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Effectiveness of information and communication programmes for children with special educational needs in the context of speech development

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ABSTRACT. The aim of the work is to determine the effectiveness of information and communication programmes for special educational needs (SENs) in the context of speech development. The aim was achieved through the use of general theoretical methods of analysis, observations and calculations of the ranking factor, efficiency coefficient, Phillips correlation coefficient. It was established that the most effective approaches for the development of children's speech are the use of information technologies (2.5), social interaction (2.37), group approach (2.25). The obtained results gave grounds to develop a programme for speech and general development of children aged 4 to 7 years. The programme provided for the creation of mind maps, provision of joint reading, performance of educational songs, development of speech in accordance with the specified topic. Training became possible due to the use of modern technologies, namely the applications MindMeister, Digital Inclusion, speech synthesis from Google and YouTube. It was established that the developed programme had a positive effect on the improvement of children's phonetic speech compared to the results at the beginning of the study. The practical significance of the work implies the possibility of using the developed programme for speech correction among a larger number of children. Research prospects are related to the elaboration of speech development mechanisms depending on the degree of speech impairment.

Keywords: information technologies; joint reading; personalized support; social interaction; speech and language disorders.

Eficácia dos programas de informação e comunicação para crianças com necessidades educacionais especiais no contexto do desenvolvimento da fala

RESUMO. O objetivo do trabalho é determinar a eficácia dos programas de informação e comunicação para necessidades educativas especiais (NEEs) no contexto do desenvolvimento da fala. O objetivo foi alcançado através da utilização de métodos teóricos gerais de análise, observações e cálculos do fator de classificação, coeficiente de eficiência, coeficiente de correlação de Phillips. Estabeleceu-se que as abordagens mais eficazes para o desenvolvimento da fala infantil são o uso de tecnologias de informação (2,5), interação social (2,37), abordagem em grupo (2,25). Os resultados obtidos fundamentaram o desenvolvimento de um programa de fala e desenvolvimento geral de crianças de 4 a 7 anos. O programa previa a criação de mapas mentais, oferta de leitura conjunta, execução de músicas educativas, desenvolvimento da fala de acordo com o tema especificado. A formação tornou-se possível devido à utilização de tecnologias modernas, nomeadamente as aplicações MindMeister, Inclusão Digital, síntese de voz do Google e YouTube. Verificou-se que o programa desenvolvido teve um efeito positivo na melhoria da fala fonética das crianças em comparação com os resultados no início do estudo. O significado prático do trabalho implica a possibilidade de utilização do programa desenvolvido para correção de fala entre um maior número de crianças. As perspectivas de pesquisa estão relacionadas à elaboração de mecanismos de desenvolvimento da fala em função do grau de comprometimento da fala.

Palavras chave: tecnologias de informação; leitura conjunta; apoio personalizado; interação social; distúrbios de fala e linguagem.

Efectividad de los programas de información y comunicación para niños con necesidades educativas especiales en el contexto del desarrollo del habla

RESUMEN. El objetivo del trabajo es determinar la eficacia de los programas de información y comunicación para necesidades educativas especiales (NEE) en el contexto del desarrollo del habla. El objetivo se logró mediante el uso de métodos teóricos generales de análisis, observaciones y cálculos del factor de clasificación, coeficiente de eficiencia y coeficiente de correlación de Phillips. Se estableció que los enfoques más efectivos para el desarrollo del habla de los niños son el uso de tecnologías de la información (2,5), la interacción social (2,37) y el enfoque grupal (2,25). Los resultados obtenidos dieron pie a desarrollar un programa para el habla y el desarrollo general de niños de 4 a 7 años. El programa preveía la creación de mapas mentales, la provisión de lectura conjunta, la interpretación de canciones educativas y el desarrollo del habla de acuerdo con el tema especificado. La formación fue posible gracias al uso de tecnologías modernas, en particular las aplicaciones MindMeister, Digital Inclusion, síntesis de voz de Google y YouTube. Se encontró que el programa desarrollado tuvo un efecto positivo en la mejora del habla fonética de los niños en comparación con los resultados al inicio del estudio. La importancia práctica del trabajo implica la posibilidad de utilizar el programa desarrollado para la corrección del habla entre un mayor número de niños. Las perspectivas de investigación están relacionadas con la elaboración de los mecanismos de desarrollo del habla en función del grado de alteración del habla.

Palavras clave: tecnologías de la información; lectura conjunta; apoyo personalizado; interacción social; trastornos del habla y del lenguaje.

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Introduction

The learning process for SENs should be aimed at developing a personality that can think productively and develop creative skills. Therefore, effective preliminary preparation should be provided, which will allow them to solve problems of different levels of complexity. The development of learning programmes should be based on the humanization and individualization principles, which are aimed at successful training. Such an approach can be provided through the use of various information and communication programmes, which forms the relevance of this research.

High-quality education for children with disabilities is provided at the state level in different countries, which contributes to their full social adaptation. The process of teaching SENs should be based on their individual needs and capabilities (Bruinsma et al., 2020). Training can take place individually, in an inclusive or in a regular group, which requires different mechanisms to ensure its effectiveness. The educational process should provide for the formation of a favourable environment, which is conductive for the development of thinking, creative skills, and establishing friendships (Rong et al., 2023b). Personalized support should be provided for the development of such children, which will eliminate psychological limitations. Inclusive education should be based on the accessibility and equality principles, which are aimed at ensuring high quality of education. A differentiated approach to the educational process should be provided, which takes into account the individual specifics of children during the organization of an effective educational process (Bayard et al., 2019; Cardile et al., 2023).

One of the categories of SENs can be children with developmental language disorder. Speech impairment reflects impaired speech abilities that do not contribute to full communication and are associated with the psychophysiological characteristics of an individual (Tsaras et al., 2018; Peng et al., 2022). Most often, such problems (speech delay (alalia), dystonia, stuttering, etc.) can occur in preschool children (about 30%). The science of defectology, namely speech therapy, deals with the study of problems of speech disorders. This science involves the study of psychophysiological peculiarities of people, patterns of upbringing, as well as methods of adaptation in the social environment. The choice of the right approach can ensure speech development in SENs, which can involve the development of information and communication programmes (Knabe et al., 2023). Such programmes can contribute to the correction of violations due to the interactivity of training, which is reflected in the provision of an individual approach to training. Information technologies will make it possible to enhance students' interest in learning, which will be reflected in the overall quality. Individuality is manifested in the selection of the complexity of tasks according to the child's level of

development, ensuring the appropriate sequence in learning, and objective control of performance (Brock et al., 2022; Popovych et al., 2022). Complexity in education contributes to the creation of conditions for psychological stabilization and regulation of behaviour.

The study of the theoretical material revealed the gaps in the appropriate educational models that will be aimed at corrective speech development using various information technologies. Therefore, the aim of the work is to determine the effectiveness of information and communication programmes for SENs in the context of speech development.

Research objectives are related to:

- determination of the most effective existing approaches for the development of speech, using calculations of the ranking factor;
- development of an information and communication programme for speech development of children using most effective approaches;
- determination of the level of impaired speech of children before and after the study;
- determination of the overall effectiveness of the developed programme for the speech development of children aged 4 to 7 years, taking into account the level of their speech and general development.

Literature review

Providing education for SENs is possible due to the development of literacy, as it facilitates access to information and speech development. But for this, the educational process must be based on a thorough intellectual approach and ensure the expansion of communication. Pupils of grades 6-14 were involved in speech development, which provided for the development of reading skills with the explanation of language constructions. The learning process involves the analysis of the read material, which is reflected in phonological awareness. Mixing of sounds, study of phoneme segmentation, analysis of words and their explanation were ensured during reading. The defined approach in education ensured the development of speech (Ulriksen et al., 2023). It is possible to ensure the development of speech through communication, as a result of the exchange of information using a common system of symbols or behaviour patterns. The use of communication has a positive effect on the reduction of aphasia (language disorder resulting from brain injury). It also affects the development of dysarthria (speech disorders caused by impaired accuracy of movement, which is reflected in articulation, resonance). Communication can also contribute to the correction of apraxia of speech, which is associated with a violation of sensorimotor commands being necessary to ensure normal speech (Fink et al., 2022). Providing a language environment for hearing-impaired children is essential to enable speech perception at an early age. The use of speech therapy improves listening skills, especially when using the French language. The Cued French application is a multi-sensory communication tool that allows for lip separation using additional gestures. The results show the effectiveness of such an application in facilitating language comprehension (Bogaert et al., 2023).

The use of tablets during education has a high effectiveness in speech development for autism or other developmental disorders. The use of information technologies ensures the exchange of information and other social interactions, which promote the development of various skills. The ProLoquo2Go application, which is based on the sequence of tasks and consistent instruction, can used in education. The application is conductive to the development of social communication (Alzrayer et al., 2019). Movement disorders in children can contribute to the creation of difficulties in pronunciation, gestures, facial expressions, which generally affects the difficulty of communication. The programmes Medline, Embase, Cinahl, Psycinfo are used to identify the characteristic parameters that affect speech development. It was established that the interaction of children with parents contributes to the development of speech and accuracy of movements, which is the basis of spoken or gestural communication (Pennington et al., 2018; Ternavska et al., 2020). Children's apraxia of speech affects the lack of accuracy and sequence of pronunciation of sounds and syllables, which is reflected in the correct rhythm of speech. This happens because of inconsistent creation of errors, violation of transitions between sounds. It can also affect the deficit of motor programming, which is reflected in individual movements. The use of digital technologies ensures the accuracy of the pronunciation of words, the consistency of speech and its coherence. The choice of digital technologies in education depends on the degree of the disorder of the nervous system, as well as on the students' age (Morgan et al., 2018).

Digital technologies make it possible to overcome disruptions in the educational process for children with disabilities. This can be achieved through digital support, speech-to-text conversion and the use of subtitles

for better understanding. They also facilitate interaction with educational content, search for concepts to express one's own opinion. Digital technologies can also facilitate the selection of the most favourable resources for learning (Hurwitz, 2023). The provision of speech therapy during the period of COVID-19 has become possible due to the use of digital technologies. They made it possible to form the motivation of children in the development of speech. However, the results showed that a mixed approach in education is the most favourable, as it supports the transfer of teacher practice as well as access to all materials (Ansari et al., 2022).

The analysis of the articles showed that the studies are mostly related to the provision of intellectual approaches to children's speech development. The use of digital technologies and communication with others is only one of the research topics, but not the main one.

Methods

Research design

The study comprised four main stages. The first stage provided for choosing the most effective approaches to speech development. The identification of effective approaches involved the study of existing ones, focusing on own experience and academic literature (Key et al., 2022; Xue et al., 2022; Church et al., 2023; Rinaldi et al., 2023). The effective approaches were chosen with a view to the possibility of their use to ensure the educational process of preschool children with SEN. The second stage of the research was related to the development of the programme, which was aimed at the development of speech of children aged 4-7 years. The programme was also expected to contribute to overall comprehensive development. The programme was aimed at ensuring constant communication, development of creative skills due to the use of modern information technologies. The development of the programme provided for the enhancing students' interest in studying the material. The education was realized in a mixed format, which involved the formation of study groups among children of different ages. So, there were children aged 4, 5, 6, 7 years in each educational group. The training programme provided for three classes a week for five months.

The third stage of the study was related to the definition of speech and language disorders among children of different ages. The gradation of violations in pronunciation included making 1-2 mistakes, 3-4, 5-6, more than 7, and the absence of mistakes was also taken into account. The results were compared before and after the start of the study, which made it possible to determine the overall effectiveness of the developed programme.

The fourth stage of the study was to determine the overall effectiveness of the developed programme for providing education to SENs. The effectiveness was determined on the basis of the development of children's speech and general awareness.

Sampling

The study involved 138 children aged four to seven years (Table 1). The sample of respondents provided for the involvement of speech-impaired children in the study. The disorders included stuttering, bradylalia, and logoneurosis manifested in a violation of the tempo and rhythm of speech, which is associated with convulsions of the speech apparatus. Also, these violations are reflected in the pace and speed of pronunciation. The condition for forming the sample of respondents was their education in preschool institutions, excluding education in schools. The sample of respondents was formed from children who work with speech pathologists. An important condition for involving children in the study was obtaining written consent from their parents.

Table 1. Distribution of children who participated during the study.

Age of the respondents	The number of respondents
4 years	30
5 years	35
6 years	39
7 years	34

Methods

Determining the most effective approaches to ensure speech development of became possible due to the use of the general theoretical method of comparison. The comparison method was intended to determine the advantages and disadvantages of existing methods, which is connected with the comparison of more than 40

different approaches. This approach made it possible to choose the 5 most effective approaches to the organization of the educational process. The efficiency was calculated for the five selected approaches by using the ranking factor. The formula was developed by the authors of the article for conducting the research:

$$r_{\text{п}} = \frac{\sum(t_{\text{p}} + d_{\text{p}})}{n-1} \quad (1)$$

t_{p} – evaluation for the possibility of using a comprehensive approach for speech development;
d_p – a score for the difficulty of implementing a separate approach for the development of speech in children;
n – the number of identified approaches.

The development of the programme of the educational process involved the selection of stages that most contributed to speech development. The authors focused on established efficiency approaches during the development of the programme. This ensured the use of information technologies, social interaction, and group approach during training. The choice of technologies for training was related to the study of existing applications and their comparison. Preference was given to applications that develop Ukrainian pronunciation. It was taken into account that the training programme should contribute to both the development of speech and the general development of children.

A general theoretical observation method was used to determine mistakes in children's pronunciation. The process involved monitoring children's pronunciation during the entire period of study. It was also planned to determine the level of children's language proficiency in the control session. For this purpose, the children were asked to pronounce individual letters, words, and sentences. The number of incorrectly pronounced sounds was also checked through the performance of developing songs. The results were found for each child and presented using percentage values.

The overall effectiveness of the training programme was determined taking into account the child's general development and speech level. The gradation of the levels of effectiveness involved high, medium and low levels. A high level provided that children could explain words and pronounce monosyllabic and polysyllabic words with up to 3 mistakes. Children were able to pronounce understandable words without compounding, as well as to correct their mistakes independently. The medium level involved a partial violation of the rhythmic pattern and preservation of correct pronunciation during the pronunciation of words. There was no low level among children. The overall effectiveness was calculated using the efficiency coefficient, which was developed by the authors of the article:

$$x_i = \frac{\left[w_i + d_g - \sum_i^l k_p\right]}{j(w_i + d_g)} \quad (2)$$

w_i – a score for speech development;
d_g – a score for general development (according to the curriculum);
k_p – the level of children's uncertainty in pronunciation;
j – the total number of favourable results that can be obtained.

Data analysis

Data analysis was intended to confirm the results obtained during statistical calculations. Statistical calculations were carried out to determine the relationship between the effectiveness of the identified approaches to learning. The statistical analysis also provided a comparison of the level of the children's determined effectiveness based on the acquired knowledge. The calculation involved the use of the Phillips correlation coefficient, which confirms the relationship between elements when the calculated value will approach 1 (Schmitt et al., 2022):

$$p = 1 - \frac{6\sum d^2}{n^3 - n} \quad (3)$$

d – the difference in indicators, which are aimed at comparing the value of one number relative to others;
n – the total number of parameters for statistical calculation;
$\sum d^2$ – the sum of the obtained difference of indicators.

Ethical criteria

Ethical norms were intended to ensure equal conditions for all respondents. For this purpose, the research programme was announced to the parents before the study. The authors confirm the absence of changes

regarding the primarily established research structure (National Committee for Research Ethics in Science and Technology, 2016). The internal policy of the state institution South Ukrainian National Pedagogical University named after K. D. Ushynsky was also complied with during the research. Orientation to the institution's internal policy was connected with the development of teaching approaches by teachers of the South Ukrainian National Pedagogical University named after K. D. Ushynsky. Therefore, the following documents were taken into account during the study: Regulation on the organization of independent work of students of the state institution 'South Ukrainian National Pedagogical University named after K. D. Ushynsky', Protocol No. 9 (2020) and Regulations on the organization of the educational process for higher education applicants at the state institution 'South Ukrainian National Pedagogical University named after K. D. Ushynsky', protocol No. 9 (2023).

Results

The first stage of the research was to determine the most effective approaches to speech development during the educational process. The indicators were chosen as a result of the orientation to the delivery of educational training by teachers, not independently. The calculation was carried out using the ranking factor (Figure 1).

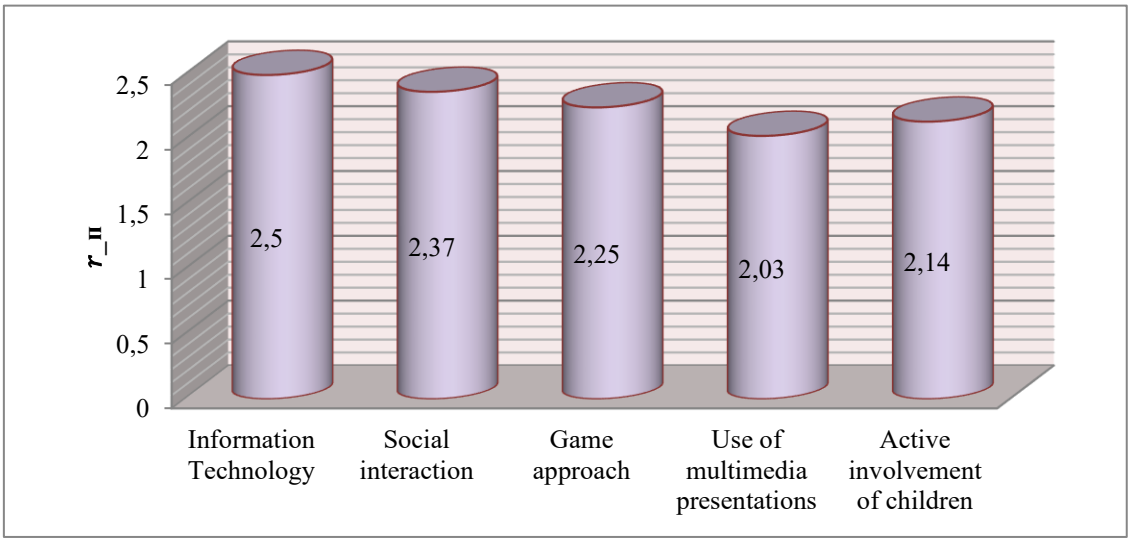

Figure 1. Analysis of the most effective approaches for speech development (Phillips correlation coefficient (p): 0,7451).

The conducted analysis made it possible to determine that the most effective approach is the use of information technologies, as they enable combining several approaches. The effectiveness of information technologies in the educational process is associated with motivational, content-related, self-developing functions. The motivational function is related to the enhancement of children's interest, which promotes the development of cognitive skills. Content-related function in education implies the possibility of using various programmes that will ensure a conscious approach to information perception. They are also reflected in the possibility of creating a positive atmosphere during classes. Independent development may involve additional development of skills by analogy with already completed corrective tasks.

Social interaction is the second most important, which ensures the development of communication skills. Social interaction can be formed during group classes, which involves interaction between children and teachers. This promotes building of creative skills, ensures communicative and speech development. Language development during interaction in a group can be a result of communication to enhance cognitive activity. This results in successful socialization, which allows to exclude psychological limitations during speech development. It also ensures better perception, develops attention and its concentration on a certain issue.

The game-based approach is also important for speech development, as it is based on non-standard assimilation of information. Games help children to establish signs of similarity or difference, understand certain patterns. They can also describe individual situations with the help of language as a result of logical thinking. The use of emotional communication approaches in the game can contribute to the development of articulation, imitation of the corresponding sounds. It is also possible to ensure the development of rhythm and intonation during the game, which is reflected in expressive speech.

The active involvement of children is of lesser importance, since at the initial stage of the study it may affect the lack of contact of children. This may be related to psychological fears. Forced communication will affect the lack of development of monologue speech, expression of one's thoughts. Active involvement of children is possible as a result of familiarization, which can manifest itself, for example, in the form of intellectual minutes. They can involve the development of new words, understanding case relations, etc.

The use of multimedia presentations without other information technologies will have only a visual meaning, which will not enable building speaking skills. Interaction with other digital technologies will allow the development of articulation and speech breathing. Visual perception itself will not motivate preschoolers to continue their studies.

The information and communication programme for children was developed in this this study taking into account the most favourable approaches to the development of speech, which were established by the authors. The use of a game-based approach was provided during the development of the programme, which contributes to the motivation of preschoolers in the perception of information. The training programme was aimed at the development of speech, as well as the comprehensive development of children (Figure 2).

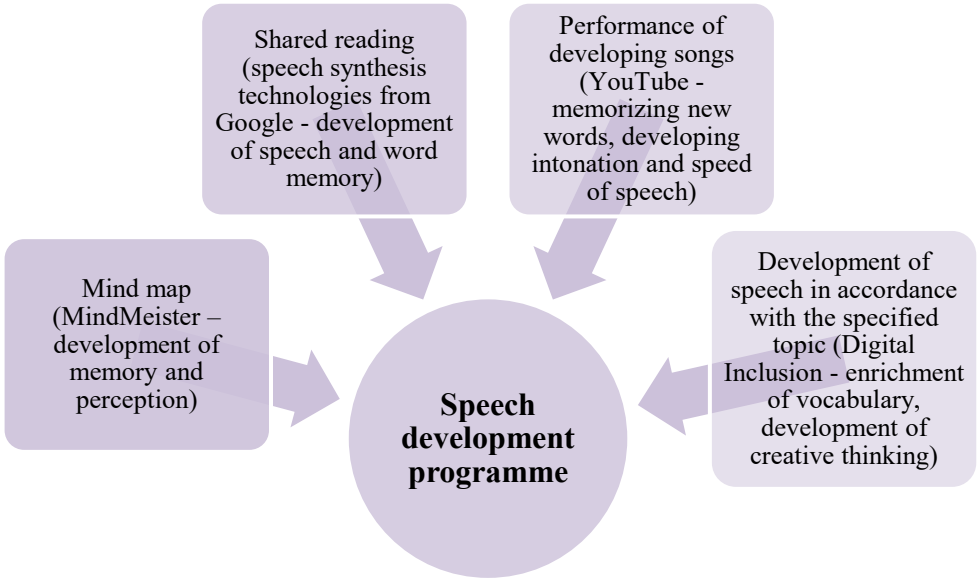

Figure 2. Information and communication programme for speech development and general development of children.

The first element of the programme was to develop memory and perception through the use of 'mind maps'. The MindMeister application was used to create mind maps, which enables using standard and custom templates. During the educational process, it was planned to divide children into groups 3 people each for discussing a certain situation. Mind maps are aimed at the development of creative thinking, which contributes to the use of new words as a result of describing a particular situation. During the explanation of the topic, children were asked to use a scheme to display information, which involved searching for symbols, pictures and discussing them. After the creation of a mind map by some children, other children were expected to supplement the scheme and at the same time describe the made changes.

'Joint reading' has a positive value for the development of speech, memorizing words, which became possible through the use of speech synthesis from Google. The process involved reading the text and individual letters that were presented on the screen. The children had to accurately reproduce the information they had heard preserving the intonation and volume. The text was accompanied by bright pictures for enhancing children's interest, which also develops attention concentration. Joint reading also involved discussion of the perceived text, which contributes to the accumulation of vocabulary.

'The performance of the developing songs' was ensured through the use of YouTube. First of all, the emphasis was on memorizing new words as a result of their repetition. Singing contributes to high-quality verbal communication, which is also manifested in the development of imagination. It also eliminates problems with intonation and speed of speech. It is possible to detect problematic behaviour and disruption of social interaction during singing. This approach in the development of speech ensures the use of unusual models of memorizing information and the correct reaction to sound stimuli.

'The development of speech in accordance with the specified topic' was ensured through the Digital Inclusion application. Its functions make it possible to choose words in a separate category (family, transport, etc.). The process of interacting with the application involved creating sentences using 1 to 10 words. In the form of a game, children were asked to guess the next word to form a sentence, focusing on its further repetition. The "creativity" category includes colouring pictures of different levels of complexity, which develops creative thinking. The application also contributes to comprehensive development (for example, introduces into the cultural heritage of Ukraine), which involves further discussion of the drawings.

The percentage of impaired phonetic speech was determined to check the effectiveness of the created approach in speech development among children of different ages. The results were compared with the children's capabilities before the study (Table 2).

Table 2. Determination of the level of students' impaired phonetic speech before and after the study.

The number of incorrectly pronounced sounds	Before the study, %				After the study, %			
	4 years	5 years	6 years	7 years	4 years	5 years	6 years	7 years
0	-	-	-	-	11%	16%	15%	17%
1-2	5%	-	9%	-	49%	40%	40%	41%
3-4	24%	31%	26%	43%	32%	37%	45%	39%
5-6	39%	32%	41%	31%	8%	7%	-	3%
>7	32%	37%	24%	26%	-	-	-	-

After determining the level of speech development in children of different ages, the high effectiveness of the developed information and communication programme was shown. The results showed that after the study, the children achieved better pronunciation, which is related to the accuracy of letters, correct intonation. The results showed that before the study, the biggest problems in pronunciation were associated with the absence of [р], [л']. There was also replacement of letters, mixing of hissing and whistling sounds. For example, [р] was replaced by [л] or [й '], and [л] was replaced by [в], etc. But after the training, the children were able to pronounce words more accurately, which is related to the selection of the back sound. Children were also able to repeat words more accurately, reducing the number of mistakes. The structure of speech has become more expressive and understandable for others.

The overall effectiveness of the developed information and communication programme for SENs was also determined during the research. The results took into account the general level of the child's development and the level of speech development (Table 3).

Table 3. The overall effectiveness of the acquired knowledge and speech development of children.

Level of effectiveness	Effectiveness depending on the age of the children				Mean value of effectiveness
	4 years	5 years	6 years	7 years	
High level	0.18 (44%)	0.18 (49%)	0.2 (53%)	0.19 (57%)	0.19
Medium level	0.16 (56%)	0.14 (51%)	0.15 (47%)	0.16 (43%)	0.15
Low level	-	-	-	-	-
Philips correlation coefficient (p)	0.9211	0.9804	0.9540	0.8967	0.9390

The results showed a high level of the overall effectiveness achieved by preschoolers. This was reflected in the accuracy of pronunciation and general perception of information. Children were able to expand their horizons while solving tasks in a game format. The results are also related to the development of thinking and creative abilities. For example, children were able to accurately solve tasks that were presented in the Digital Inclusion application. Children who completed the training course were able to improve the quality of their speech and learn the curriculum. Children's communication also increased, which eliminated the limitation of speech contacts for full-fledged communication. The improved level of speech made it possible to minimize difficulties in the perception of information, which was reflected in the development of intellectual skills.

Discussion

The development of speech reflects a complex process of the nervous system, which is associated not only with physiological, but also with psychological limitations. Assessment of the level of speech impairment is the first stage for its development. The development of children's communication is possible due to the use

of videos, which will ensure the intelligibility of speech. Recording of lessons enables identifying mistakes that occur in children's communication and identify positive changes in speech (Seyhan-Biyik et al., 2023). The formation of correct intonation in the speech of children with autism affects the limited perception of speech. It is possible to improve pronunciation as a result of ensuring productive perception of information by students, which correlates with language abilities. It is necessary to use pitch patterns and constantly accumulate language experience in order to distinguish the meaning of words. Research findings show that language impairment can also have a negative impact on sound processing (Rong et al., 2023a). Violation of the process of repetition of words in children is more often observed among European languages and very rarely among Mandarin Chinese. This problem can be eliminated by taking into account language components (rhyme, tone), the number of syllables that are most common among children. Therefore, constant repetition of words is necessary, which will ensure the relationship between rhymes and tones (Xue et al., 2023). Unlike the reviewed studies, where the emphasis is on improving children's pronunciation due to the development of a particular skill, our article uses a more comprehensive approach. The results showed effectiveness in the development of speech through the use of mind maps, joint reading, performance of developing songs and discussion of the specified topic.

The use of virtual reality promotes the development of social competence, but under the teacher's supervision. The formation of facial expressions from a narrow to a wide spectrum is also important during speech development. This can be achieved due to the development of cognitive and reading skills, working memory, oral language. This can be achieved by learning another language (Wang et al., 2024). Speech development of children with autism spectrum disorders is possible due to the use of speech output technologies. Their effectiveness is related to the provision of functional communication skills and repetition of the material. The use of digital technologies also allows for vocal communication, which contributes to more effective speech development (Muharib et al., 2019). The development of reading skills also contributes to the formation of correct pronunciation, which is connected with the structural connectivity of words. However, ensuring the early development of speech-impaired children has a greater value that can be realized through the use of digital technologies. A non-standard approach in the development of speech showed improved language indicators during one school year. Regular training allows for a positive change in language skills, enriched expressive vocabulary (Bruinsma et al., 2023). Our article also revealed the effectiveness of information technologies in the development of children's speech. However, in contrast to the presented works, the use of different technologies (MindMeister, Digital Inclusion, speech synthesis from Google and YouTube) in our article was provided for each element of the training programme. The training programme also provided for both speech and general development of the child.

Language disorders are characterized by a violation of verbal expression, which can be corrected by using virtual reality. An interactive approach allows for a better understanding of the meaning of words and their repetition. This also helps to understand parts of words, which affects the length of the utterance, the construction of sentences (Cappadona et al., 2023).

The study of the specifics of the published articles showed that more attention is paid to children with autism and mechanisms of speech improvement in cases of speech disorders. In our article, we studied the possibility of improving speech development for children aged 4-7 years who have minor speech development problems. The authors first identified the most effective approaches to improve speech, which later contributed to the development of a speech improvement programme. The authors used information technology, active communication, and a game approach, which improved the effectiveness of children's pronunciation.

Limitation

Based on the research, it is possible to draw a conclusion about the limitation of comparing the quality of various digital technologies for improving communication skills among children with SEN. Further research may be related to comparing the effectiveness of digital technologies of different directions for the development of communication among children of a separate age category (separately for children 4 years old, 5 years old, 6 years old, 7 years old). This approach will allow for finding more effective teaching methods. Despite the possible limitation, the study indicated effective digital mechanisms for developing communication skills among children with SEN, confirmed by the work's relevant stages.

Recommendations

For children with special educational needs, their role in society and the opportunity to communicate with peers is important. Therefore, focusing on information and communication programs allows for a comprehensive approach to education. This will create a positive atmosphere during learning and ensure joint interaction with students. The program presented by the authors for speech and general development of children is highly effective, which was confirmed in the study. Therefore, its use on a wider scale will allow for the achievement of greater skills for children with SEN.

Conclusion

The authors achieved the aim et in the research, as the effectiveness of the developed information and communication programme for the speech development of children with special educational needs was established. First of all, it was determined which educational and educational approaches are more effective in general. It was established that the use of information technologies (2.5) allows creating a positive atmosphere in classes and ensures comprehensiveness in education. Social interaction (2.37) contributes not only to communication, but also to learning new words. The game-based approach (2.25), in addition to the motivating function, also provides the development of logical thinking. The active involvement of children (2.14) and the use of multimedia presentations (2.03) are less important, as it requires the use of additional tools.

The training programme developed by the authors included the development of mind maps implemented with the help of the MindMeister application. Mind maps were aimed at developing logical thinking and learning new words. Google's speech synthesis technology facilitated joint reading, which was aimed at ensuring clear pronunciation of words. The performance of development songs involved the use of YouTube, which formed an unusual model of memorizing information. The development of speech in accordance with the specified topic was based on the use of the Digital Inclusion application. It was established that the developed training programme had a positive effect on reducing the percentage of impaired phonetic speech after the study. The absence of violations was greatest among seven-year-olds (17%) and five-year-olds (16%). The overall effectiveness of children was achieved at high (0.19) and medium (0.15) levels.

The practical significance of the study in the possibility of using the developed information and communication approaches to correct children's speech, focusing on the use of digital technologies. Prospects for further research may be related to the comparison of the effectiveness of different digital technologies for providing speech development.

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