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EDUCATIONAL INTEGRATION OF PEOPLE WITH VISION IMPAIRMENTS

ODGOJNO-OBRAZOVNA INTEGRACIJA OSOBA OŠTEĆENOG VIDA

Gorica Kurtuma, Ševala Tulumović, Hurma Begić*

Faculty of Education and Rehabilitation Sciences, University of Tuzla
Univerzitetska 1 Street, 75000 Tuzla, Bosnia and Herzegovina

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ABSTRACT

The educational integration of blind and visually impaired children has proven to be an upward trajectory in the process of upbringing, education, acquisition of knowledge and competencies in children with visual impairment. In addition to the benefits for the child's intellectual development, the integration process is of great importance in the social context. The education system has changed over time, both for visually impaired students and for their without visual impairment peers. Modern approaches and methods in the process of upbringing and education have made many means for work and learning for children who are blind and visually impaired inaccessible. We strive to adapt the environment for children with disabilities in order to fully include them and give them the opportunity to follow the most modern methods and use modern teaching aids in the process of upbringing and education.

Key words: modern approaches, modern methods, integration, blind, visually impaired

SAŽETAK

Odgojno-obrazovna integracija slijepe i slabovidne djece pokazala se kao uzlazna putanja u procesu odgoja, obrazovanja, sticanja znanja i kompetencija kod djece sa oštećenjem vida. Pored dobrobiti za djetetovo intelektualno usavršavanje proces integracije ima veliki značaj u socijalnom kontekstu. Obrazovni sistem se vremenom mijenjao, kako za učenike sa oštećenjem vida tako i za njihove vršnjake intaktnog vida. Savremeni pristupi i metode u procesu odgoja i obrazovanja kreirali su mnoga sredstva za rad i učenje koja su nedosutpna za djecu sa oštećenjem vida.

* Corresspondence to:
Hurma Begić, Faculty of Education and Rehabilitation, University of Tuzla
E-mail: hurmabegicjahic@gmail.com

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Teži se ka prilagodbi okoline za djecu sa invaliditetom radi njihovog potpunog uključivanja i davanja mogućnosti da prate najsavremenije metode i koriste savremena didaktička sredstva u procesu odgoja i obrazovanja.

Ključne riječi: savremeni pristupi, savremene metode, integracija, slijepa i slabovidna djeca.

INTRODUCTION

The educational process is very dynamic and brings a large number of changes from generation to generation. It is necessary that students, in accordance with their individual abilities, are educated according to approaches and methods that are the same for each student. Involving visually impaired children in educational integration is not an easy task for the students themselves, and thus for a large number of professionals and the environment.
Students with visual impairment differ from each other as do their peers with intact vision, except in terms of the type of impairment they may differ in terms of perceptual functions, intellectual and emotional maturity, motor development or in terms of compensatory mechanisms they use.

THE OLDEST RESEARCH AND INTENION TO INNOVATION

Experts from educational-rehabilitation science as well as related sciences monitored, researched and evaluated new approaches, methods and aids in working with blind and students with vision impairment in the educational process. Emphasis is placed on a wide range of methods that help in orientation, mobility, learning, communication and various activities with the aim of overcoming existing methods and strategies, and the introduction of computer technology and innovative solutions.
Orienteering is a time running race that uses maps and compasses to get to checkpoints on an unknown track. It can be used in conjunction with orientation and mobility programs to improve the skills of blind and partially sighted people[1]. It is necessary to determine the efficiency of teaching methods and different types of equipment, such as: Mowat sensor, Braille compass, hearing maps and tactile-visual maps in orienteering programs for the visually impaired. Research has been made to examine the abilities of detection and orientation on tactile maps and developed strategies to promote these skills. Further understandings of the transformation from two-dimensional to three-dimensional space were made, which reaffirmed the so-called cross-modal transfer between sight and touch[2]. Models for computer-assisted mediation are presented and its application in the field of education of blind children is presented. The model consists of five elements: domain model, student model, pedagogical model, and dynamic and static projection of learning. A system based on stored expertise guides the child in what he or she can or wants to learn. Efficiency is dynamically evaluated in order to constantly adjust the teaching methodology[3].

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OVERVIEW OF STRATEGIES AND ARRIVAL OF BIO-PSYCHO-SOCIAL STRUCTURE

Strategies for classroom teachers include: avoiding the use of words such as “this,” “that,” and “there,” which will be meaningless to students with visual impairment;
ensuring that descriptions of problems or techniques used are carefully worded to avoid ambiguity; pronouncing everything written on the board and pronouncing new words as they are written; providing transparent foils and notes for teachers to transcribe them into Braille so that students can use them at their desks; when describing the terms, it is recommended to use everyday objects, by choosing objects that the visually impaired student can easily access and understand; providing printed copies of textbooks and brochures to students who are blind, which the reader will use at home; providing additional table space for Braille materials; oral testing / oral questioning; provide a person who can read math assignments to check in Braille and arrange the proceeding of assignments and answer keys to the teacher in advance[4]. At the beginning of the 21st century, efforts are being made to correct mistakes in the educational system for blind and partially sighted students. The open education scheme aims to replace residential schools with the blind, rather than stressing that they need to be supplemented[5].
The pursuit of educational integration would imply the use of traditional models of education with the addition of modern means and teaching methods. An approach that would give satisfactory and innovative results should unite a team of experts and include the students' social skills in the process.
In relation to the faculty, as well as in the classrooms of primary and secondary schools, teachers for visually impaired students do not have the opportunity to put emphasis on learning social skills[6]. Books for the blind use tactile perception as a substitute for sight. A number of different systems have been proposed in different periods of scientific advancement, but the Braille alphabet is undoubtedly the most commonly used script by blind people around the world[7]. The development of print reading and Braille in blind and partially sighted children was compared with Chall's stage model of reading development. Chall’s model includes a pre-reading period, in which concepts are developed, intermediate stages, in which the skills needed to decode the text are developed, and later stages, which distinguish skilled readers based on their highly developed schemes and cognitive skills necessary for effective understanding and integration. The results speak of the effectiveness of a better method for teaching based on Braille, in students with visual impairment[8]. We observe blindness and its meaning through the domain of the man as a bio-psycho-social structure. This structure includes elements of social, psychological, biotic nature and they are mutually correlated [9].
Given the new understanding, the entire educational system needs to change and supplement its relationships, methods and strategies towards people with visual impairments.

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MORE EFFICIENT LEARNING SYSTEMS AND FINDING MODERN METHODS

method of oral expression (the teacher should speak loudly, clearly, grammatically correct, good intonation and rhythm, and with a calm tone); the method of conversation (the teacher should try to alleviate verbalism, it should be concrete, precise and short, and make sure that the words have an idea, experience); method of written and illustrative conversations (the teacher should give the student a plan of the board and the content on Braille, speak loudly and clearly what he/she writes on the board, and blind students can make some tables and diagrams using the number system, and use foil accessories for drawing and rubber pads); demonstration method (whenever possible the teacher should have the actual subject he / she talks about, before watching the slide, film, cassette, it is obligatory to orally explain to the student the content to be shown, maps, diagrams, charts, tables and sketches for the visually impaired student should be individual, simple, embossed and sharp contrast); method of printed works (blind students use materials printed on Braille, (letters, numbers, symbols and other signs), but can use so-called audio books); methods of laboratory work (blind students individually practice the manipulation of objects, tools and instruments, group work is carried out with the help of teachers, and to work in the space outside the classroom it is necessary to provide help from a guide to move and get to know the space)[10]. After reviewing new methods in the educational process, the emphasis is on technology and the ability to find additional, compensatory systems, software, aids that will make the education system more accessible, cheaper, easier and more personalized for people with visual impairments.

In order to avoid an inefficient learning system for blind and partially sighted students and to reduce the degree of complexity of the adoption of teaching units, it is proposed to teach Braille via a haptic device. The device includes the functionality of six balls representing six Braille cells, once fully assembled they create the desired pattern[11]. The use of assistive technology is a compensatory skill because it allows blind and partially sighted students to undertake tasks that are often performed by people without visual impairment[12].
An interactive test method for assessing the degree of material adopted includes a device with an LCD screen and a custom keyboard. This system reduces the set of necessary paperwork and workload, eliminates the use of Braille sheets and thus saves on costs, and helps teachers reduce the level of workload. Audio, visual and tactile output with sound announcement on the LCD screen allows visual verification, and the information obtained provides a better level of understanding and learning, insight into feedback on the material[13]. The modern world of higher education students requires the adoption and implementation of e-learning. The addition of e-learning access and storage platforms can be used successfully to facilitate the inclusion of students with visual impairments in the educational process, giving them greater access to brochures, notes and lecture notes. However, individual variability in students with visual impairment means that e-learning should not be considered an "easy solution"[14].

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In order to save time, it is necessary to harmonize the already existing mechanisms, systems and aids with even more modern technology and shorten the path for a blind and partially sighted student to reach a solution. Research suggests that screen readers should allow way right to the main content, skip peripheral or duplicate content, which would save a lot of time for the blind user and keep the user from getting tired. A particular website should also be divided, defined and should indicate exactly what could be found where, for example: main part, header, advertisement, contact, announcements, so that the blind student can orient himself/herself faster and easier, and thus reach the information he/she needs [14].

Modern computer tools are able not only to convert digital data into a suitable audio channel or Braille point for the blind, but also to provide the blind with a complete computerized place to work, with all possibilities, from text work, Internet access or mastering appropriate programming languages. The digital talk book, which covers both audio and text data, is an invaluable multimedia information source for the visually impaired[15]. Promoting the inclusion of students with disabilities in E-learning systems has brought a number of challenges to researchers and teachers. The use of synchronous communication tools, such as interactive whiteboards, was considered an obstacle to inclusive education and the inclusion of visually impaired students in the educational process. With available descriptions, students can navigate through the elements and explore the content of the lecture using a screen reader. Evidence of the applied concept has shown that many further possibilities for improving the interaction of blind users with educational content on whiteboards can be explored, and from this proposal further pedagogical approaches and more innovative methods can be explored[16].

THE ROLE OF TEACHERS IN EDUCATIONAL INTEGRATION AND NEWER LEARNING SYSTEMS

From the perspective of teachers of blind students, teaching methods must be in line with typical student learning habits, such as the proper use of the board. It is well known that, no matter how advanced modern teaching methods are, blackboard writing cannot be completely replaced in classroom teaching[17]. The research sought to determine the degree of professionalism and innovative standards of teachers who teach visually impaired students. The results of the research showed that there is not enough knowledge and skills among teachers regarding the implementation of teaching for students with visual impairments[18]. Formal assessment, including exams, is an integral part of most education. Standard exam formats and procedures can pose particular challenges for blind and partially sighted students, leading them to fail to demonstrate their abilities under standard examination conditions[19]. McSig, a multimodal system for teaching blind children cursive handwriting so they can create a personal signature, was introduced. For blind people, handwriting is very difficult to learn, as it is an almost zero feedback activity that is needed only occasionally, but in important situations; for example, to make attractive and repeatable signatures for legal contracts.

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McSig helps teach signature by translating digital ink from a teacher's pen gesture into three non-visual forms: the audio pen and its height represent the x and y movement of the pen; kinaesthetic information is provided to the student using a haptic pen with a reciprocating force that mimics the movement of the teacher's pen, and a physical tactile line is created on the writing sheet with the haptic pen[20].

In relation to the individual abilities of students with visual impairment, teachers should adjust the contents of individual subjects.

Depending on personal preferences and possibilities, the contents of the literature can be adopted with the help of audio and digital recordings (CD, mp3) and analogue recordings (audio cassettes for classic or four-channel cassette player). For the contents of media culture, in the classes in which the blind student is included, the same media are used, videos - digital and analogue recordings provided by the subject curriculum (CD, DVD, videocassettes etc...)[21]. Learning becomes meaningful when it is seen as the science and art of imparting knowledge - science because it follows systemic principles and theories, and art because it requires creative skills and innovation [22]. The teaching staff should also pay attention to the educational medium that a student with visual impairment, in the educational process, chooses as an adequate access to information and content in textbooks. Total access to information means that the blind student uses all available ways of accessing written information during classes and then uses three different educational media (black press, Braille, and audio recording)[21].

MODERN AGE AND MANDATORY USE OF INFORMATION TECHNOLOGY IN EDUCATION

The last decades in the educational process involve the use of innovative methods and computer technology in the process of transferring knowledge and skills. Expert research is focused on examining the efficiency of the use of information technology as well as descriptions of the most modernly designed support systems, software and assistive technology that are increasingly applicable in the methodology of working with students with visual impairments.

The opinion (98.8%) of teachers indicates the necessity of using information technology for work in schools for students with visual impairments, primarily for reading and writing, as well as for various applications of technology with blind and partially sighted students. The results of the research, which examined the competencies and level of computer literacy of high school students with visual impairments, showed that students on the screen must have easy access to the Internet and search engines, in terms of easy and fast reading.

Website source codes, as well as web designers, should, along with each animation, include a description of the text, instructions that will be set up so that screen readers successfully display information to a blind user[23].

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It was examined whether in the learning process blind and partially sighted children will better understand the appropriate representative technique, and whether it will enable the identification of objects more effectively, that is, which technique is uniformly suitable for all blind people. The results showed better recognition of textured images than thermoformed and elevated line images[24].

Information and media literacy are indispensable in the modern world. Little attention has been paid to specific aspects of information and media literacy suitable for people with disabilities, and especially for blind and partially sighted people. Media and technology are even more important in the world of people with visual impairments. Media literacy and skills imply personal independence and improved quality of life as well as a higher degree of participation in society and education[25]. The use of modern information technology to provide information to blind people is an urgent problem, the solution of which has found new approaches in education[26].

In referring blind and partially sighted students to information technology in education, it is necessary to find the simplest and cheapest solutions.

Students who are blind or visually impaired are often at a disadvantage when information is given to them in the regular education system. This is especially true of curricular areas such as mathematics and science, which often rely on visual elements to convey key aspects of content. There are a number of methods that provide accessibility, such as 2D tactile graphics, 3D physical models, video description, etc. However, most often these items are not available to every child due to costs and many other circumstances. The use of cheap computer technology can be an alternative means of providing access to information to people with visual impairments. There are thousands of computer programs for educating blind children, but very few computer educational applications for students who are visually impaired[27]. A new method for introducing algorithmic thinking using a haptic model (e.g. LEGO boards and cubes) suitable for all students has been proposed. The method was evaluated in a case study with 5 blind students, teaching them three basic search algorithms: linear search, binary search, and search in the binary search tree. It turned out that the haptic method facilitates the understanding of basic algorithmic ideas. Furthermore, it has the advantage of inhibiting the common problem of thinking about many steps at the same time, because it forces students to perform steps successively with their hands. This also facilitates the transfer from the model to the source code. The new haptic method is a convenient way to teach visually impaired students the basic algorithmic thinking[28]. Recent advances in three-dimensional (3D) printing technology have created low-cost systems that can translate 3D models of terrain shapes and elevations into physical models. Affordable, commercially available 3D printers are able to use data from topographic maps, radar, altimetry and digital terrain models and convert them into accurate 3D models from multiple materials within hours. The resulting models not only provide material for the study of lunar and planetary terrains and small space bodies, but also enable the creation of libraries of physical objects accessible to the visually impaired.[29].

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Adaptation of computer technology, input, output, application of computer programs, and interaction with appropriate computer equipment also depends on the individual psychophysical, cognitive and sensory abilities of students[30]. Although there are various traditional and modern computer techniques, the realization of technical (mathematics and physics) education of blind and partially sighted students is currently not an easy task[31]. The participation of blind and partially sighted students is needed to design and create the best possible solution and use a modern method in order to eliminate problems, overcome barriers and more easily master the intended content.

For visually impaired and blind people, assistive software has been developed, closely dependent on existing assistive devices and assistive technologies, as an alternative to the modern educational process, but above all useful, aimed at developing basic professional skills and social skills needed for their social inclusion and learning[32]. New technologies create a highly interactive learning environment. Education is increasingly using combinations of different communication technologies to improve the ability of students and teachers to communicate with each other[33]. When creating and using modern approaches and methods intended for blind and partially sighted students in the process of educational integration, it is important to pay attention to the associated obstacles and the effectiveness of the application of new technologies. The more severe difficulties of children are blindness, deafness, complete absence of speech communication, motor impairments, significantly reduced intellectual abilities, autism and multiple difficulties, combinations of mild difficulties or any mild difficulty combined with mild intellectual disabilities[4].

It is necessary to choose an adequate aid in relation to the type of difficulty.

Some of the adaptive technology devices include: Braille, tactile maps and diagrams, including devices that print text using optical devices and screen readers. Categories of adaptive technology for blind and partially sighted students include: academic and teaching aids, computer access and instruction, professional and vocational aids, and visual aids[35]. New decades have also brought a new understanding of tactile materials, especially tactile maps in the process of raising children with visual impairments[36].

The new approach is one of the new inventions - it enables people with visual impairment to visually enlarge the relevant parts of tactile maps. These audiovisual tactile maps can be used in conjunction with tablets and smart phones. By integrating conductive elements into tactile maps printed in 3D, they can be recognized with a single touch on the screen of a mobile device, which facilitates the management of blind and partially sighted people[37]. Schools for the blind suffer from marginalization in terms of easy access and use of communication and assistive technology [38].

It is necessary to make assistive technologies and the latest system software available to schools for blind and partially sighted students, thus achieving better results of the institutions themselves in the process of modern ways to integrate students with visual impairments.

The goal of technology leadership is to integrate and deliver technology for teaching and learning and to bring transformation to improve the performance as well as the results of the institution[39].

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Combining the latest advances in computer technology and visual impairment and artificial intelligence using revolutionary deep-region networks (R-CNN), recurrent neural networks (RNN) and speech, we have sought to help provide individuals with visual impairments with an interactive learning experience.[40].

It is necessary to consult with students in order to get an interactive approach and avoid creating unnecessary obstacles and mistakes in choosing the technology to be used in the educational process.

The non-use of any textual material during lectures, and sending homework, vocabulary and exercises via E-mail was considered by the students to be a very successful method. The students were completely satisfied and stated that this method is the most effective[41]. The main contribution to the educational process by modern technology is the introduction of a cheap robot based on the Arduino system, compatible with the robotic framework and integrated with audio feedback and text-to-speech converter[42].

In addition to information literacy and its importance, it is important not to lose the connection with relaxation through art and the creation of new, innovative art content that is accessible to blind and partially sighted children.

In case of impairment or loss of visual functions, a person's artistic potential is most secure when applied to music and that art acts as an optimal field for the artistic development of blind and partially sighted students. It is necessary to focus on methods that can help the student understand the need to think, feel, learn, create and discover meaning. It is the only possible way to introduce his/her life into the creative search and realization of full artistic activity[43].

THE MOST SIGNIFICANT INNOVATIONS IN THE PREVIOUS THREE YEARS

Output files created using the XML language to indicate the structure of the input content provide a representation of content in a variety of shapes and styles. For example, XML files and source image files can be used not only for print products but also for Braille fonts, font size, HTML pages, audio files, DAISY readable books or with the help of speech synthesizers, etc. The main developer of this standard is DAISY, which has communicated with a number of professional and civic organizations and formed the conceptual framework of the standard in close collaboration with the leading staff of a number of libraries, scientists and users. Science and technological innovation are aimed at the main target group - students with visual impairments and users with other physical disabilities.

The DAISY book is multimedia content with synchronization of text, audio and graphic information[44]. Tactile graphics play a key role in imparting knowledge to blind people. The solution may be the concept of tactile graphics printed in 3D, which offers the use of audio-tactile graphics with smart phones or tablets. Using capacitive markers simplifies the connection of tactile graphics to a mobile device. These tactile graphics that integrate markers can be printed in a single line using a 3D printer without any post-processing and allow us to use multiple height levels for graphic elements[45].

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Music computer technologies (MCT) open wide possibilities for blind students to more efficiently study various contents and methods of presentation of educational material in informatics, contributing to the achievement of positive learning outcomes in a shorter time. This is especially important for children studying in music schools. Mastery of MCT in children with visual impairment has a number of characteristic features, which are most clearly manifested in the initial period of learning computer science.

With the help of modern computer technologies (speech synthesizers, Braille screens, etc.), as well as the possibility of using "hotkeys", blind students can quickly master many MCT programs[46]. The main modules of IT training for visually impaired students consist of the following thematic blocks: introduction to special equipment installed in the classroom, its main characteristics and possibilities of practical application; computer device and operating system, computer capabilities for a person with visual impairment; working with a computer keyboard, the location of the keys and the main functions of the keyboard; basic principles of working with screen access programs; principles of operation of the operating system Red "Windows"; what are "intervention keys" and how they can help in work; work with files and folders using keyboard shortcuts; work with data (information), data transfer to various removable media (flash disks, portable hard disks and CDs); work with dialogues and pop-up system messages, work in popular text editors, scanning books, photos, documents; work with electronic libraries, work with sound, music, audio files; work with E-mail and popular site searches, dating; work on social networks, etc.[47]. The influence of the iPad on the achievements of blind students in algebra and solving mathematical problems was researched. Students learned algebraic subjects, such as drawing and paragraphs, using an iPad. The results showed that the application of the device is easier and motivating for blind students to learn[48]. Although digitally enhanced learning tools can provide valuable access to information as well as personalized support, people with specific accessibility needs, such as severe visual impairment, can often be excluded from their use. This requires technology developers to build a more comprehensive design and to offer learning experiences that can be used by students with mixed visual abilities. There is also room to integrate a DIY approach and provide educators-rehabilitators with the opportunity to design their own low-cost educational tools, tailored to pedagogical goals and the various visual and cognitive abilities of their students[49].

New pedagogical relationships require learning new technologies and considering innovative approaches to teaching and assessment, redesigning pedagogical practice in an effort to involve blind and partially sighted students in the educational process[50].

There are many problems with the teaching and assessment of students with disabilities in higher education, especially in technical sciences, where knowledge is represented mainly by structural information such as: mathematical formulas, graphs, etc. The development of an e-learning platform for distance education solves this problem only in part due to the lack of accessibility for the blind[51]. Today, the presence of children with special needs in regular education is common.

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What they need to have enabled is the use of state-of-the-art information technology so that they can participate in the teaching process in the easiest possible way[52]. In the last decade, many studies have shown that learning based on digital games is emerging as an effective way to combine the process of teaching and learning with the attractiveness of digital technologies because they are dynamic. However, the vast majority of these digital resources, such as educational games, are still basically visual, preventing access for people with visual impairments[53].

A study was conducted aimed at designing, developing and testing the effectiveness of teaching an online-based English vocabulary exercise program, developed for visually impaired high school students. Quantitative results revealed that students showed significant progress on vocabulary tests and maintained their achievements after the research[54]. Graphic content is an important resource for transmitting information and its use is fundamental in the teaching process. Visually impaired people do not have easy access to this resource due to their impairments. They mainly use tactile graphics to explore visual content. It is necessary to develop tools for tablets intended for visually impaired people in the interpretation of tactile graphics. After studying the different research strategies of tactile graphics adopted by visually impaired people, an application that prefers a wealth of multimodal interactions should be used[55]. Modern society requires a new level of development of the basics of special education for special, integrated, combined and inclusive education and upbringing[56].

The integration of visually impaired students into the educational environment is one of the main challenges. This requires curricula that fit into such a category and overcome barriers to their learning[57]. Features of the methodology and a new approach in teaching visually impaired people with special educational needs are offered, including completely blind people on the example of foreign language teaching. This technique is innovative and can be used for didactic purposes in teaching any topic with people with visual impairments, of all ages, including completely blind people in terms of inclusive education.

The results of the experimental research are based on the testing of a dedicated computer program "Communicative English for students with visual impairments", which has been successfully implemented and can be used in all educational institutions[58]. Universal Learning Design is a framework for a teaching and learning transaction that conceptualizes knowledge through a focus on student accessibility, collaboration, and community [59].

ADJUSTMENT OF METHODS TO CONTINGENT CHANGES

The COVID-19 pandemic has imposed dramatic changes in day-to-day functioning, but especially in children with developmental disabilities. The Robert Hollman Foundation decided not to interrupt the service for all visually impaired children and launched a remote support project. It was an online process that covered all aspects of child support and included audio-video calls, videos and tailor-made multisensory material created specifically for each child.[60].

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The need to improve methods and techniques in the educational process is necessary in order to achieve maximum efficiency and create the least restrictive environment for the education of blind and partially sighted students. Unforeseen (contingent) situations, such as the current pandemic, are just one of the indicators that the introduction of computer technology in the process of educational integration is not just a desire but a necessary need.

CONCLUSION

In the process of educational integration, it is necessary to include a whole team of experts who will adapt modern approaches and methods for students with visual impairments.

Most of the innovative solutions and modern methods used in the modern methodological approach with students with intact vision are not available to students who are blind and visually impaired.

Finding new solutions and adapting informatics should be available to every student with visual impairment in accordance with individual characteristics and remaining abilities in order to fully integrate into the school and social system. Some unforeseen situations, such as the pandemic, have forced everyone, even students with disabilities, to adapt to the situation, and modern approaches have shown their true meaning and complete value. Once the use of modern technology was a choice, now there is a need for the most basic things and full involvement in the educational system.

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