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Influence of Digital Assistive Technologies Used in Higher Education on the Development of Individual Educational Strategies among Students with Disabilities

Abstract

The digitalization of education significantly facilitates access to the educational process for people with special needs.

The study aims at determining the main possibilities of using digital technologies as a means of supporting the education of students with disabilities. The research strategy requires both quantitative and qualitative methods to understand what university staff considers effective when using digital technologies for students with disabilities with due regard to their experience, knowledge and abilities to meet the needs of such students.

To achieve this objective, the authors used a set of theoretical and empirical methods: theoretical, empirical and numerical methods. The main research method was an online survey.

Based on the online survey of teachers, IT specialists and network administrators (from six Russian universities), the authors of the article have revealed the advantages, directions and opportunities of digital technologies to support the learning of students with disabilities, considered the use of digital assistive technologies in teaching such students and the issues of introducing digital technologies as a means of supporting students with disabilities and creating conditions for overcoming them.

The study results have demonstrated that the pedagogically balanced and expedient use of digital technologies will help students with disabilities fully engage in the educational process and develop individual educational strategies acceptable to them.

Keywords: Inclusive Education, People with Disabilities, Digital Technologies, Education Support, Assistive Technologies.

Introduction

According to numerous studies (Van Oyen et al., 2018), 10-12% of the world's population belongs to people with disabilities. The number

of children under the age of 16 in this category is estimated at 140-165 million. They face many barriers to education, therefore the attendance rate and the share of those who completed their studies are significantly lower compared to their

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healthier peers. A third of 75 million children worldwide who are out of school have disabilities.

The inability to get an academic degree deprives people with disabilities of the opportunity to get a profession, decent wages and social recognition. The World Bank estimates that 20% of the world's poorest people have some form of disability. Their literacy rate (in global terms) is only 3% and unemployment rate is 80% (Chatterji et al., 2015).

A partial solution to these social and educational problems is to increase the availability of digital technologies for certain categories of the population (Nemer, 2015) and ensure open access to educational and scientific content, which will provide alternative ways of obtaining knowledge regardless of time or space constraints.

Digital technologies can bring positive changes because their use attracts more participants in education at lower costs, meet the requirements of social justice for all groups of the population, open up broad prospects for improving the quality of education and its accessibility for people with disabilities, promote equal access to information and education services and ensure full-fledged social integration. Digital technologies enable people with disabilities to develop their abilities and talents, get a profession and communicate with like-minded people. Using digital technologies, they overcome socio-psychological barriers in learning, get access to various didactic materials in an acceptable form and obtain the opportunity to demonstrate their educational achievements.

Literature Review

Scholars (Lindner, Schwab, 2020) note that the educational needs of people with disabilities are much wider in comparison with healthy people: on the one hand, they should acquire the knowledge, skills and abilities necessary for full-fledged social interaction like their healthier peers; on the other hand, they have additional needs caused by their functional limitations, which sometimes makes it impossible to apply standard teaching methods and can negatively affect academic performance and self-esteem.

The process of identifying and meeting different needs of each student through their increased involvement in learning, cultural and social activities is defined as "inclusive education" (Lindner, Schwab, 2020). It adjusts and changes educational content, approaches, structure and strategies based on a single concept covering all individuals within one age group, as well as proves that the education of each individual is the responsibility of the formal education system (Bourke, Mentis, 2014).

The main goal of inclusive learning is to create an environment in which educators and students will be willing to accept the challenges and benefits of diversity for the entire education system (Smith, Tyler, 2011). This approach provides new methods for transforming educational systems to satisfy the needs of a wide range of students (Bjekic et al., 2014).

We have summarized the existing scientific approaches on the possibility of using digital technologies. Digital technologies in inclusive education can be used as compensatory, communication and didactic tools (Table 1).

Table 1.

Opportunities for using digital technologies in inclusive education

No.	Possible use	Typical features	Source
1	As a compensatory agent	The use of traditional teaching activities as means of technical support (reading and writing) facilitating access to didactic resources and learning interaction, partially compensating or replacing the lack of natural functions	(Nabokova, 2014; Wood et al., 2018; Arfé, Mason, Fajardo, 2018)
2	As a communication tool	To provide an alternative form of communication, support alternative communication, facilitate and/or enable communication, allowing people with disabilities to communicate in a more convenient way	(Filipovich, Borozinets, 2019; Maguire et al., 2006; Karpov, 2013)
3	As a didactic tool	New technologies brought a variety of pedagogical strategies for teaching people with disabilities and became a real tool for introducing inclusive education	(Hamburg, Lütgen, 2019; Cumming et al., 2017; Smith et al., 2016)

At the same time, scholars (Adebisi, Liman, Longpoe, 2015) highlight that digital technologies, in particular assistive technologies,

should be selected with due regard to the specifics of various functional limitations.

Assistive technologies are a subgroup of digital tools used to support the learning of

students with disabilities. Generally, these are technologies that can support certain types of activities for people with disabilities (Dokhoyan, Maslova, 2020). According to (Ahmad, 2014), assistive technologies represent a wide range of tools, strategies and services that satisfy the individual needs, capabilities and tasks of a person. These are as follows: the assessment of the needs of people with disabilities, the functional assessment of the environment, the selection, design, customization, adaptation, application, maintenance, repair and/or replacement of assistive services, their coordination with educational and rehabilitation plans and programs for comprehensive development and full-fledged inclusion.

The research hypothesis is that the pedagogically balanced and expedient use of digital assistive technologies as compensatory, communication and didactic means will help students with disabilities fully engage in the educational process and develop individual educational strategies acceptable to them.

The research objectives are as follows:

- To determine the advantages, directions and means of digital technologies to support the learning of students with disabilities;
- To analyze the use of digital assistive technologies in teaching students with disabilities;
- To consider the issues of introducing digital technologies as a means of supporting students with disabilities and creating conditions for overcoming them.

The article comprises the introduction, literature review, methods, results, discussion and conclusion.

Methods

Study Structure

To attain this end, we conducted a qualitative study of digital technologies used as a means of supporting the learning of students with disabilities. In the course of the survey, we used the following theoretical and empirical methods:

Theoretical methods (analysis, synthesis, comparison and generalization) for studying literary sources related to the research topic;

Empirical methods (online survey);

Numerical methods (the mathematical processing and ranking of respondents' answers).

The main research method was an online survey.

Research Tools and Procedures

The online survey conducted in June-July 2020 embraced educators, IT professionals and network administrators (33 experts in total).

We sent e-mails to the experts asking them to answer the following questions:

1. What are the benefits of using digital technologies to support the education of students with disabilities?
2. What are the main directions to support students with disabilities using digital technologies?
3. What are the main types of digital technologies that should be used as a means of supporting the learning of students with disabilities?
4. Name the possibilities of using assistive technologies to support various types of learning activities: reading, writing, seeing, listening, access to a computer, alternative communication, as well as specific traits of students that complicate learning.

The respondents were sent the same list of questions in Russian and were given ten calendar days to answer them.

After receiving and processing their responses, we asked the experts to rank the results obtained.

All the survey participants were informed about the main objective and that the authors plan to publish the results in a generalized form.

Statistical Analysis

The advantages and directions of using digital technologies to support the learning of students with disabilities were ranked by each expert in descending order.

Results

The experts called several advantages of digital technologies to support the education of students with disabilities (Table 2).

Table 2.

Benefits of digital technologies to support the learning of students with disabilities

No.	Advantages	Ranking
General		
1	To encourage learner autonomy	1
2	To help to overcome communication difficulties and barriers	2
3	To provide students with the opportunity to demonstrate their study achievements in a convenient way	3
4	To develop tasks with due regard to the individual skills and capabilities of students	4
Benefits for students		
1	Independent access to education information	1
2	The opportunity to do tasks at their own pace (in the asynchronous mode)	2
3	The opportunity to use digital technologies as a compensatory agent to gain access to educational information in a different way	3
Benefits for educators		
1	The opportunity to communicate with their colleagues remotely, explore the most efficient experience of teaching inclusive groups and share their own educational techniques	1
2	The opportunity to improve their own skills in using digital technologies to ensure effective work with students	2
3	More opportunities for preparing didactic materials and illustrations. Using multimedia, it is possible to exert and adjust an impact on various sensorial areas. Electronic materials are easier to adapt to student needs (e.g. large font, Braille script, etc.)	3

Note: based on the online survey

While discussing possible areas to support technologies, the experts emphasized the students with disabilities through digital following main directions (Table 3).

Table 3.

The areas of using digital technologies to support students with disabilities

No.	Direction	Ranking
1	To determine the initial level of the student's personal development, i.e. the initial level at the moment when studies begin	1
2	To support personal development through the formation of new skills or to develop the ones already acquired	2
3	To improve access to educational resources	3
4	To overcome geographic or social remoteness through communication and networking support	4
5	To promote the use and increase the awareness of the benefits of digital technologies as means of supporting the learning of students with disabilities	5

The main types of digital technologies that of students with disabilities are presented in the table below (Table 4).

Table 4.

Digital technologies to support the learning of students with disabilities

No.	Means	Typical features	Ranking
1	Standard technologies	personal computers (desktop PCs), portable PCs (laptops, netbooks), tablets, etc. with built-in customization options for students with disabilities	3
2	Available data formats or alternative formats	accessible HTML; DAISY is a technical standard for digital audiobooks; Braille embossers, displays and speech synthesizers, etc.	2
3	Assistive technologies	screen readers, assistive keyboards, augmentative and alternative communication systems, etc.	1

Note: based on the online survey

The experts highlighted the feasibility of introducing assistive technologies into the educational process of inclusive groups. As a result, students get the opportunity to do educational tasks with a greater degree of independence, making less effort.

Table 5 presents the possibilities of using the means of assistive technologies recommended by the experts to support various types of educational activities.

Table 5.

Possibilities of using the means of assistive technologies in teaching students with disabilities

Scope of application	Feasibility for an inclusive group	Means of assistive technologies	Ranking
Reading	For students with reading disorders	electronic books	1
		audiobooks	2
		predictive text inputs	3
Writing	For students with dysgraphia	templates	1
		word processors and editors	2
		spelling and grammar checker services	3
		adapted documents	4
Seeing	For students with visual impairments	screen magnifier	1
		screen reader (service to convey visual data as audio)	2
		lecture notes	3
Listening	For students with hearing impairments	hear aids	1
		signalling devices	2
		subtitles	3
Computer access	For students who have difficulties using a computer in the usual way and completing study assignments	predictive typing	1
		alternative keyboards	2
		electro-optical manipulation	3
		voice recognition systems	4
Alternative communication	For students who have problems understanding speech and/or expressing their own thoughts, speech delay	speech synthesis software for printing	1
		communication panels	2
		eye-tracking technologies	3
		voice input devices	4
Specific areas that complicate learning	For students who have problems with reading, writing, counting, concentrating, as well as dyslexia, dysgraphia, hyperactivity, attention deficit disorder, poor hand-eye coordination	text-to-speech services	1
		text highlighting	2
		digital stickers and notes (for example, Google Keep)	3
		spelling checker services	4
		electronic notebooks	5

Note: based on the online survey

Discussion

While interpreting the results obtained, we highlighted the advantages of digital technologies in supporting the education of students with disabilities (Table 2), directions of their use (Table 3) and important features. A decisive factor in ensuring the participation of each student with disabilities in the learning process is the availability of digital technologies, first of all, for the university as a whole and, as a result, for each student. Access to educational resources through the availability of a general curriculum, assistive means and necessary support services can help students with

disabilities obtain an academic degree together with their peers, successfully overcoming barriers. A comprehensive study of these barriers hindering equal access to high-quality educational services was among our study objectives. This aspect is sufficiently covered in the research of R. Bourke (2014).

Within the framework of this article, we compared the results obtained and correlated them with similar scientific works on this topic. Based on the comparative analysis, we have defined the main issues of introducing digital technologies as means of supporting students with disabilities (Table 4), in particular:

- The high cost and/or low availability, especially of assistive technologies (Adebisi, Liman, Longpoe, 2015);
- Refusal to use digital technologies due to the low digital competence of users (students with disabilities), their ignorance of the possibilities and advantages of such technologies in teaching people with disabilities (Kurth, Miller, Toews, 2020);
- The reluctance of teachers to use information and communication technologies due to uncertainty, negative attitude towards technologies in general, underestimation of their potential for people with disabilities (Filipovich et al., 2019);
- The insufficient support of teachers and students, including the lack of training and technical support for the use of special digital technologies (Ahmad, 2014; Matraeva et al., 2020).
- To avoid these problems, to train students with disabilities using digital technologies, to improve its quality and accessibility for people with disabilities, it is necessary to create appropriate conditions, namely:
- To implement an appropriate digital infrastructure (environment) into universities that would meet the principles of accessibility, usability, flexibility and cost-effectiveness;
- To adjust some components of the curriculum, including content, teaching methods and means of assessing academic performance, by introducing digital technologies based on the educational needs of students with disabilities;
- To increase the digital competence of teachers for inclusive education and their awareness about the possibilities of using new technologies in pedagogical interaction with physically and mentally challenged students.

As the survey has shown, the most significant digital technologies that can be used as means of supporting the learning of students with disabilities are assistive technologies (Table 4).

We have combined the main requirements for using assistive technologies to support the learning of students with disabilities contained in certain studies over the past 10 years with our survey of experts (Table 5). As a result, we have formed the following conditions for understanding how to improve the learning environment so that students fulfill their own educational strategies.

Firstly, correspondence to the needs of users. Assistive technologies should be compatible with the user's tasks, emotional needs, lifestyle and local culture. These devices should be convenient and easy to use, safe, resistant to failures and breakdowns (Smith, Tyler, 2011; Dudin et al., 2019).

Secondly, the affordable cost and ease of purchase. Reasonable prices should be among the priorities in the development of assistive technologies since many people from the Pension Fund Department of the Russian Federation have a low level of wealth. It is also recommended to involve government and public organizations in the purchase of such devices for their further distribution free of charge or at reduced prices (Karpov, 2013). When developing assistive technologies, it is important to minimize the risks of failures and breakdowns to prevent the costs of their maintenance and repair, to ensure reliable and long-term operation (Wood et al., 2018).

Thirdly, ease of use. The tutorial on assistive technologies should be accessible and understandable for every user without proper technical experience (Bjekic et al., 2014). Their use should not require preliminary training or additional skills. At the same time, assistive technologies need to be portable and lightweight (Maguire et al., 2006).

Thus, the effectiveness of assistive technologies as the most significant digital technologies used as means of supporting the learning of students with disabilities (Table 4) is determined by their actual use, accessibility to users and the degree of their satisfaction. In our opinion, it is necessary to ensure that such tools consider the specific needs of students with disabilities, are inexpensive (affordable) to create, purchase and maintain, simple, reliable and high-quality, which can be achieved by attracting potential users at all the stages of design and development.

Conclusion

For some students, the use of technical solutions is the only way to declare their needs, gain access to several resources like their peers and realize their educational strategies.

It is worth mentioning that the sole introduction of digital technologies cannot solve all the problems of training people with disabilities. The key is the motivation and willingness of university personnel (from management to technical staff) to develop and apply innovative teaching methods or adapt the existing ones based on available university resources. If employees work in a team, they want to create conditions for each student so that the latter has the opportunity to receive the

necessary information and conveniently demonstrate educational results. Thus, even the lack of technical or information resources can be compensated. In this connection, the staff should integrate the digital technologies that the university has at its disposal in all the educational programs so that they harmoniously complement and support student learning. Updating programs is not about simplifying them for students with disabilities, reducing their academic requirements or standards. This means the maximum support of such students to help them develop the knowledge, skills and abilities necessary for the successful implementation of an individual educational strategy.

Any software, electronic educational resources and virtual educational environments used in the educational process should consider the needs of all students and be usable regardless of individual characteristics and limitations.

The study results have confirmed the hypothesis that the pedagogically balanced and expedient use of digital technologies as compensatory, communication and didactic tools will help students with disabilities fully engage in the educational process and develop individual educational strategies acceptable to them.

It is still questionable which means and technologies should be used to achieve the best pedagogical effect, improve learning results, realize the full potential of digital technologies, simplify access to the necessary data and services, and satisfy the needs of each user. Therefore, the use of digital technologies in supporting the digital learning environment of universities and teaching students with disabilities requires further research to find the best ways to improve the quality of these tools, as well as to monitor their availability, reliability and efficiency in conformity with students' opinions.

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