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**METHODOLOGICAL ASPECTS OF ASSESSING THE LEVEL OF YOUNGER STUDENTS'
SPEECH DEVELOPMENT ON THE BASIS OF AN INTEGRAL INDICATOR
FOR THE PURPOSES OF SPEECH DIAGNOSTICS**

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Abstract

The article touches upon the topical question for the speech therapy practice of accuracy and informativeness for the specialists in the methods of psychological and pedagogical examination of speech of younger school children. The hypothesis of this study was the assertion that when developing new diagnostic methods, one should pay more attention to the combination of separate speech or language tests in the structure of the whole method, as well as assess their influence on the overall result to obtain the accurate data about the level of speech development of students and the nature of the identified violations. The most important criterion of a diagnostic technique should be the accuracy of the result. To diagnose the level of the speech development of younger school children, it is proposed to apply an integral indicator of the speech development, developed with the use of an integral score method.

Keywords

Diagnostic methods of the speech therapy – Speech development – Speech system

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Introduction

In modern Russian education, a speech therapist practice cannot be isolated from the educational process. The requirements of the Federal State Learning Standard (GEF) list specialists recommended for assisting children with speech disorder who go to educational institutions. The biggest significance among the listed specialists is assigned to a speech therapist. According to the Federal State Learning Standard, the duties of a school speech therapist include examining students with disabilities, determining the structure and severity of their speech disorders using special methods and tools to simulate special conditions in which students can show progress in cognitive motivation, independence in learning activities, and training competencies. As a rule, speech therapists use techniques that can be used to comprehensively examine students' speech, and sometimes even other higher mental functions.

Most complex approaches for speech disorders diagnostics, being developed and based on traditional speech therapy technologies, are now accessible for speech therapists, but they are a reflection of the internal speech matrix as a system function. The language material of the methods is divided into sections, corresponding to the basic speech structural components (the phonetic and phonemic side of speech, the lexical and grammatical side of speech, coherent speech, and written speech).

The authors and developers of the diagnostic techniques focus primarily on the functional basis of speech, and that determines the validity and reliability of the results and makes it possible to apply the results in the practice of speech therapists, teachers, and psychologists. Standardized methods can be used as a common means of assessing the speech of students by different practitioners such as speech therapists and pathologists, psychologists, neuropsychologists, etc., which solves the main diagnostic problem to identify disorders of children's speech development.

Since the beginning of 2000 in Russia, there was a surge in the interest of speech therapists and practitioners to standardize their methodological tools, as a result, speech therapies have enriched their tools arsenal with a number of standardized methods aimed at diagnosing the speech of children of different ages¹ However, the advent of standardized techniques has caused discrepancies among experts on the accurate diagnostics of speech or language disorders. The same trend is observed in foreign studies² indicating the danger of using these diagnostic methods for all categories of

¹ G. V. Babina, "Standardized methodology as a tool for evaluating the analysis of the text of schoolchildren with speech underdevelopment", *Science and school*, num 6 (2011): 127-131; T. A. Fotekova, T.V. Akhutina. *Diagnosis of speech disorders of schoolchildren using neuropsychological methods. Manual for speech therapists and psychologists* (Moscow: ARKTI, 2002); L. N. Mochalova, "Standardization of the methodology of evaluation of text analysis in students of fifth grades", *Journal of the Northern (Arctic) Federal University. Series: Humanities and Sociological Sciences*, num 3 (2011): 143-146 y R. Paul and C. F. Norbury, *Language Disorders from Infancy through Adolescence: Listening, Speaking, Reading, Writing and Communicating*. 4th edition (St. Louis, MO: Elsevier, 2012).

² S. K. Betz; J. R. Eickhof and S. F. Sullivan, "Factors Influencing the Selection of Standardized Tests for the Diagnosis of Specific Language Impairment", *Lang Speech Hear Serv Sch.*, Vol: 44 num 2 (2013): 133-146; G. Conti-Ramsden; N. Botting and B. Faragher, "Psycholinguistic markers for specific language impairment (SLI)", *Journal of Child Psychology and Psychiatry*, Vol: 42 num 6 (2001): 741-748; M. A. Kerr; S. Guildford and B. E. Kay-Raining, "Standardized Language Test Use: A Canadian Survey", *Journal of Speech-Language Pathology and Audiology*, Vol: 27 num 1 (2003):

students in an inclusive school without taking into account the individual characteristics of children. Many factors affect specialists when choosing certain tests or methods for an accurate assessment of children's speech development³. As a result, they do not always correspond to an acceptable level of both sensitivity and specificity for developmental disorders studied in children⁴.

Standardization involves a uniformity of the procedure for conducting speech therapy examinations and evaluating its results. Nevertheless, the practice of using such techniques shows that the outcomes are interpreted selectively and not holistically by different specialists (the speech therapist chooses the language component of the technique, the psychologist relies more on cognitive tests, the neuropsychologist uses neuropsychological tests). A similar phenomenon, in our opinion, is connected not only with the disunity of those areas that can be integrated into the fabric of the diagnostic technique, but, to a greater extent, with a different understanding of the content of the fundamental terms that ensure the semantic and technological unity of the various speech therapy diagnostic techniques.

In the studies prior to this publication⁵ it is shown that various parameters of a speech therapy diagnostic technique cannot and should not be considered equivalent when assessing the current level of speech of a child of a certain age. As a result of the analysis of the interaction of different speech components (parameters), represented by individual tests of the diagnostic technique⁶, it was proved that there are parameters that are basic for assessing the speech development of younger school children, which simultaneously act as markers of disordered inner speech mechanisms of children of this age group.

10-28; J. C. Friberg and T. L. McNamara, "Evaluating the Reliability and Validity of (Central) Auditory Processing Tests: A Preliminary Investigation", *Journal of Educational Audiology*, num 16 (2010): 4-17; T. M. Shahmahmood; N. N. Ansari and Z. Soleymani, "Methods for identification of specific language impairment", *Audiology*, num 23 (2014): 1-18 y T. M. Shahmahmood; S. Jalai; Z. Soleymani; F. Haresabadi and P. Nemati, "A systematic review on diagnostic procedures for specific language impairment: The sensitivity and specificity issues", *Journal of Research in Medical Sciences*, Vol: 21 num 5 (2016): 1-16.

³ S. K. Betz; J. R. Eickhoff and S. F. Sullivan, "Factors Influencing the Selection of Standardized Tests for the Diagnosis of Specific Language Impairment", *Lang Speech Hear Serv Sch.*, Vol: 44 num 2 (2013): 133-146.

⁴ American Educational Research Association. *Standards for educational and psychological testing* (Washington, DC: 2014); R. Paul and C. F. Norbury, *Language Disorders from Infancy through Adolescence: Listening, Speaking, Reading, Writing and Communicating*. 4th edition (St. Louis, MO: Elsevier, 2012) y J. C. Friberg and T. L. McNamara, "Evaluating the Reliability and Validity of (Central) Auditory Processing Tests: A Preliminary Investigation", *Journal of Educational Audiology*, num 16 (2010): 4-17.

⁵ N. Y. Kiseleva and Yu. A. Shulekina, "Diagnosis of speech violations of schoolchildren in the conditions of modern education", *Pedagogy*, num 4 (2018): 64-69 y N. Y. Kiseleva and Yu.A. Shulekina, "Correlation analysis of structural components of speech therapist's diagnostic methodology" *Problems of modern pedagogical education. Series: Pedagogy and Psychology*, Vol: 59 num 1 (2018): 179-183.

⁶ N. Y. Kiseleva and Yu. A. Shulekina, "Correlation analysis of structural components of speech therapist's diagnostic methodology", *Problems of modern pedagogical education. Series: Pedagogy and Psychology*, Vol: 59 num 1 (2018): 179-183.

Methods

To increase the convenience and unambiguity of the result of the assessment of the speech development of younger school children, we consider it appropriate to apply the method of integrated assessment. The main methods of integrated assessment, currently widely used in the study of social and economic phenomena and processes, are the methods of multivariate comparative analysis and integrated scoring.

The calculation of integral indicators using the methods of multivariate comparative analysis is based on the comparison of an object for each of the indicators, included in the integral one, with a conditional reference object that shows the best results for all the compared indicators. The practical application of this method does not impose any restrictions on the number of indicators included in the integral, and the number of compared objects⁷. However, this method is based on the assumption of the equal importance of all the studied indicators in the integral, which seems to us unacceptable for the situation of a comprehensive study of the speech development of children. Therefore, from the authors' point of view, it is optimal to form an integral indicator of the speech development of elementary school students using the integral score method, which allows taking into account the different significance of individual indicators as part of the integral.

The integral score for speech development is a linear combination of individual assessment parameters for the speech development of younger school children. The total score in the integral indicator includes the quantities of the speech development parameters included in it as weighting coefficients, and the maximum value of the sum is normalized due to a specific selection of point estimates and is basing on the formula.

$$ИП = \sum_{i=1}^n b_i \cdot \kappa_i, \quad (1)$$

where κ_i is point estimate of the range of values of the i parameter of the integral indicator;

b_i is the sum of the points given to the K_i indicator depending on its value to the aims of integral assessment.

When developing an integral indicator of the speech development of younger school children (IISD YSC), the indicators that had been provided by the methodology of N.Yu. Kiseleva, Yu.A. Shulekina were used as assessment parameters *Diagnostics of speech disorders of students of educational (pilot experiment)*^{1,2}. The list of indicators and their maximum assessment values are shown in Table 1.

⁷ O. V. Dmitrieva and A. S. Petenkova, Assessment of investment attractiveness of the organization in conditions of economic crisis (Moscow: Moscow State University of Printing named after Ivan Fedorov, 2012).

No.	Indicator	Maximum Estimated Values
1	Level of Motor Realization of the Utterance	120
2	Word-building Processes	90
3	Skill Level of the Grammatical Structure of Speech	150
4	Coherent Speech	120
5	Nominative Speech Function	120
6	Understanding the Meaning of Words	120
7	Understanding of Complex Logical and Grammatical Constructions	30
8	Phonemic Perception	30
9	Language Analysis Skills	30
10	Writing Skills	45
11	Reading Skills	45

Table 1

The indicators that make up IISD YSC, and their maximum estimated values in accordance with the methodology^{8,9}

IISD stands for the integral indicator of speech development

YSC stands for younger school children

Assessment of children's speech development by the parameters stated above was carried out basing on a test of 113 people, selected from students of different ages from Grades 1-4 of primary schools in Moscow. All children had a proper level of intellectual and speech development, according to a medical conclusion.

The selection of students was carried out with a deterministic approach to building a sample with the subsequent selection of elements of the population based on the possibility and ease of establishing contacts with them. This method of testing is acceptable for pedagogical researches due to its simplicity, cost-effectiveness, and efficiency while ensuring the level of representativeness of the testing that meets the stated objectives.

The students and the structure of the selection are presented in Table 2.

Grade	Number of students, people	Including		Proportion, %	Average age, y.o.	Including, %	
		Girls	Boys			Girls	Boys
1	40	23	17	35,4	7,2	20,4	15,0
2	37	17	20	32,7	8,3	15,0	17,7
3	19	6	13	16,8	9,0	5,3	11,5
4	17	11	6	15,1	10,1	9,8	5,3
Total	113	57	56	100,0	-	50,5	49,5

Table 2

Students and the structure of the selection of younger school children when carrying out the assessment of the speech development

⁸ N.Y. Kiseleva and Yu.A. Shulekina, "Diagnosis of speech violations of schoolchildren in the conditions of modern education", *Pedagogy*, num 4 (2018): 64-69.

⁹ N. Y. Kiseleva and Yu.A. Shulekina, "Correlation analysis of structural components of speech therapist's diagnostic methodology". *Problems of modern pedagogical education. Series: Pedagogy and Psychology*, Vol: 59 num 1 (2018): 179-183.

Weighting coefficients characterizing the significance of each evaluation parameter for the integrated assessment of speech development were determined using the expert assessment method. The average expert assessment (weight) of each parameter is calculated using the formula:

$$a_i = \sum_{j=1}^m a_{ij} / \sum_{j=1}^m \sum_{i=1}^n a_{ij}, \quad (2)$$

Where is the value of parameter, calculated by all experts.

$$a_{ij} = x_{ij} / \sum_{i=1}^n x_{ij}, \quad (3)$$

Where stands for the value of the factor, given by the expert,

Stand for the number of factors;

Stands for the number of experts.

The authors have conducted a survey of 30 specialists in the following subject areas: speech therapy, education in the field of rehabilitation pedagogy, neurolinguistics, psycholinguistics. The experts were asked to rank the significance of individual parameters both for the purpose of an integrated assessment of speech development and for diagnosing the possible speech disorders of younger school children on the following scale (Table 3).

The Significance of the Parameter	Parameter Score
Irrelevant	0
Very Weak Value	1
Weak Value	2
Moderate Value	3
High Value	4
Very High Value	5
Defining Value	6

Table 3

The scale of ranking the significance of individual parameters of speech development for integrated assessment of speech development and diagnosis of the presence of speech disorders

Results

The weighting coefficients of the parameters obtained as a result of processing expert estimates for integrated assessment of speech development, are shown in Table 4. The study also took into account the agreement of expert opinions on the significance of each parameter based on the calculation of variation coefficients¹⁰ to assess the adequacy of the use of the obtained weighting coefficients for the goals of integral estimates (table 4, last column). The values of various coefficients of less than 0.3 indicate the consistency of expert opinions on all evaluated parameters.

¹⁰ O. V. Dmitrieva, Statistics: tutorial (Moscow: Moscow State University of Printing, 2006).

Indicator	The Symbol in the IISD YSC Formula	Assignable Weight Factor	Coefficient of variation in assessing the significance of a parameter
Level of Motor Realization of the Utterance	x ₁	0,0787	0,2180
Word-building Processes	x ₂	0,0831	0,2390
Skill Level of the Grammatical Structure of Speech	x ₃	0,0940	0,1450
Coherent Speech	x ₄	0,0982	0,1863
Nominative Speech Function	x ₅	0,0802	0,2528
Understanding the Meaning of Words	x ₆	0,0970	0,2421
Understanding of Complex Logical and Grammatical Constructions	x ₇	0,0901	0,1907
Phonemic Perception	x ₈	0,0976	0,1969
Language Analysis Skills	x ₉	0,0958	0,2091
Writing Skills	x ₁₀	0,0909	0,2005
Reading Skills	x ₁₁	0,0944	0,2142

Table 4

Weights of individual indicators for integrated assessment of the speech development of elementary school students

The Formula of IISD YSC looks as following:

$$IISD\ YSC = 0,0787 \cdot x_1 + 0,0831 \cdot x_2 + 0,0940 \cdot x_3 + 0,0982 \cdot x_4 + 0,0802 \cdot x_5 + 0,0970 \cdot x_6 + 0,0901 \cdot x_7 + 0,0976 \cdot x_8 + 0,0958 \cdot x_9 + 0,0909 \cdot x_{10} + 0,0944 \cdot x_{11} \quad (4)$$

The IISD YSC Formula (4) The formula is universal for this set of private indicators that are part of the integral, and can be used without any modifications to assess the speech development of younger school children.

The obtained values of the weighting coefficients for the indicators included in the integral indicate the significance level of a particular indicator to assess speech development, determined based on expert assessment. The higher the weight coefficient, the more significant this indicator is, taking into account the agreed opinion of experts. In this regard, we consider it necessary to note that, from the point of view of the experts surveyed, the most significant for assessing the level of speech development of primary school students are indicators of connected speech, phonemic perception, and understanding of the meaning of words (weighting coefficients for these indicators were 0,0982; 0,0976 and 0,0970). The least significant, according to experts, is an indicator of the motor realization of a statement with a weight coefficient of 0,0787.

A mandatory requirement for the aggregates and indicators of speech development, as a part of the integral, is the availability of numerical standards for the minimum satisfactory level of an indicator or a range of its changes, as well as ensuring the conditions for comparability of these indicators. The condition of comparability is met due to a preliminary scoring (in the range from 1 to 5) of indicators of speech development of younger schoolchildren obtained experimentally on a five-point scale (Table 5).

Experimental Estimated Speech Development Indicators											Scoring
X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	
0-24	0-18	0-30	0-24	0-24	0-24	0-6	0-6	0-6	0-9	0-9	1
25-48	19-36	31-60	25-48	25-48	25-48	7-12	7-12	7-12	10-18	10-18	2
49-72	37-54	61-90	49-72	49-72	49-72	13-18	13-18	13-18	19-27	19-27	3
73-96	55-72	91-120	73-96	73-96	73-96	19-24	19-24	19-24	28-36	28-36	4
97-120	73-90	121-150	97-120	97-120	97-120	25-30	25-30	25-30	37-45	37-45	5

Table 5

Transfer of experimental evaluation values of speech development indicators of elementary school students into a score

The level of speech development of a younger student is determined depending on the interval into which the value of the integral indicator calculated by the formula (4) falls. The authors recommend using four intervals, each of which corresponds to a certain qualitative gradation of the level of speech development of a younger student (Table 6).

IISD YSC Value, points	Qualitative assessment of the speech development of a younger student
More than 4,5	High level of speech development
[3,5 – 4,5)	Normal Speech Development
[2,5 – 3,5)	Satisfactory level of speech development
Less than 2,5	Poor level of speech development

Table 6

Assessment of the child's speech development based on the integral indicator of the speech development of younger school children IISD YSC

IISD stands for the Integral Indicator of Speech Development
YSC stands for Younger School Children

Let us present the testing of the proposed integral indicator by the example of the selected students' results, the parameters of which are given in Table 2. For this presentation, we randomly select 4 students from Grades 1-4. The first figure of the student's code number corresponds to the elementary school grade. The calculation results are presented in Table 7. From our point of view, the presented tabular form is the best option for the developed table to be applied in the proposed methodology for assessing speech development. This form is easily adaptable for calculations using the proposed method using the Microsoft Excel spreadsheet processor and has a high level of visibility when conducting a comparative assessment of the level of speech development of various students.

Indicators	Student 1.6		Student 2.26		Student 3.12		Student 4.11	
	Estimated Value	Points	Estimated Value	Points	Estimated Value	Points	Estimated Value	Points
X ₁	70	3	73	4	110	5	112	5
X ₂	70	4	39	3	88	5	78	5
X ₃	115	4	67	3	111	4	132	5
X ₄	50	3	30	2	70	3	100	5
X ₅	100	5	28	2	110	5	115	5
X ₆	80	4	107	5	120	5	112	5
X ₇	30	5	22	4	24	4	28	5
X ₈	15	3	27	5	25	5	28	5
X ₉	20	4	24	4	26	5	30	5

X ₁₀	30	4	5	1	10	2	45	5
X ₁₁	30	4	10	2	20	3	40	5
IISD YSC	3,896		3,199		4,158		5,0	
Speech Development Level	Normal		Satisfactory		Normal		High	

Table 7

An example of assessing the level of speech development of elementary school students based on IISD YSC (Younger School Children)

IISD stands for the Integral Indicator of Speech Development

YSC stands for Younger School Children

SDL stands for Speech Development Level

Discussion

According to the authors, the main advantages of the proposed methodology for assessing the speech development of schoolchildren on the basis of the IISD YSC (Younger School Children) are:

- Unambiguity of the assessment, achieved through the development of an integrated indicator of speech development of IISD YSC, the calculation method of which includes a detailed description of the principles for translating experimental estimates into point estimates.
- The possibility to conduct a comparative analysis by ranking the examined students in terms of their level of speech development based on the IISD YSC.
- Orientation to a wide range of users (teachers, speech therapists) who have a practical interest in assessing the speech development of students to individualize educational curricula in the Russian language.
- Consistency in combining the most important indicators of speech development of younger school children within the framework of an integral indicator.

Thus, the applied method ensures the information content of the pilot version of the developed methodology^{11,12} and serves as the basis for planning further steps for its testing to establish a criterion for the diagnosis of speech disorders of younger school children based on an integral indicator of speech development.

Conclusions

The study results in the following conclusions:

1. An integral indicator (developed with the use of an integral score method) of the speech development of younger school children (IISD YSC) is proposed to assess the speech development of younger school children. The significance of individual indicators of speech development, included in the integral one, is determined by using the expert assessment method. Criteria are established for turning the quantitative values of the integral indicator into a qualitative assessment of the child's level of speech development.

¹¹ N.Y. Kiseleva and Yu. A. Shulekina, Diagnosis of speech violations of schoolchildren...

¹² N. Y. Kiseleva and Yu.A. Shulekina, Correlation analysis of structural components...

2. The proposed formula of the integral indicator can be applied by a wide range of interested users (speech therapists, speech pathologists, elementary school teachers) without making any modifications to it. The study proposes a form of a development table for assessing the speech development of children based on the IISD YSC, which makes it easy to automate calculations in the Microsoft Excel spreadsheet processor and has a high degree of visibility when conducting a comparative assessment of the speech development of different students.

3. The study has revealed a topical issue that reflects a subjective approach to understanding the contents of the parameters of a diagnostic speech therapy methodology both by different specialists (speech pathologists, neurolinguists, psycholinguists) and specialists of the same practice (speech therapists). We emphasize the necessity of universalizing the connotations of parameters included in the structure of various speech therapy diagnostic techniques.

4. There remains an open discussion on the mandatory standardization of means of speech therapy diagnostics of speech disorders used in primary school.

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