

### Educational accessibility in higher education institutions through the transformation of the academic environment for students with individual needs

**Acessibilidade educacional em instituições de ensino superior através da transformação do ambiente acadêmico para estudantes com necessidades individuais** (resumo: p. 21)

**Accesibilidad educativa en las instituciones de educación superior mediante la transformación del entorno académico para los estudiantes con necesidades individuales** (resumen: p. 21)


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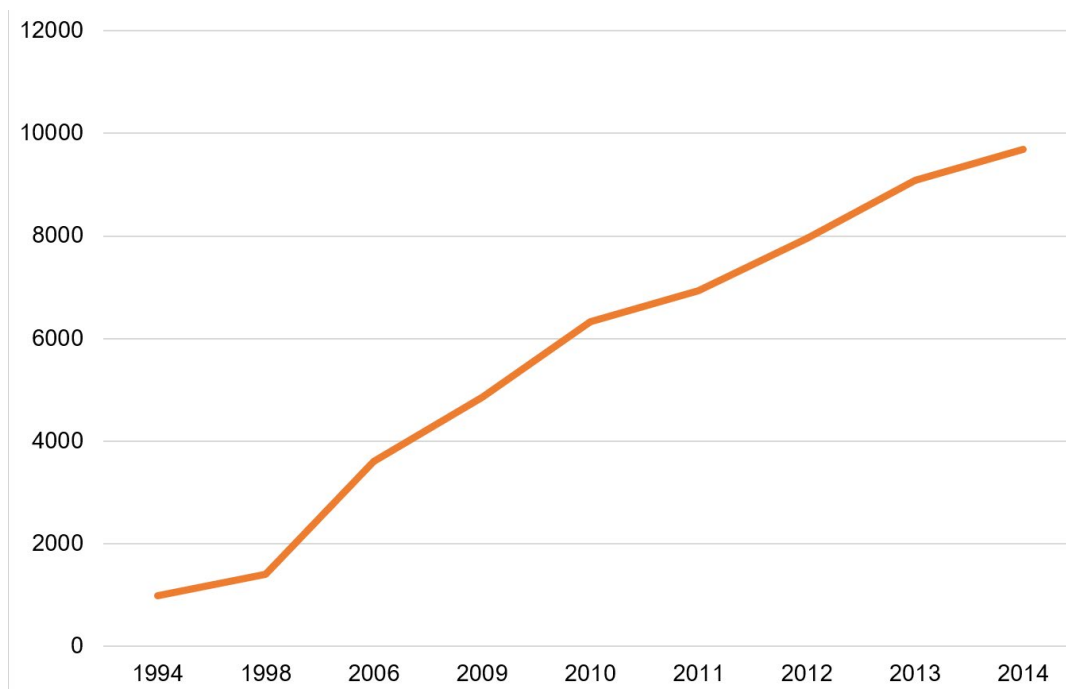
The study is relevant due to the challenge of ensuring effective educational support for people with disabilities. Adapting programs to inclusion remains complex and understudied, especially amid growing global challenges. The aim of the study is to analyze contemporary concepts of inclusive education development: adaptation of educational programs, provision of psychological and pedagogical support, and personalization of the educational process. The article discusses innovative approaches, means, and tools in the field of inclusive educational technologies. The nature of the impact of active digitalization of education on the effectiveness of inclusion in education is investigated. The potential of audiovisualization, gamification, project research, immersive technologies, and the case method is highlighted. A metaverse-based model for inclusive education of visually impaired students is proposed. The study shows that modern technologies can create effective learning environments, supported by proper psychological and pedagogical assistance.

**Keywords:** Inclusive education. Psychological support for people with visual impairments. Preschool institutions. General education institutions.

## Introduction

Today, there is an increase in the number of people with disabilities, including people with varying degrees of visual impairment. The traditional educational environment has a destructive effect (more pronounced “maladjustment,” low levels of “self-acceptance,” “emotional comfort,” and “dominance,” low scores for “rejection of others” and “internality”) on the development of such students and causes specific problems in their adaptation.

According to Hauschildt et al.<sup>1</sup>, 15% of students in Europe report having a disability that restricts their capacity to study. Their academic performance may suffer greatly if the required modifications are not made<sup>2,3</sup>, and dropout rates may result<sup>4</sup>. Ireland’s only confirmed statistics on the number of students with disabilities enrolled in higher education are gathered annually by the AHEAD Journal. Every year, a survey covering a wide range of topics, from study areas to test accommodations, is distributed to the Disability/Access Officers of all funded institutions of higher education. The data gathered from these surveys is compiled into a written report. The statistics demonstrates state-of-the-art back in 2014 (see Figure 1). Number of students with disabilities grown ten fold in the period of 1994–2014. In 2014, there were almost 10,000 students with disabilities in HE in Ireland, that is, 4.7% of the total student body<sup>5</sup>.



**Figure 1.** Number of HE students with disabilities in Ireland, dynamics for 1994–2014.

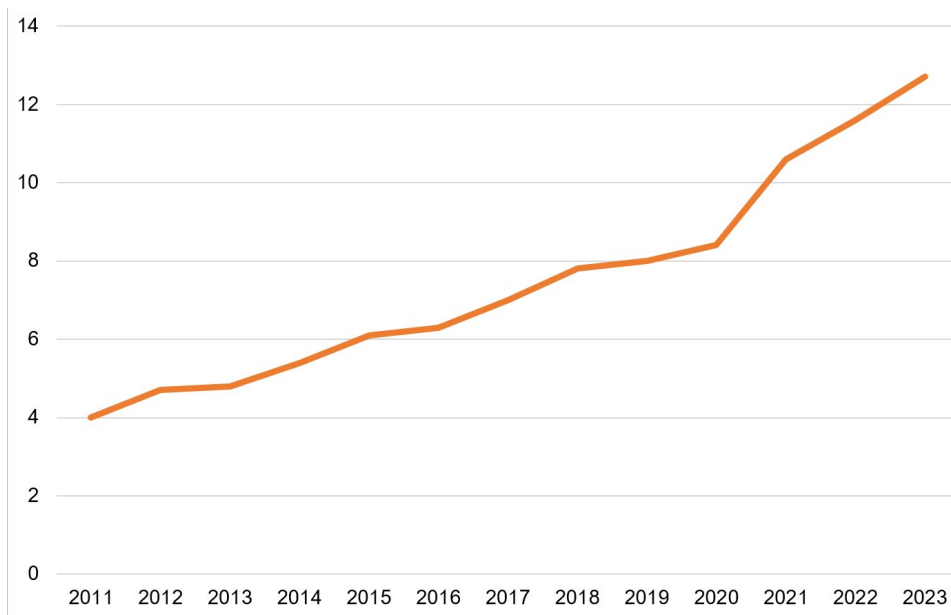
Source: Ryder<sup>5</sup>.



More recent data of the same AHEAD Journal demonstrate that Over the period of 2009–2020, the number of HE students engaged with disability services has increased by more than 226% (4,853 in 08/09 to 15,846 in 19/20)<sup>6</sup>.

Despite sufficient intellectual development, children with visual impairments experience secondary developmental delays<sup>2</sup>. As noted in the BCVIS2 study by Teoh et al.<sup>7</sup>, 72% of children with newly diagnosed visual impairments had clinically significant neo-ophthalmological disorders or comorbid conditions, and 48% of children had brain and visual tract lesions, indicating a high prevalence of polymorbidity and neurodevelopmental vulnerability among this category. Teoh et al.<sup>7</sup> emphasize that visual impairments in children are characterized by heterogeneity, polymorbidity, and increased vulnerability, and the highest frequency of their detection falls on the first year of life, which is critical for overall psychophysical development. In pedagogical studies, Bystrova et al.<sup>8</sup> noted that persistent and pronounced visual deprivation leads to a disruption of the overall development of the child's personality and causes a discrepancy between the biological and social developmental profiles, which complicates the process of socialization. Scientists record a low level of social adaptation, insufficient development of the communicative and motivational spheres, and difficulties in forming life plans and self-determination in children with visual impairments, especially in the presence of complex developmental disorders. In this context, Teslenko<sup>9</sup> underscores the importance of timely and systematic socio-pedagogical support as a priority condition for the successful adaptation of children with visual impairments in the educational environment, the development of compensatory mechanisms, and the growth of social and integrative skills. This necessitates maximum personalization of the educational environment in inclusive settings and the implementation of comprehensive psychological support, which is considered a determining factor in ensuring the social adaptation of the student. Existing drawbacks in the inclusive environment in preschool institutions and high school naturally find their continuation and implication in higher education<sup>4</sup>.

In Australia, there is also a trend of raising a percentage of HE students with disabilities. The number of domestic undergraduate students with disabilities increased in 2023 compared to 2022. In the year of 2023, 91,726 students identified as having a disability, accounting for 12.7% of the undergraduate population. This represents an increase from 11.6% in 2022<sup>10</sup>. Figure 2 shows a percentage share of enrolments of students with disability in Australia in the period from 2011 to 2023.



**Figure 2.** Percentage share of enrolments of students with disability in Australia in the period from 2011 to 2023.

Source: Cadby et al.<sup>7</sup>.

These growing numbers necessitates the search for the most effective strategies for training this category of students, providing them with the possibility of acquiring both hard and soft skills necessary for being competitive in today labor market and society. Due to their increased susceptibility to socioeconomic disparities, students with impairments should pay particular attention to this<sup>11</sup>.

Nevertheless, a number of studies have documented irregularities in the provision of the support and modifications required for students with disabilities to succeed in postsecondary education<sup>1</sup>. A lack of adaptive learning resources, architectural obstacles, and teachers who do not seem willing to change their teaching methods are some of the challenges faced by certain students<sup>12</sup>. Additionally, professionals' commitment to including students with disabilities varies; some seem unwilling to put in the effort, while others value inclusion<sup>13</sup>.

Collaboration across pertinent stakeholders has been proposed as a focus for future study on students with impairments in HE (higher education) by recent studies<sup>14,15</sup>. However, a crucial role is still inherent in curricula design, content and structure of educational programs, and customized learning process.

The development of this issue has been addressed by a number of contemporary researchers<sup>16,17</sup>. Students with visual impairments require particular attention. The research focuses on developing a model for the practical upgrade of educational programs for the development of inclusive education for students with visual impairments, which involves the integration of innovative teaching aids, maximum personalization of the educational process, and effective psychological and pedagogical support.

## Literature review

The theoretical and methodological basis for the research problem was laid by researchers studying best practices in the field of corrective and developmental pedagogical activities and psychological and pedagogical support in inclusive education. In particular, the issues outlined fall within the scope of scientific interests of Bešić<sup>18</sup>, Zhang et al.<sup>19</sup>, Choi et al.<sup>20</sup>, Cole et al.<sup>21</sup>, who have worked on the development of innovative pedagogical tools and the possibility of psychological and pedagogical support for children with special needs both in inclusive resource centers or specialized schools and in regular general education institutions.

According to Moriña<sup>22</sup>, faculty readiness is a significant impediment to inclusive practices in HE. Specifically, many faculty members lack experience working with different learners. While Individualized School Plans (IEPs) are vital in primary and secondary school, it is claimed that their absence in higher education institutions affects the lives of people with disabilities<sup>23</sup>. Moreover, cooperation between secondary school (i.e., general education institutions) and university is not systematic, resulting in a gap during transition with many students being underprepared intellectually and socially<sup>24</sup>.

IEPs, in addition to the teaching framework, are essential for creating tailored learning support for people with disabilities. IEPs raise achievement and engagement, according to research from Saudi Arabia<sup>25</sup> and Malaysia<sup>23</sup>. However, faculty members' ignorance of disability-related issues frequently makes it difficult to put these strategies into practice<sup>26</sup>. Rashid and Wong<sup>23</sup> claim that most instructors lack the necessary training to create and carry out IEPs.

According to the researchers, psychological and pedagogical support in the inclusive education system should cover the content, activity, and personal components of personality development<sup>27</sup>.

According to research on learning obstacles and the involvement of students with disabilities in higher education, inclusive policies must be put in place, and students with these traits must receive sufficient academic help<sup>28</sup>. However, the various actors engaged have differing opinions about how effective these policies are<sup>29</sup>. Furthermore, although some studies emphasize how technologies can be used as learning aids<sup>30</sup>, others highlight the substantial obstacles to their adoption, particularly in developing nations, due to structural and attitude barriers<sup>31</sup>. In this regard, students' ability to speak up for their wants and rights becomes a crucial tactic to get past obstacles and guarantee access to high-quality education<sup>32</sup>.

Table 1 presents brief review of barriers to learning and participation experienced by students with disabilities in HE, as it is considered in the literature.

**Table 1.** Barriers to learning and participation experienced by students with disabilities in HE, as presented in the literature.

Authors	Year	Methodology	Population and sample	Results
Almog <sup>25</sup>	2018	Qualitative narrative	Students with visual impairments at universities	Stories from college students with visual impairments are shared, emphasizing the need of accessibility and inclusivity.
Lombardi et al. <sup>33</sup>	2018	Systematic review	The qualities tested and the psychometric rigor stated in published studies (n = 203) on the creation of new or improved instruments were examined	The findings' implications support the need for disability to be given top priority in higher education scholarship as a component of diversity. They also help with this prioritizing by giving researchers and practitioners a list of useful tools.
Li et al. <sup>32</sup>	2024	Qualitative research	Students with disabilities in HE	Students report having several difficulties in school and not having enough resources to help them learn.
Moriña & Biagiotti <sup>28</sup>	2022	Systematic review	Graduates in a range of academic fields with disabilities	The evaluation emphasizes how crucial university inclusion is to enhancing graduates with impairments' employability.
Muyor-Rodríguez et al. <sup>31</sup>	2021	Qualitative discourse analysis	Educational factors in Bolivia	In the Bolivian context, many perspectives about university inclusion are noted, and methods to enhance it are suggested.
Nieminen et al. <sup>34</sup>	2024	Meta-ethnography	HE students with disabilities	The study demonstrates that evaluation procedures are frequently discriminatory and recommends adjustments to guarantee equitable and inclusive evaluation.
Oviedo-Cáceres & Hernández-Quirama <sup>29</sup>	2020	Qualitative research	Colombian university students with impairments	For students with disabilities to succeed academically, persistence and institutional support are crucial.
Paz-Maldonado <sup>35</sup>	2024	Systematic review	Disabled students at different universities	The review identifies typical obstacles that students encounter and offers practical solutions to enhance educational inclusion.
Pérez-Esteban et al. <sup>12</sup>	2023	Systematic review	HE students with special educational needs	In order to effectively serve students with impairments, new difficulties in higher education have been discovered that call for pedagogical innovations.

Source: developed by the authors based on literature review.

However, university students with disabilities must overcome significant obstacles to inclusive educational practices, including the physical environment and academic and administrative procedures<sup>36</sup>. Even though there are numerous university education programs available to them, many students with intellectual impairments fail to complete their schoolwork and lack the intellectual and social skills essential to blend in at universities<sup>37</sup>. HE institutions should pay attention to the concerns of students with disabilities and include them in the creation of courses and the environment, according to a study by Bartolo et al.<sup>17</sup>.

Publications by contemporary authors provide a comprehensive overview of existing approaches to transforming education to ensure effective inclusion. At the same time, a number of questions remain open regarding the practical adaptation of educational programs for people with disabilities.



## Aim

The aim of the study is to analyze contemporary concepts of inclusive education development: adaptation of educational programs, provision of psychological and pedagogical support, and personalization of the educational process.

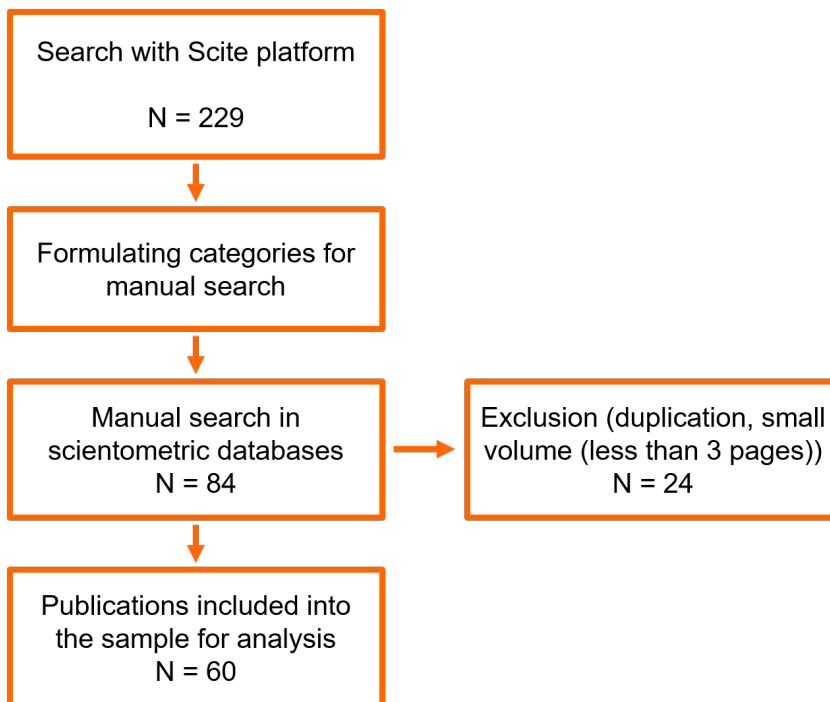
## Material and method

According to the general research methodology, a theoretical framework inside an interpretative paradigm served as the basis for the analysis of the data collected during the research that served as the basis for this article<sup>38,39</sup>. The study findings were analyzed and interpreted using a mixed-method approach that combined thematic analysis with a rhizoanalytic framework taken from Deleuze and Guattari's work<sup>40</sup>. The identification of similar themes was aided by a thematic approach. In contrast, the data were connected through the application of rhizo-analysis, a concept of meaning-making that contrasts with comprehension based on hierarchical logic and cause-and-effect relationships. This method discusses "multiple and shifting truths" that are subject to becoming rather than assigning "hard facts" to circumstances<sup>41</sup> (p. 92).

Rhizomatic learning understands that learning is a complicated process of sense-making, with each learner bringing their own context and requirements. It challenges traditional concepts of instructional pedagogy by arguing that "the community is the curriculum"<sup>42</sup>; that learning is a social activity in which we learn with and from one another rather than around content.

This principle is laid down in our developed Metaverse and principles of its application in inclusive pedagogical process.

The research combined elements of scoping review and pedagogical experiment. The search for literature sources was conducted in Google Scholar, JSTOR, ScienceDirect, Wiley, specialized (for educational researches) ERIC and IEEE (for engineering and IT researches) databases based on the preliminary defined list of keywords formulated from the categories obtained in the process of grounded theory application for analysis of preliminary sample of sources with the help of Scite platform. The platform enables finding information by searching across a mix of metadata (like titles and abstracts), as well as citation statements indexed from the full-text of research articles. In total, 62 sources were chosen for further elaboration (works of Deleuze and Guattari<sup>40</sup>, McNaughton<sup>41</sup>, Stake<sup>39</sup>, and Yin<sup>38</sup> were chosen by us manually for developing methodology of research). The scheme of search process is depicted in Figure 3 below.



**Figure 3.** Scheme of searching the sources for analysis.

Source: developed by the authors.

The pedagogical experiment implied creation of a metaverse for teaching people with disabilities, in particular, those with visual impairments. The experiment was conducted on the base of Ivano-Frankivsk National Medical University (Ivano-Frankivsk, Ukraine). Speaking about justification of selecting a country for empirical study, one should note that the concept of “inclusion” in Ukraine is quite not new and became entrenched in the education system. Inclusive education is a pedagogical innovation and at the same time a requirement not only of the time, but also one of the international obligations of the state as a result of the ratification of the UN Convention on the Rights of Persons with Disabilities. An alarming fact is the absence of statistical data regarding HE people with disabilities in Ukraine, on the background of detailed (including in regional and even city breakdown) statistics of primary and secondary inclusive education.

Total sample of participants was 64 students (the three groups of the 3<sup>rd</sup> year students in occupational therapy and pharmacy departments), of whom 16 were people with disabilities, predominantly with visual impairments. Distinguishing of people with disabilities was based on student’ recorded in University’ database self-reporting about special educational needs. All students were asked in oral form whether they are willing to participate in the experiment. All students expressed their consent. Informed consent form was signed by all participants. Prior to communicating with potential participants, since they represent vulnerable population, the approval of University commission on ethics was obtained.



After the completion of experiment, people with disabilities (N=16) were asked whether they observed any enhancement of their skills in discipline, their communication and team work skills, and raising motivation and interest to learning. In five questions, students were asked to provide answers in scores, on 10-point scale. The answers were then processed statistically. The questions are provided below:

1. Did you notice enhancement of your skills in discipline?
2. Did you notice enhancement of your communication skills?
3. Did you notice enhancement of your team work skills?
4. Did you notice raising your motivation to learning?
5. Did you notice raising your interest to learning?

Moreover, along with survey of students, we conducted unstructured interviews with teachers who conducted teaching process with the use of metaverse and maintained metaverse technical parameters and technological organization. The results of interviews were processed with the help of grounded theory method.

Moreover, an analytical and synthetic method was used to comprehensively study scientific approaches to the definitions, essence, and functionality of inclusive education. Induction was used to generalize trends in the development of media literacy using specific examples. The generalization made it possible to develop a conceptual educational model of pedagogical and educational activities with students with special educational needs. Using abstraction, the most significant aspects of the problem were identified, taking into account the potential opportunities and related challenges.

## Results and discussion

Among the main pedagogical approaches that optimize the effectiveness of learning material by people with disabilities, it is worth highlighting interactive technologies and gamification, audiovisual methods and project methodology, immersive technologies, as well as group interaction formats. The metaverse represents one of the cutting-edge technologies in modern higher education. Due to its increasing importance in both current and future educational practices, educators and trainers are closely examining the Metaverse and virtual reality. Kemp and Livingstone<sup>43</sup> put a hypothesis about the effectiveness of the Metaverse integration with Learning Management Systems (LMS) using the virtual reality “Second Life”. Collins<sup>44</sup>, focusing on the concept of virtuality, claimed that the Metaverse may help students learn in meaningful ways while also promoting interpersonal socialization. With the emergence of immersive technologies, namely VR, AR, MR, and XR, the metaverse became increasingly more popular in educational settings. Virtual experiences, which link students and teachers in virtual classrooms and labs, are beneficial for both high schools and HE<sup>45</sup>. According to Reeves et al.<sup>46</sup>, these virtual experiences are relevant for any year and may be used to teach any subject, but they are especially expedient for teaching scientific disciplines like computer science, physics, chemistry, medicine, and earth sciences. For our study and experiment, core principles for designing a good

Metaverse embracing inclusion, diversity, equity, accessibility, and safety are especially important, determining the reason of our choice of this innovative tool.

The Metaverse represents an integrative ecosystem of virtual worlds that provide users with immersive experiences that alter existing ones and generate new values from social, cultural, environmental, and economic viewpoints. It is described as an ongoing, interwoven fusion of the real and virtual worlds made possible by technologies like AR and VR, where users interact with many senses in shared, persistent immersive settings<sup>47</sup>. The Metaverse is frequently described as a completely immersive and interactive environment that provides users with the chance to explore, create, and engage in a variety of activities<sup>48</sup>.

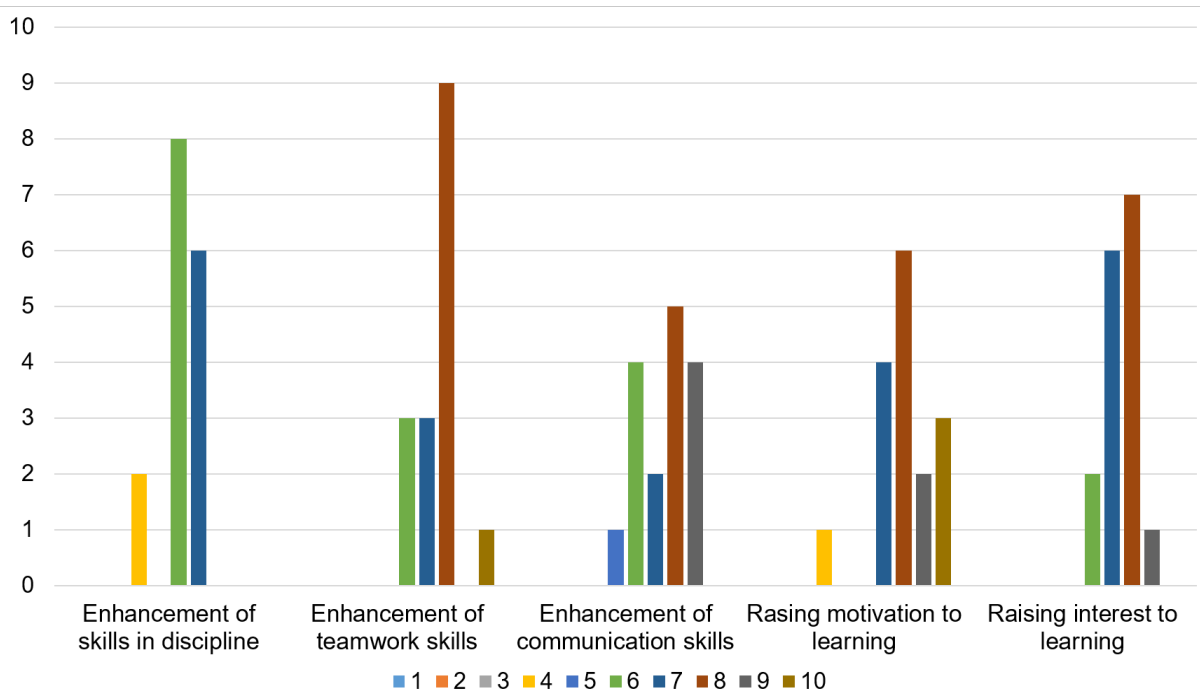
Although numerous initiatives have provided recommendations for enhancing the accessibility of virtual and augmented reality content, comprehensive accessibility solutions seem to be somewhat sparse<sup>49</sup>. One of the biggest challenges is that many virtual reality systems and applications are inaccessible<sup>50</sup>. Since accessibility requirements are not included into current software development methodologies, people who are neurodivergent may experience sensory overload when using XR technology<sup>51</sup>. Addressing Metaverse-related concerns for educational purposes requires consideration of potential accessibility and integration issues for those with learning disabilities<sup>52</sup>.

The potential and difficulties faced by inclusive schools in delivering education for all in the meta-verse era were the main topics of Bakhri and Sofyan<sup>53</sup>. The authors believe that in order to achieve inclusive education, it is essential to develop metaverse platforms and gadgets that facilitate accessibility for students with special needs.

## Empirical part

In this study, we designed, developed, and tested a meta-learning intelligent system that is based on the metaverse and AI, specifically tailored for students with visual impairments. For the design of Metaverse application, a virtual environment for teaching and learning place was developed via Gravity Sketch software. Activities that were assessed included visual discrimination, navigation, and a dual task that included both. In the VR experiment, participants controlled a virtual industrial robotic arm using HTC VIVE Pro Eye VR headsets and controllers. Options to increase visual contrast and to turn on a colorblind mode were provided.

The designed metaverse was applied within classroom for two weeks. The focus of educational tasks was on teaching anatomy and communication skills. Following, this, a survey described above was conducted. The results are presented in Figure 4.



**Figure 4.** Results of survey following the experiment.

Source: calculated by the authors.

As it is evident from the Figure 3, the use of metaverse technology showed sound results, significantly increasing students' interest and positively affecting both hard and soft skills acquisition. Since metaverse represents a flexible technology, its design can imply participation of both students with and without special educational needs, thus creating tremendous opportunities for seamless enhancement of inclusive practices within HEIs.

Additionally, for providing a kind of triangulation of obtained empirical results, we conducted unstructured interview with teachers (N = 5) who participated in teaching process with the use of Metaverse. We asked them to share their overall opinion of its effectiveness and benefits. Interviews transcripts were processed based on grounded theory method. Appropriate codes and categories are presented in Table 2.

**Table 2.** Codes, categories, and themes generated from the answers of teachers-respondents to interview\*

Number of teachers	Codes	Categories	Theme
5	SEN students' understanding the subject Usefulness	Usefulness in understanding the subject	Ease of use and advantages in inclusive education
4	Providing learning retention	Facilitating learning	
5	Providing clarity on difficult subjects for SEN students		
5	Facilitating understanding		



3	Attractiveness	Enjoyment and attraction
2	Enjoyment	
5	Better inclusive teamwork	Seamless inclusive
5	Better inclusive communication	communication and cooperation

Source: developed by the authors.

Note: SEN students: students with special educational needs

As evident from the Table 2, teachers' evaluation of Metaverse efficiency in inclusive HE practices, in fact, fully echoes with the evaluative characteristics obtained in survey of students. Both students and teachers noted high efficiency of metaverse in facilitating inclusive educational practices.

It should be noted that the success of the process is determined by the competence of teachers and their readiness to interact with students based on coaching and tutoring approaches<sup>54</sup>.

There are several interpretations of the ideas, requirements, and models for creating educational programs that represent the scientific debate on incorporating technological advancements into inclusive education practices. This suggests that a single, universal model for the individualized education of people with disabilities to be developed. Atanga et al.<sup>55</sup>, Graham<sup>56</sup>, and Kefallinou et al.<sup>57</sup> all hold this belief. Utilizing tactile and sensory capabilities as well as reflection, the researchers offer several workable options for incorporating immersive technological tools. When working with kids who have visual impairments, this is especially helpful.

Online platforms and interactive technology are helpful for inclusive learning practices, as Mitchell and Sutherland<sup>58</sup> rightly claim. These scholars believe that learning should be all-encompassing and incorporate cognitive activity, the cognitive domain, and logical-verbal skills. Simultaneously, educational and sociocommunicative outcomes should be used to gauge how effective the learning process is.

Maor et al.<sup>59</sup> and Miyauchi<sup>60</sup> in their publications substantiate the potential of embodied learning, which increases the interest of schoolchildren and allows them to acquire practical skills, in particular in the process of studying natural sciences. The researchers also argue that embodied learning develops critical and creative thinking, optimizes communication processes, and promotes the formation of sustainable skills for independent decision-making and teamwork.

Nilholm<sup>61</sup>, Rahmatullah et al.<sup>62</sup> emphasize the importance of providing practical psychological support to students with inclusion in the process of using innovations in the educational process. Scientists are convinced that gamification, while developing information processing speed, attention, and memory, also has a positive psychological and educational impact. As Reina et al.<sup>63</sup> point out, teachers should choose the most appropriate teaching tools that are complementary to the age and psycho-physiological characteristics of the person.



According to Parmigiani et al.<sup>64</sup> and Van Mieghem et al.<sup>65</sup>, the use of interactive tools in inclusive education develops children's imaginative and verbal-logical thinking, which allows them to solve verbal tasks. In addition, speech supports complex reasoning through the active direct influence of verbal memory. The simultaneous operation of the following mental processes is necessary to carry out these tasks: speech, perception, memory, attention, and thought. These tasks can be handled in a synergistic way by using the metaverse.

The study by Bakhri and Sofyan<sup>53</sup> focused on the challenges and opportunities of inclusive schools in educating everyone in the metaverse era. They claimed that creating metaverse platforms and devices that make learning more accessible for children with special needs is crucial to achieving inclusive education. Our research confirms these assertions.

Similarly, Bilotti et al.<sup>66</sup> looked into the potential applications of machine learning in the educational metaverse to address the psychological and social needs of students with disabilities. The authors' emphasized the need for more empirical research to understand how different learners interact and grow in metaverse-based learning environments and how they could be guided by personalized feedback. Our research demonstrated high potential of metaverse in raising students' motivation and interest to learning, thus confirming the findings of Bilotti et al.<sup>66</sup>.

Our study goes further in comparison with the research by Altinay et al.<sup>67</sup>, who, based on a systematic review, demonstrate the effectiveness of metaverse in special education. Despite a limitation of a small sample size, our experiment outlined the benefits of metaverse namely in inclusive education, contributing to vectors of search for pedagogic technologies capable of seamless uniting of students who have and do not have special educational needs, within single educational ecosystem.

At the same time, it is necessary to focus on the identified risks of using the metaverse in higher education: digital dependence, shift in content focus, information manipulation, insufficient regulatory and legal support, as well as the need to improve the digital competence of teachers. It is also necessary to emphasize the importance of ensuring ethical standards and preserving academic autonomy in the context of full or partial virtualization of education.

## Conclusion

An inclusive strategy for teaching people with disabilities involves the use of various digital resources and a virtual learning environment that engages the emotional sphere and sensory system, allows for the visualization of abstract and complex concepts, and stimulates the development of creativity and problem-oriented thinking, communication, and social skills.

Theoretical analysis has revealed the main directions of digitization in higher education and the principles of creating an immersive educational environment for people with disabilities. The study confirmed that the use of AR/VR technologies and the integration of artificial intelligence contribute to the personalization of learning,



increased student motivation, and the creation of new models of interaction in the learning environment. At the same time, a number of risks have been identified, including a shift in content focus, digital dependence, information manipulation, outdated or fragmented regulatory and legal support, and the need to improve the digital competence of teachers. The need to ensure ethical standards and preserve academic autonomy in the context of full or partial virtualization of education has been highlighted.

To guarantee that inclusive education transitions from policy to practice in a sustainable manner, educators, students, administrative bodies, and legislators must all actively engage together. In short, these suggestions would serve as a framework for developing inclusive education plans that align with both national interests and international standards.

Understanding how educational interactions might be optimized in the metaverse would significantly improve the learning experiences and outcomes for students with impairments. Furthermore, it is critical to create comprehensive digital literacy training programs for both people with disabilities and inclusive teachers.

Prospects for further research lie in the development of a practical strategy for the fragmentary digitization of higher education that would best suit the specific characteristics of students' development and demonstrate high adaptability.



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## Data Availability

The contents underlying the research text are non-handwritten contents.

## Authors' contribution

Ribtsun Y, participated conceptualization of the research idea, methodology development, coordination of the research process, interpretation of results, and drafting of the original manuscript; Kupras V, participated data collection, formal analysis, validation of results, and contribution to the literature review and manuscript editing; Miliutina K, participated methodological support, statistical analysis, visualization of results, and critical revision of the manuscript; Nahorniak S, participated theoretical framework development, resources provision, supervision of the research process, and substantive review of the manuscript; Shlapko T, participated investigation, data curation, assistance in results interpretation, and proofreading and final editing of the manuscript; All authors have approved the final version of the manuscript.

## Conflict of interest

The authors have no conflict of interest to declare.

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Este estudo é relevante devido ao desafio de garantir um apoio educacional eficaz para pessoas com deficiência. A adaptação de programas para a inclusão permanece complexa e pouco estudada, especialmente em meio aos crescentes desafios globais. O objetivo deste estudo é analisar conceitos contemporâneos de desenvolvimento da educação inclusiva: adaptação de programas educacionais, provisão de apoio psicológico e pedagógico e personalização do processo educativo. O artigo discute abordagens, meios e ferramentas inovadoras no campo das tecnologias educacionais inclusivas. Investiga-se a natureza do impacto da digitalização ativa da educação na eficácia da inclusão educacional. Destaca-se o potencial da audiovisualização, da gamificação, da pesquisa por projetos, das tecnologias imersivas e do método de estudo de caso. Propõe-se um modelo baseado no metaverso para a educação inclusiva de alunos com deficiência visual. O estudo demonstra que as tecnologias modernas podem criar ambientes de aprendizagem eficazes, apoiados por assistência psicológica e pedagógica adequada.

**Palavras-chave:** Educação inclusiva. Apoio psicológico para pessoas com deficiência visual. Instituições pré-escolares. Instituições de ensino geral.

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El estudio aborda el desafío de garantizar un apoyo educativo eficaz para personas con discapacidad. Se analiza la adaptación de programas educativos, el apoyo psicológico y pedagógico, y la personalización del proceso de enseñanza. El artículo examina enfoques y herramientas innovadoras en tecnologías educativas inclusivas, destacando el impacto de la digitalización en la eficacia de la inclusión. Se valoran la audiovisualización, la gamificación, el aprendizaje basado en proyectos, las tecnologías inmersivas y el método del caso. Además, se propone un modelo educativo inclusivo basado en el metaverso para estudiantes con discapacidad visual. Los resultados indican que las tecnologías modernas, junto con un adecuado acompañamiento psicopedagógico, pueden crear entornos de aprendizaje eficaces.

**Palabras clave:** Educación inclusiva. Apoyo psicológico para personas con discapacidad visual. Instituciones preescolares. Instituciones de educación general.