphasis is laid on teaching writing through the use of keyboards and tablets. Of course, it is preferable to teach the writing skills using laptop keyboards in the case of school children with ADHD and with serious associated disorders, such as specific learning disorders with an underlying neuropathology, particularly when those pupils show symptoms of dyspraxia and of severe dysgraphia or agraphia.

Based on the research we have designed and carried out, we have brought forth arguments supporting the necessity of introducing, within the framework of continuous professional training programmes for teachers, special modules dedicated to increasing their knowledge of ADHD

aetiology and symptomatology and of personalised pedagogical, logopaedic and psychological programmes.

THEORETICAL BACKGROUND

CHAPTER I. ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)

The definition of ADHD proposed in *DSM IV* (2003) groups together all of its symptoms under the heading *attention deficit hyperactivity disorder,* while the majority of French child psychiatrists insist on the trans-nosographic character of hyperactivity, considered as "the symptomatic expression of a personality disorder that ought to be placed under psycho-therapeutic supervision" (Mille, 2001, p. 200).

According to *DSM-V* (2013), the defining feature of the attention deficit hyperactivity disorder is a persistent pattern of inattention and/or hyperactivity-impulsivity. Inattention manifests itself at the level of the person's behaviour and activities, through: the instability of attention, the difficulty of concentration, the lack of organisation, the abandonment of tasks. These dysfunctions are not caused by a lack of understanding or by an attitude of defiant opposition.

As a rule, ADHD begins before the age of 7 years, the problems associated with it encompassing three domains of mental life and activity: ***inattention, hyperactivity*** and ***impulsivivity.*** Considering the heterogeneity of ADHD and the evolution of this disorder, it is rather complicated to establish a definitive diagnosis. The clinician must build a thorough and detailed case history of the patient, using data from as many sources as possible and including important factors, such as the persistence of various symptoms or the extent to which those factors might be the sources of the child's behavioural problems. Afterwards, the child ought to be examined on the basis of valid neuropsychological evidence. According to *DSM-IV* and *DSM-V*, the associated disorders encountered in children with ADHD include *internalised behavioural disorders*, *externalized behavioural disorders*, and, in some cases, *learning difficulties (reading, writing, mathematics).*

In children with ADHD, the *executive functions* are poorly developed and disturbed, and their impairment can have repercussions on school performance, especially in the case of activities that rely on executive tasks: for instance, writing. The *executive functions* integrate regulatory and cognitive processes, such as attention and working memory. These functions encompass a wide range of skills, such as: attention stability and concentration, working memory, flexibility, planning, control, inhibition on a cognitive or on a behavioural level for abandoning inappropriate or incorrect actions (Levin et al. – cited by Noël, 2007, p. 120). The executive functions involved in the

acquisition of written language concern the child's ability to develop, plan, execute and, possibly, to operate the necessary corrections in the sphere of writing or reading.

Some researchers, such as Thomas B. Johnson (cited by Thomas and Willems, 1997) suggest that we should not consider the *characteristics* of ADHD as the *signs of a pathology*, but rather as the *indicators of a psychological type* and of *a particular learning style.* School children with ADHD have a particular learning style, which is predominantly kinaesthetic and spatial.

CHAPTER II. CHARACTERISTICS OF LEARNING DIFFICULTIES AND DISORDERS

According to the criteria listed in *DSM-IV* and *DSM-V*, *learning disorders* have a neuropathological substrate and are diagnosed based on the person's performance in individually-administered standardised tests, referring to reading, arithmetic calculus, or graphic expression: the results are far below what is expected in relation to the pupil's age, schooling and intelligence level. Learning problems interfere significantly with school performance or with daily activities that require lexical, graphic or arithmetic skills.

A parallel between the characteristics of learning disorders and the school children's learning difficulties

Learning disorders	Learning difficulties
►their cause is neurological. ► they are chronic, permanent. ►they can occur throughout the learning process. ►in the case of dyslexia or dysorthographia, we may detect: - a major difficulty in integrating the basic processes that enable comprehension; - an inability to automatise the correspondence between letters and sounds (phonemes) or to read and pronounce the words. ►these can be diagnosed by a neuropsychologist, a psychologist, a special educator or a speech therapist, with the help of standardised tests.	►they are often temporary and can be corrected more easily; ►they may occur in different stages of the learning process; ►they may have multiple causes, but these are not neurological: - lacunae in the learning of reading and writing; - psycho-emotional disorders; - the lack of motivation and interest for learning; - adverse socio-economic and cultural conditions.

Among the academic learning difficulties with an impact on the acquisition of oral and written language skills, the most commonly encountered are related to reading and writing. The generic terms under which they are known are *dyslexia* and *dysgraphia*. School children with

dyslexia may also exhibit other written language disorders, in particular dysgraphia or/and dysorthographia.

Some researchers (Soppelsa, 2007; Vaivre et al., 2011) have shown that we should distinguish between dysgraphia and dysorthographia. According to them, dysgraphia is most often the expression of a *psychomotor developmental coordination disorder* (DCD), of visual-spatial deficits, of graphomotor procedural memory disorders, or of developmental dyspraxia. School children with dysgraphia may incorrectly produce certain letters, mark out the ligatures between letters and properly organise their paragraphs on a page. *Dysorthographia* is the consequence of a vague, imprecise or even wrong lexical representation. School children with dysorthographia have limited access to the graphemic lexicon, especially in the case of attention dysfunctions and poor phonological or graphemic short-term memory skills (Morgane, 2013; INSERM, 2007 - www.inserm.fr.).

CHAPTER III. PSYCHO-PEDAGOGICAL AND NEUROPSYCHOLOGICAL APPROACHES TO WRITING ACTIVITIES

From a *cognitive* point of view, writing consists in the transcription of oral language into written language, through the encoding of phonemes into graphemes. From a *motor* point of view, writing comprises a series of movements of the hand and of the fingers which, based on an acceptor of the graphomotor action, must be initiated and programmed before being executed. Writing requires a certain degree of development of the hand motor skills, of psychomotor skills and of oculomotor praxia. The *execution of the graphomotor gestures of writing* is based on complex brain mechanisms. Bourdin and Fayol (1994) show that the writing of letters and the retention of words resort to the same mental system of *mnesic resources.* Linguistic knowledge and the motor execution programme and process mobilise the subsystems of long-term memory and working memory.

Studies (Nicolsoon, Fawcett, 2011) referring to ADHD associated with developmental coordination disorder (DCD) and to oral language disorders associated with the dyslexic-dysgraphic syndrome have analysed the specificity of deficient mechanisms based on *the model of atypical brain development* and on the *model of procedural memory deficit.*

Neuropsychological models of writing

1. Van Galen's model (1991)

The design of Van Galen's neuropsychological model (1991) starts from the assumption that the letter is the unit of graphic production. Van Galen describes three systems that are activated in parallel: the treatment module, the units and the types of memory.

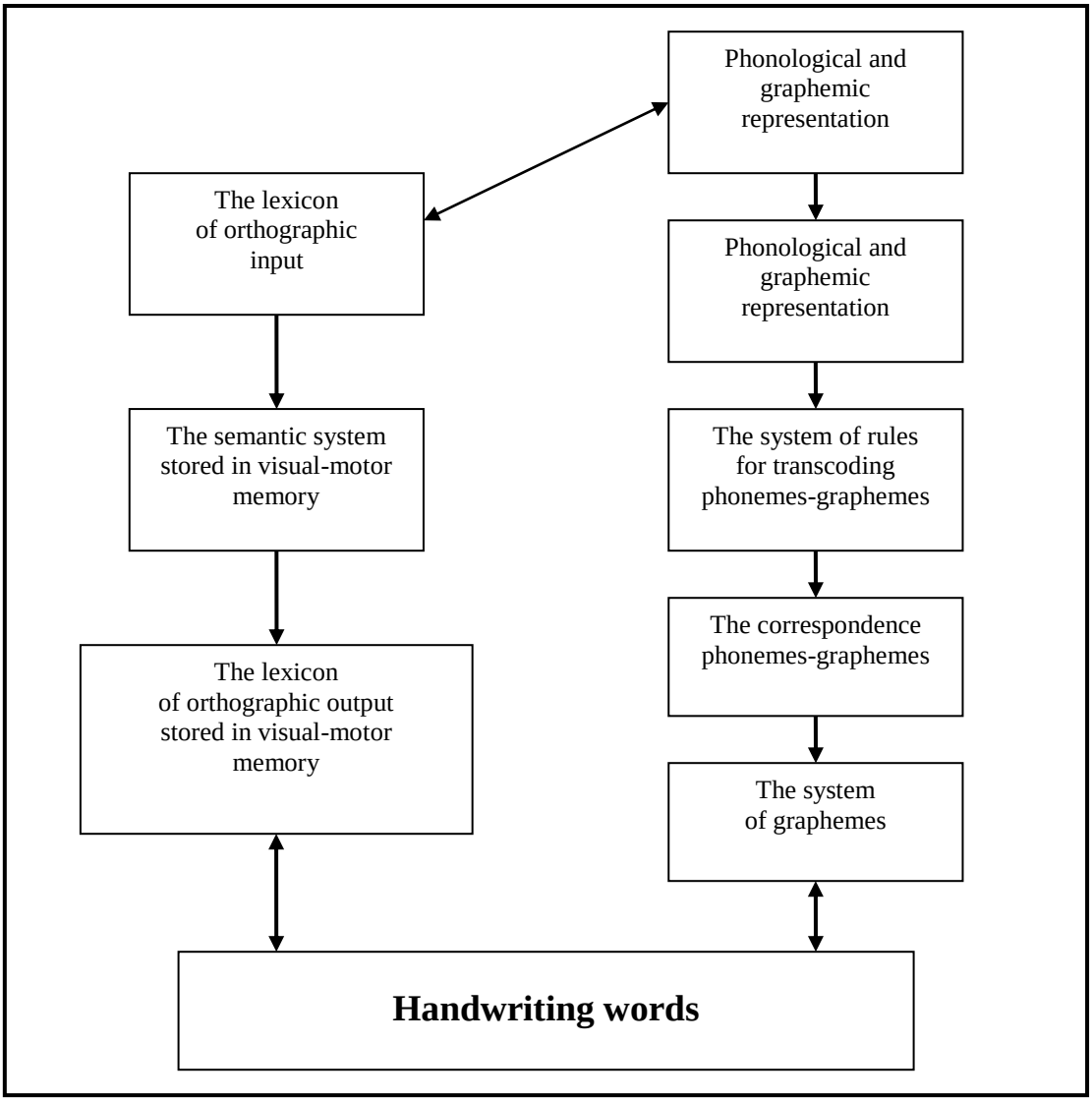
The model of handwriting developed by Van Galen (1991)

Treatment modules ↔ Unit size ↔ Memory storage systems/memory types de memorie

Activating the intention ▼	Ideas ▼	Episodic memory ▼
Semantic retrieval ▼	Concepts ▼	Verbal lexis ▼
Syntactic construction ▼	Phrases ▼	Long-term memory and short-term memory ▼
Syllabification ▼	Words ▼	Orthographic memory ▼
Allographic selection ▼	Graphemes ▼	Motor memory ▼
Size control ▼	Allographs ▼	Realisation of the graphic trajectory
Muscle adjustment ▼	Graphic features ▼	
Realisation of the graphic trajectory	Realisation of the graphic trajectory	

2. ***The neuropsychological model of handwriting proposed by Zesiger (1995)*** pertains to the trend of cognitive neuropsychology. According to Zesiger, *visual-motor integration* and *visual-spatial factors* should be added to the model proposed by Van Galen. The motor processes involved in writing define the sequences of strokes that have to be produced for shaping the desired letters, these being stored in the long-term motor memory.

3. The "dual-route cascaded" model of word writing. Starting from the representation of the dual-route cascaded model of visual word recognition and of reading aloud (Colheart et al., 2001), we propose the following *psycholinguistic model for writing words.*



The "dual-route cascaded" model of word writing (O. Preda, 2017).

The structure and the processes included in the dual-route cascaded psycholinguistic model provide a good explanation for the correct writing of words, as well as for the occurrence of dysgraphia or dysorthographia, due to possible perturbations of the components listed in the model above.

CHAPTER IV. THE ROLE OF PHONOLOGICAL AWARENESS, PHONOLOGICAL PROCESSING AND THE TREATMENT OF LINGUISTIC INFORMATION IN WRITTEN LANGUAGE

Phonological processing includes phonological awareness and phonemic awareness, both of them focusing on discriminating between the linguistic sounds.

Phonological memory is essential for learning the written language, especially when the child uses the *system of converting phonemes into graphemes or of graphemes into phonemes* (Baddley, Gathercole, Papagne, 1998 – cited by Noël, 2007, p. 201).

Orthographic writing simultaneously entails mastering the rules for converting phonemes into graphemes and the formation of the *orthographic vocabulary*. To write orthographically, school children will resort both to the *orthographic representations* of letters and to those of the words stored in memory, which they will need to reactualise in the activity of writing.

When it comes to writing in Romanian, which is a phonetic-alphabetical language, *mastering the relations between graphemes and phonemes / or between phonemes and graphemes* and *mastering the decoding process* depend on certain skills: a) phonemic awareness; b) the accuracy of the grapheme-phoneme correspondence and of the phoneme-grapheme correspondence; c) fluency; d) understanding; d) vocabulary. These skills correspond, in fact, to the components of the effective acquisition of reading and writing skills.

The findings of numerous studies confirm the hypothesis of a mutual causation relationship between phonological awareness and the acquisition of written language. According to this hypothesis, phonological awareness is a predictive factor for the acquisition of reading and writing skills; in addition to this, learning how to read contributes to a better awareness of phonemes and of grapheme-phoneme or phoneme-grapheme relations (Ramus, Szenkovits, 2008; Pagani et al., 2011).

The deficits noticed in children with specific language disorders are the results of deficits in the phonological treatment, having repercussions for the development of their lexical and grammatical skills, as well as for the acquisition of morphology and syntax (Gérard, 2006). Research (Mather, 2003; Hoffman, Gilliam, 2004; Kaiser, 2009) has highlighted the fact that the *rapidity* and *effectiveness of treating linguistic information* bear a significant impact for the acquisition of writing and reading skills and for academic success.

CHAPTER V. THE SPECIFICS OF DYSGRAPHIA – AS A DISORDER AFFECTING THE ACQUISITION OF WRITING SKILLS

With regard to **disorders of written expression**, we can detect three main categories of difficulties: *alterations of handwriting* (trembling, insecure graphic gestures, the wrong composition of letters, difficulties in marking out the ligatures between letters, or the absence of ligatures, the omission of squiggles), *spatial disorders of writing* (the misalignment of letters or words, the absence of a margin on the page), *syntactic disorders* (grammatical mistakes), which are linguistic by nature.

According to Postel (1993 – cited by David, 2015, p. 254) – dysgraphia resides in a disturbance of the graphic function that manifests itself at the level of the spatial components of writing, without affecting the morphosyntactic structures. In this case, the difficulties of writing are of a spatial nature, affecting the composition of the letters, the ligatures between the letters and the organisation of writing on the page. It should be noted that the dysgraphia scale developed by Ajuriaguerra (1980) includes items targeting some of the disorders above.

The difficulties encountered by children with ADHD in achieving cursive writing may be the result of a disorder impairing the executive function, behavioural inhibition and working memory (Barkley, 1997; Lussier, Flessas, 2001; Engle, 2002). The working memory of children with ADHD is ineffective due to the fact that they store some irrelevant information, which disrupts the treatment of necessary information. In some school contexts, the treatment of information involves postponing the answer that must be given to certain tasks, which is difficult for children with ADHD because of their hyperkinesis/ impulsivity and the executive function disorder.

The relations between the developmental coordination disorder (DCD) and developmental dyspraxia with an impact on dysgraphia have been analysed by Vaivre-Douret et al. (2011a), who have identified three sub-types of developmental dyspraxia.

Sub-group 1: children with ideo-motor dyspraxia (IM). These children are deficient in terms of digital praxia, gnoseo-praxia and digital gnosia. They also present axial or global hypotonia, laterality disorders, tonic and gestural organisation disorders, difficulties of motor programming and of motor control adjustment. The school children in this subgroup can present symptoms of motor dysgraphia.

Sub-group 2: children with visual-spatial and/or visual-constructive dyspraxia (VSC). These children feature visual-motor integration disorders, visual-spatial processing disorders and visual-constructive disorders. Vaivre-Douret (2011a) shows that children with VSC frequently display specific perceptual-motor disorders associated with eye-tracking disorders, without exhibiting visual-perceptual disorders or sensory neuro-visual disorders.

Sub-group 3: *children with mixed dyspraxia (MX), combining the two pure types of dyspraxia (IM and VSC),* and suffering from other associated disorders, which include specific motor coordination disorders. At the level of motor coordination, the children in this subgroup present manual skill and bimanual coordination disorders and voluntary executive motricity disorders, exhibiting symptoms of muscle spasticity and/or synkinesia. In addition to these, the disorders of the executive functions, of procedural memory, and of attention are much more common here than in the other two subgroups.

The typology of developmental dyspraxia sub-types proposed by Vaivre-Douret et al. (2011b) is based on the analysis of symptoms and on the gradients of the intensity with which it manifests itself: low intensity: difficulties in the motor representation of the execution of a particular gesture, the alteration of the visual-spatial structure of motricity; strong intensity: a disturbance of motor coordination, affecting postural control and tactile-kinesthetic motricity.

The handwriting of children with dyspraxia or with DCD is not calligraphic; sometimes it is downright illegible (Barray, 2012). Poor motor coordination entails an inadequate gripping of the writing tool and makes it difficult to correctly shape the letters, which has a negative effect on calligraphy attempts. Letter strokes reveal shape and size errors, with many retracings for the sake of correction, which is not always successful. The considerable effort made by these school children when writing letters and words depletes their attentional resources and diminishes their effective allocation of resources necessary for carrying out tasks such as writing from dictation or writing compositions. Because these school children have difficulties pertaining to spatial organisation and orientation, their written productions are disorganised and unsightly.

THE RESEARCHER'S EMPIRICAL INVESTIGATIONS

STUDY no. I. INVESTIGATING THE TEACHERS' KNOWLEDGE REGARDING ADHD

The **question** we tried to answer was: *to what extent is the knowledge of the aetiology, diagnosis and symptoms of ADHD different in teachers from inclusive schools/classes compared to teachers from noninclusive schools/classes?*

The method of investigation and the research instrument used: We have developed a survey based on a questionnaire, starting from the analysis of the following tools: *K-ADHD* developed by Jerome et al. (1994), *K-ADD* used by Sciutto et al. (2000); *Questionnaire to Access Teachers' Knowledge of ADHD (IRA-AGHN)* – validated and used by Soroa, Balluerka and Gorostiaga (2012).

Procedure: The questionnaire was disseminated online or directly, being administered to 100 teachers from inclusive schools/classes and to 100 teachers from noninclusive schools/classes, in the counties of Cluj, Sibiu and Sălaj, during the school years 2015-2016 and 2016-2017.

The response rate to all the items was 90% in the case of teachers from inclusive schools/classes and 85% in the case of teachers from noninclusive classes.

The calculation of Cronbach's alpha correlation coefficients shows a high internal consistency of the questionnaire's variables. Thus, the total consistency is .92, and the internal consistency of the variables ranges between .78 and.88. Thus, Cronbach's alpha correlation coefficients show that this tool is useful for assessing the teachers' knowledge in the field of ADHD.

Discussion of the findings obtained by administering the questionnaire

Starting from the research question, we found, based on the analysis of the data, that there are some differences between teachers from inclusive schools and those from noninclusive schools regarding *general knowledge about ADHD, the aetiology, the symptoms, the diagnosis and the treatment of ADHD through pharmacological, psychological, pedagogical and psychosocial methods.*

Teachers from inclusive schools demonstrate a more appropriate knowledge of all the aspects related to ADHD, both on the basis of scientific research and through direct experiences with such pupils, who are included in this education system in relatively greater numbers. Teachers from inclusive schools, who have a partnership with the pupils' parents and provide them with psycho-pedagogical counseling, in a percentage that is up to 20% higher than that of teachers from noninclusive schools, believe that having a child with ADHD does not limit the social life of a family and that the dropout rate is not higher among school children with ADHD.

In terms of the pedagogical, educational programmes, teachers must collaborate with school counsellors, with support teachers, and with the parents of children with ADHD.

Within the framework of continuous training programmes, teachers should have access to special modules intended dedicated to increasing their knowledge of ADHD aetiology and symptomatology and of psycho-pedagogical programmes. Staying informed about the scientifically validated ADHD aetiology, symptoms and therapy, teachers will then apply this knowledge in their instructive-educational activities. Valorising this knowledge will contribute to the attenuation of ADHD symptoms in the school environment, increasing the pupils' efficiency.

STUDY no. II. DISORDERS OF VISUAL ATTENTION, PSYCHO-MOTOR SKILLS, PROCEDURAL MEMORY AND EXECUTIVE FUNCTIONS IN THE MANIFESTATION OF DYSGRAPHIA AMONG STUDENTS WITH ADHD

Research aim: Highlighting the predictive value of some psychological tests that assess disorders of visual attention, psycho-motor skills, procedural memory and executive functions concerning the manifestation of dysgraphia.

Hypotheses:

The hypothesis is that the following psychological variables have predictive value for the manifestation of dysgraphia:

a) Difficulties of managing visual attention;

b) Disorders affecting the acquisition of visual-motor coordination/eye-hand coordination;

c) Disruptions of the perceptual-motor function;

d) Disruptions of the visual-spatial skills and of the spatial organisation and structuring capacity;

e) Disorders affecting the capacity of graphomotor planning and organisation;

f) Dysfunctions of perceptual-motor procedural memory;

g) Disorders of executive functions in the field of visual-motor planning, monitoring and self-regulation.

The research was conducted during the school years 2014-2015 and 2015-2016, on a sample of 42 school children aged between 8 and 13 years, studying in grades II, III and IV of inclusive secondary schools in Cluj-Napoca and in the Special Secondary School C.R.D.E.I.I.

The criteria for the inclusion of participants in the research were based on the methodological rules in force. Thus, we selected school children who were initially diagnosed with *the combined type of ADHD* at the Child and Adolescent Psychiatric Clinic in Cluj-Napoca. In selecting the school children, we took into account the diagnostic criteria of ADHD specified in *DSM-IV-TR* and *DSM-V*: the presence of at least 6 inattention symptoms and the presence of at least 6 hyperactivity-impulsivity symptoms.

The distribution of pupils into grades by gender and age

Grade/gender/ age					
School children with ADHD/ second grade		School children with ADHD/ third grade		School children with ADHD/ fourth grade	
M	F	M	F	M	F
10	4	9	5	8	6
Average age: 8.6 $\sigma = 0.4$	Average age: 8.4 $\sigma = 0.6$	Average age: 10.7 $\sigma = 0.5$	Average age: 10.5 $\sigma = 0.6$	Average age: 11.8 $\sigma = 0.9$	Average age: 11.5 $\sigma = 0.7$

The school children who participated in the research and their teachers were requested to provide a verbal agreement, while the pupils' parents were asked to submit a written agreement.

Research methods: psychological testing; systematic observation; the psycho-pedagogical analysis of the products of the writing activity; statistical methods of data analysis with SPSS.13.

a) Tools for reconfirming the ADHD diagnosis:

►ADHD criteria from DSM-IV-TR;

►*Conners Teachers Questionnaire – short version.*The results obtained on the basis of this questionnaire correspond to the ADHD criteria in *DSM IV-TR.*

Based on this questionnaire, we can ascertain that pupils predominantly exhibit *inattention/passivity, hyperactivity* or that they have a *combined type of ADHD.*

b) Tests for the assessment of the mental processes involved in learning handwriting

►The Bender-Santucci test, designed for examining children aged between 6 and 14 years, which assesses the *perceptive-motor function.* This test was validated and calibrated in our country by Kulcsár (1977).

The test has a predictive value for the acquisition of reading and writing skills. Very poor results in this test permit a presumptive diagnosis of instrumental perceptual-motor disorders, which typically affect people with dyslexia and dysgraphia.

►The Kohs-Goldstein test, the version developed by N. Galifret-Granjon and H. Santucci, and adapted by V. Preda (1997) for the population of our country.

The test assesses the level *of visual-motor coordination acquisition and the spatial organisation and structuring capacity,* having a predictive value for the acquisition of writing and reading.

Very poor results in this test permit a presumptive diagnosis of developmental coordination disorder (DCD), especially as regards eye-hand coordination, with a negative impact on the acquisition of writing.

►The Rey Complex Figure test, which highlights the ability to structure perceptual-motor space and, at the same time, detects any possible memory deficits, which are often contingent on perceptive-visual deficiencies.

The *Rey Complex Figure* test has criteria for the interpretation of results that recommend it for the study of *"attention management"* and also for the study of the role that attention plays: the role of an "interface" between perceptual-motor development and graphomotor procedural memory

Copying the Rey Complex Figure demonstrates an ability of *graphomotor organisation and visual-spatial skills.*

The reproduction of the Complex Figure from memory evaluates procedural memory based on the degree of correlating spatial data.

►**Items from the NEPSY battery**, developed by Korkman, Kirk and Kemp in 1997, based on developmental psychology, neuropsychology, and the theory of cognitive neuroscience.

This battery of neuropsychological tests, adapted and validated in our country by a team of psychologists at COGNITROM (Benga et al., 2009) allows the evaluation of five functional areas of cognition: Attention/Executive Functions, Language, Sensorimotor Functions, Visual-Spatial Processing, Memory and Learning.

In this research we used only the subtests necessary for assessing the aspects involved in the formation of writing competences in school children with ADHD, more precisely, the Attention/Executive Functions tests.

►The Dysgraphia Scale designed by Ajuriaguera (1980) is a useful tool for the *individual diagnosis of the handwriting mastery level* and for *the detection of children with dysgraphia.*

The **research variables**: ***independent variables***: level of schooling, the tools for highlighting ADHD symptoms; the tests applied for evaluating them: the management of visual attention; the acquisition of visual-motor / eye-hand coordination; the perceptual-motor function; visual-spatial skills, the ability of spatial organisation and structuring; the ability of graphomotor planning and organisation; perceptual-motor procedural memory; executive functions**. *Dependent variables*:** the quality of the graphic activity; the dysgraphia scores

The analysis of the findings

The inattention and hyperactivity/impulsivity scores obtained by the school children in grades II – IV on the basis of the ADHD criteria from *DSM-IV-TR*

School children/ ADHD criteria	**Criterion A 1: Inattention** Median	**Criterion A 2: Hyperactivity/impulsivity** Median
The second grade N=14	8 symptoms	7 symptoms
The third grade N=14	7 symptoms	7 symptoms
The fourth grade N=14	10 symptoms	9 symptoms

The above table shows that all the evaluated school children have a *combined type of ADHD.* Most of the inattention and hyperactivity/impulsivity symptoms are encountered in fourth-grade pupils, but they are less frequent in second- and third-grade pupils.

In order to see to what extent these results are consistent with those obtained from the Conners Questionnaire that was filled out by teachers, we shall present in the table below the frequency of conduct problems, of hyperactivity and inattention/passivity, as they were assessed in second-, third- and fourth-grade pupils.

The scores of the conduct problems, inattention and hyperactivity/impulsivity obtained by the second-, third- and fourth-grade pupils to the Conners Questionnaire - the short version, filled out by teachers

School children/ ADHD scores	**Conduct problems** Average score	**Hyperactivity** Average score	**Inattention/passivity** Average score
The second grade N=14	**14**	**17**	**18**
The third grade N=14	**15**	**16**	**17**
The fourth grade N=14	**17**	**19**	**20**

The above table shows that all the evaluated school children have a *combined type of ADHD.* Most symptoms of inattention, hyperactivity/impulsivity and conduct problems are found among fourth-grade pupils, but they are less frequent among third-graders. Therefore, *the data obtained through the application of the Conners Questionnaire by the teachers are consistent with those we have obtained on the basis of the ADHD criteria from DSM IV-TR.* The initial diagnosis made at the Child and Adolescent Psychiatric Clinic, two-three years before our own and the teachers' assessments, is thus reconfirmed.

The average scores on the *Dysgraphia Scale* obtained by pupils with ADHD from the second, third and fourth grades

School children with ADHD/	**Testing on the Dysgraphia Scale**		
Grade	***N***	***m***	***σ***
second	14	18.92	5.28
third	14	14.78	4.02
fourth	14	17.18	5.57

Starting from the data relating to the dysgraphia scores obtained by students with ADHD in grades II-IV, we considered that it would be useful to conduct an analysis of the results obtained by these school children in various tests with predictive value for the manifestation of dysgraphia. On the other hand, we wanted to highlight what types of dysfunctions overlap with the symptoms of ADHD.

To that end, we resorted to an ***analysis of the regression coefficients and of the significance thresholds,*** starting from the assumption that in the case of school children with ADHD, attentional and hyperactivity/impulsivity deficits overlap other disorders, which are probably associated in different ways in second-, third- and fourth-grade pupils.

Discussion of the data. The research hypotheses were confirmed, the data analysis ***highlighting the high predictive value, for the manifestation of dysgraphia, of the following tests: Bender-Santucci, Kohs-Goldstein, Rey Complex Figure and the items Attention/Executive Functions in the NEPSY battery.*** In all the tests that were applied, there is a highly significant negative correlation at the threshold of 0.001 (r = between – 805 and – 986 for the Pearson Correlation and the Nonparametric Correlation) between the scores obtained by the school children

with ADHD whom we examined and the scores obtained on the Dysgraphia Scale. The *ANOVA* also shows the highly significant value of F at p =.000, which emphasises dysgraphia as a strong predictor, due to the disorders associated with ADHD.

As the scores on the Bender-Santucci, Kohs-Goldstein and Rey Complex Figure tests and to the Attention/Executive Functions items of the NEPSY battery are getting lower, the scores on the Dysgraphia Scale are getting higher. Thus, low scores on these tests have predictive value in terms of the possibility of dysgraphia manifesting in children with ADHD and associated disorders.

By applying these tests, we showed that in school children with *the combined type of ADHD* the manifestation of dysgraphia is caused both by attention management difficulties and motor impulsivity / hyperactivity, and by related disorders (disorders pertaining to the acquisition of visual-motor / eye-hand coordination; disruptions of the perceptual-motor function, of visual-spatial skills and of the capacity of spatial organisation and structuring; disturbances of the capacity of graphomotor planning and organisation; dysfunctions of the perceptual-motor procedural memory; disorders of the executive functions in the field of visual-motor planning, monitoring and self-regulation).

STUDY no. 3. THE EFFECT OF PERSONALISED EDUCATIONAL PROGRAMMES FOR IMPROVING THE HANDWRITING SKILLS OF PRIMARY SCHOOL CHILDREN WITH ADHD

The **aim of the research** is to highlight the factors that hamper the production of correct handwriting in the case of school children with ADHD and the efficiency of personalised psycho-pedagogical and logopaedic programmes.

Research aims:

1) Highlighting and analysing the disruptions of handwriting abilities in school children with ADHD and eye-hand developmental coordination disorders (DCD)

2) Analysing the activity of writing in school children with ADHD and with dysfunctions of space perception

3) Highlighting the difficulties of writing for school children with specific learning disorders (SLD) associated with ADHD.

4) Analysing the impact of the level of schooling and of personalised psycho-pedagogical and logopaedic programmes on the decreasing writing difficulties, depending on their typology.

Research hypotheses:

It is assumed that:

a) Writing difficulties among primary school children with ADHD can be enhanced due to DCD – eye-hand developmental coordination disorders.

b) Primary school children with ADHD and with learning difficulties can be affected by dysgraphia due to dysfunctions of space perception.

c) Among school children with specific learning disorders (SLD) and with ADHD, dysgraphia is persistent and chronic; writing difficulties are of a pathological nature.

d) The more severe the diagnosis and the more pronounced the symptoms, especially in the case of school children with specific learning disorders associated with ADHD, the less relevant the level of schooling for the correction of dysgraphia.

e) It is assumed that the effectiveness of personalised psycho-pedagogical programmes for improving the activity of writing is influenced by the heterogeneity and severity of the symptoms manifested by different pupils; the lowest impact of these programmes is registered among school children with specific learning disorders.

The research was conducted during the school years 2015-2016 and 2016-2017, on a sample of 42 pupils aged between 8 and 12 years old, in grades II, III and IV of the inclusive secondary schools in Cluj-Napoca and of the Special Secondary School C.R.D.E.I.I.

The research participants

The distribution of pupils into grades by gender and age

Grade/gender/ age					
second grade School children with ADHD and eye-hand developmental coordination disorders (DCD)		third grade School children with ADHD and dysfunctions of space perception		fourth grade School children with ADHD and specific learning disorders (SLD)	
M	F	M	F	M	F
10	4	9	5	8	6
Average age: 8.6 σ = 0.4	Average age: 8.4 σ = 0.6	Average age: 10.7 σ = 0.5	Average age: 10.5 σ = 0.6	Average age: 11.8 σ = 0.9	Average age: 11.5 σ = 0.7

Research methods, tests and tools

Research methods: psychological testing; questionnaire-based survey; systematic observation; psycho-pedagogical analysis of the products of the writing activity; psycho-pedagogical experiment; the case study method; statistical methods of data analysis with SPSS.13.

Tools:

1) The CONNERS Questionnaire for teachers, short version, translated

and adapted after *south lake/xl/850/856/conners questionnaire*

2) Tests for the assessment of the quality of writing and dysgraphia

a) The E Scale (EF and EM subscales) - instruments for *measuring the general level of graphism.*

b) The Dysgraphia Scale

Research variables: *Independent variables*: level of schooling, the criteria and tests for the assessment of ADHD; the assessment scales for the quality of writing and dysgraphia. *Dependent variables*: the frequency of ADHD symptoms; the frequency of dysgraphic symptoms, the quality of graphic activity; the level of dysgraphia correction; the degree to which the quality of writing has improved. *Content variables*: The activities and exercises in personalised psycho-pedagogical and logopaedic programmes for optimising the quality of writing.

Conducting the research

a) **The observational, pre-experimental phase (pre-test)** designed to assess the *mental processes involved in the acquisition of writing* and to assess the *written language disorders, in particular, the dysgraphia* affecting the pupils enrolled in the study. This research phase was carried out in the first semester of the school year 2015-2016.

b)**The corrective and formative phase, designed to enable school children with ADHD to practise graphic activities** through personalised psycho-pedagogical methods and programmes, applied in a differentiated manner, over the course of a school year, in speech therapy and counselling centres. The **personalised programme** proposed to each student was applied during the second semester of the 2015-2016 school year and during the first semester of the 2016-2017 school year, in the psychodiagnosis and speech therapy centres and in the classroom.

c) **The post-experimental phase (post-test)** was aimed at determining how efficient the intervention methods of the personalised psycho-pedagogical programmes were with regard to the mitigation/elimination of writing difficulties and of dysgraphia and to the improvement of the quality of writing. The assessment of the effectiveness of the personalised programmes was made at the end of the second semester of the 2015-2016 school year and at the end of the first semester of the 2016-2017 school year.

The duration, frequency and complexity of the programmes differed, depending on the severity of the symptoms and the types of writing difficulties.The implementation of the personalised corrective-formative programme and the analysis of the results are presented in detail in the case studies. The personalised psycho-pedagogical programmes included *sets of exercises* that were scheduled depending on the type of ADHD and the associated disorders that had caused dysgraphia, as well as depending on the level of writing conceptualisation and achievement in the case of each student.

Psycho-pedagogical interventions for the correction of dysgraphia in school children with ADHD and with associated disorders (DCD, visual-spatial impairments and specific learning disorders)

HE TYPOLOGY OF DISORDERS	SPECIFIC OBJECTIVES	PSYCHO-PEDAGOGICAL PROCEDURES
Attention disorders specific to ADHD	Reducing distractability and developing the capacity of sustained attention	Exercises for the development of attention capacities through the use of *items from the NEPSY battery, the Porteus Maze test and from the Prague barrage test.*
Hyperactivity/ impulsivity	Decreasing hyperactivity and motor impulsivity	Sensory-motor control exercises, using the *Test of the child's voluntary stopping of graphic movements* (A. Rey)
Proprioceptive dysfunctions	Attenuating proprioceptive dysfunctions and developing proprioceptive control	Exercises for developing global motor skills and fine hand motor skills, using *items from the tests proposed by A. Rey, De Meur and Staes*
Inadequate static posture	Correcting postural deficits that produce difficulties for graphomotor movement coordination	Exercises for training static postural control in order to achieve a good coordination of graphomotor movements
Disorders of hand motor skills	Developing hand and finger fine motor skills	Exercising digital gnosia and training the hand and finger fine motor skills Exercises for achieving a suitable prehension and manipulation of the writing instrument.
Disorder of the eye-hand coordination	Developing the capacity of eye-hand coordination	Tracing the outline of geometric figures, incomplete drawings, letters, etc., using tasksheets from the *"Graphic Exercises Notebook" (L. Netto and T. Rey) or the Frostig test*
Disruptions of the visual-spatial skills and of the visual-motor integration function	Developing the capacity of relating the tactile-kinaesthetic sense, visual perception and manual motricity	Exercises for developing the visual-spatial function and for visual-motor integration, by using tasksheets inspired from the *tests for the "organisation of points" (A. Rey, R. Feuerstein) and from the Bender-Santucci test*

Poor functioning of visual-spatial and visual-motor working memory	Alleviating the disorders of the working memory, the development and automation of visual-spatial and graphomotor mnesic programmes specific to the writing of letters and words.	Exercises for the development of visual-motor mnesic programmes and for their automation, by *using tests for the memorisation and graphic reproduction of essentially geometric figures* (*The Rey Complex Figure, the Test for the memorisation and reproduction of 15 graphic signs, using 5 repetitions*). Training cursive writing.
The insufficient development of metacognition	Developing the capacity to memorise the patterns of letters, to exercise graphomotor self-control, to correct writing errors and to optimise the execution of writing tasks	Exercises for training psycho-motor self-control, for correcting errors in writing letters and words, for planning the method of writing various types of essays, etc.

Comparing the averages of the scores on the Dysgraphia Scale obtained by pupils from grades II, III and IV, with ADHD and with different associated disorders, has outlined the fact that between the pre-test and the post-test there are differences with varying degrees of statistical significance, depending on the level of writing quality improvement through the reduction of dysgraphia.

Comparing the averages of the scores obtained on the *Dysgraphia Scale*, pre-test and post-test, by school children with ADHD and associated disorders

School children with ADHD and associated disorders/grade	**Pre-test**			**Post-test**			***t***	***p***
	N	***m***	***σ***	***N***	***m***	***σ***		
second: ADHD and DCD	14	18.92	5.28	14	17.25	4.41	0.914	> 0.05
third: ADHD and perceptive-spatial dysfunctions	14	14.78	4.02	14	10.46	3.69	3.331	< 0.003
fourth: ADHD and specific learning disorders	14	17.18	5.57	14	14.11	5.33	1.201	> 0.05

In the case of second-grade pupils with ADHD and developmental coordination disorders, there are no statistically significant differences between the pre-test and the post-test on the Dysgraphia Scale *(t=0.914; p> 0.05), confirming hypotheses* ***a*** and ***e.*** Dysgraphia frequently appears in these pupils, due to their hyperactivity/impulsivity and attention deficits; to these are added the specific symptoms of eye-motor developmental coordination disorder, a type of coordination that is important for the acquisition of writing skills.

Of course, if eye-hand developmental coordination disorders overlap the symptoms of ADHD, they may encourage the maintenance of dysgraphic manifestations, which are difficult to alleviate through writing exercises in the different subjects taught in school, through personalised programmes and through speech therapy.

Statistically significant differences (t=3.331; p<0.003) between the pre-test and the post-test occur for third-grade school children with ADHD and perceptual-motor disorders, whose quality of writing has improved, *confirming hypotheses* ***b*** and ***e***. This is explained by the fact that in the case of these school children, perceptual-motor disorders and some of the ADHD symptoms have been alleviated thanks to the personalised psycho-pedagogical programmes that were applied to them for five months, in the first semester and in the second semester of the school year.

The analysis of the results on the *Dysgraphia Scale* highlights the pathological nature of writing difficulties in fourth-grade pupils with ADHD and with specific learning disorders, the dysgraphia symptoms being chronic in their case. Thus, even though they have already attended three years of schooling and have followed personalised corrective programmes, there are no statistically significant differences between the pre-test and the post-test *(t=1.201; p > 0.05, confirming hypotheses* ***d*** and ***e.***

The analysis of the results on the *EM Scale*, also highlights the pathological nature of the graphomotor difficulties in reproducing letters and words in the case of fourth-grade school children with ADHD and with specific learning disorders. Thus, although they have been practising writing throughout their schooling years and have attended personalised corrective programmes, there are no statistically significant differences between the pre-test conducted in the first semester and the post-test conducted at the end of the second semester *(t*=1.421*; p > 0.05), confirming hypothesis* ***e.***

A qualitative study of the protocols has revealed hat the fourteen fourth-grade children with ADHD and with specific learning disorders have an incorrect graphomotor style, as also indicated by the low EF/EM ratio (<0.75). Due to the specific learning disorders with a neuropathological background, these school children's quality of writing is very poor, 12 of them having a dysgraphic writing ability, and 2 of them presenting agraphia.

On the basis of the data presented above, we can consider that the difficulties in learning how to write encountered by school children with ADHD and with specific learning disorders are

largely of a pathological nature, which can lead to chronic dysgraphia or even to agraphia. In DSM-IV and DSM 5, it is stated that specific learning disorders with a neuropathological causes tend to be very persistent, leading to chronic deficits of the writing ability, to dysgraphia or agraphia, and the improvement of writing in these pupils based on the personalised programmes is not considerable.

Comparing the results from the pre-test and the post-test stages shows that ***the research hypotheses are confirmed.*** *Thus, the more severe the disorders associated with ADHD are and the more pronounced their symptoms - as is the case of school children with specific learning disorders - the less will the level of schooling be reflected in the correction of dysgraphia.*

The effectiveness of personalised psycho-pedagogical programmes designed to improve the activity of writing is influenced by the heterogeneity and severity of the symptoms manifested by different school children, being the lowest in pupils with specific learning disorders, which have a neuropathological background.

The case studies – a total of six - were meant to highlight in more detail the effect of specific therapies – logopaedic, psychological and psycho-pedagogical, based on personalised programmes – on the disorders associated with ADHD and on improving the quality of writing among primary school children, by reducing dysgraphia. The period of assessment/ reassessment: *the school year 2016-2017.*

The aim of the personalised programmes was to enable the school children presented in the case studies to acquire the necessary graphomotor skills, to reduce their hyperactivity, to develop their capacity of sustained attention, through cognitive stimulation, which entails carrying out activities of varying difficulty that will allow pupils to obtain positive results, at their own learning pace.

General skills targeted: decreasing distractibility and developing their capacity of sustained attention; developing procedural, visual-spatial memory; developing psychomotricity; stimulating and developing perceptive-motor and spatio-temporal structures; building the capacity to discriminate the identical from the symmetrical in structures; forming and developing graphic skills; developing the psychoindividual skills required for the formation of independent behaviours.

Specific skills: developing eye-motor coordination; building orientation and organisation skills, as well as the capacity to structure space-time; forming and developing fine hand motor skills; developing writing skills (the graphic shape of letters and syllables, the spelling of words and sentences; the correct arrangement of texts on a page, leaving a margin and allowing for spacing between words; calligraphic/ legible writing.

The following *methods* and *means of education* were used: conversation, explanation, exercises, teaching games, independent work, individualised worksheets.

The *intervention team* was composed of a speech therapist, a psychologist, a special educator, the class teacher and the class educator, demonstrating the importance of working in a multidisciplinary team.

FINAL CONCLUSIONS

►The *low level of the quality of writing* manifested through dysgraphia in the school children with ADHD who participated in the research is the sum result of attentional deficits, of hyperactivity and impulsivity, as well as of other associated disorders (developmental coordination disorder, dysfunctions of space perception, specific learning disorders).

►The predictability of dysgraphia by applying the Bender-Santucci, Kohs-Goldstein and Rey Complex Figure tests and the tests from NEPSY battery targeting executive functions, visual-spatial functions and visual attention is attested by the ANOVA data, as well as by the values of the standardised and unstandardised coefficients and of their significance thresholds (p =.000). As the scores in these tests become lower, the scores on the Dysgraphia Scale become higher.

► The results on the EF subscale and on the EM subscale obtained by school children with ADHD highlight the deficits of handwriting caused by graphomotor difficulties, by the intensity and frequency of hyperkinetic/impulsive manifestations and by deficits in the sphere of attention and of the executive functions, as well as by the low level of space perception skills, or by eye-hand developmental coordination disorders.

► In the case of school children with ADHD, the persistence of the faulty components of writing, centered around motor incapacity, determines them to develop graphism at their own pace. School children with a high dose of impulsivity – hyperactivity have a *hasty-impulsive psychomotor style*, characterised by a small EF / EM ratio (<0.75), which leads to a poor quality of writing.

► In agreement with the views of some researchers (Corraze, Albaret, 1996; Pitcher et al., 2003; Thomas and Willems, 2005; Albaret, Soppelsa, 2008), we noticed in the school children with ADHD we examined parasitic graphomotor movements, variable or inappropriate motor reaction times, difficulties in fine motor skills, a poor coordination of complex graphic movements, a lack of feedback necessary for the control of hand movements, the slowness and/or inaccuracy of graphomotor gestures, etc.

► The perceptual-motor deficits detected in the writing of hyperactive second-grade children can be maintained due to their eye-hand developmental coordination disorders, to their

impulsivity – hyperactivity and to their attention deficits. These disorders determine a lower global level of graphism. Psycho-motor difficulties have a negative impact on the reproduction of calligraphic shapes, particularly in the first two years of children learning how to write.

► For school children with ADHD symptoms, the second grade is a critical school year for the acquisition of writing. At this school level, they should be switching from the *precalligraphic phase* to the *infantile calligraphic phase*, and the third grade is extremely important for consolidating the writing skills.

►The greatest disruptions of writing occur in school children with ADHD and with specific learning disorders, against the background of neurological dysfunctions of a dyspraxic nature. In the case of these pupils, dysgraphia is chronic, some of them presenting even symptoms of agraphia.

► The scores for the Rey Complex Figure test (copying and rendering from memory), and the high degree of disruption affecting perceptual-motor procedural memory and the capacity of graphomotor planning and organisation, have predictive value for the manifestation of dyspraxic and dysgraphic disorders in fourth-grade pupils with ADHD and with specific learning disorders.The low scores in the Rey Complex Figure test (copying and rendering from memory), and the high degree of disruption affecting perceptual-motor procedural memory and the capacity of graphomotor planning and organisation, have predictive value for the manifestation of dyspraxia and dysgraphia in fourth-grade pupils with ADHD and with specific learning disorders. The analysis of the results on the *Dysgraphia Scale*, in the tests from the NEPSY battery and in the Rey Complex Figure test has revealed the pathological nature of the writing difficulties faced by some school children with specific learning disorders and with ADHD.

►The fourth-grade pupils with ADHD show associated disorders, such as visual-constructive dyspraxia, as well as specific learning disorders with a neurological background, which explains why the dysgraphic symptoms persist despite the long-term period of practising writing, throughout schooling, in different academic subjects and despite being exposed to speech therapy. In the case of students with specific learning disorders and with ADHD, dysgraphia and dysorthographia are manifested through deficits in word-spelling accuracy, in the spatial organisation of the written text on a page, through the lack of handwriting fluency and legibility, of punctuation accuracy or of grammar correctness, in spite of the level of schooling and of psycho-pedagogical interventions through personalised programmes.

►Children who are at risk for severe dysgraphia (due to dyspraxia, to visual-spatial disorders and to graphomotor procedural memory disorders, etc.) must be identified very early on, preferably in kindergarten or in the first two primary grades, and they must trained to *write using a*

computer keyboard. Of course, using a computer for writing does not solve all the problems created by various disorders of written language, as are, for instance, the problems of severe dysorthographia. These disorders require the use of orthographic correctors.

►The case studies highlight the fact that primary school children with ADHD who have followed psychomotor and speech therapy, as well as personalised psycho-pedagogical programmes, have lower levels of dysgraphia and dysorthographia, showing an optimisation of their writing skills. Also, it turns out that team work is beneficial.

►The data obtained show that there are some differences between teachers from inclusive schools and those from noninclusive schools as regards their *general knowledge about ADHD, the ADHD aetiology, symptoms, diagnosis and treatment through pharmacological, psychological, pedagogical and psychosocial interventions.* To a great extent, teachers from inclusive schools demonstrate a more appropriate knowledge of all the aspects related to ADHD, both on the basis of scientific research and as a result of their direct experiences with such pupils, who are in relatively greater numbers included in this education system.

► Within the framework of continuing education programmes, teachers should benefit from special modules dedicated to the ADHD syndrome and to specific pedagogical and psychological interventions.

The value of the research, its limitations and new directions of research

►This research complies with the paradigms of educational sciences, having an unquestionable theoretical, methodological and practical value for the optimisation of psycho-pedagogical programmes for students with ADHD, with the purpose of increasing their academic efficiency in the area of writing.

►An **original contribution** with regard to the explanatory models of the functional structure of the factors involved in the acquisition and production of writing consists in the *"Dual-route cascaded model of word writing,"* presented in the theoretical part of this PhD thesis, a model which has been valorised in the research.

►The value of the research methodology consists in the combined use of some scales for the evaluation of ADHD symptoms, of some classic psychodiagnostic tests (Bender-Santucci, Kohs-Goldstein, Rey Complex Figure) and some tests from the NEPSY neuropsychological battery, with a view to outlining their predictive value for the manifestation of dysgraphia. The manner of conducting, interpreting and valorising the complex diagnostic tests, including through case studies, represents an **original contribution** of this PhD thesis.

►Moreover, through these psychological tests, we emphasised the psychological factors involved in the correct acquisition of writing, as well as the degree to which these factors are disturbed, with an impact on the emergence of difficulties affecting the formation of the necessary skills for writing activities. Based on the results of these complex assessments, we developed and applied personalised psycho-pedagogical programmes.

►We highlighted the effectiveness of personalised psycho-pedagogical and logopaedic programmes, developed on the basis of dynamic-formative assessments, as revealed in the case studies.

►In students with ADHD and associated disorders, *personalised psycho-pedagogical programmes* lead to a decrease in hyperactivity / impulsivity, in attention dysfunctions and in executive functions disorders.

►We found an improvement of visual attention, of the perceptual-motor function, of graphomotor procedural memory and of the executive functions – with a positive effect on the output of writing activities.

►The relatively long timespan envisaged for conducting the therapeutic approaches for pupils with ADHD, especially for the therapy of dysgraphia, demonstrates that in order to improve the effectiveness of psycho-pedagogical and logopaedic interventions we need to personalise them in keeping with the severity and the specific symptoms of ADHD and its related disorders (eye-hand developmental coordination disorders, perceptual-motor deficits, specific learning disorders with a dyspraxic background etc.).

►We should mention the fact that this research approached, for the first time in our country, the issue of ADHD-related disorders, with a focus on the specific design and implementation of personalised psycho-pedagogical programmes.

►The practical-applicative character of this research can be deduced from the conception of its research design, from the well-argued results presented and discussed here, as well as from the case studies based on complex psychological and pedagogical examinations; all of these are arguments in favour of scientifically validated personalised psycho-pedagogical programmes.

As regards the **limitations of the research,** we should mention:

►the inclusion in the research of a relatively small number of participants from each grade, pupils with ADHD and dysgraphia, limits the possibility of generalising the findings;

► all the pupils investigated had the combined type of ADHD, which did not allow an investigation and a psycho-pedagogical approach to the dysgraphia/dysorthographia of pupils belonging to the predominantly inattentive type or to the predominantly hyperactive/impulsive type;

►difficulties were encountered in making the personalised psycho-pedagogical programmes more efficient, due to the high degree of heterogeneity of the group of pupils with ADHD and with associated disorders, especially those with specific learning disorders caused by visual-spatial and visual-constructive dyspraxia.

The new research directions are aimed at:

►increasing the sample of participants who have dysgraphia/dysorthographia, in such a way as to comprise pupils belonging to the three types of ADHD: the combinedtype; the predominantly inattentive type; and the predominantly hyperactive/impulsive type.

►the dynamic psychodiagnostic assessment of students with ADHD and dysgraphia/dysorthographia over the course of several school years.

►conducting longitudinal psycho-pedagogical experiments based on the implementation of personalised, scientifically validated pedagogical and logopaedic programs and projects.

►conducting research on the effectiveness of the curricular approaches from the continuous training modules related to the characteristics of students with ADHD and their consequences on an academic level, so that teachers can collaborate more efficiently with speech therapists, with psychological counsellors and with support teachers for the prevention or for the therapy of dysgraphia/dysorthographia.

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