Psychological and pedagogical experiment of research into the rehabilitation impact of typhlo devices on the formation of people with visual impairments

Experimento psicológico pedagógico del estudio de la influencia de rehabilitación de tiflodispositivos en la formación de una personalidad con discapacidad visual

Written by:
Tetiana Kostenko[79]
https://orcid.org/0000-0002-4976-1236
Anna Petrykina[80]
https://orcid.org/0000-0002-3841-9312
Oksana Los[81]
https://orcid.org/0000-0002-0177-9381
Oleg Legkiy[82]
https://orcid.org/0000-0001-8934-7390
Olena Palamar[83]
https://orcid.org/0000-0003-2982-0558
Ihor Popovych[84]
https://orcid.org/0000-0002-1663-111X

Abstract

The aim of the article is to study the rehabilitation effect of typhlo devices on the formation of the cognitive sphere of the personality of a school student with visual impairments with the help of psychological and pedagogical experiment. Materials and methods. The research was conducted as a psychological and pedagogical experiment. The following information technologies were used with the help of typhlo devices: "RUBY"; "SAPPHIRE"; "PEARL"; "TOPAZ"; "ONIX"; "SARA CE"; "PIEX TALK"; "TOUCH MEMO"; "FOCUS 40 BLUE". Results. Significant differences in the use of typhlo devices with information technology were identified in the experimental and control groups (t=2.0-6.1; p<.01; p<.05): "RUBY"; "SAPPHIRE"; "PEARL"; "TOPAZ";

Resumen

El objetivo del artículo es estudiar el impacto de rehabilitación de tiflodispositivos en la formación de la esfera cognitiva de un alumno con discapacidad visual al realizar un experimento psicológico pedagógico. Materiales y métodos. La investigación se llevó a cabo en forma de un experimento psicológico pedagógico. Con la ayuda de tiflodispositivos utilizaron las siguientes tecnologías de la información: "RUBY"; "SAPPHIRE"; "PEARL"; "TOPAZ"; "ONIX"; "SARA CE"; "PIEX TALK"; "TOUCH MEMO"; "FOCUS 40 BLUE". Resultados. Se constató las diferencias significativas del uso de toflodispositivos con las tecnologías de la información en el grupo experimental y en el de control (t = 2,0-6,1; p < 0,01; p < 0,05): "RUBY"; "SAPPHIRE"; "PEARL"; "TOPAZ"; "SARA

[79] Candidate of Psychological Sciences, Head of the Department of Education of Children with Visual Impairments, Mykola Yarmachenko Institute of Special Pedagogy and Psychology, National Academy of Pedagogical Sciences of Ukraine, Kyiv, Ukraine.
[80] Foreign Language Teacher, Communal establishment "Kharkiv special school named after V.G. Korolenko" Kharkiv Regional Council, National Academy of Sciences of Ukraine, Kharkiv, Ukraine.
[81] Candidate of Psychological Sciences, Associate Professor of the Department of Pedagogy of Preschool and Primary Education, Kherson State University, Kherson, Ukraine.
[82] Candidate of Pedagogical Sciences, Senior Research of the Department of Education of Children with visual impairments, Mykola Yarmachenko Institute of Special Pedagogy and Psychology, National Academy of Pedagogical Sciences of Ukraine, Kyiv, Ukraine.
[83] Candidate of Psychological Sciences, Associate Professor at the Department of Ophthalmopedagogy and Ophthalmopsychology, National Pedagogical Dragomanov University, Kyiv, Ukraine.
[84] Doctor of Psychological Sciences, Full Professor of the Department of Psychology, Kherson State University, Kherson, Ukraine.

"SARA CE"; "PIEX TALK"; "FOCUS 40 BLUE". The absence of significant differences was identified (t=1.5-1.6; p>.05): "ONIX"; "TOUCH MEMO". It has been proved that implementing the recommended information technology increases interest in lessons, promotes cognitive activity, and enhances the school student's creative potential. Conclusions. It was generalized that using typhlo devices during the work of school students with visual impairments allowed them to personalize their learning as much as possible, making the learning process creative and investigational.

Keywords: special psychology, typhlo devices, basic competencies, cognitive sphere, inclusive educational process.

CE"; "PIEX TALK"; "FOCUS 40 BLUE". No constataron diferencias significativas (t = 1.5-1.6; p> .05): "ONIX"; "TOUCH MEMO". Se comprobó que la implementación de las tecnologías propuestas de la información contribuye a aumentar el interés hacia las clases, acelera la actividad cognitiva, desarrolla el potencial creativo del estudiante. Conclusiones. Se generalizó que el uso de tiflodispositivos durante el trabajo de los estudiantes con discapacidad visual permitió individualizar al máximo el aprendizaje, hacer este proceso de aprendizaje más creativo e investigativo.

Palabras clave: psicología especial, tiflodispositivos, competencias básicas, esfera cognitiva, proceso educativo inclusivo.

Introduction

The global problem of vision impairment is critical, and it necessitates permanent innovative intervention. This applies to the creation of an inclusive educational space, the implementation of sophisticated teaching methods, the utilization of information technology, and the application of the most recent innovations in typhlo device functioning.

Ukraine has ratified a number of international documents on the protection of the rights of persons with disabilities. The state vector aims to explore ways to rearrange the education system, providing an alternative educational space for children with visual impairments that includes the development of adaptive functions, ensuring optimal development, and receiving quality education in the school. The search for effective strategies to improve the quality of education for children with visual impairments needs to enhance the effectiveness of scientific knowledge acquisition and provide access to school for these children. In this context, incorporating relevant information into the education of such children is a top priority, as it allows for the application of various learning methods, depending on the educational needs of each child, and supports the child's more effective participation in the educational process. It's also positive that every child with special needs, who has the capacity to reach his or her full potential as a person, has as much engagement with society as possible. That really is, the use of information technology in the education of children with visual impairments is a required component of such children's educational activities.

We underline that the success of integrating children with disabilities into the educational process presents the question of informative learning, which entails assuring each child's individual progress throughout their lives. There are currently a number of inconsistencies between ensuring equal access to quality education for children with visual impairments and the effectiveness of mechanisms for implementing educational policy based on competence and personality-oriented approaches, as well as existing destabilizing factors, in order to ensure optimal development and quality education for these children in various types of educational institutions. Using modern information technologies in the educational process helps create conditions for the child's social and intellectual growth by increasing the perception and assimilation of educational material in line with the educational system's aims and objectives. In the future, there will be a true possibility to choose a higher education institution and increased competitiveness in both domestic and foreign job markets.

Hypothesis. The authors suggest that the rehabilitation benefits of typhlo devices will have a considerable favorable impact on the cognitive domain of school students with visual impairments.

The aim. Investigate the rehabilitation effect of typhlo devices on the formation of the cognitive sphere of the personality of a school student with visual impairments with the help of psychological and pedagogical experiment.

Literature review

Researchers have proved that the advancement of information technology and its integration into the educational process of children with disabilities have a favorable impact on the child's cognitive and personal development. It's also a brilliant idea to modernize the process of informatization in education for children with impairments (Prokhorenko & Romanenko, 2019; Tatyanchikova & Sakhno, 2020). The processing and perception of information content of cognitive material by children is disrupted in conditions of visual derivation, therefore the structuring of the educational process necessitates the use of special extra equipment and informatization. Moreover, the educational system's informatization is based on a system of theoretical and methodological provisions in the education of children with disabilities. The semantic characteristics of information technology use in special and inclusive education are investigated (Tatyanchikova & Sakhno, 2020). The study of opportunities to improve the effectiveness of such children's education through the use of electronic play resources in primary school (Bykov et al., 2017); the study of the peculiarities of children with mental retardation's classification of information field objects (Prokhorenko & Romanenko, 2019) are both of scientific interest.

Despite their differing perspectives on the specific topic, researchers agree that incorporating information technology into the educational process will not only increase school student's motivation and achievement, but will also assist in the acquisition of skills in a variety of situations, including some that are unusual, enrich practical experience for child, etcetera (Bykov et al., 2017; Tudge, 1986).

A child with visual impairments has the opportunity to learn about the world only with the help of preserved analyzers. Therefore, the mental development of such children, as well as the construction of compensating processes, active life positions, awareness, and mastery of self-realization methods, are influenced by a variety of factors, including biological, social, mental, and educational factors. According to scientists, using information technology in the education of visually impaired children produces ideal conditions for their education in all educational institutions, regardless of ownership, access to educational services, active involvement in society, and other factors (Klopota, 2015; Kobilchenko, 2016).

Analysis of theoretical studies shows that a fairly recurring phenomenon is the combination of multiple visual impairments in one child (Prokhorenko & Romanenko, 2019), including: decreased visual acuity or blindness and loss of sensitivity of the fingers (in diabetes); simultaneous impairment of vision, hearing, speech and cognitive impairment (cerebral palsy); multiple sensory defect (impaired vision and hearing) in combination with intellectual disabilities (Down syndrome). This causes significant problems in the organization of the child's learning process and not always well-established methods of teaching people with visual impairments, including the blind, can be successful because of their inability to read Braille with loss of finger sensitivity due to diabetes (Prokhorenko & Romanenko, 2019; Simpson, 1998).

The development and implementation of flexible strategies and methods, combining modern information technology with the rehabilitation effect of typhlo devices, which take into account the individual characteristics of each school student with visual impairment, should, in our opinion, address the above issues of effective education for such children.

Information technology has an educational and developmental role since it acts as an effective instrument for the child to complete tasks. In addition, information technology promotes intellectual growth, enhances self-esteem, and releases the child from routine tasks. The successful use of information technology supports the development of children's visual, thinking, memory, self-organization, and co-creation skills, as well as their learning motivation and, as a result, their sociability level (Drozd & Bystrova, 2020; Klopota, 2015; Popovych et al., 2020).

Scientists have come to the opinion that information technology has a favorable impact on the learning and education process, owing to the fact that it modifies the knowledge transmission scheme and teaching methods (Bykov et al., 2017; Klopota, 2015). Furthermore, the implementation of such technologies in the school system for children with visual impairments relies on the employment of specialized equipment, software and hardware, and information processing systems (Kostenko, & Goshovsky, 2019).

This provides justification for considering the study of the issues associated with the use of new information technologies and the rehabilitation

impact of typhlo devices in the education of children with special needs to be both theoretical and practical.

We claim that, despite countless scientific studies, the issue of successfully preparing children with visual impairments for independent living and subsequent integration into society remains under investigation. The success of such children is determined by the educational environment in which they are placed, as well as the content of education's correctional and developmental orientation, which should include the development of compensation, correction, and restoration of impaired functions, as well as the identification of potential opportunities for children with visual impairments. The rehabilitation effect of typhlo devices in the educational process of school students with visual impairments allows them to study according to their specific traits and abilities in this context.

Methodology and methods

Methodology. The knowledge that relying on visual perception in schools for the blind is impossible is one of the important foundations of the research of the rehabilitative impact of typhlo devices on the construction of the cognitive sphere of school students with visual impairments. Concurrently, the learning process in traditional educational institutions is centered on visual perception. Ophthalmology, physiology, pedagogy, and psychology developments have created chances to enhance a child's sensory experience with visual impairments. The articulation of scientific problems is emphasized, and it provides the foundation for organizing the educational process of school students with visual impairments using modern special equipment, or typhlo devices, as they are known. Objects, phenomena, and concepts were portrayed using typhlo devices, which provided circumstances for high-quality information processing and presentation in the process of teaching children with visual impairments. The application of typhlo devices allowed blind children with coexisting problems access to cognitive material. The devices were meant to compensate for visual deprivation, as well as serve as a conduit of communication with the environment and an information conductor.

The experience of scientists was studied during the creation of an empirical picture of the study, the selection of relevant psychodiagnostic tools, and the selection of reliability criteria, who

experimentally and empirically established the following: psychological patterns in the adaptation process of personality, age patterns (Blynova et al., 2020; 2021; Halian et al., 2021; Kononenko et al., 2020; Popovych et al., 2021c; Shevchenko, 2019), regularities of semantic and value regulation of activity (Plokhikh, 2021; Plokhikh et al., 2021), patterns of educational and rehabilitation work (Popovych et al., 2022; Shevchenko et al., 2020), mental expectations and anticipatory processes (Nosov et al., 2020; Popovych et al., 2021a; 2021b), transformations in society due to the progression of the COVID-19 pandemic (Hudimova, 2021; Hudimova et al., 2021; Kharytonov et al., 2021; Khmiliar et al., 2020).

Participants. The experimental study involved school students of the fourth grade of special education institutions: Kyiv Special School № 11 (n = 30) (Kyiv, Ukraine); Kharkiv Special School № 12 (n = 30) (Kharkiv, Ukraine). The sample consisted of 60 people. School students represented special education institutions that specialized in teaching children with visual impairments. The mean age of the sample was 11.23 years (SD = 1.19, range 11-12 years). There were n = 31 (51.6%) girls and n = 29 (48.4%) boys in the sample.

Procedures and instruments. The experimental work was carried out in two stages. The level of development of basic competencies in children with visual impairments and concomitant disorders was determined in the first stage. The developed by Prokhorenko et al. (2021) questionnaires for teachers and parents of middle school students, as well as monitoring the availability of information in the classroom were used for this purpose.

The gathered data were examined in the first stage, and it was determined which typhlo devices should be applied in the educational process for high-quality information content processing and presentation.

The second stage was to confirm or deny the hypothesis that the cognitive sphere of a school student with visual impairments will undergo substantial beneficial changes as a consequence of the rehabilitative effect of typhlo devices.

The work was organized with both children and teachers to ensure that the experiment's tasks were carried out effectively. Teachers' participation in this process was beneficial. In the

event that if any device failed, teachers were given guidance and help.

Respondents accomplished two tasks at once: they assimilated new information and also learned how to use typhlo assistants. With the assistance of typhlo devices, the following information technologies were used: 1) "RUBY"; 2) "SAPPHIRE"; 3) "PEARL"; 4) "TOPAZ"; 5) "ONIX"; 6) "SARA CE"; 7) "PIEX TALK"; 8) "TOUCH MEMO"; 9) "FOCUS 40 BLUE".

Visually impaired children might read literature, look at small details, write, and execute a variety of other tasks by using "SAPPHIRE" portable video magnifier, which has the ability to change the backdrop setting on the display and magnify up to sixteen times. Children received instant access to printed texts through voice playback by connecting a portable "PEARL" reader to a personal computer. As a result, new educational material was more quickly learned and assimilated. Children may read books and other printed materials with the "TOPAZ" stationary electronic magnifier. The electronic magnifier made it possible to study the small details of any learning object by enlarging the displayed image of the object on the screen. Visually impaired children used the "ONIX" magnifier to study distant objects.

A foreign language was learned using the "SARA CE" scanning and recognition machine. This typhlo device read and scanned materials in a variety of languages automatically (the most common eighteen languages in the world). Children with visual impairments controlled the speed at which they read and saved files. Every step was stated throughout the work with "SARA CE", providing children with a convenient and pleasant work environment in the class and during the completion of individual and homework assignments.

The talking books were read by the respondents on a special device with "RIEX TALK" language synthesis. This is a multifunctional digital device with a voice recorder and media player that support a variety of file formats, including "DAISY" files.

The digital pen-marker-dictaphone was the next device. Respondents used "TOUCH MEMO" to find listed things and objects fast.

For blind school students, the "FOCUS 40 BLUE" portable Braille display provided comfortable computer work and information accessibility. The device is made using cutting-edge technology and can connect to a personal computer or laptop via Bluetooth. Also, using a voice synthesizer via an audio card on a computer, the program for blind and partially sighted school students "JAWS" for Windows was used to access the essential information and the Internet. Respondents used the "MAGIC" screen magnification application to capture information while listening to it through a voice synthesizer. "Dolphin Guide" software was used to create documents and send/receive e-mails, as well as listen to music and play audiobooks.

The use of typhlo devices in an experimental study was permitted by ethical boards and school administrations. School students with vision impairments were notified ahead of time and volunteered to take part in the study. The children's parents gave their consent for them to participate in the study. The study's organizers followed all of the WMA Declaration of Helsinki's (2013) ethical guidelines.

Statistical Analysis. The statistical processing of the collected empirical measures with the assistance of typhlo devices was done with "MS Excel 2011" and the statistical software package "SPSS" version 24.0. The reliability coefficients and variations in parameters recorded on typhlo devices were estimated using the Student's t-test.

Results

A randomly chosen sample (n = 60) of school students with visual impairments, aged 11-12 years, from various areas of Ukraine, was organized during the research's ascertaining stage. Table 1 presents descriptive frequency characteristics for the use of information technology in the ascertaining stage of the experiment.

Table 1.
Descriptive characteristics of the study of school students with visual impairments.

Device	Parameters / minute	Arithmetic mean (M)	Mean-square deviation (SD)
"RUBY"	Words	53.35	8.15
"SAPPHIRE"	Words	54.41	8.42
"PEARL"	The number of sheets of material processed	.63	.12
"TOPAZ"	Words	55.2	8.91
"ONIX"	Number of detected objects	3.45	.97
"SARA CE"	Number of translated foreign words	1.85	.48
"PIEX TALK"	Words	52.3	8.09
"TOUCH MEMO"	Search for items (pcs.)	1.2	.63
"FOCUS 40 BLUE"	Information search	1.4	.71

Source: Personal elaboration, 2021.

The speed (S) is the key parameter determined through the usage of typhlo devices. Speed is determined by the number of words read in a fixed period of time, usually one minute (60 s) ("RUBY", "SAPPHIRE", "TOPAZ", "PIEX TALK"), the number of sheets of processed material per minute ("PEARL"), number of recognized objects per minute ("ONIX"), number of translated foreign words per minute ("SARA CE"), found objects per minute ("TOUCH MEMO") and found information per minute ("FOCUS 40 BLUE"). A universal formula for determining the studied parameter (S) is presented:

$$S = \frac{n}{t} \quad (1)$$

where, S – the speed, units / s; n – the number of objects that are fixed with the help of typhlo device, units; t – the measurement time, s.

The data obtained with the use of typhlo devices on the ascertaining stage did not have significant deviations, which should be emphasized. In general, the obtained data of descriptive characteristics, according to researchers in this field (Kostenko & Goshovsky, 2019; Prokhorenko et al., 2020), were within acceptable limits.

The aim of the experimental work was to form the cognitive sphere of the personality of a school student with visual impairments due to rehabilitation effects. The effects of rehabilitation were achieved by the use of typhlo devices and modern information technologies. The content of the formative experiment with rehabilitation orientation was to create and implement developmental, educational, and cognitive technologies in order to form the basic competencies of respondents, in particular, to increase the level of native language proficiency; communication in a foreign language; increase mathematical competence; digital competence; formation of learning ability; development of social and civic competences; initiative and entrepreneurship skills; cultural self-awareness and self-expression. The organized complex of formative and developmental activities is the outcome of the authors' many years of work with visually impaired children. At the control stage of the investigation, Table 2 shows the results of the experimental (n = 20) and control groups (n = 20).

Table 2.
The results of the arithmetic mean of the experimental and control groups.

Device	Parameters / minute	M	
		EG (n=20)	CG (n=20)
"RUBY"	Words	90.60	53.15
"SAPPHIRE"	Words	92.20	49.40
"PEARL"	Number of sheets of processed material	1.88	.54
"TOPAZ"	Words	94.40	55.10
"ONIX"	Number of recognized objects	7.75	3.34
"SARA CE"	Number of translated foreign words	5.05	1.85
"PIEX TALK"	Words	92.10	51.15
"TOUCH MEMO"	Search for items (pcs.)	6.25	1.40
"FOCUS 40 BLUE"	Information search	5.50	1.50

Source: Personal elaboration, 2021.
Note: M – arithmetic mean; EG – experimental group; CG – control group.

Table 3 shows the results of a Student's t-test on statistical differences in study parameters, demonstrating the efficiency of the formative experiment with rehabilitative effects in respondents with visual impairments.

Table 3.
Student's t-test data on the levels of statistical differences in the parameters before and after the experiment.

Device	EG$_1$ & EG$_2$	CG$_1$ & CG$_2$	EG$_2$ & CG$_2$
"RUBY"	5.0; p<.01	1.2; p>.05	4.3; p<.01
"SAPPHIRE"	8.3; p<.01	1.1; p>.05	5.2; p<.01
"PEARL"	2.6; p<.05	1.3; p>.05	2.0; p<.05
"TOPAZ"	5.7; p<.01	1.6; p>.05	4.7; p<.01
"ONIX"	2.7; p<.05	1.5; p>.05	1.6; p>.05
"SARA CE"	6.8; p<.01	1.0; p>.05	5.2; p<.01
"PIEX TALK"	5.1; p<.01	1.5; p>.05	3.8; p<.01
"TOUCH MEMO"	2.8; p<.05	1.0; p>.05	1.5; p>.05
"FOCUS 40 BLUE"	8.7; p<.01	1.6; p>.05	6.1; p<.01

Source: Personal elaboration, 2021.
Note: M – arithmetic mean; EG$_1$ – experimental group before the formative experiment; EG$_2$ – experimental group after the formative experiment; CG$_1$ – control group before the formative experiment; CG$_2$ – control group after the formative experiment.

We state that statistical differences between the experimental groups (EG$_1$; EG$_2$) before and after the formative experiment (EG$_1$ & EG$_2$) were likely to be the most significant at the level (p<.05; p<.01), which was within t=2.6-8.7. Also, it was expected that there were insignificant changes in the comparison of control groups (CG$_1$; CG$_2$) before and after the formative experiment (CG$_1$ & CG$_2$) at the level (p>.05), which were in the range t=1.0-1.5. We explain this by the fact that traditional education has a favorable effect on children with visual impairments, but the short time frame in which our experiment was conducted did not allow us to notice significant changes in this positive effect. The results of statistical differences in the comparison of the experimental group with the control group (EG$_2$; CG$_2$) after the experiment (EG$_2$ & CG$_2$) at the level (p<.05; p<.01), which are in the range t=1.5-6.1, are interesting in a scientific sense. There were significant differences in how typhlo devices were used in combination with information technologies: "RUBY" (t=4.3; p<.01); "SAPPHIRE" (t=5.2; p<.01); "PEARL" (t=2.0; p<.05); "TOPAZ" (t=4.7; p<.01); "SARA CE" (t=5.2; p<.01); "PIEX TALK" (t=3.8; p<.01); "FOCUS 40 BLUE" (t=6.1; p<.01). It was stated that there were no significant differences: "ONIX" (t=1.6; p>.05); "TOUCH MEMO" (t=1.5; p>.05).

Discussion

The results demonstrated that using information technologies in education is one of the most effective ways to increase the level of basic competencies in children with visual impairments. There is a deficit of empirical research that allows us to compare our findings. Other researchers in special psychology (Talay-Ongan, 1998; Yakovleva, 2019), typhlopedagogy, and typhlopsychology (Kostenko, & Goshovsky, 2019; Prokhorenko & Kostenko, 2020), on the other hand, have concluded that using typhlo devices allows children to master educational knowledge in a short amount of time and enhances basic competencies. We state that combining typhlo devices with information technology allowed the child to retain and analyze a large quantity of various information (audio, visuals, text, and video content), as well as create it in a convenient format. As a result, the rehabilitative effect was realized, and it contributed to the discovery, preservation, and development of children's individual abilities and personal qualities, as well as the establishment of their cognitive sphere.

In the context of the formation of basic competencies, the effectiveness of information technology's impact is undeniable: communication in native language; communication in a foreign language; mathematical competence and basic competencies in science and technology; digital competencies; ability to learn; social and civic competencies; initiative and entrepreneurship skills; cultural self-awareness and self-expression. Related to our results are the studies of O. Romanenko (2020) and V. Kobilchenko (2016). We emphasize the increase of efficiency of theoretical knowledge acquisition and the increase of efficiency during practical use of typhlo devices. It is also valuable that the proposed results of the study can be used to improve the effectiveness of learning in inclusive

classes, which can teach children with visual impairments.

We state that the introduction of information technology has enabled in the expansion of student autonomy, allowing children to overcome social and communication challenges as well as learning barriers. It's also important that school students have the option to demonstrate learning outcomes in a convenient manner, such as by performing learning assignments based on individual skills and abilities at various rates of performance. We claim that using typhlo devices in the education of visually impaired children has numerous advantages over traditional teaching methods. The benefits include the ability to determine the student's initial level of cognitive development at the beginning of learning; support for cognitive development through the formation of new skills or the development of previously acquired skills; improved access to educational resources; overcoming geographical or social deprivation through communication and network support; and increasing motivation to learn.

The use of typhlo devices in the educational process helps to increase the formation of core competencies and individual psychological qualities of school students, according to a psychological and pedagogical experiment in the study of the rehabilitation effect of typhlo devices on the formation of personality with visual impairments. Thus, the analysis of the protocols of observation of the experimental group's children in the lessons, the children became more engaged and autonomous in the lessons. As a result, confidence in practical tasks increased, and the objectivity of self-esteem was sustained. It was discovered that during breaks, children began to communicate more with each other, which had not previously been noticed, and that they were the first to initiate acquaintance. Respondents even took the initiative to enter the competition for Best Reader (an annual competition for visually impaired school students). It's also a sign of self-confidence.

Conclusions

1. The use of typhlo devices in combination with information technology in the teaching of children with visual impairments is a top priority in addressing educational, upbringing, and development issues. Their rehabilitation impact and technical assistance, for compensatory, communication and didactic purposes, helps to bridge the digital divide, significantly increase the level of teaching school subjects, increase school student motivation to study disciplines, expand the scope of independent activity and form objective self-esteem.

2. It was found that the application of information technology promotes the development of the cognitive sphere of a school student's personality while also meeting the demands of modern society. During the psychological and pedagogical experiment, it was documented as enhancing respondents' confidence in executing practical tasks and exhibiting objective self-esteem in interpersonal interaction. The children began to communicate more with each other during breaks, which had not been observed previously, and they were the first to initiate contact.

3. We stated the significant differences in the use of typhlo devices with information technology in the experimental and control groups: "RUBY" (t=4.3; p<.01); "SAPPHIRE" (t=5.2; p<.01); "PEARL" (t=2.0; p<.05); "TOPAZ" (t=4.7; p<.01); "SARA CE" (t=5.2; p<.01); "PIEX TALK" (t=3.8; p<.01); "FOCUS 40 BLUE" (t=6.1; p<.01). We stated absence of significant differences: "ONIX" (t=1.6; p>.05); "TOUCH MEMO" (t=1.5; p>.05). It has been proven that implementing the recommended information technology increases interest in lessons, promotes cognitive activity, and enhances the school student's creative potential.

4. It is generalized that the use of information technologies in the educational process of children with visual impairments allowed to intensify the learning process, implement the ideas of developmental learning, increase the pace of the lesson, increase the amount of independent work of school students. The use of typhlo devices during the work of school students with visual impairments made it possible to individualize learning as much as possible, to make the learning process more creative and investigational.

5. It should be noted that the study does not cover all aspects of the problem. Due to the rapid growth of information flows, we believe it will be necessary in the future to investigate the impact of information technology on the intensification of the educational process of certain categories of school students with special needs, such as children with autism spectrum disorders and combined disorders, first and foremost in the differentiation and specialization of

textbooks and other educational materials. Also, the prospects for further research in the field of education of children with disabilities are the detailed development and justification of the general model of organization of educational space for school students using information technology.

6. The hypothesis was proved and significant positive differences were observed as a result of the use of typhlo devices with information technology. The positive changes refered to the cognitive sphere of school students with visual impairments and had a rehabilitative effect.

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