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METHODOLOGY FOR TEACHERS' USE OF INNOVATIVE TECHNOLOGIES IN DEVELOPING SPEECH IN CHILDREN WITH HEARING IMPAIRMENTS

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Abstract
This article analyzes how teachers working with children who have hearing impairments can use innovative technologies to develop speech, particularly articulation skills, during the teaching of reading and writing in Grades 1–2. Hearing technologies, visual acoustic feedback programs, information and computer technologies, organized games, and collaboration with the family were reviewed on the basis of fourteen scientific sources in English, Russian and Uzbek. The analysis showed that technology does not teach on its own: its effectiveness depends on the teacher. The teacher checks whether the child can hear the sound, links sounds with letters and words, and ensures that the work continues at home.

Keywords: children with hearing impairments; innovative technologies; articulation; reading and writing; Grades 1–2; cochlear implant; visual feedback; surdopedagogy.

Introduction

Speech is the main instrument of school education, and for a child with a hearing impairment, mastering this instrument is the most difficult task. The auditory channel provides incomplete and often distorted information about speech sounds, so pronunciation, vocabulary and grammar develop under restricted conditions. L.S. Vygotsky distinguished the primary (organic) consequences of a defect from its secondary (social-psychological) consequences. He argued that the secondary consequences, above all the underdevelopment of speech and the resulting slowness of thinking, can be prevented or mitigated through properly organized education [4]. Grades 1–2 are the period in which this idea is tested in practice. At this age a child must connect the sound, the position of the speech organs, the letter and the meaning

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of the word at the same time. If pronunciation is taught in one lesson and writing in another, and no one links them, the child is forced to discover that connection alone. Research shows how decisive the early years are. Yoshinaga-Itano and co-authors compared 72 deaf and hard-of-hearing children whose hearing loss was identified before six months of age with 78 children identified later. All of them began intervention on average about two months after identification, yet the early-identified group had significantly higher receptive and expressive language scores [1]. Moeller examined the relationship between the age at which children entered an intervention program and their speech outcomes at age five. Children enrolled early performed close to their hearing peers regardless of the degree of hearing loss, and the most successful children combined early enrollment with high family involvement [2]. Hearing aids create the possibility of access to sound; the classroom determines how fully that possibility is used. The aim of this article is to analyze how teachers can use innovative technologies to develop the speech and pronunciation of children with hearing impairments in Grades 1–2, and how this work contributes to learning to read and write. Here, "innovative" is not a synonym for "new". We regard a technology as innovative if it delivers to the child information that impaired hearing does not provide (acoustic or visual), or if it gives the teacher a new way to check and correct the child's speech.

Literature Review

The theoretical foundation of the field was built within Russian surdopedagogy. F.F. Rau and N.F. Slezina described how pronunciation is taught in schools for the deaf, relying on visual, tactile-vibrational and kinesthetic perception together with residual hearing [5]. T.G. Bogdanova's textbook on surdopsychology characterizes the cognitive features of children with reduced hearing, that is, how they perceive and remember material presented by the teacher [6]. In Uzbekistan, the textbook by P. Po‘latova and co-authors systematized the classification of hearing impairments and the content of correctional-pedagogical work with these children [11]. G. Xomidova notes that children with hearing impairments may lag behind their hearing peers in vocabulary, grammatically correct sentence construction, pronunciation and oral communication, and that a specific methodological approach is therefore required. She observes that the problem of speech formation in these children has been studied

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by Solovyov, Rau, Shif, Zikov, Rozanova, Morozov and Boskis, and she emphasizes that special exercises shape speech breathing [14].

Research Methodology. This article is theoretical in nature. It applies analysis, comparison, generalization and systematization to the scientific literature on surdopedagogy, developmental psychology and speech development.

Results and Discussion

Technology is an assistant to the teacher, not a substitute for the teacher. Table 1 summarizes the types of technology mentioned in the sources. The first conclusion is straightforward: none of them works without a teacher. M. Xamidova stresses that restoring sound perception alone does not produce speech, and that auditory-speech work after surgery is the longest stage of cochlear implant rehabilitation [12]. Koroleva also views implantation as a system in which medical measures are complemented by psychological and pedagogical measures [7]. For a primary-school teacher, this means that the first "technological" task of every lesson is not the software but checking that the child's hearing device is fitted and working.

Table 1. Types of technology used in working on speech and pronunciation, and what the sources report about them

Technology	Role in the lesson	What the sources report
Hearing aids and cochlear implants, together with listening exercises	Make speech sounds audible to the child; the teacher checks daily use and designs listening tasks	Rehabilitation is long and staged; restored hearing alone does not produce speech [7; 12]; success depends on the regularity of training [13]
Visual acoustic feedback programs (Speechviewer, "Vidimaya rech")	Display breathing, voice, tempo and stress as images, in real time and with delay	Described as useful for breathing, voice, rhythm, stress, sound pronunciation and self-monitoring; the descriptions rely on expert opinion, and the study was conducted with children with normal hearing [10]
Information and computer technologies within differentiated pronunciation training	Support graded tasks according to the level of speech intelligibility	Part of a model tested with 40 students; intelligibility improved [9]
Educational programs and simple software tools (Word, Paint, dactyl alphabets)	Develop perception, attention and visual memory	Five-year experience with 40 students; perception and attention improved the most [8]
Organized games and picture-based tasks	Sound discrimination, vocabulary and connected speech	Games described as a systematic technology [12]; pictures widely used in early lessons [13]; no numerical results reported [12]
Continuous family-oriented work	Continues the tasks at home	The most successful children were those enrolled early and whose families were actively involved [2]; the role of parents is emphasized [12; 13]

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A teacher in Grades 1–2 can support both. Before a sound lesson, the teacher checks that the device is switched on and properly fitted, reduces background noise, stands where the child can see the teacher's face, and, if the child does not understand, repeats key words slowly and clearly. The principle described by M. Xamidova, of relying on hearing and gradually reducing visual aids, also applies here [12]: the teacher starts with sounds the child can hear, and uses lip-reading and pictures as auxiliary tools rather than as substitutes.

Hearing aids do not make every sound audible, so the teacher needs a second channel through which pronunciation can be checked. Programs of the Speechviewer type provide that channel by converting the acoustic components of speech into images the child can interpret. They are used to work on breathing, voice, rhythm and intonation, tempo, syllable structure, stress, sound pronunciation and self-monitoring [10]. Among the local sources, the strongest evidence comes from Denisova's study. In her sample of 40 primary-school pupils, at the beginning 37.5% had unintelligible speech, 40% had low intelligibility, and 22.5% had intelligible speech. By the end of the year, 22.5% of pupils had moved from the unintelligible group to the low-intelligibility group, 12.5% had moved from low intelligibility to intelligible speech, and the score for recognizing unfamiliar speech material had risen by 17.5 percentage points [9]. These data come from a differentiated support model that included several conditions, among them information and communication technologies, so the progress cannot be attributed to technology alone. The study shows that pupils within one class differ sharply in intelligibility and need different tasks. This is practical evidence for using technology as a support for graded tasks designed by the teacher.

In Grades 1–2, the teacher's main contribution is not to separate sound from letter. Uzbek orthography rests mainly on the phonetic principle, meaning that a letter in most cases denotes a specific sound. For a child who cannot produce or distinguish a sound, there is no firm basis for the corresponding letter, and imprecise pronunciation may also reappear in spelling. This is the author's own linguistic observation rather than a conclusion drawn from the sources, but it is consistent with the Russian tradition, in which pronunciation is formed on the basis of auditory perception together with visual, tactile and kinesthetic perception [5]. Raximova and Akbarov write that pictures are widely used in the early period of rehabilitation, and that the child perceives a word as a whole before dividing it into sounds [13]. For literacy, this suggests a natural sequence: picture, whole word, sound, letter. The evidence on

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writing deserves particular attention. In Mayer and Trezek's review, the writing outcomes of students with cochlear implants were lower than their reading outcomes, but better than previously reported figures [3]. The teacher should therefore not assume that writing will develop automatically from reading and speaking. Writing needs its own planned exercise, in which the child pronounces the word, hears it, sees it and writes it.

Trifonova's long experience offers a useful caution. Among deaf primary-school pupils who worked with computer programs, perception and attention improved the most, while short-term visual memory improved the least. The author links this to weaker visual imagery in deaf children, and reports that pupils with the lowest initial level progressed fastest [8]. Bogdanova's textbook explains why cognitive processes require particular attention in these children [6], and Vygotsky's view of the word as a tool of thought [4] shows why this matters for speech: a child who cannot say a word clearly also finds it difficult to use that word in thinking and communication. For the teacher, this leads to specific choices. Screen tasks should be short and focused on a single sound. The same material should be repeated in several forms to support visual memory. The child should not be asked to listen, look at the screen and write at the same time.

M. Xamidova describes games not as recreation but as an organized pedagogical technology. Children select the correct sound from several options, classify pictures, build sentences in a shop role-play, and retell sequential picture stories with adult help gradually reduced [12]. The expert opinions cited by Zelenskaya and the results reported by Denisova both address motivation. The program helped to spark and sustain interest [10], and in Denisova's study pupils showed a greater willingness to use speech and their hearing aids [9]. Raximova and Akbarov advise encouraging every attempt by young children to vocalize and speak, and working while the child is interested rather than forcing participation [13]. A pupil in Grade 1 or 2 who fears making mistakes may stop both speaking and writing, so the teacher's tone is itself part of the method.

The sources agree that technology is effective only to the extent that the teacher using it is competent. E. Trifonova lists the teacher's own information and computer competence among four conditions for effective use, and a survey of 122 teachers was designed to assess and improve it [8]. I. Denisova also includes the training of teachers and parents among the conditions of her model [9]. At the same time, the evidence

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has clear limits. Some of the Russian and Uzbek sources are dissertations or conference materials that report results descriptively [8; 9; 12]. The most precise figures on pronunciation come from a single sample of 40 pupils [9]. The Speechviewer study was conducted with children with normal hearing [10]. None of the sources measured separately the effect of technology on reading and writing in Grades 1–2. These gaps should be addressed by controlled studies in Uzbek-medium schools.

Conclusion

The analysis leads to three conclusions. First, innovative technologies, namely hearing aids, visual acoustic feedback programs, general information and computer technologies, and organized games, open a new route to speech for children with hearing impairments. However, they work only through the teacher: the teacher checks whether the child can hear the sounds, selects the feedback channel, links sounds with letters and words, and involves the family. Second, in Grades 1–2, pronunciation and literacy should be taught as a single process. The sequence of picture, whole word, sound and letter, together with a dedicated writing exercise, follows from the sources and from the phonetic character of Uzbek orthography (the latter being the author's own observation). Third, differentiated tasks based on each child's level of intelligibility, and short, single-purpose sessions supported by technology, take into account the cognitive characteristics of these children, in particular their weaker visual memory.

The six-stage lesson model presented here is a theoretical proposal. In future work it should be tested in a controlled study in Grades 1–2, measuring intelligibility, reading and writing before and after the intervention, and comparing classes that use visual acoustic feedback technology with classes that do not.

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