

Diagnosis of the audio-verbal memory as a basic modality of mnemonic processes of elementary school children with Dyslexia

Zhanna Svirska

Kryvyi Rih State Pedagogical University, 54, Gagarina Ave.,
50086, Kryvyi Rih, Ukraine

sirkomama@i.ua

Abstract. The article is devoted to the first Ukrainian research of the audio-verbal memory as the basic modality of the mnemonic processes necessary for successful mastering in text reading skills. More specifically, we observe the correlation between the number of immature mental processes and barriers in the perception and active processing (decoding) of information for elementary school children. We could see that mastering in the reading skills is greatly influenced by impairment of the audio-verbal memory for children with specific disorders of psychological development. This research is the only one in Ukraine that defines and determines the performance indicators of audio-verbal memory, its qualitative and quantitative characteristics for the young children with Dyslexia. Studying the age-related dynamics of memory of children with Dyslexia has shown that its varieties have a different rate of development intensity: the basic parameters of audio-verbal memory of children with impaired reading skills have improved significantly with aging.

Keywords: dyslexia, elementary schoolchildren, hearing-speech memory, diagnosis, analysis, inclusion.

1 Urgency of the research

Reading as a process of perception and active processing (decoding) of information is a complex perceptual mnemonic-thinking activity. Early and modern researchers agree that reading is a heterogeneous mental process, observing this heterogeneity as a characteristic that makes it difficult to master the information decoding process and its research.

According to legislative documents, vulnerable groups of children include those who may encounter learning difficulties, including disorders characterized by impaired reading skills. This complex disorder which is typical for children with normal intelligence who have significant difficulties in memorizing letters, understanding words, symbols and figures, is called “Dyslexia” (from the Greek. $\Delta\nu\sigma$ — disorders, $\lambda\varepsilon\xi\iota\varsigma$ — language). Dyslexia is characterized by difficulties in quick recognizing of familiar words and decoding unfamiliar words in reading and writing.

In the Chartbook “International Classification of Diseases of the Eleventh Edition (ICD–11)”, dated June 18, 2018, dyslexia is interpreted as impaired recognition of various signs, symbols, on the basis of which difficulties arise in understanding them.

To understand the phenomenon of dyslexia people traditionally address specialists in speech therapy — those who are working with impairments of writing, reading. This is due to the fact that the difficulties in teaching to read, for a long time, our scientists associated only with problems in the processing phonemes and impaired speech development. Unfortunately, this stereotypical vision has not produced the desired results.

It should be taken into account that for English-speaking countries this issue is urgent, since written English is very difficult to learn, and dyslexia is diagnosed there more often (according to the International Dyslexia Association, up to 12% of the population). The urgency of the study is based on the high prevalence of such a disorder in the world and a constant increase in our country. Therefore, diagnostic process is an important condition for effective assistance to children with dyslexia. As a consequence, it is important to study audio-verbal memory as the basic modality of the mnemonic processes necessary for successful mastering in text reading skills

2 The objective of the research

The objective of the research is to diagnose the state of impairment of the audio-verbal memory for children with specific disorders of psychological development.

Hypothetically, we suggest that children with signs of dyslexia have impairment of the audio-verbal memory compared to their age norm.

3 Methods and research methodology

Methods and research methodology: fundamental scientific and theoretical ideas of psychological science about the laws of individual mental development; neuropsychological ideas about systemic organization of higher mental functions; principles of psychology on the dynamic unity of verbal and mental development. Empirical methods: observation, conversation, survey; diagnosing by the method of “Express diagnostics” Luria-90”; methods of mathematical analysis: data correlation analysis.

The slowdown in mastering the reading skills of students is associated with disorders of complex psychophysiological mechanisms, which involve various cortical analyzers: visual, speech-motoric, speech-auditory ones.

A statement of O. Luria that memory is a prerequisite of the reading experience formation, [1, p. 12] allows suggestion of its disturbance for children with learning difficulties. Some researchers believe that the disorder is associated with problems of the “working memory”, so scientists put forward the hypothesis that dyslexia is caused by mnemonic processes deficit and disorders in the storage and replication of information (E. Witruk, M. Bogdanowicz, J. Magnuson, A. Kukona, D. Braze, C. Johns, J. Van Dyke, W. Tabor, W. Mencl, K. Pugh, D. Shankweiler [2–5].

Prominent authorities of the field also point on the non-formation of a certain mental processes, including memory, of pupils, that have difficulties with reading. Especially convincing are thesis of T. Kalashnikova, Y. Kravtsov, A. Kornev, O. Ishimova, O. Perepada, L. Tsvetkova and others) [6–10].

Although this idea is not shared by all (Wolff & Melngailis) [11], there is lack of special researches devoted to the study of different types of memory of children with impaired reading skills. In addition, the literature available to us has not revealed studies of memory of students with dyslexia, which would analyze peculiarities of its functioning. However, knowledge of this specificity makes it possible to individualize programs of study in post-classical education. Currently, the state of mental processes in most of the works of domestic authors, in general, is presented within the psychological and pedagogical characteristics of children with ADHD (A. Kornev, O. Ishimova, O. Perepada, L. Burlachuk) [6, 9, 12].

Thus, the analysis of the literature indicates that researches of working memory for impaired reading cases are fragmentary in terms of tasks, not numerous and don't provide an understanding of the mnemonic processes state of elementary schoolchildren. The lack of fundamental works has a negative impact on the theory of predicting the education of students with dyslexia.

A timely thorough diagnostic process is an important prerequisite for effective assistance to children. In this regard, it is relevant to study the audible memory as the basic modality of the mnemonic processes necessary for the successful acquisition of reading skills.

The empirical study was conducted on the basis of an inclusive-resource center (city Dnipro, Desnyanskiy district), schools № 190 (city Dnipro), № 35, № 74 (city Kryvyi Rih). The diagnostic examination was carried out at the end of the school year. Based on the goals and objectives of the study, reached the sample group of respondents: 35 persons aged 7–10 years and enrolled in grades 2–4. Respondents had different sexual parameters.

To obtain the normative values, a group of 29 students with normotypic development (15 boys and 14 girls) was formed. According to the medical records, hearing, vision and intelligence of all students is recorded within the age norm. These children formed a control group.

At the same time 6 students (4 boys and 2 girls) of the same age with a specific disorder of psychological development were selected. Based on the complex psychological and pedagogical evaluations were diagnosed the signs of dyslexia, which causes learning difficulties. According to the results of the developmental examination, students have the conclusion of an inclusive-resource center about the need to study with a psychologist and corrective speech therapist. Those children were included to the Experimental group.

By age, the group was distributed in the following order (Table 1):

Table 1. Distribution of control and experimental groups by age

class	age	control group	experimental group
2	7–8 years	8 students	1 student
3	8–9 years	11 students	2 students
4	9–10 years	10 students	3 students

It should be noted that the study was conducted in the morning. Testing of junior pupils was carried out individually, all tasks were offered in a play form, the examination took into account the mood of the child, his physical health.

Among the causes of Dyslexia researchers determines the factors that influence the development of the brain during a prenatal, puerperal and postpartum periods – infections (e. g. herpes) during pregnancy or overuse of the toxic substances. Childbirth anomalies are important: asphyxia of the fetus, premature detachment of the placenta. This means that it is necessary to find out the results of pregnancy pathology and childbirth while examining the children of the experimental group.

The anamnesis of two mothers of the researched children (Timothy, Myroslava) contained reports of severe pregnancy toxicosis, one of them with the phenomena of a threatening miscarriage, but all were born full-term. One girl suffered a birth trauma (Myroslava), and three children (Timothy, Ivan, Anna) had asphyxia during childbirth. Despite this, all infants were applied to the breast in 2–3 days after birth. One boy was seriously ill with measles (Ivan) and had complications after other Infectious diseases (flu).

Two students (Timothy, Myroslava) expressed neurotic effects related to the symptoms of dyslexia: spewing between meals; anxiety, myoclonia in sleep and shuddering sounds; tearfulness and unfounded concern.

Analysis of motor functions revealed some delay in development for two children (Timothy, Andrew). They began to sit in age from 8 to 9 months and walk alone — at 13–14. In four children the development of motor functions was within the low norm of the age (Timothy, Andrew, Dmytro, Anna).

Analysis of the speech ontogeny of children in this group shows significant difference from the normal development. The first words of one boy (Andrew) appeared from 1 year and 3 months to 1 year 8 months of life, the other (Timothy) — from 1.5 to 2 years. Andrew, Dmytro and Hanna began to develop the phrase speech only after 2.5 years and then there was a long period of its formation. In 3 years they could say simple phrases, but the speech was not clear. Phrase speech of two children (Timothy, Myroslava) actively developed after 3 years; they were late with the forming of complex lexica-grammatical structures. In the future, speech developed slowly, but hereditary speech pathology was not noted. Andrew's close relatives had minor speech defects (functional dyslalia, sigmatism).

No child in the experimental group has eating disorders. However, the observation did not record deviations of the ability to absorb new knowledge and learning abilities in general. Pathological peculiarities in the process of examination of intelligence, thinking, perception, attention is also not revealed.

The children were active enough and able to work at the beginning of classes for 10–15 minutes, in the future they concentrated attention poorly, were distracted and restless. Parents say during the survey that when students return from school, they are nervous, crying, sleep badly, often waking up in the middle of the night.

Specialists of the school noticed a lack of attention, impaired ability to work, and memory impairment in the psychological and pedagogical characteristics of students. For example, a characteristic given by a teacher to Myroslava (2 nd grade, 9.5 years) states that “A student reads badly, confuses letters, rearranges syllables, pauses between words and does not divide them. Myroslava has difficulty reading and recognizing individual letters, especially when she is called to read the first. Classroom work cannot be done if it's needed to read or write a task from the textbook. The schoolgirl has a weak memory, she remembers if you repeat reading the text several times. A student remembers texts by heart extremely bad. The same letters are confused during the reading and writing”. During

the examination in the inclusive-resource center, it was found that in the girl has dyslexia accompanied by dysgraphia. School achievement in the subjects of written and oral cycles is low.

Keep in mind that the “Typical educational program” for secondary schools, developed by O. Savchenko and others, defines the following in the “Reading” content line. With completing studies in 1 class, the student masters the basic skills of reading. They should read aloud simple texts mostly intact (words with complex structures — by syllables); to demonstrate the understanding of the meaning of most words in the process of reading, to pay attention to unfamiliar words. The Ministry of Education and Science of Ukraine has defined the criteria for speed of reading, expressiveness, correct use of accents [13].

An analysis of the results of the observation of the experimental group confirmed that all students had both a lateral and a verbal form of dyslexia. The problems with mastering the alphabet, and a variety of specific persistent errors were found for 6 pupils of 2–4 classes. In particular, Andrew (grade 3, 9 years and 10 months) often uses double reading: “silent” — a whisper of letters, aloud — in syllables or in whole words. Myroslava (2nd grade, 9.5 years old) does not distinguish (“does not see”) the letters “r, k, l” thus misses it while reading; Dmytro (Grade 3, 9.5 years) and Timothy (3 class, 10 years) swallowed letters and their combinations, are constantly losing the string or repeatedly returned to the word they have read. The boys complain that when they have to read the condition of the task on their own, they are not always able to read it, and therefore to understand it. Anna (4th grade, 11 years old) reads the text correctly in content, if it is illustrated with a picture, but tries to guess words, always has difficulty in reading individual words.

The analysis of medical and pedagogical documentation in the anamnestic records of the studied children of the control group reflected that serious disorders of the prenatal development, childbirth and early development were not recorded. The synchronous development of motor and speech functions was observed for all participants. None of the parents of these children indicated a delay in motor or speech development.

The characteristics and results of the observations indicate that all children at the time of physical, mental and speech development were in line with the age norm. No student has experienced difficulties in mastering reading skills. Errors that occurred in reading, called random, that is, non-frequency and consistently repeated.

To solve these problems, we used a neuro-psychological method developed by E. Simernitskaya Technique “Express diagnostics” Luria-90

specifically for the diagnosis of preschool children and elementary schoolchildren [14]. This is an extended version of the 1985 technique that contains the task of examining basic functional systems of the brain. The technique involves 4 tasks on short-term and long-term memorization of verbal and nonverbal material from which a series of 10 sets of sub-tasks. The results are evaluated quantitatively by the scoring system. Qualitative analysis of quantitative indicators allows conducting topic-diagnostic interpretation for 6 possible brain structures: frontal, rectilinear, temporal, left-hemispherical, occipital rectilinear, structural connections of the corpus callosum and left hemisphere.

Luria-90 express diagnostics is focused on qualitative and quantitative analysis of the state of audible-hearing memory of children in the conditions of short-term and long-term memorization.

The technique analyzes 6 parameters of hearing memory. This analysis is performed using 6 series. Each parameter was evaluated according to the results of an experimental study in which there were 6 series.

Auditory memory has been evaluated in the process of oral reproduction of words suggested for oral memorization. Series had a clear sequence so that to describe the experiment over and short and long-term memory. The number of the series indicated the sequence of experimental tasks. All series were run without interruption. The research was conducted individually. During the experiment, each diagnosed person was filled out with a protocol indicating the answers as well as mistakes made by the student while reading. After completing series 6, the process of psycho-diagnostic research was considered complete.

The table 2 shows the analyzed parameter of memory.

Table 2. Hearing memory parameters

1	The amount of short-term hearing memory.
2	Inhibition of auditory traces (words), indicating the processes of forgetting verbal material.
3	Strength of auditory traces (words), which characterizes long-term hearing memory.
4	Playing the sound structure of words.
5	Recognizing words that have been suggested for hearing.
6	Randomness and control of hearing memory. Characterizes the level of development of the random memory.

The evaluation results of diagnosis performed in the scoring system proposed by E. Simernitskaya. Results of the series number 1, 2, 3, 4, 6

performance were evaluated by the 10 – point scale, and the results of a series number 5 was determined by the number of committed errors, for each of which counted appropriate point. The maximum score means there are maximum violations.

Standard procedures were used in the statistical processing of the experimental data. According to this, we compared equally relevant distribution of experimental data with a theoretical law of distribution (Poisson's distribution, the normal distribution of Gauss). To confirm the empirical and theoretical laws of distribution, the processing was performed by the criteria χ^2 (ksi-squared). The agreement recognized reached if the probability was not less than $p=0.95$. Then we calculated confidence intervals for the average normal population by using t – criteria Student and comparison of average values of Poisson sampling.

Hypothesis of the differences in experimental data obtained for samples with frequency characteristics was checked by using dispersion analysis (F – criterion by Fischer). Intermediate calculations of received empirical data were performed using software for mathematical processing – Microsoft Excel and package statistical program SPSS-19.

Short-term hearing-speech memory volume diagnosis of the control group proves that the process of memorizing words of students in different classes somewhat differs. Second-graders restored in memory only 3 words from 5 after the first group of words. They should hear the material three times in average to reproduce the full amount of words in the group. The average score of this indicator was $t=2.25$ points. Third and fourth-graders memorized experimental material the same: after the first sound they reproduced 4 words from 5. On average, these children are able to remember full amount of proposed words in the second attempt, which expresses the average estimate of $t=1.81$ score to 3-d grade and $t=1$ point for 4th grade.

According to this research reflects that younger students can hold in short-term memory all five hearing-speech stimuli (words) after the second calling in normal. The amount of short-term hearing memory in children of the control group reflects the indicator $t=1.6$ points.

Diagnosis of inhibitory hearing-speech traces found that younger pupils held in memory and correctly replicated words from the first and the second group of words after the second attempt of hearing because of the lack of the inhibition impact effects (from previous and subsequent stimuli). The average score of this indicator for the second-graders was $t=1.6$, third-graders – $t=1.1$ and fourth-graders – $t=1.41$. Differences in the characterization of the inhibition traces in all age groups were not statistically significant ($p<0.95$).

The research revealed the absence of inhibitory (from previous and subsequent stimuli) influences on the process of memorizing the auditory stimuli of the entire control group, which is reflected in the overall estimate of $t=1.28$ points. It means that students have resistant hearing-speech traces, because adverse stimuli essentially not affected them and do not lead to their inhibition.

Study of the hearing-speech traces strength convinced that the control group of 2-nd and 3-d grade required triple repetition and direct playback of verbal stimuli to keep them in long-term memory and reproduce in full volume. The average grade of this indicator for the second-graders was $t=1.98$, the third graders — $t=1.4$. Fourth — graders needed a double word spelling. Assessment of hearing traces — $t=1.08$ points.

Children of the 2–4 grade control group could firmly hold a long-term memory hearing-speech incentives and reproduce them in full volume after they listen to and immediately duplicate incentives twice.

Studying the sound structure of words convinces that the pupils of primary school properly remembered and replicated sound structure of words. The replacement of words that were similar by sound or by meaning happened rarely both in the short and in the long term reproduction. The average grade of this indicator of the second-graders is $t=0.69$, third — graders — $t=0.17$ and fourth — graders $t=1.13$. The differences in the characteristics of the sound structure of words were not statistically significant in all age groups, that testifies of such results of research for students of 2–4 grades.

Words recognition process of different classes students was different as well. Second-graders generally erroneously indicated 4 words, third-grade — 2 words, and fourth — performed the task without errors. The average score for 2-nd grade is $t=4.13$, 3-d grade — $t=1.9$ and 4-th — $t=0.6$.

Research results analysis of the randomness and control of hearing-speech memory proves that the perseveration or adverse association in the reproduction of words rarely appears for children of the control group. They did not call the words twice and the words that were not voiced earlier. It is defined that the average score of the index for the second-graders is $t=0.78$, third — $t=0.74$, and fourth — $t=0.25$. The differences in the characteristics of randomness and control of the hearing-speech memory in all age groups are not statistically significant. That proves the similarity of the results of research for younger students.

According to the diagnosis it was identified that randomness and control parameter of the hearing-speech memory of the control group shown in the general assessment $t=0.56$. The level of the indicator shows a conscious

organization of the hearing-speech mnemonic activity aimed at random memorization and accurate reproduction of the audio information.

Research results analysis of all memory parameters of control group students shows that level of hearing-speech mental capacity of children expressed in an average index $t=6$ points. For second-graders, this indicator corresponds to the level of $t=11.1$ third – graders – $t=6.98$ and fourth – graders – $t=4.40$.

The measurement of the short-term memory volume of the experimental group students indicates that the process of memorization of students of different classes is slightly different. Second-graders memorized and reproduced only 3 from 5 words voiced in the group of words. It's needed three times for them to repeat words to reproduce it in full volume. Third- and fourth-grade pupils memorized material similarly: after the first attempt they reproduced 4 words from 5. On average, children with signs of dyslexia remembered a proposed number of words in the full scope after the second attempt.

Diagnosis showed that students with disorders that are characterized by the impairment of the reading skills kept in short-term memory five hearing-speech stimuli (words) after the second pronunciation. The short-term memory volume of the experimental group children reflects the indicator $t=1.79$ points.

Research of the hearing-speech traces inhibition found that students of all ages of the experimental group were not able to memorize and replicate the words of both first and the second words group not only after the second sound, and even after of the third speech. Students with signs of dyslexia could keep in memory and correctly reproduce the words only after the fourth attempt. Four students mispronounced the first and second group of words after five attempts. Average score of hearing-speech trace inhibition of the 2-nd grade students is $t=3.63$, 3-d grade – $t=2.85$ and 4-d grade – $t=2.4$. The differences in the characteristics in all age groups are not statistically significant ($p<0.95$). Average total score $t=2.99$ points. This means that for children with specific disorders of psychological development these traces are stable, and affected side stimuli, which leads to inhibition of traces.

The hearing-speech traces strength study showed that sounding twice and direct reproduction of hearing stimuli (words) is not sufficient for students with difficulties in acquiring reading skills to achieve durable retention of traces in long-term memory. The results of research found distortions in 85% of children with signs of dyslexia. The average score of this indicator for the second-graders – $t=4.41$, third-graders – $t=2.83$ and

fourth-graders $t=2.09$. Number of errors had positive dynamics from class to class, that is statistically confirmed ($p>0.95$).

It should be noted, that second-graders needed five times to repeat words to keep these trails in the long-term memory and reproduce them in full volume; third — graders needed four attempts; fourth-graders needed three times to repeat words.

In order for children with signs of dyslexia to firmly retain stimuli in long-term memory and to reproduce them in full, they need to listen to the stimuli four times. Score of the strength of the hearing-speech traces for the group is $t=3.18$ points. This means that the time lapse between direct and delayed reproduction affects memory traces, and therefore affects the performance of long-term memory of children with impaired reading skills.

The sound structure of the words was evaluated during the entire research. The results of this parameter: 91% of students with dyslexia signs distort the sound structure of words. The average score of this indicator in all classes is $t=0.52$. Responses to both short-term and long-term reproduction were replaced by words close to a particular word by sound or content. For the 2nd grade students this indicator is $t=0.68$, for third grade students it is $t=0.46$, for fourth grade students it is $t=0.1$.

The words recognition process was impaired in 91% of children with specific developmental disorders. The average value of this indicator is $t=4.08$ points. Students who did not master the reading skill did not recognize all of the suggested words, evaluating new ones as the ones heard earlier.

We emphasize that the process of recognition among students of different classes also differed. For the 2nd-graders this indicator was $t=6.81$, for the 3d-graders $t=3.71$, and the 4th-graders $t=1.4$. 2nd-graders, on average, spelled 7 words incorrectly, sometimes unable to recognize the words they had heard before. Third-graders did not recognize 4 words, and fourth-graders — 2 words. Differences in the characteristics of recognizable words in all age groups were statistically significant, therefore, the results of the study had a positive trend ($p=0.95$).

Analysis of the results of the diagnosis of randomness and memory control showed that for 91% of children with signs of dyslexia this parameter is disturbed. Perseverations and side associations have often occurred in the reproduction of words. Children have repeated the words and also called the words they were not offered. For 2-nd grade students this indicator is $t=4.72$, third-graders $t=1.85$, fourth-graders $t=2.1$. Despite the difference in numbers, the characteristics of randomness and memory control in all age groups are not statistically significant.

The parameter of randomness and memory control for children with signs of dyslexia has an overall estimate of $t=2.90$. The level of this indicator shows the low level of randomness of the mnemonic activity.

Therefore, the results of studying different memory parameters illustrate its impairment in 83% of children with specific disorders of psychological development. Hearing ability was expressed by the average score $t=15.64$. Second-graders score was $t=23.69$, third-graders $t=12.37$, fourth-graders $t=10.74$.

The short-term memory volume parameter was preserved for children with signs of dyslexia. Disturbed parameters are the inhibition of hearing-speech traces (words) that indicates the processes of forgetting verbal material; the strength of hearing-speech traces (words) that characterizes long-term memory; reproduction of the sound structure of words, words recognition and memory control.

The vast majority of memory impairments had statistically significant positive class-to-class dynamics. An exception is the parameter of inhibition of hearing-speech traces (words), as well as the randomness and control of memory, the characteristics of these disorders remained stable and did not change with age.

Comparative analysis of the results of diagnosis of hearing-speech memory of the control and experimental groups. Comparative data is shown in the table 3.

Table 3. Comparative results of diagnostic hearing-speech memory of the control and experimental groups

№	Memory parameters	Score in points (t)	
		Control groups	Experimental groups
1	The volume of short-term hearing memory	14	*33
2	Inhibition of hearing-speech traces (words)	8	*30
3	Strength of hearing-speech traces (words)	22	*62
4	The sound structure of memorized words	19	57
5	Words recognition	14	*29
6	Randomness and control of hearing-speech memory	14	54

NOTE: the * sign indicates statistically valid data

4 Conclusions

As a result, it becomes obvious that the audio-verbal memory functions differently. All memory scores of the control group were better than those of the experimental group.

Thus, it can be seen that disorders of mnemonic processes greatly influences the difficulty of mastering in reading skills in the process of perceiving and information active processing (decoding) for schoolchildren who have a specific disorder of psychological development with signs of dyslexia.

Diagnosis of the audio-verbal memory of the children aged 8–11, who successfully decode information in the process of reading allowed obtaining performance indicators of these mental functions. Quantitative and qualitative characteristics of audio-verbal memory for elementary school children have been determined.

The results of the research illustrated that for almost all the children (83%) with signs of dyslexia, the following impairments of audio-verbal memory are noticed:

- high inhibition of audio-verbal traces (words),
- low strength of audio-verbal traces (words),
- impaired reproduction of the sound structure of words,
- impaired recognition of words for aurally memorizing,
- low level of randomness development and memory control.

It has been found that for children with a specific disorder of psychological development, that causes learning difficulties, the parameter of the short-term memory volume does not differ from the norm.

Studying the age-related dynamics of memory of children with Dyslexia has shown that its varieties have a different rate of development intensity: the basic parameters of audio-verbal memory of children with impaired reading skills have improved significantly with aging.

Comparing the results of diagnosing the memory of children without impairment with the results of diagnosed children with signs of dyslexia illustrated that most of these children had shown deviations from the norm of varying degrees of nearly all the defined parameters of audio-verbal memory.

Psychological support of a child with psychophysical development peculiarities includes educational content in the conditions of inclusion, which will increase the level of its autonomy and social activity, will

promote the development of intellectual sphere, the formation of values that correspond to the mental and physical abilities of the child [15]. Based on the data obtained as a result of diagnostics, psychotechnics for the different memory types development should be introduced to the main areas of work with children with special learning difficulties. The work aimed at developing audio-verbal memory is not a special link that starts or ends a process. It is performed in a step-by-step correction system conducted by a psychologist and correction speech therapist for children with dyslexia.

References

1. A. Luriya, *Ocherki psikhofiziologii pisma* (Essays in psychophysiology of writing), (Akademiya, Moscow, 2002)
2. E. Witruk, C. S.-H. Ho, U. Schuster, in *Basic Functions of Language, Reading and Reading Disability*, ed. by E. Witruk, A. Friederici, T. Lachmann. *Neuropsychology and Cognition*, Vol. 20, (Springer, Boston, 2002), p. 281–297
3. M. Bogdanowicz, *O dysleksji, czyli specyficznych trudnościach w czytaniu i pisaniu* (On dyslexia, or specific difficulties in reading and writing). (Wydawnictwo Linea, Lubin, 1994)
4. J. Magnuson, A. Kukona, D. Braze, C. Johns, J. Van Dyke, W. Tabor, W. Mencl, K. Pugh, D. Shankweiler, *Dyslexia across languages: Orthography and the brain-gene-behavior link*. (Brookes Publishing Company, Baltimore, 2011)
5. P. Tamboer, H. Vorst, A New Self-Report Inventory of Dyslexia For Students: Criterion and Construct Validity. *Dyslexia*, **21** (1):1–34 (2015). doi: 10.1002/dys.1492
6. A. N. Kornev, O. A. Ishimova, *Metodika diagnostiki disleksii u detey* (Methods of diagnosis of dyslexia of children). (Izdatelstvo Politekhnikheskogo universiteta, Sankt-Peterburg, 2018)
7. L. Zhuravleva, *Naukovyi chasopys NPU imeni M. P. Drahomanova. Serii 19. Korektsiina pedahohika ta spetsialna psykhohihiia*. **33**, 16–22 (2017)
8. T. Kalashnikova, Y. Kravtsov, *International neurological journal*, **7** (2006)
9. O. Perepada, *Bulletin of the T. H. Shevchenko National University “Chernihiv Colehium”*, 121 (2), 84–87 (2014)

10. L. S. Tsvetkova, *Neyropsikhologiya scheta, pisma i chteniya: narusheniye i vosstanovleniye* (Neuropsychology of counting, writing and reading: Disruption and Recovery). (Yurist, Moscow, 1997)
11. P. Wolff, H. Melngailis, *American journal of medical genetics*, 54 (2), 122–131 (1994). doi: 10.1002/ajmg.1320540207
12. L. F. Burlachuk, O. M. Perepada, *Scientific Journal of National Pedagogical Dragomanov University. Series 12. Psychological Sciences*, **37**, 254–256 (2012)
13. O. Savchenko, *Typova osvitnia prohrama, rozroblena pid kerivnytstvom Savchenko O. Ya.* (Ministry of Education and Science of Ukraine, Kyiv, 2019), <https://mon.gov.ua/storage/app/media/zagalna%20serednya/programy-1-4-klas/2019/11/1-2-dodatki.pdf> Accessed 18 Dec. 2019
14. E. G. Simernitskaya, *Neyropsikhologicheskaya metodika ekspres diagnostiki “Luriya-90”* (Neuropsychological method of express diagnostics “Luria-90”), (Obshchestvo “Znaniye” RSFSR, Moscow, 1991)
15. Law of Ukraine of September 5, 2017 № 2145–VIII “On Education” (2017), <https://zakon.rada.gov.ua/laws/show/2145-19> Accessed 18 Dec. 2019