PSYCHOLINGUISTIC FOUNDATIONS FOR THE FORMATION OF PHONEMATIC SKILLS OF YOUNGER SCHOOLCHILDREN

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Abstract: The article interprets the results of empirical-theoretical research of the phonematic skills of junior schoolchildren. The urgency of the problem is determined by primary school's tasks on the formation of children's ability to explore speech, the need for effective organization of teaching students phonematic perception. The research was performed using a set of methods: theoretical – allowed to identify the basic provisions and formulate conclusions of scientific work; empirical – provided the association of respondents on the qualitative levels of phonematic perception, checking the effectiveness of the implemented didactic influences; data processing – used to establish the interdependencies between the obtained indicators, to determine the structure of the observed units. Phonematic skill as a psycholinguistic phenomenon, its structure, and mechanism of formation are defined. Prospects for further scientific research are outlined in the context of the integrative development of phonematic and musical hearing of junior schoolchildren.

Keywords: Junior schoolchildren, methods of examination of speech sounds, phonematic perception, phonematic skill, standards of speech sounds.

1 Introduction

One of the first-grade school tasks is to form the ability to speak the language fluently, study speech, experiment with sounds, words, and phrases [12]. Execution of the set task actualizes a problem of improvement of pupils' speech hearing, demands the effective organization of training of phonematic perception in 1–4 classes.

Important for scientific intelligence are the provisions of the theory of the formation of perceptual actions concerning their operational composition and mechanism of creation [14, 21, 25]; linguistic data on the acoustic characteristics of sounds and their pronunciation [8]. The psycholinguistic context of the phonematic sensory processes of a child's personality is illuminated by theoretical conclusions about the interaction of motor and acoustic components in speech perception; connection of sensory, perceptual, and cognitive levels of input sound signal processing [7, 9, 15, 27, 28]; interdependence of perceptual and articulatory bases of language: the first of them consists of memorized standards of phonetic units, the second – language and motor skills of the pronunciation of sounds [1, 3, 6, 16].

The purpose of the article is to describe the process and interpret the results of empirical-theoretical research of junior schoolchildren's phonematic skills. The stated goal is specified in several tasks:

- To define phonematic skills as a psycholinguistic concept;
- To identify levels of students' mastery of phonematic skills;
- To substantiate the system of educational and perceptual tasks to improve the perception of speech sounds;
- To prove the effectiveness of the developed developmental influences.

2 Literature Review

Of great interest is the discussion by foreign authors of issues that emphasize the complexity of the relationship of perceptual and cognitive mechanisms of phonological-phonematic perception, in particular the impact of phonematic awareness of primary school students on the formation of reading skills [10, 16], perception bilingual students of phonetic contrasts of non-native language [4, 18], children's ability to distinguish the voices of speakers by gender timbre characteristics [11, 19], etc.

Equally important is the assessment of didactic support for the development of phonematic perception of students, identification of sensory and developmental resources of modern educational programs, educational and methodical publications [2, 5, 17, 20].

Thus, the problem raised is multifaceted, requires rethinking and integration of various scientific information, taking into account the new challenges facing primary education at the present stage of its reform.

3 Materials and Methods

Achieving the goal required the use of a set of methods: theoretical – allowed to identify the basic provisions and formulate the conclusions of scientific intelligence (analytical-synthetic, induction-deductive, generalization and systematization); empirical – provided the association of respondents on the qualitative levels of phonematic perception, testing the effectiveness of the implemented didactic influences (psychological and pedagogical experiment, observation of the course and processing of products of the educational and perceptual process); data processing – made it possible to establish interdependencies between the obtained indicators, determine the structure of the observed units.

The sample was randomized – random in designing, serial – consisted of contact and relatively homogeneous groups (classes), sufficient – included 208 younger students, grouped into equivalent groups – experimental and control.

The practical sample students were divided into four groups: with medium, sufficient, high, and consistently high levels of phonematic skills with the predominance of sufficient and high. The control sample participants were divided into three groups: with low, medium, and sufficient levels of mastery of phonematic skills with a specific weight of the average.

4 Results

In interpreting the phonematic skill, the author proceeded from understanding the basic concept of skill as a way of acting, provided with a set of acquired knowledge and skills. However, phonematic skill has specific characterological features, which are the subject of this study and require detailed coverage.

The first position in the definition of phonematic skill is its consideration as a perceptual action – a structural unit of perception manifested in the transformation of external information and the formation of images of objects and phenomena of reality.

Of considerable interest is the establishment of the internal structure of phonematic skills. Well-known is the provision of coordinated functioning in the sensory reflection of two types of perceptual actions – introductory and cognitive.

The purpose of introductory phonematic action is to form a primary verbal image. Its means are motor copies created by effector components. The main importance of constructing these copies is the movements of the articulatory organs, the head's activities to localize the source of the audible signal. Operations of acquaintance action make such sequence: search and finding of a sound among the general stream of speech stimuli, allocation of its most informative properties, acquaintance with them. As a result of performing these operations, a basic sound image is created [14, p.186, 21, p.80, 25, p.63, 28, p.298].

The purpose of cognitive phonematic action is to compare the basic sound image with a memorized class (category) of verbal images [21, p.83]. The means of carrying out the analyzed action are sensory standards – the "lattice" of samples of speech sounds produced by society.

It is known that standards of any modality are systemic associations of components ordered based on classification and serialization [21, p. 102]. Naturally, the question arises whether these relationships of elements are observed in the system of phonemes of the Ukrainian language?

In our opinion, the answer should be in the affirmative. Indeed, speech sounds are systematized in general according to the principle of classification, divided into vowels and consonants with subsequent grouping: vowels – with the participation of the lips, the degree of the lifting of the tongue, place of articulation, open mouth, emphasis in the word; consonants – with the participation of voice and noise, the method and place of creation, the degree of palatalization, sound and acoustic expression. Serial relations are inherent in some vowel sounds and their variants ([e] – [e^{y}], [y] – [y^{e}]). Probably, paired consonant sounds – sonorous and deaf ([d] – [t], [d'] – [t'], etc.), hard and soft ([d] – [d'], [t] – (t'], etc.), whistling and hissing ([s] – [sh], [z] – [zh], etc.) – are also short two-element serial series, because the sounds of acoustic pairs are quite similar in place and method of creation and differ in only one parameter – the presence/absence of voice, increased position of the back of the tongue, the characteristic noise.

The system of standards of speech sounds determines the specific operational composition of cognitive phonematic action. Thus, the subject consistently compares the basic verbal image with stored in memory standards, determines the class of the basic sound image by its multilevel categorization, makes inferences about the belonging of a speech unit to a hierarchical class, which is manifested in a brief description of the phoneme differential features (for younger students the smallest set of these characteristics covers loudness, stress or unstressed, loudness, deafness or sonority, softness or hardness), updates all other information about this class and subclass of sounds [22, p.56, 14, p.199–200].

The generalized structure of phonematic sensory ability is presented in Table 1.

Table 1: The structure of phonematic skills

Structural elements	Phonematic perceptual actions	
	Introductory	Cognitive
Goal	Formation of the primary verbal image	Assignment of the presented object to the class (categories) fixed in memory
Means	Motor copies created by effector components	The system of sensory standards of speech sounds is a "lattice" of phonemes
Operations	Search, finding the object among the flow of speech stimuli, selection of informative properties in the object, acquaintance with the selected properties	Comparison of the basic image of the sound signal with the mastered standard, categorization of acoustic and articulatory properties of sounds, interpretation of differential features of phonemes
Result	Basic image	Adequate image

The second position in the characterization of phonematic skill involves the disclosure of the mechanism of its formation, which is based on the phenomenon of internalization – the transformation of external processes into internal ones. Investigating the internalization of perceptual actions, Zaporozhets distinguishes three stages in it: at the first stage the problem is solved in practical terms, through external actions with objects; on the second – sensory processes become perceptual actions that precede the next practical operations; on the third – perceptual actions are reduced, reduced, the external orienting-research action grows into an ideal one [26, p.116–118].

This mechanism in the transformation of phonematic processes is different because speech sounds are not objects of reality [13]. It is impossible to operate on them as objects [15]. However, in the method of primary education, there are well-known ways to give the properties of speech sounds certain objectivity with the help of special marks, counters [20]. In the author's opinion, the internalization of phonematic perceptual actions is carried out in the following phases: loud and stressed pronunciation of the sounds of the word with parallel filling with chips of the sound scheme (the first stage); whispering of a token and modeling by fragments of its sound form (the second stage); condensed sound analysis – without chips, with verbal identification of phonemes (third stage).

Given the above, it is possible to formulate the following definition of phonematic ability – it is mastered by the subject method of performing internalized introductory-cognitive perceptual actions, provided with a set of acquired standards of speech sounds and skills of their use in the examination of phonetic phenomena.

Let us characterize the quality of children's mastering of phonematic skills in the modern learning experience. The evaluation criteria were selected: a) distinction of phonemes; b) establishing classification and serial relations between them; c) reproduction of word sounds.

The language material for the sensation of individual sounds were tokens, the examined phonetic units in which they occupied a strong position; the respondents were asked to react to the given sound in a certain way (by clapping their hands); awareness of the classification arrangement of phonemes was checked by assigning the heard sound to a certain group, serial - by selection to the consonant of the corresponding acoustic pair; reproduction of the sound structure of a word included articulation and marking of its sounds with chips [2, p.80–81].

During the diagnosis, it was found that at the beginning of school, children accurately differentiate vowel sounds, but have complications in the perception of individual consonants – sonorous [r], [l], their soft correlates [r'], [l'], whistling and hissing [z], [zh], their stunned paired variants [s], [sh]. Thus, for first-graders, the main feature of speech sounds is a voice; students do not fully distinguish the noise's essential properties.

Dividing the sounds heard into vowels and consonants, first-graders correctly categorized vowels and the majority of consonants, sometimes making mistakes in assigning them [d͡z] (8% of respondents) and quite often – [y] (73% of respondents). In the further grouping of consonant sounds, more erroneous decisions were stated. For example, 62% of students did not consider the consonant [ts'], 73% of children did not consider the consonant [d͡z], and any respondent did not characterize the sound [y] as a soft consonant. The experiment participants performed a series of consonants in terms of hardness/softness more precisely in the case of matching a paired hard sound to a given soft one. Still, the opposite arrangement of acoustic pairs was performed with less efficiency.

In the reproduction of the phonetic structure of the given tokens, the students quite accurately determined the components of the fusion of the type hard consonant + vowel ("*yenot*", "*pivnyk*"); successfully identified hard consonants outside syllables ("*yenot*", "*pivnyk*"), with slightly lower results – soft ("*kin'*"); occasionally omitted consonant sounds for their coincidence ("*pivnyk*" – "*pinyk*"). Significant complications were caused by the analysis of the combination of type soft consonant and vowel: students modeled these syllables as one soft consonant (for example, [k'] in the word "*kin'*") or replaced them with a combination of paired hard consonant and vowel ("*kin'*" – [k], [i], [n']); the merging of the soft consonant [y] with the vowel was always pronounced inseparably by the students [ye] in the word "*yenot*"), denoting it by the symbol of the vowel sound. In the author's opinion, the children's low awareness of sound and letter concepts focuses mostly on the graphic rather than the phonetic form of the token. An additional argument for this statement is the complete inability of respondents to reproduce the word according to its model ("*mak*", "*zhuk*", "*lys*", etc.).

Thus, six-year-old schoolchildren are most likely to form introductory operations that reflect a purely sensory stage of phonematic perception; but cognitive operations, which correspond to the perceptual and cognitive stages of phonematic perception and are related to mastering the system of standards and skills of their application in the examination of the sound form of words, develop at a slower pace. The total quality of

phonematic skills of 1st-grade students corresponds to an indicator of 0.52 relative to the ideal grade of 1. According to individual performance, the participants of the experiment with low (27%), medium (54%), sufficient (19%) quality levels were distinguished, while a high level of mastery of the studied skills was not detected.

The logic of the molding experiment was as follows. At the motivational-orientational stage (first grade), didactic influences were focused on the expansion and systematization of existing in children's reference ideas about speech sounds. Performing the provided educational and perceptual tasks – the teacher's instructions to students on the content and method of phonematic actions – first-graders found the difference between speech sounds from the sounds of the natural environment, observed by ear, sight, and touch the work of articulatory organs; classified sounds into non-speech and speech, speech – into vowels/consonants, vowels – into stressed/unstressed, consonants – into hard/soft, ringing/deaf; established serial relations between paired consonants in terms of hardness/softness and sonority/deafness of sound.

The performance-transformation stage covered the second and third years of study: in the second grade, attention was paid to the development of students' detailed methods of examination of sounds based on manipulations with symbolic marks; in the third class – the collapse and stereotyping of sound-examination operations, their translation into an ideal form. The acquisition of these methods of phonematic perception was facilitated by educational and perceptual tasks in which students updated their knowledge of speech sounds, systematized sounds by articulatory properties and marked them with chips, practiced correct sound pronunciation; selected graphic models for words, words for graphic models; carried out a detailed analysis of the sound shell of tokens: emphasized the sounds, modeled their properties with graphic symbols, synthesized individual sounds into words according to the scheme; performed condensed sound analysis – whispered sounds, determined vowels and consonants, distinguished between vowels stressed and unstressed sounds, among consonants – calls and deaf, hard and soft; converted the given consonants into opposite paired sounds.

Control and correctional stage (fourth grade) – is devoted to assessing the degree of solving the problems of previous stages, analysis of deviations of the obtained results from the planned, individual adjustment of students' educational and perceptual activities depending on the nature of the detected deformations.

Experimental didactic influences significantly supplemented the traditional method of forming phonematic hearing, increasing the share of developmental tasks, especially in grades 2–4; were fully compliant with the program requirements; provided for the use of an extended set of graphic symbols of language units: in addition to models of vowels, consonants, hard and soft sounds – a circle, one or two dashes, indicating the free passage of air, its entry into an obstacle of varying complexity – younger students operated with additional chips/consonant deafness – with a short horizontal wavy line and a short horizontal straight line, which symbolize the vibration of the vocal cords or its absence [2, p.425–430, p.448–451].

According to the results of the formation of phonematic actions, the numerical values of quality criteria – distinction, classification and serial ordering of speech sounds, reproduction of speech sounds – indicate positive changes in both control and experimental groups with the prevalence of indicators in the second of them (Table 2).

Table 2: Qualimetric model for assessing the quality of phonematic skills (control section, average values)

Criteria	**Validity**	**Indexes**	**Validity**	Detection of indicators		Evaluation of indicators		Manifestation of criteria		Evaluation of criteria	
				CG	**EG**	**CG**	**EG**	**CG**	**EG**	**CG**	**EG**
Distinguishing speech sounds	.34	distinction of vowels	.20	1.0	1.0	.20	.20	.87	.90	.30	.31
		distinction of consonants: hard, soft; loud, deaf	.80	.84	.87	.67	.70				
Classification and series of speech sounds	.33	classification of speech sounds	.50	.72	.76	.36	.38	.61	.73	.20	.24
		consonant series by hardness/softness; sonority/deafness	.50	.51	.71	.25	.35				
Reproduction of the sound form of the word	.33	reproduction of word sounds based on a graphic model	1.0	.19	.58	.19	.58	.19	.58	.06	.19
∑	**1**						Quality of phonematic skills (control section)			**.56**	**.74**
							Quality of phonematic skills (statement section)			.52	
							Dynamics of formation of phonemic skills			.04	.22

5 Discussion

All participants in the control experiment confirmed the absolute success in distinguishing vowels; fourth-graders of both groups performed consonant recognition with slightly lower efficiency – single erroneous separations of soft sonorous [r'], [l'] and hard deaf [s], [sh] were revealed. However, the average quality scores are quite high (greater than 0.80 relative to the ideal score of 1), which allows us to conclude that this operation is in the final stage of formation.

The students of the experimental group classified speech sound with high success: they had no difficulties in dividing the heard sounds into vowels and consonants, attributed the sound [y] to consonants, categorized [d͡z] as an inseparable merger, not a sequence of two sounds, differentiated most consonants by hardness and softness, sonority and deafness. Simultaneously, it is necessary to recognize the presence of errors in the further categorization of the mentioned sounds: some children could not accurately determine the affiliation [y] to the soft and sonorous consonants, [d͡z] – to sonorous consonants. In students of the control group as a whole did not cause difficulties only the first stage of ordering – classification of speech sounds into vowels/consonants (except for the sound [y], which is 8% of cases was attached to vowels), other units, including delimitation of consonants by ringing/deafness, remained mastered to a lesser

extent. However, these features cannot be called mass because the control group scores also reflect the sufficient quality of learning the classification relations in speech sounds (with average scores above .70).

There is a significant difference in the respondents' selection of serial acoustic pairs to the given consonant sounds. Thus, in the control group, fourth-graders' weight was quite specific (22%), who showed the lowest quality of establishing serial relations: adequately selected for soft consonants, even hard pairs, partly – for hard consonants sonority/deafness. The highest result was in the correct combination of pairs for hardness/softness of consonants and creating at least one pair for sonority/deafness, usually [b] – [p]. No one was able to perform the reverse operation of selection to a deaf consonant pair call.

The experimental group students, more precisely established pairs with both soft and hard consonants, selected the appropriate deaf consonant sounds for the sonorous ones, making mistakes only in the opposite order of order – selection to the given deaf consonants of their sonorous correlates. In 27% of students, the effectiveness of the series of consonant sounds approached the maximum values, except for one or two errors in searching for acoustic pairs to the sounds [ch], [kh].

The most noticeable is the dynamics of changes in the reproduction of word sounds. The children were asked to build a sound model of words *"Vedmid'," "Yablunia," "Kompiuter*" with the help of chips and play the word according to the scheme.

In the control group, the ratio of students who did not reflect the phonetic form of any word, and those who correctly analyzed the sound composition of one word (no other options for the task), corresponds to a percentage of 23/73 – as in the entrance test.

The division of the recipients of the experimental group is more complex and includes those who did not model a single word, modeled one, respectively, two, three words, all tokens, and chose a word for the presented model. The quantitative composition of persons at these levels can be given by the following percentages: 8/4/50/23/15. As we can see, despite the introduction of developmental influences, there are still children who have not been able to reflect the phonetic structure of a single word adequately, but their number has almost halved.

In this case, all participants in the control section accurately identified the elements in the mergers *("vedmid'," "yablunia," "kompiuter"*), hard and soft consonants outside the syllables (*"vedmid'," "yablunia," "kompiuter," "kompiuter"*); with some difficulty distinguished soft consonants in the sound combinations *("vedmid'," "yablunia"*); it was difficult to analyze the merging of the soft consonant [y] with the following vowels (*"yablunia," "kompiuter"*), pronouncing these sounds inseparably ([ya], [yu]) and modeling them with a vowel sound chip.

These errors were detected mainly in the control group, to a lesser extent – in the experimental group. Also, only fourth-graders in the experimental group (15%) were able to reproduce words on the model, such as *"banany," "doroga," "zhyrafa," "komakha," "moloko," "muzyka"*, etc.

The examination methods, in the perception of vowel sounds, were realized as internalized condensed perceptual operations. All students knew the most informative feature of these sounds – the absence of obstruction to the exhaled air – and quickly installed it. Consonant sounds were examined by representatives of different groups with specific differences. Thus, even with the certain categorization of the sound [y], children were asked, "Why do you consider the sound [y] consonant?" The students of the experimental group emphasized the sound. They concluded, "Because there is an obstacle in the air." Polls were complicated by, "Which speech organs create this obstacle?" Further actions were carried out in the same way – the repeated articulation of a sound and the characteristic of an obstacle: "It is language". Even if they considered the obstacle to be the leading feature of consonant sounds, Respondents of the control group usually could not specify it.

An example of other situations that prompted the study participants to use appropriate ways of perceiving consonant sounds can be considered acoustic pairs in sonority/deafness. If there are difficulties in choosing a deaf consonant [kh] of the ringing pair, the student was first asked to prove that the sound is deaf, "How to recognize whether this sound is ringing or deaf?" The child recalled the articulatory features of these consonants ("there is a voice or no voice", "trembling vocal cords or not trembling"), put his fingers to the larynx, felt that the vocal cords do not vibrate, and came to the conclusion that the sound is a deaf consonant. They continued, "Now say the consonant [kh] so that the vocal cords tremble. What sound was formed?" Under such conditions, the vast majority of individuals in the experimental group correctly identified a paired consonant [h]. In the control group, the help often had to be stopped after the first question because the respondents remembered neither the leading sign of ringing/deaf consonants nor the method of studying it. In the case of correct categorization of the sound [kh], the appropriate acoustic pair was not set.

Thus, due to the introduction of the developed didactic tools, the degree of sensation, perception, and awareness of phonetic phenomena has increased significantly and formed a zone of immediate sensory operations development for their examination.

The internal structure of samples of retest participants can be defined as different levels: in the control sample, the division of schoolchildren into three groups is relevant – with low (18%), medium (59%), and sufficient (23%) levels of phonematic skills; in the experimental sample, children were divided into four groups – with medium (14%), sufficient (48%), high (27%) and consistently high (12%) levels of mastery of phonematic skills.

The average value of the quality of phonematic skills in the control sample corresponds to .56 relative to the ideal score of 1; students of the experimental sample – an indicator of .74. The increase in quality indicators is positive and is as follows: .04 – in the control group; .22 – in the experimental. The non-belonging of these samples and the sample of participants of the input diagnostics to one general population is illustrated by the graph of one-factor analysis of variance ANOVA, performed by statistical package "STATISTIKA": F-criterion exceeds one (equal to 188.03), significance level of the statistical conclusion *p* is less than .05 (equal to 0.0000), hence – group averages differ from each other (Figure 1).

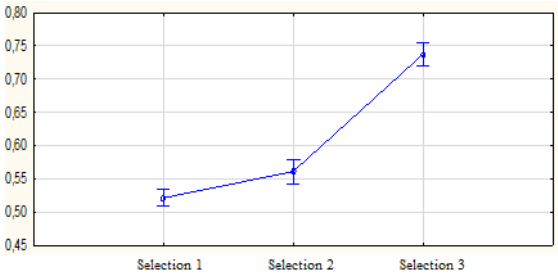

Figure 1 – Graph of average vibration values 1 (input test), 2 (retest; control group), 3 (retest; experimental group)

6 Conclusion

The scientific results give grounds for formulating such conclusions.

Phonematic skill as a psycholinguistic concept is a way of performing internalized introductory-cognitive perceptual actions, provided with a set of acquired standards of speech sounds and skills of their application in the examination of phonetic phenomena.

Incoming diagnosis showed that children are more developed purely sensory stage of phonematic perception at the time of

entering school. Still, perceptual and cognitive stages of phonematic perception, which are near related to mastering the system of standards and skills in their use in examining the sound form of words not formed.

Special educational and perceptual tasks are the leading means of improving the phonematic hearing of junior schoolchildren. They are introduced into the educational process in stages. They aim to expand and systematize the standards of speech sounds (motivational-orientational stage, 1st grade), developing detailed methods of examining sounds based on the manipulation of symbolic marks and condensed sound-examination operations with gradual translation into ideal transformation stage, 2–3 grades); adjustment of educational and perceptual activity by regulating the degree of complexity and dosing of phonematic actions, taking into account children's achievements (control and correction stage, 4th grade).

Experimental testing proved the effectiveness of the developed didactic influences: the quality of functioning of phonematic processes, primarily perceptual and cognitive stages (reproduction of the sound shell of words, awareness of phonetic phenomena), increased more markedly experimental group than in the control one.

Further research on the problem of integrative formation of phonematic and musical hearing of junior schoolchildren could be promising.

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Primary Paper Section: A

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