Eduweb, 2026, abril-junio, v.20, n.2. ISSN: 1856-7576
Doi: https://doi.org/10.46502/issn.1856-7576/2026.20.02.22

Original Article

El papel de las tecnologías digitales en el avance de la calidad educativa para estudiantes con necesidades educativas especiales: un análisis de la educación superior

The role of digital technologies in advancing educational quality for students with special educational needs: A higher education analysis

Liudmyla Nikolenko[1] Svitlana Kulbida[2] Nataliia Pakhomova[3] Olha Hubar[4] Serhii Levsha[5]

Afiliación autor:
[1] Oles Honchar Dnipro National University, Associate Professor, Professor, Dnipro, Ukraine. nikolenko_l@ujis.in.ua
[2] Mykola Yarmachenko Institute of Special Pedagogy and Psychology, National Academy of Educational Sciences of Ukraine, Professor, Kyiv, Ukraine. svk5554@gmail.com
[3] Educational and Research Institute of Special and Inclusive Education, Poltava V.G. Korolenko National Pedagogical University, Professor, Poltava, Ukraine. nataliypng24@gmail.com
[4] Educational and Research Institute of Special and Inclusive Education, Poltava V. G. Korolenko National Pedagogical University, Associate Professor, Poltava, Ukraine. olgagubar82@gmail.com
[5] Educational and Scientific Institute of Special and Inclusive Education, Poltava V.G. Korolenko National Pedagogical University, Poltava, Ukraine. serhiilevsha@gmail.com

Recibido: 06/04/26
Aceptado: 09/06/26

Cómo citar:
Nikolenko, L., Kulbida, S., Pakhomova, N., Hubar, O., & Levsha, S. (2026). The role of digital technologies in advancing educational quality for students with special educational needs: A higher education analysis. *Revista Eduweb, 20*(2), 378-396. https://doi.org/10.46502/issn.1856-7576/2026.20.02.22

Resumen

La integración funcional de la tecnología digital en la educación superior es clave para mejorar el acceso a los materiales de aprendizaje y apoyar la inclusión de estudiantes con necesidades educativas especiales (NEE). El objetivo de este artículo es reconocer las tecnologías digitales relevantes e identificar las brechas y barreras en el proceso educativo en las instituciones de educación superior (IES) de la Unión Europea (UE). La síntesis, sistematización y generalización de la literatura científica, para delinear las principales soluciones digitales en educación inclusiva y las barreras estructurales relacionadas, se realizó mediante métodos cualitativos. La parte cuantitativa se basa en cálculos de chi-cuadrado (χ^2) y utiliza datos agregados de estadísticas oficiales para analizar patrones de distribución a lo largo de los ejes de tipo de discapacidad, nivel de logro educativo, edad y género. Encontramos evidencia de un efecto de estratificación en el logro educativo entre grupos con diferente gravedad de discapacidad, aunque con patrones específicos por edad y género. Sin embargo, debido a la naturaleza del análisis de datos agregados, los resultados deben considerarse descriptivos y no inferenciales, y no implican relaciones causales. Los hallazgos destacan el papel de las tecnologías digitales como elemento facilitador para brindar acceso y equidad a la educación superior a estudiantes con necesidades educativas especiales (NEE). No obstante, el impacto del acceso digital en los resultados sigue viéndose limitado por barreras y desafíos organizativos, infraestructurales y socioeconómicos, que deberán explorarse mediante enfoques empíricos más rigurosos.

Palabras clave: tecnologías digitales, educación superior inclusiva, tecnologías de la información y la comunicación (TIC), rendimiento educativo, estudiantes con necesidades educativas especiales (NEE), Unión Europea, análisis de chi-cuadrado, enfoque de métodos mixtos, accesibilidad, inclusión digital.

Abstract

The integration of enabling digital technology in a functional way in higher education is the key to enhance access to learning materials and to support the inclusion of students with special educational needs (SEN). The scope of this article is to recognise digital technologies which are relevant and to identify gaps and barriers to the educational process in higher education institutions (HEIs) in the European Union (EU). The synthesis, systematization and generalization of scientific literature, for outlining main digital solutions in inclusive education and related structural barriers, was realized through qualitative methods. The quantitative part is based on chi-square (χ^2) calculations, and uses data at an aggregated level from official statistics to analyze patterns of distribution along the axes of type of disability, level of educational attainment, age and gender. We find evidence of a stratification effect in educational attainment between groups with differing severity of disability, albeit with age and gender specific patterns. However, because of the nature of aggregate data analysis, the results are to be considered descriptive and not inferential, and no causal relationships are implied. The findings emphasize the role

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

of digital technologies as an enabling element in providing access to and equity in higher education for students with SEN. Nevertheless, the impact of digital access on outcomes continues to be limited by organizational, infrastructural and socio-economic barriers and challenges, and these will need to be explored using stronger empirical approaches.

Keywords: digital technologies, inclusive higher education, information and communication technologies (ICT), educational attainment, students with special educational needs (SEN), European Union, chi-square analysis, mixed-methods approach, accessibility, digital inclusion.

Introduction

Currently, inclusion is a widely accepted strategy for the development of education around the world. European countries demonstrate some of the highest levels of adaptation to learners with special educational needs. According to EASNIE (2024) data on average education levels, these countries include Denmark (ISCED 2 = 100), the Netherlands (ISCED 2 = 100), Switzerland (ISCED 2 = 100), Luxembourg (ISCED 1 = 99.73), Malta (ISCED 02 = 100), etc. However, more recent studies by Olsson & Volleberg (2025) have shown that the highest level of inclusion is in higher education institutions in Iceland (7.9), Norway (7.4), Scotland (7.4), and Sweden (7.2). Although the term “inclusion” is now used to refer to a much wider range of learners, not just those with special educational needs, we will focus on learners with special educational needs (hereafter, SEN) in higher education institutions, as it is for this group that specialized changes in approaches to theoretical and practical training are being implemented. In other words, the EU’s education and training systems are currently geared towards ensuring that all students, regardless of their physical and/or mental health, complete their education. It is important to note that inclusive education in the EU appeals to the formation of intercultural competencies, democratic values, and respect for fundamental rights in students with special educational needs, preparing young people of different nationalities for positive interaction in society. Therefore, the issue of providing higher education institutions (hereafter, HEIs) with adaptive, adequate, and functional digital technologies capable of meeting the specific needs of students with SEN is becoming increasingly relevant.

Nonetheless, even with the increased attention to inclusive education and digital transformation, there is still a vague understanding of how digital tools affect the quality of the educational process in the case of students with special educational needs in higher education. This reveals an open issue in research regarding the identification of appropriate digital tools and their effect on the learning outcomes of this category of students. Within this framework, the research question of the study is: To what degree and in what ways can the use of digital technologies enhance the quality of education for students with special educational needs in Tertiary Education Institutions? Conversely, greater specificity is needed in the definition of the research purpose since a general statement thereof may be construed as lack of clarity and purpose for the work.

The purpose of the article is to identify digital technologies that ensure the proper quality of education for students with disabilities in higher education institutions of the European Union. The paper presents a theoretical analysis of the gaps and barriers that affect the quality of the educational process for this category of students. The study also includes an empirical analysis of the relationship between the type of disability and the level of education, taking into account gender differences. The descriptive analysis revealed notable structural differences in educational attainment across disability groups. The obtained results outline the

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

directions for the development of digital technologies in the higher education system and their use to improve accessibility and quality of education.

Literature Review

Digital accessibility and assistive technologies in inclusive higher education

The literature on digital technologies in inclusive higher education shows that digital tools should not be considered as a homogeneous group of technical solutions. Their educational value depends on the type of barrier they address and on the specific needs of students with special educational needs. In this regard, previous studies distinguish several functional groups of technologies: assistive tools that compensate for sensory, motor or communicative limitations; adaptive learning environments that personalize access to educational content; communication-support technologies; and institutional digital platforms that organize learning, assessment and interaction.

Assistive and adaptive technologies are most often discussed as instruments for expanding access to learning materials and supporting participation in the educational process. For example, AI-enhanced mind-mapping platforms and immersive tools such as ClassVR are considered useful for students with neurodevelopmental disorders because they support visual structuring, creative thinking and alternative ways of processing information (Fang et al., 2024). Virtual learning environments and online platforms also support course administration, assessment and interaction between students and teachers, which is especially important for students who need flexible learning formats (Long & Bouck, 2022). In science education, three-dimensional virtual laboratories may compensate for limited access to physical laboratory environments and provide alternative forms of practical learning (Elfakki et al., 2023). For students with hearing impairments, digital avatars and sign-language translation tools create additional channels of communication and improve access to educational information (Rocha et al., 2023). Another group of technologies is connected with independent learning and alternative access to educational content. Screen readers, speech-to-text tools, adaptive keyboards and specialized graphical interfaces help students overcome sensory, communicative and motor barriers in everyday learning activities (Matre & Cameron, 2024). Adaptive learning modules also make it possible to adjust the pace, sequence and format of educational content to students' individual cognitive responses. In the case of students with motor and neurological impairments, digital aids, speech therapy software and specialized keyboard interfaces may support communication and improve the accuracy of learning operations.

However, the existing literature also demonstrates that the technological availability of digital tools does not automatically guarantee educational quality. A number of studies emphasize the potential of assistive and adaptive technologies, but their long-term impact on educational attainment, academic retention and successful transition through higher education remains insufficiently measured. Therefore, digital technologies should be analyzed not only as tools that provide access, but also as elements of a broader inclusive educational environment.

Digital divide and structural barriers to SEN inclusion

A second important group of studies focuses on the digital divide and structural barriers that limit the inclusive potential of digital technologies. This literature is

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

significant because it challenges the assumption that digitalization is automatically inclusive. Although digital tools can expand access to educational materials, students from different socioeconomic contexts and rural communities often face unequal access to technological infrastructure and stable digital learning environments (Coker & Mercieca, 2023; Kormos & Julio, 2020). Therefore, the problem of digital inclusion is not limited to the physical availability of devices or Internet access.

International studies and policy reports also show that digital inequality includes differences in digital competencies, institutional readiness, technical support and the accessibility of digital platforms (European Agency for Special Needs and Inclusive Education, 2022; OECD, 2023). From this perspective, the digital divide is not only a technological issue, but also an organizational and social problem. If higher education institutions introduce digital tools without accessible design, adapted materials and systematic support, digitalization may reproduce the same inequalities that inclusive education is expected to reduce.

This point is especially important for students with SEN, because their educational barriers are often cumulative. They may include limited access to infrastructure, insufficient adaptation of educational content, lack of teacher preparedness and persistent social stereotypes about disability (Budnyk et al., 2022; Olinyk et al., 2023). Consequently, digital technologies can support inclusion only when they are integrated into a broader system of institutional accessibility and academic support.

Pedagogical and institutional conditions of digital inclusion

A third strand of literature examines how digital technologies are embedded in pedagogical practices and institutional strategies. Studies show that digital instruments can improve students' motivation, collaboration, communication and participation in inclusive educational settings (Kolbina et al., 2025; Ubachs, 2022). At the same time, these effects depend on the pedagogical conditions under which digital technologies are used. Digital tools do not improve educational quality by themselves; their effectiveness depends on teacher competence, inclusive instructional design, accessibility standards and the ability of higher education institutions to adapt learning environments to diverse student needs.

Teacher preparedness is one of the most frequently mentioned institutional conditions of inclusive digital education. Previous studies indicate that teachers often lack sufficient training for working with students with SEN in digitally mediated environments (Lopatina et al., 2024). This creates a gap between the formal availability of technologies and their real pedagogical use. In other words, assistive technologies may be present in the institution, but they may remain ineffective if teachers do not know how to integrate them into learning tasks, communication, assessment and feedback.

Policy-oriented literature adds another dimension to this discussion. International organizations emphasize that technological innovation should be aligned with inclusive policy frameworks, universal design principles and institutional quality assurance mechanisms (UNESCO, 2025). However, policy recommendations often remain general and do not always explain how digital inclusion affects concrete educational outcomes. This creates a gap between policy-level discourse and empirical analysis of educational attainment among students with disabilities.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

Identifying critical gaps in literature

The reviewed literature allows several conclusions to be drawn. First, existing studies convincingly demonstrate that digital technologies can expand access to learning materials, support communication, personalize educational trajectories and increase the participation of students with SEN in higher education (Bešić et al., 2025; Fang et al., 2024; Navas-Bonilla et al., 2025; Samaniego López et al., 2025). Second, research on the digital divide shows that digitalization can also reproduce inequality when access to infrastructure, digital skills, accessible platforms and institutional support remains uneven (Coker & Mercieca, 2023; European Agency for Special Needs and Inclusive Education, 2022; Kormos & Julio, 2020; OECD, 2023). Third, studies on pedagogy and institutional readiness indicate that the inclusive effect of technology depends on teacher training, adapted materials, accessible design, academic support and organizational capacity (Lopatina et al., 2024; Ubachs, 2022).

At the same time, the literature remains fragmented. One group of studies concentrates mainly on the description of digital tools and their potential benefits (Elfakki et al., 2023; Long & Bouck, 2022; Matre & Cameron, 2024; Rocha et al., 2023). Another group focuses on structural barriers and institutional limitations (Budnyk et al., 2022; Olinyk et al., 2023). A third group discusses inclusive digital education at the level of policy and strategic recommendations (OECD, 2023; UNESCO, 2025). However, fewer studies connect these discussions with descriptive evidence on educational attainment and with the socio-demographic differentiation of persons with disabilities by age and gender.

This gap is important because the presence of digital technologies does not necessarily mean that educational inequality is reduced. The literature tends to emphasize the enabling potential of digital tools, but it less often examines whether students with different levels of disability are equally represented at higher levels of education. Therefore, the present study addresses this gap by combining a thematic synthesis of digital technologies and barriers in inclusive higher education with a descriptive analysis of aggregated Eurostat data on educational attainment among persons with different levels of disability. Such an approach does not aim to establish causal effects, but it allows digital inclusion to be discussed within the broader context of persistent structural disparities in access to higher education.

Methodology

Qualitative analysis

The following general scientific methods of cognition were used in the research process: (1) synthesis of scientific literature, which allowed characterizing digital technologies that support inclusive education for higher education seekers with SEN in the EU; (2) systematization method to identify gaps and barriers in ensuring the quality of the educational process for students with SEN in higher education institutions; (3) generalization method to compare the results of empirical research on the nature of educational inequality with the needs of students with disabilities in improving the quality of education through the introduction of digital technologies.

The goal of the qualitative part of the study is to recognize structural patterns, major barriers, and systemic voids in delivering inclusive higher education via digital technologies, which provides a more profound conceptual insight into the issue under investigation and enriches the empirical results.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

Quantitative analysis

The empirical part of the study is based on the chi-square (χ2) calculation as a structural indicator of distribution consistency (in %), which is acceptable for aggregated official data if the p-value is not interpreted as an inference. For this study, the chi-square (χ^2) test is only applied as a descriptive structure to compare the distributions, without considering the p-value for the interpretation as statistical inference, as the data are aggregated and have been taken from the official statistics.

The study involves a series of steps to identify structural differences in access to higher education among different groups of persons with disabilities:

I. The formation of initial data for further calculations involves the analysis of secondary data from official reports (official percentage distributions) of the European Union (Eurostat, 2025), which allowed them to be systematized in Figure 1.

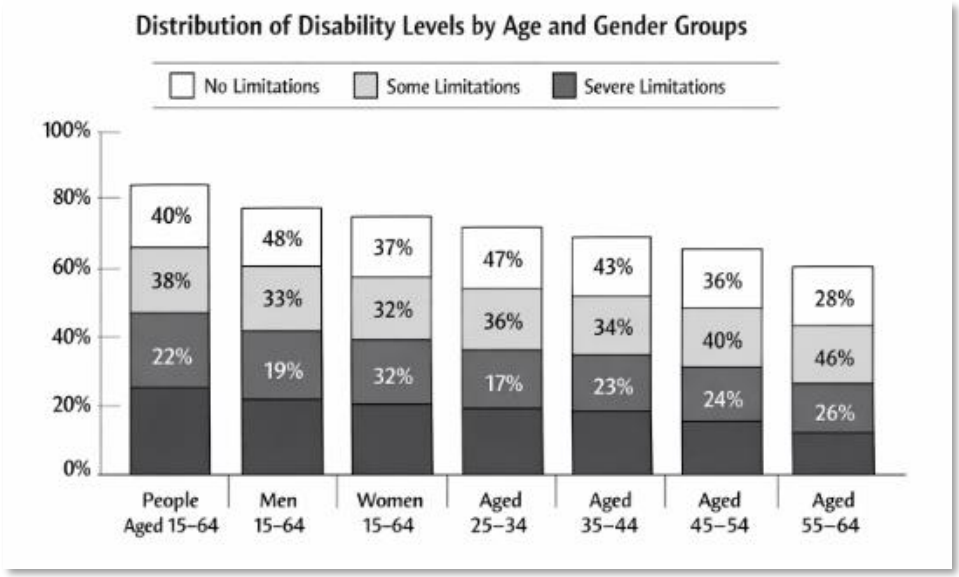

Figure 1. Observed values (O)
Source: Eurostat (2025)
Note: * – high educational attainment: low reliability.

Source of empirical data is the data collected by the European Labour Force Survey (EU Labour Force Survey), published by Eurostat (Eurostat, 2025). The EU Labour Force Survey is covering a wide range of issues regarding women employment, since it is collecting data on the involvement of adults in formal or non-formal education and training. Learner activity is counted during the four weeks prior to the date of survey. Participation rate in courses or training is presented as the ratio of participants to the total population of a selected age group. The respondents that did not respond the question referring to participation in an activity of employment, training or education are excluded from the sample.

In order to measure the disability, we have chosen the indicator limitation of the daily activities. It measures the severity of the handicap of an individual in carrying out his usual activities. It measures the extent of the limitation experienced by the individual in usual activities because of his health problem. In statistical terms the indicator is

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

known as the global activity limitation indicator (GALI). This GALI parameter is used in comparative analysis of the health and the functional capability of the population in the European social studies. The educational characteristics of the respondents in the figures are given in the form of grouped levels of educational achievement.

Based on the ISCED (International Standard Classification of Education), this classification is led by three good categories. First one, low educational level, it is for below primary education, primary education, and lower secondary education (ISCED 0–2); second one, secondary education, it is for upper secondary education and post-secondary non-tertiary education (ISCED 3–4); last one, tertiary education, it is for bachelor's, master's anddoctoral programmes (ISCED 5–8).

However, within the scope of the calculations (in particular for the formation of initial data), only data on persons with disabilities and special educational needs in the context of higher education were used.

I. The calculation of expected values to test the hypothesis of independence between disability type and education level was performed using the following formula:

$$E_{ij} = \frac{(Rowtotal_i * Columntotal_j)}{Grandtotal}, \quad (1)$$

where E_{ij} – expected values;

II. Chi-square (χ2) calculation to estimate the deviation of the observed distribution from the expected distribution, assuming statistical independence of variables. The calculation formula is as follows:

$$\chi^2_{cell} = \frac{(O * E)^2}{E}, \quad (2)$$

where χ^2_{cell} – chi-square; O – observed values (input data); E – expected values (E_{ij}).

III. For testing the statistical significance of the association between the examined variables, the df was calculated as:

$$df = (r-1)(c-1), \quad (3)$$

df – degree of freedom; r – type of disability; c – level of education.

In this instance, since the data collected are not samples but aggregated percentages, the p-value cannot be interpreted as classical statistical significance. It is important to point out that because aggregated official data were used, the application of inferential statistics is limited; thus, in this study, the χ^2 test is used in a descriptive and comparative manner.

Using the qualitative and quantitative methodologies for data collection assures for methodological triangulation, enabling a holistic research problem investigation and contributes to research findings validity and reliability.

Thus, the purpose of applying the χ^2 calculation in this study is not to conduct inferential hypothesis testing, but to describe the extent to which the observed

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

distribution of educational attainment differs from the distribution expected under a condition of proportional independence between disability level, age group and gender. Since the study relies on aggregated official percentage data rather than individual-level microdata, the χ^2 values are interpreted as descriptive indicators of structural deviation, not as evidence for accepting or rejecting statistical hypotheses.
H1: If educational attainment were distributed proportionally across disability groups, the observed values would be close to the expected values calculated under the independence benchmark.

H2: Larger deviations between observed and expected values indicate stronger structural disproportions in educational attainment across disability groups.
H3: Age and gender distributions are used to describe whether these disproportions are uniform across socio-demographic groups or concentrated in specific categories.

Results and Discussion

In recent years, education reforms in the European Union have been focused on the development of inclusive education. The EU's education policy shapes approaches that support the integration of people with different educational needs. Inclusion is based on the principle of equal value of every person in society. A person's social status is not linked to their abilities or academic achievements. Persons with disabilities and special educational needs are involved in a common educational space. The educational systems of EU countries are focused on eliminating discrimination in the educational process. At the same time, they are developing mechanisms for making education accessible to all groups of the population. The implementation of these approaches is coordinated by the European Pillar of Social Rights. The document was adopted by the European Council and the European Commission in December 2017. The provisions of the act enshrine the social, educational and cultural dimension of EU policy. These provisions define the strategic guidelines for shaping a common European future (European Commission, 2024).

Meanwhile, modern studies point out that the quality of inclusive education is more and more influenced by the degree of digitization of the educational environments, which allow for a flexible customization of the teaching and learning processes towards the specific needs of each student (OECD, 2023; UNESCO, 2025). Consequently, in the context of higher education, the digital transformation is emerging as a major facilitator of pan-European inclusive development.

The inclusive educational process involves the use of digital and information and communication technologies (ICT). Higher education institutions use these tools in teaching students with special educational needs. Digital educational technologies support the development of technical competencies of teachers and students. Navas-Bonilla et al. (2025) describe their use in the development of professional skills. A similar position is supported by González Villavicencio, & Estrella Flores (2023). The researchers link the use of digital tools to the expansion of the teacher's pedagogical capabilities. At the same time, digital educational technologies integrate students into a collaborative learning process. Therefore, **Figure** 2 presents the conditions related to teachers and the institutional sphere for the effective digital inclusion of students with special educational needs.

Also, recent research shows that digital technologies have an outsize impact on improving access to and the personalization of learning for students with special educational needs, supporting the building of adaptive educational trajectories and

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

inclusive learning spaces (Bešić et al, 2025; Samaniego López et al., 2025). The convergence of assistive technologies, learning management systems, and AI-powered applications is also helping to break down structural barriers and increase participation rates among disabled students (Kolbina et al., 2025).

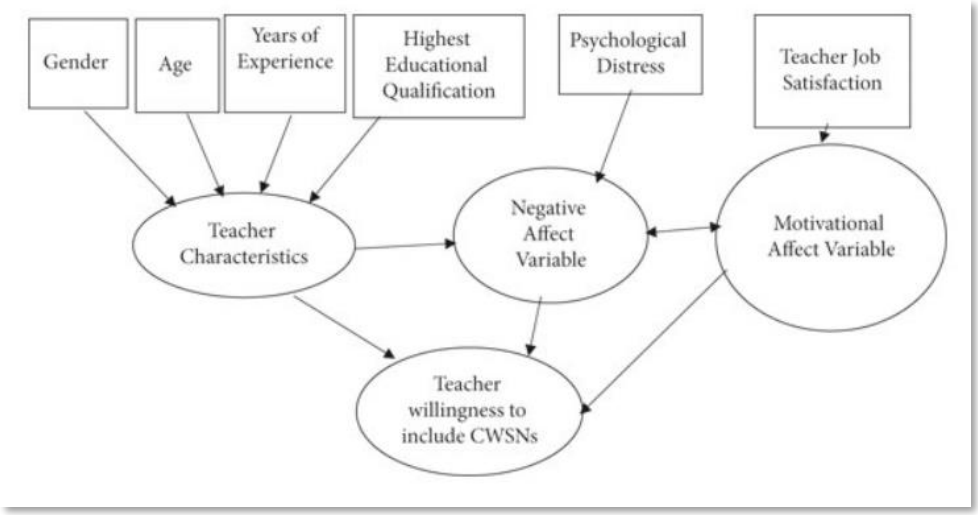

Figure 2. Teacher-related and institutional conditions for effective digital inclusion of students with special educational needs.
Source: compiled by the author based on Elfakki et al. (2023); Fang et al. (2024); Matre and Cameron (2024); Navas-Bonilla et al. (2025); Rocha et al. (2023); González Villavicencio, & Estrella Flores (2023)

This conditions clarifies that the inclusive potential of digital technologies depends on the interaction between technological access and the human, pedagogical and organizational conditions of higher education institutions. Digital technologies used by educational institutions in the European Union can expand student participation in the learning process and increase access to education. However, their effectiveness is limited when teachers lack training for inclusive digital instruction, when digital platforms are not accessible, or when institutional support for students with special educational needs remains fragmented. Therefore, digital inclusion should be understood not only as the introduction of technological tools, but also as the creation of conditions in which these tools can be pedagogically effective.

Digital technologies used by educational institutions in the European Union expand student participation in the learning process and increase access to education. The use of these tools improves the learning environment for people with special educational needs in higher education. Despite the proliferation of digital solutions, accessibility of education for people with disabilities remains uneven. Studies have identified a number of structural barriers to inclusive education. These include imperfect legislative regulation, limited accessibility of educational infrastructure, and differences between urban and rural educational institutions. Additional difficulties are created by insufficient adaptation of teaching materials and low levels of teacher training to work in an inclusive educational environment. Social stereotypes also limit the educational opportunities of people with disabilities. According to research, these factors explain the lower proportion of people with moderate and severe disabilities among higher education graduates (Kauffman et al., 2022).

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

In addition, reports from international bodies show that digital divide is still a major problem, with gaps in access to technologies, digital skills, and the readiness of institutions continuing to have an impact on the quality of education received by students with SEN (OECD, 2023; European Agency for Special Needs and Inclusive Education, 2022). This underscores the importance of integrated policies in which technological innovation is accompanied with pedagogical and institutional reform.
According to the Eurostat Labor Force Survey (2025), the educational attainment of the EU population varies significantly depending on health status. Among people aged 15-64 without disabilities, 33.6% have a university degree. For people with certain disabilities, this figure is lower and amounts to 23.9%. An even lower level is recorded among people with severe disabilities, where the share is 15.3%. The distribution of secondary education shows a different picture. The indicators hardly change depending on the presence of disability. Among people with severe disabilities, 43.7% have a secondary education. For people without disabilities, this figure is 43.9%. A slightly higher share is recorded among people with certain disabilities, 46.4%. The opposite pattern is observed in the group with low levels of education. The lowest share is recorded among people without disabilities, 22.5%. Among people with certain disabilities, the figure increases to 29.6%. The highest value is recorded in the severe disability group, where the share reaches 41.0%.

The analysis of the gender structure shows a similar gap between people without disabilities and people with certain disabilities for men and women. This gender distinction further confirms the complexity of educational inequality of the complexity of educational inequality, affected not just by the status of disability but layered by other socio-demographic factors, making multidimensional policy responses and inclusive digital tools necessary (Bešić et al., 2025; Ubachs, 2022). The same trend is observed in each education group. Women are more likely to have a high level of education. Men are more likely to fall into the category of low educational level. In 2024, the largest gender differences are recorded among people with higher education. Among people with certain disabilities, the share of young women with higher education is 26.3%. For young men, this figure is 21.1%, and the difference sometimes reaches 5%. A similar trend is found among people with severe disabilities. The share of young women with higher education is 18.1%. Among young men, this figure is 12.4%. The gender gap in this group reaches 5.7%. Meanwhile, digital technologies are progressively being understood as strategic instruments for the mitigation of such gaps through increased accessibility, flexibility and inclusiveness of the higher education systems (UNESCO, 2025; Kolbina et al., 2025).

The full distribution of educational attainment among people with special educational needs in the European Union is shown in Figure 3.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

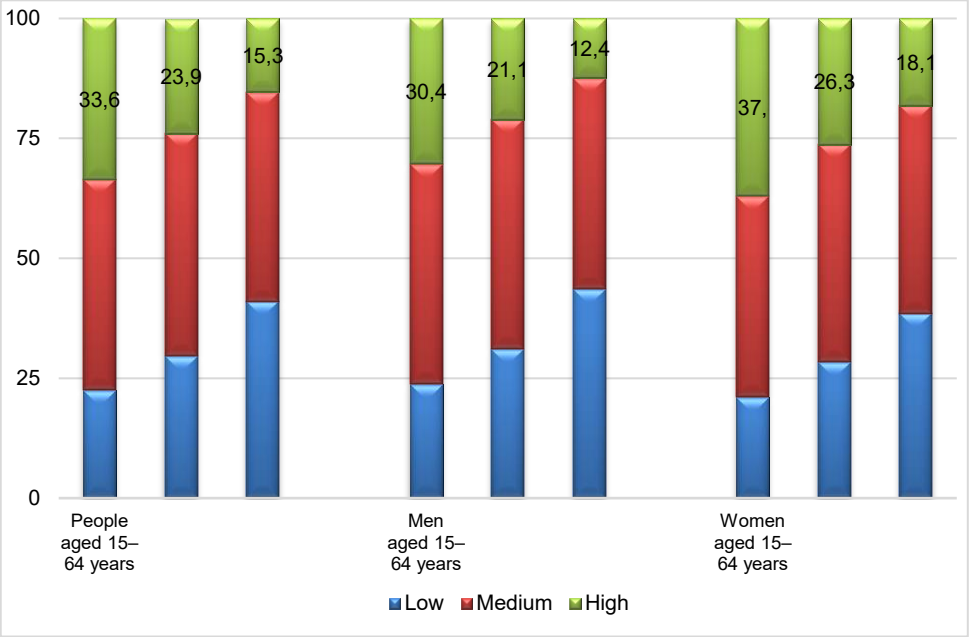

Figure 3. Distribution of educational attainment among persons with special educational needs in the EU in 2024 (%)
Source: Eurostat (2025)

A similar pattern was observed for each age group (divided into 10-year increments) shown in Figure 4.

Analysis by level of disability shows insignificant differences in the share of people with secondary education. The distribution of this category remains relatively stable across different groups. The situation is different for high and low educational levels. Among people without disabilities, high levels of education are more common. In this group, low levels of educational achievement are less common. Among people with severe disabilities, the share of low educational attainment is higher. At the same time, the share of people with higher education in this group is lower. Comparison of age groups shows a similar gap between people without disabilities and people with certain disabilities. This difference persists for all educational levels. It can be traced in groups from 25-34 years old to 55-64 years old. In the youngest age group of 15-24 years, the gap between disability groups is smaller. This is especially noticeable for the share of people with low or high levels of education.

Looking at the age groups of 25-34 years and older, researchers record a different trend. Regardless of disability, younger respondents are more likely to have a high level of education. Low educational level is less common among them compared to older generations. Some deviations from this trend are also recorded. For example, the proportion of people with severe disabilities who have higher education is higher among people aged 35-44. In this group, the figure is almost 18.6%. For people aged 25-34, it is lower and equals 16.3%.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

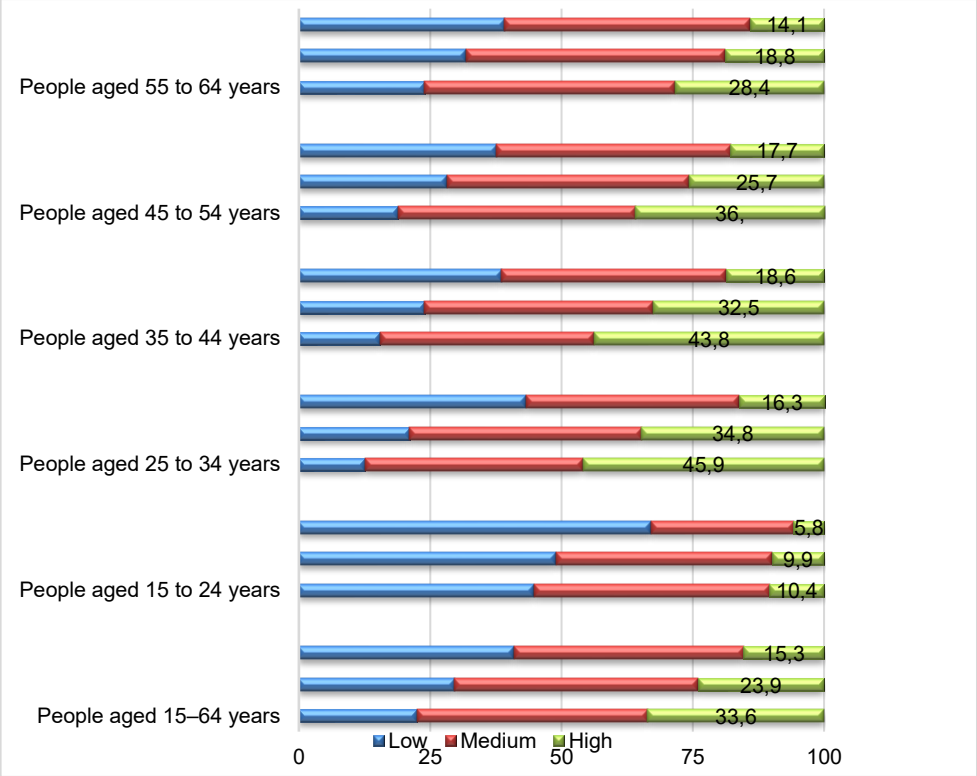

Figure 4. Distribution of educational attainment by disability level and age group among persons with special educational needs in the EU in 2024 (%)
Source: Eurostat (2025)
Note: * – high educational attainment: low reliability.

Among people with disabilities, the highest proportion of people aged 25-34 with higher education in 2024 was recorded in Luxembourg. The figure in this country is 46.6%. High values are also observed in Lithuania, 41.9%, and the Netherlands, 40.7%. All of these figures are above the European Union average. The EU average is 30.0%. The difference exceeds 10.0 percentage points. The lowest rate of educational attainment among people with disabilities was recorded in the Czech Republic. The share of people with higher education is 11.8%. The gap between people with and without disabilities in the EU remains significant. On average, it reaches 15.9%. The share of people with higher education among people with disabilities is 30.0%. For people without disabilities, this figure is 45.9%. There are significant differences in the size of the educational gap between the countries of the European Union. The smallest difference is recorded in Finland. In this country, it is 9.6%. In Poland, the gap is much larger and reaches 31.9%. The highest value is recorded in Ireland, where the difference between the groups is 34.6%.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

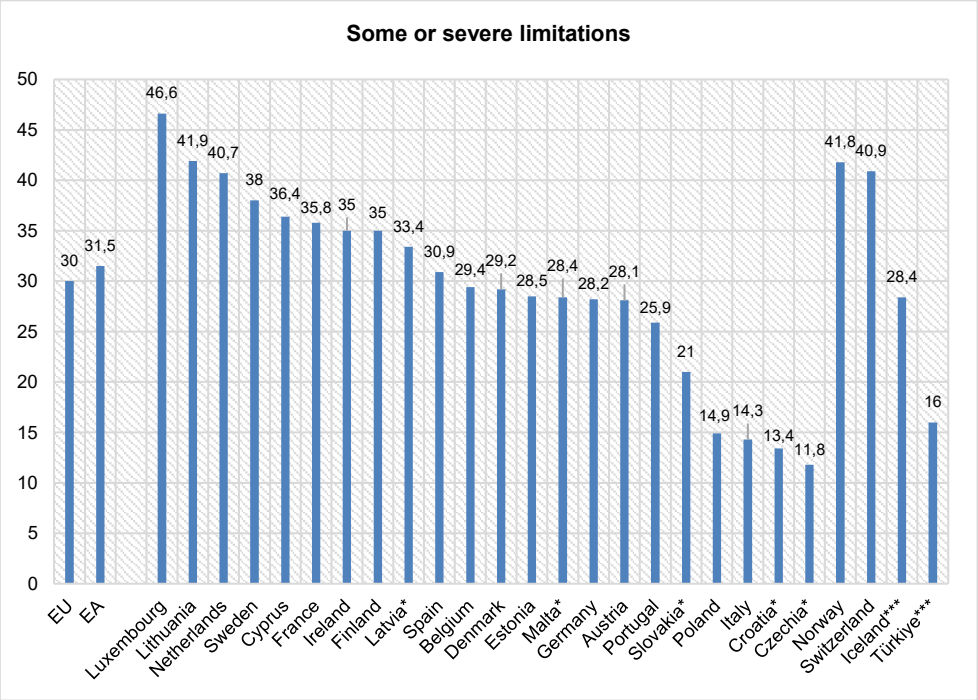

Figure 5. Level of higher education among people aged 25–34 by disability level in 2024 (%)
Source: Eurostat (2025)
Note: * – some or severe limitations: low reliability; ** – some or severe limitations: not published for reasons of low reliability; *** – data for 2022.

To empirically verify the existence of a statistically significant relationship between the level of disability and the educational level of persons with special educational needs, a quantitative analysis was conducted using the χ^2 (chi-square) criterion.

The χ^2 test is used in this study as a descriptive analytical instrument to detect structural patterns between variables, which is consistent with methodologies in recent literature on aggregated international data (OECD, 2023).

The analysis is based on aggregated statistical data from Eurostat (2025) and aims to identify structural differences in the distribution of educational achievements depending on the level of disability, age groups, and gender characteristics. The results obtained allow us to assess the inequality of educational opportunities within the EU's inclusive higher education system.

First, expected values were calculated for the observed distribution of educational attainment by disability level among persons aged 15–64. The calculation was performed under the independence benchmark, where the distribution of educational attainment is assumed to be proportional across disability groups. Since the study relies on aggregated Eurostat percentage data rather than individual-level microdata, these expected values are used only as descriptive reference values for comparison with the observed distribution (**Figure** 6).

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

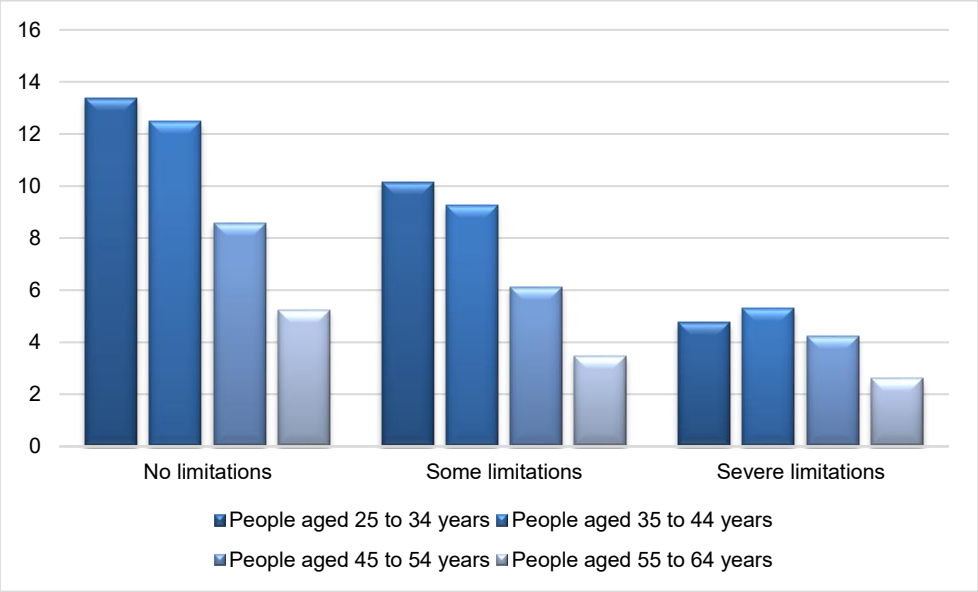

Figure 6. Expected distribution of educational attainment by disability level under the independence benchmark (%)
Source: calculated by the author based on aggregated percentage data from Eurostat.

The next step is to calculate the chi-square (χ^2) for different age groups and disability levels. The values obtained in Table 4 demonstrate the contribution of each cell to the total value of the χ^2 criterion.

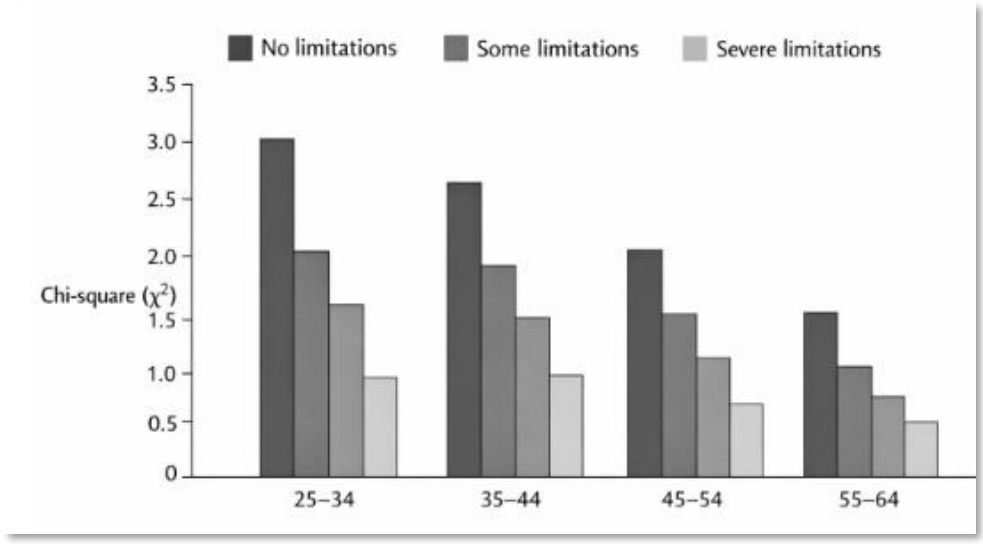

Figure 7. Results of calculating the χ^2 criterion.
Source: calculated by the author.

The largest contribution to the total χ^2 value is observed among persons without disabilities and persons with certain limitations in the 25–34 and 35–44 age groups, which indicates significant deviations from the expected distribution precisely during the period of higher education formation and completion.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

The calculation produced $\chi^2 = 17.17884356$ at df = 4. In this study, this value is not used for inferential hypothesis testing. Rather, it indicates a noticeable descriptive deviation between the observed distribution of educational attainment and the distribution expected under the independence benchmark. The largest deviations are concentrated in groups where disability severity is associated with lower representation at the tertiary education level and higher representation at the low educational attainment level.

Next, to reflect the theoretical distribution of indicators in the absence of the influence of the level of disability on the educational outcomes of men and women (for further calculation of the χ^2 criterion), the expected values were calculated for the analysis of the relationship between the level of disability and educational achievements, taking into account the gender distribution among persons aged 15–64 (**Figure** 8).

Figure 8. Results of calculating expected values.
Source: calculated by the author.

The results of the calculations shown in Table 6 illustrate the χ^2 values for each cell, taking into account gender differentiation.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

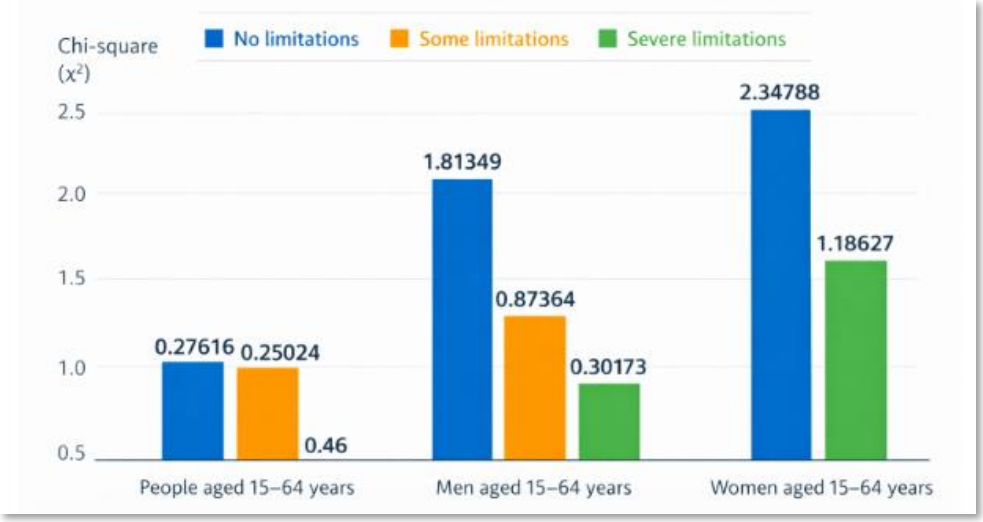

Figure 9. Results of calculating the χ^2 criterion considering gender differentiation. Source: calculated by the author.

The total χ^2 value is 7.697169937 with df = 4. In accordance with the methodological limitations of the study, this value is not interpreted as evidence for rejecting or confirming statistical hypotheses. Rather, it is used as a descriptive indicator of deviation between the observed distribution of educational attainment and the distribution expected under the independence benchmark. The results show that gender differentiation does not remove the structural gap associated with disability severity. Instead, disability-related disproportions remain visible across educational levels, although their intensity differs between men and women.

These findings should therefore be interpreted not as proof of a causal relationship, but as evidence of persistent structural inequality in educational attainment among persons with different levels of disability. The results are consistent with previous studies emphasizing that digital technologies may improve accessibility, personalization and participation in inclusive education (Bešić et al., 2025; Navas-Bonilla et al., 2025; Samaniego López et al., 2025). However, the present analysis also shows that the availability of digital tools alone is not sufficient to eliminate educational stratification. The lower representation of persons with severe limitations at the tertiary education level suggests that digital inclusion depends on broader institutional conditions, including accessible infrastructure, teacher preparedness, adapted learning materials, regulatory coherence and continuous academic support.

In this sense, the contribution of the study lies in connecting the literature on digital technologies in inclusive education with descriptive evidence on disability-related differences in educational attainment. The results indicate that digital technologies should be understood as enabling conditions of educational quality rather than as independent solutions. Their inclusive potential becomes meaningful only when technological access is combined with pedagogical, organizational and policy-level changes in higher education institutions. This interpretation is also important for future research, since aggregated data allow only descriptive comparison and should be complemented by individual-level data, institutional case studies and mixed-methods designs capable of explaining how digital tools affect the actual educational trajectories of students with SEN.

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

Conclusions

The research confirms that digital tools are important instruments for ensuring personalization, access, and flexibility for students with special educational needs in higher education institutions of the European Union. Unlike predominantly descriptive patterns in literature, this study contributes to the discussion by combining a qualitative systematization of digital technologies with a quantitative descriptive analysis of disability-related disparities in educational attainment. The empirical results indicate a consistent structural association between disability severity and educational level, suggesting the persistence of stratification in higher education among persons with different levels of disability.

The results have significant theoretical implications, as they strengthen the idea that digitalization needs to be viewed not only as a matter of technology-related processes but also as a systemic element of inclusive education policy. The findings enrich current theoretical understandings of inclusive education by incorporating the factor of digital accessibility and by demonstrating how disability status, socio-demographic variables and educational outcomes interrelate.

At the same time, there are some methodological limitations of the research. The analysis of secondary data in its aggregated form constraint the use of inferential statistical methods and the establishment of causal links. Moreover, the qualitative part is founded on the synthesis of already conducted research, which might be to some extent generalising with respect to the diversity of institutional solutions in the individual EU member states. These constraints point to the potential for additional inquiry employing primary data and mixed methods designs with enhanced inferential capability.

From an applicative viewpoint, the findings highlight that merely adopting digital technologies does not guarantee equal education. The success of digital inclusion is influenced by existence of institutional infrastructure and digital competencies in educators and by coherence in regulations. Stubborn obstacles, including disparities in infrastructure, a lack of legislation, gaps between urban and rural schools, inadequate teacher training, and social stereotypes, still hinder the full realization of inclusive education.

In general the results of the study indicate that digital technologies can significantly contribute to equalizing opportunities and the quality of higher education for students with special educational needs. Nevertheless, the realisation of this potential will need a whole policy approach that encompasses technological innovation through to institutional, pedagogical and societal change.

Bibliographic references

Bešić, E., Frizzarin, A., & Todorova, K. (2025). Digital technology use in inclusive schools in four European countries: Within- and between-school differences. *Journal of Research on Technology in Education*, *57*(5), 1190–1203. https://doi.org/10.1080/15391523.2024.2378084

Budnyk, O., Sydoriv, S., Serman, L., Lushchynska, O., Tsehelnyk, T., & Matsuk, L. (2022). Inclusive education in rural schools of Ukraine or how to ensure quality inclusive education in rural schools in Ukraine? *Revista Brasileira De Educação Do Campo*, *7*, e13940–e13940. https://doi.org/10.20873/uft.rbec.e13940

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

Coker, H., & Mercieca, D. (2023). Digital technology for inclusive education: reflecting on the role of teachers. In *Inclusion, equity, diversity, and social justice in education: A critical exploration of the sustainable development goals* (pp. 233–243). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-5008-7_16

EASNIE (2024). Cross-country reports. *European Agency for Special Needs and Inclusive Education (EASNIE)*. https://www.european-agency.org/activities/data/cross-country-reports

Elfakki, A. O., Sghaier, S., & Alotaibi, A. A. (2023). An efficient system based on experimental laboratory in 3D virtual environment for students with learning disabilities. *Electronics, 12*(4), 989. https://doi.org/10.3390/electronics12040989

European Agency for Special Needs and Inclusive Education. (2022). *Inclusive digital education methodology paper*. https://www.european-agency.org/sites/default/files/Inclusive_Digital_Education_Methodology_Paper.pdf

European Commission (2024). *Inclusive education*. European Education Area. https://education.ec.europa.eu/focus-topics/improving-quality/inclusive-education

Eurostat (2025). Disability statistics - access to education and training. https://acortar.link/XZ9P6G

Fang, M., Abdallah, A. K., & Vorfolomeyeva, O. (2024). Collaborative AI-enhanced digital mind-mapping as a tool for stimulating creative thinking in inclusive education for students with neurodevelopmental disorders. *BMC Psychology*, *12*(1), 488. https://doi.org/10.1186/s40359-024-01975-4

González Villavicencio, J. L., & Estrella Flores, J. P. (2023). Educación del Siglo XXI, competencias, metodologías y estrategias. *Esprint Investigación*, *2*(1), 5–15. https://doi.org/10.61347/ei.v2i1.50

Kauffman, J. M., Anastasiou, D., Felder, M., Lopes, J., Hallenbeck, B. A., Hornby, G., & Ahrbeck, B. (2022). Trends and issues involving disabilities in higher education. *Trends in Higher Education*, *2*(1), 1–15. https://doi.org/10.3390/higheredu2010001

Kolbina, L., Sopivnyk, I., Hubar, O., Teslenko, S., & Tsymbal-Slatvinska, S. (2025). Implementation of inclusive higher education through the use of digital technologies. *Revista Eduweb, 19*(1), 68-84. https://doi.org/10.46502/issn.1856-7576/2025.19.01.5

Kormos, E., & Julio, L. (2020). Contrasting instructional technology adoption in K-12 education to promote digital equity. *International Journal of Web-Based Learning and Teaching Technologies (IJWLTT)*, *15*(3), 19–30. https://doi.org/10.4018/IJWLTT.2020070102

Long, H. M., & Bouck, E. C. (2022). Calculators and online games: Supporting students with learning disabilities in mathematics. *Intervention in School and Clinic, 58*(4), 280–286. https://doi.org/10.1177/10534512221093787

Lopatina, H., Tsybuliak, N., Popova, A., Hurenko, O., & Suchikova, Y. (2024). Inclusive education in higher education institution: Are Ukrainian faculty members' ready for it? *Research in Education*, *118*(1), 49-72. https://doi.org/10.1177/00345237231207721

Matre, M. E., & Cameron, D. L. (2024). A scoping review on the use of speech-to-text technology for adolescents with learning difficulties in secondary education. *Disability and Rehabilitation: Assistive Technology*, *19*(3), 1103-1116. https://doi.org/10.1080/17483107.2022.2149865

Navas-Bonilla, C. D. R., Guerra-Arango, J. A., Oviedo-Guado, D. A., & Murillo-Noriega, D. E. (2025). Inclusive education through technology: a systematic review of types, tools and characteristics. *Frontiers in Education*, 10, 1527851. https://doi.org/10.3389/feduc.2025.1527851

https://revistaeduweb.org/
ISSN: 1856-7576
Open Acces

OECD. (2023). *Digital equity and inclusion in education: An overview of practice and policy in OECD countries*. https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/08/digital-equity-and-inclusion-in-education_c56b91ad/7cb15030-en.pdf

Olinyk, T., Mishchenko, O., Iievliev, O., Saveliev, D., & Hubina, S. (2023). Inclusive education in Ukraine: conditions of implementation and challenges. *Cadernos de Educação Tecnologia e Sociedade*, *16*(se2), 50–62. https://doi.org/10.14571/brajets.v16.nse2.50-62

Olsson, E., & Volleberg, I. (2025). *Inclusion Indicators 2025: Rights and inclusion of people with intellectual disabilities in 33 European countries*. Inclusion Europe. https://str.inclusion.eu/abd4926d4300153c68fc98502.pdf

Rocha, D. F., Bittencourt, I. I., de Amorim Silva, R., & Ospina, P. L. (2023). An assistive technology based on Peirce's semiotics for the inclusive education of deaf and hearing children. *Universal Access in the Information Society, 22*(4), 1097–1116. https://doi.org/10.1007/s10209-022-00919-2

Samaniego López, M. V., Orrego Riofrío, M. C., Barriga-Fray, S. F., & Paz Viteri, B. S. (2025). Technologies in Inclusive Education: Solution or Challenge? A Systematic Review. *Education Sciences*, *15*(6), 715. https://doi.org/10.3390/educsci15060715

Ubachs, G. (2022). *Diversity and inclusion in digital higher education*. Eadtu. https://eadtu.eu/images/Task_Force_Diversity_and_Inclusion_report_2022.pdf

UNESCO Institute for Information Technologies in Education. (2025). *Digital technologies for inclusive education: Recommendations*. https://iite.unesco.org/wp-content/uploads/2025/01/IITE_Publication-2_Recommendations.pdf