EQUALITY AND INCLUSIVENESS IN DISTANCE EDUCATION: SEN DISCOURSE

IGUALDADE E INCLUSÃO NA EDUCAÇÃO À DISTÂNCIA: DISCURSO SOBRE NECESSIDADES EDUCATIVAS ESPECIAIS

Liudmyla Konstantynenko
PhD in Biology, Associate Professor, Head of Department of Botany, Biological Resources and Conservation of Biological Diversity, Faculty of Natural Sciences, Zhytomyr Ivan Franko State University, Zhytomyr, Ukraine
ORCID: https://orcid.org/0000-0002-9959-777X
Email: lkonstantynenko@ukr.net

Svitlana Rashydova
Candidate of Pedagogical Sciences, Associate Professor, Senior Researcher of the Department of Scientific Information and Analytical Support of Education, Acting Deputy Director for Research of the V. Sukhomlynskyi State Scientific and Educational Library of Ukraine, V. Sukhomlynskyi State Scientific and Educational Library of Ukraine, Kyiv, Ukraine
ORCID: https://orcid.org/0000-0002-2573-4276
Email: svetlana101068@gmail.com

Eliana Danilavichiutie
Candidate of Pedagogical Sciences (PhD), Senior Researcher, Head of the Department of Speech Therapy, Mykola Yarmachenko Institute of Special Education and Psychology, National Academy of Educational Sciences of Ukraine, Kyiv, Ukraine
ORCID: https://orcid.org/0000-0003-3911-7612
Email: elyana_d@ukr.net

Iryna Sasina
Ph.D. in Psychological Sciences, Docent, Assistant Professor, Department of Technologies of Education and Rehabilitation of Visually Impaired Persons, Faculty of Special and Inclusion Education, Dragomanov Ukrainian State University, Kyiv, Ukraine
ORCID: https://orcid.org/0000-0001-8046-5083
Email: sasina.prof@gmail.com

Svitlana Herashchenko
Candidate of Pedagogical Sciences, Associate Professor, Associate Professor of the Department of Psychocorrectional Pedagogy and Rehabilitation, Faculty of Special and Inclusive Education, Mykhailo Dragomanov Ukrainian State University, Kyiv, Ukraine
ORCID: https://orcid.org/0000-0002-7829-9722
Email: fetlana35@gmail.com

Abstract: *People with special educational needs can improve their access to education and participation in society through the development of assistive technologies and distance learning. This study aimed to provide recommendations for special education teachers enrolled in distance education programs when designing online courses. The central focus is the application of Universal Design for Learning (UDL). Using a literature review, the paper systematized and summarized the benefits of UDL and the potential for its full integration into online learning environments. UDL ensures that learning experiences are adaptable to diverse student needs through three core principles: representation, action and expression, and multiple means of engagement. By fostering intentional lesson planning and tailored resources, UDL supports varied learning requirements. This approach allows all students, including those with disabilities, to access materials, participate actively, and demonstrate understanding. Rather than emphasizing deficits, UDL promotes a spectrum of learning opportunities to support equity and inclusion.*

Keywords: *Individuals with special speech needs. Neuro-psycho-linguistic-synergetic basis of adaptations. Visual perception. Preparation of future biology teachers. Online education.*

Resumo: *Pessoas com necessidades educativas especiais podem melhorar o seu acesso à educação e participação na sociedade através do desenvolvimento de tecnologias assistivas e ensino à distância. Este estudo teve como objetivo fornecer recomendações para professores de educação especial matriculados em programas de ensino à distância ao projetar cursos online. O foco central é a aplicação do Design Universal para Aprendizagem (UDL). Usando uma revisão da literatura, o artigo sistematizou e resumiu os benefícios do UDL e o potencial para a sua integração total em ambientes de aprendizagem online. O UDL garante que as experiências de aprendizagem sejam adaptáveis às diversas necessidades dos alunos por meio de três princípios fundamentais: representação, ação e expressão, e múltiplos meios de envolvimento. Ao promover o planejamento intencional das aulas e recursos personalizados, o UDL oferece suporte a diversos requisitos de aprendizagem. Essa abordagem permite que todos os alunos, incluindo aqueles com deficiências, tenham acesso aos materiais, participem ativamente e demonstrem compreensão. Em vez de enfatizar as deficiências, o UDL promove uma gama de oportunidades de aprendizagem para apoiar a equidade e a inclusão.*

Palavras-chave: *Indivíduos com necessidades especiais de fala. Bases neuropsicolinguísticas e sinérgicas das adaptações. Percepção visual. Preparação de futuros professores de biologia. Educação online.*

Introduction

Different populations are denied the opportunity to learn and, thus, to fully engage in society. Social, gender, racial, and religious injustices, wars, illnesses, and other factors are among the numerous causes (Vlasenko et al., 2023). However, disability is a factor that transcends all societies, irrespective of social, political, and economic circumstances. As such, it necessitates solutions that address both the issue of educational accessibility and the promotion of full participation that can maximize the potential of all members of society, irrespective of their disability. Facilitating the attainment of this goal is the duty and responsibility of educators. According to some frameworks, this is accomplished by integrating viewpoints that allow them to address how disabilities are portrayed during their preparation, such as involving people with disabilities in disability education and integrating a viewpoint that views the teacher as a social justice agent (Ruppar et al., 2023).

For those with Special Educational Needs (SEN), equitable access to remote learning necessitates removing any potential obstacles and making sure inclusive practices are followed. This entails offering individualized support, accessible educational resources, and suitable assistive technology. In online and distance learning settings, tactics like tailored accommodations and Universal Design for Learning can aid in fostering fair learning experiences (Sánchez et al., 2024).

Giving all students, particularly those with special needs, access to unique educational opportunities is the aim of open, distance, and digital education (ODDE). Although ODDE provides flexible and accessible learning possibilities for children with special needs, it may also result in the emergence of some challenges. Supporting students with special needs in ODDE circumstances is therefore essential for all educational institutions. These days, research focuses on the difficulties that students with special needs face while learning in ODDE, as well as the strategies that can help them get past these difficulties. These strategies include ways to make learning more accessible, acknowledging the principles of Universal Design for Learning, utilizing assistive technology, offering accommodations, and making adjustments in terms of pedagogical, managerial, social, and technical support. Kocdar and Bozkurt (2022) stress that because ODDE is inclusive, it should put more of an emphasis on care-oriented pedagogies and empathy. Drawing inspiration from the openness principle, ODDE aims to promote justice, equality, and equity for all students, including those with special needs.

These days, studies concentrate on the challenges that special needs students encounter in ODDE and the methods that can assist them in overcoming these challenges. Making learning more accessible, embracing the Universal Design for Learning principles, using assistive technology, providing accommodations, and modifying pedagogical, administrative, social, and technical support are some of these tactics. Because ODDE is inclusive, Kocdar and Bozkurt (2022) emphasize that it should emphasize empathy and care-oriented pedagogies more. ODDE seeks to advance equity, equality, and justice for all students - including those with special needs - by drawing inspiration from the openness principle. ODDE guarantees that the “back door is kept open for non-traditional learners” in addition to traditional learners. These include students with special needs and those who are disadvantaged due to factors like gender, ethnicity, remoteness, language, migration, wealth, disability, displacement, incarceration, religion, and other beliefs and attitudes (UNESCO, 2020).

Reiser and Dempsey (2012) provide four criteria for analyzing students with special needs in a broad context: visual engagement, auditory involvement, mobility involvement, and cognitive involvement. In ODDE, these four categories are most frequently utilized when thinking about how to serve students with exceptional needs. In addition to providing learners with flexibility in terms of time and space by letting them study at their own speed, ODDE makes learning more accessible for students who might not otherwise be able to attend in-person classes (Galkienė & Monkevičienė, 2021). Additionally, assistive technologies and multimedia that incorporates text, audiovisual, and voice resources can benefit students with special needs by increasing accessibility (Erickson & Larwin, 2016). These students might therefore do better in online courses than in in-person ones (Espada-Chavarria et al., 2023). Empirical data indicates that students with disabilities are more likely than other students to choose to take online courses, and they are aware of the advantages of ODDE, as various other researchers have pointed out (Alamri et al., 2017).

Today, the UDL conceptual framework is positioned as a pillar that can support educational

practices that mediate between special education needs and assistive technologies using inclusive pedagogical principles that can be applied to distance learning (Myhill et al., 2007; Espada-Chavarria et al., 2023). Furthermore, it is now feasible to expand the range of virtual learning environments that can be utilized in instructional designs for individuals with special educational requirements thanks to contemporary distant education trends and technology.

Organizations should proactively apply accessible design principles, offer extensive support services, and modify curriculum and instructional strategies to guarantee that people with special needs have equitable access to distant learning as well. This entails creating a conducive learning environment, providing tailored support, and enabling online platforms and resources to be accessed via assistive technologies.

In this regard, the goal of this study is to examine the scientific literature on assistive technology-mediated distance learning in order to expand on the features, patterns, opportunities, and challenges of the field and to provide insights for future research that will help direct the investigation in the face of current technological and educational obstacles.

Literature review

In the area of educational inclusion, technology has emerged as a vital instrument for expanding people's opportunities. According to academics, assistive technology is made to help people live better lives in their communities and families, increase their functionality, and fortify their independence (Ifenthaler et al., 2023). Additionally, it helps close the access gaps between students with and without disabilities in the same classroom (Daniela, 2022).

According to studies in the field, there are three immediate benefits to using assistive technologies in education: improvements in attending behaviors, comprehension and adherence to the rules of appropriate behavior, and communication skills in the classroom (Parette & Stoner, 2008). According to other research, teachers' classroom management practices (Markelz et al., 2020), perceived knowledge, confidence, and utility (Hirsch et al., 2023) all alter in ways that are highly accepted when innovations and technology are integrated. Park et al. (2022) found that preservice teachers' perceptions and level of preparedness about assistive technology changed statistically significantly after taking part in an orientation study on instructional and assistive technologies.

The science, technology, and economic circumstances of their respective societies inform the development of these technologies. As a result, we can examine the development of various prostheses, ranging from the pirate's peg foot to the therapeutic usage of robotic humanoids with elderly patients (Moyle et al., 2022).

Yuknis (2016) provides a broad viewpoint, moving beyond a purely material vision to position the issue of accessibility to educational goods from the methodologies employed. Following the analysis of the documents, a UDL-based framework for integrating technology into the curriculum of remote learning courses for students with disabilities is put forth. Furthermore, a specific technology is the topic of the systematic review by da Silva et al. (2018) and the state of the art by Mangina et al. (2016). Therefore, while the second author focuses on how students with hearing impairments can access MOOCs, the first review conducts a state-of-the-art analysis of drone use as artifacts that can be approached from assistive technology, leading to a joint proposal for the use of drones and virtual reality to enable people with reduced mobility to access sites through those who could not attend due to their disability. This final study not only suggests gamifying distance-assisted learning for deaf students, but it also suggests improving digital literacy, which the authors believe can be done in a MOOC setting while teaching specific material.

Koustriava's (2021) study adds depth by studying the preparedness of individuals with visual impairments to participate in distance education, whereas Da Silva's (2010) work cleared the path for understanding accessibility aspects inside Distance Learning Management Systems. Koustriava (2021) clarifies the intricate relationship between accessibility issues and individual ready elements by comparing readiness with personal traits like educational attainment and computer usage frequency. This knowledge is crucial for creating inclusive distance learning programs in the future

that are suited to the various demands of students with visual impairments in an increasingly digital environment. By providing a workable answer to the accessibility issues experienced by students with visual impairments in technical courses like mathematics, the study by Maćkowski et al. (2018) enhances earlier studies. Research by Maćkowski et al. (2018) presents an interactive tutoring platform created especially to make mathematics instruction and assessment accessible to the blind, while works like Da Silva (2010) and Koustriava (2021) concentrated on comprehending accessibility features within distance learning systems and the preparedness of individuals with visual impairments for distance education.

We identified publications that proposed technologies designed to address the special needs of students in distance education were identified, as well as online course designs capable of sustaining an adequate educational flow with people with special needs. The innovations in development propose solutions to specific accessibility problems that in turn require empirical studies capable of knowing the real impact of such assistive technologies on the academic trajectories of learners who require them.

As a result, research like that of Mulfari and Mulfari (2018) suggests a customized human–computer interaction system that uses cameras and sensors to enable the student to engage with the learning environment, addressing the issue of access for students with mobility issues to videoconferences as instructional channels for distance learning. Furthermore, some researchers outline software for sign language recognition that can enhance students' accessibility in distance learning settings (Sánchez et al., 2024).

Ulisses et al. (2018) discuss the BDC-API (Blind/Deaf Communications API), a modular toolkit that enables blind and deaf individuals to access educational digital content. Their solution is predicated on the idea that blind and deaf pupils can interact and communicate in serious gaming situations.

The "permanent need for accommodation", as defined by Blair et al. (2004), is another aspect that jumps out from reviews on assistive technology and that discuss distance education as a modality for delivering conditions for learning. This refers to the issue that people with special needs face as a result of the rapid advancement of technology, as they must constantly adjust to new technological prostheses. This, in turn, makes it difficult for them to fully utilize the opportunities presented by some current technology for distance education. Accordingly, the authors note that technology developers are more focused on the novel features or attributes of assistive technologies than on guaranteeing the ability to use them. According to Do Nascimento et al. (2019), comprehending and acknowledging the needs of individuals with severe visual impairments in online learning settings might facilitate the transition from learning instructional materials to attempting to comprehend how websites function.

Researchers observe that a multidisciplinary and inter-agency strategy is necessary for the management of students who struggle with speech and language (Taylor & Yuknis, 2023). In order to fulfill the increasing need for assessment, intervention, consulting, and remote learning within their scope of practice, speech-language pathologists and therapists have been employing a different service delivery model known as telepractice for about 40 years (Rocha et al., 2020). In the meantime, to guarantee accessibility and efficacy, inclusive distance education for students with speech-language pathology (SLP) needs to be carefully planned and executed. This entails utilizing assistive technology, modifying curriculum, offering focused assistance, and resolving possible obstacles such as caregiver capacity and technology access. All students, including those with SLP needs, can benefit from inclusive distance learning experiences that are developed using the Universal Design for Learning (UDL) principles.

It is also concerning that, despite nearly twenty years of research, scientific output does not adequately address the difficulties and advancements in material circumstances for inclusion through assistive technology in distant mode. Many of the issues raised cannot be entirely resolved in more recent experiences or in completely reliable reports like do Nascimento's (2019). The lack of scientific output hinders the creation of discoveries that significantly advance the creation of tools, curricula, and public inclusion regulations to improve the educational experience of students with disabilities who use distance learning.

Methodology

Qualitative technique was implied by the research. A literature review was used to address the research topic in order to conduct this investigation. In general, the literature review was conducted using a restricted search in a particular database in order to subsequently discriminate the content based on the inclusion or exclusion criteria. Our goal was to provide a broad overview of the phenomenon of assistive technology use in distance learning, which prompted us to examine empirical scientific articles, model proposals, and local policies pertaining to educational inclusion and assistive technology use in distance learning. Additionally, the sample included some research on teaching topics and even early versions of new technology for educational inclusion. Below is a detailed description of the search criteria and procedure.

Selection Criteria

To conduct the search, two categories of criteria were developed. First, there were exploratory criteria that addressed a portion of the phenomenon and made it possible to determine the extent to which particular educational levels were represented in the scientific literature as well as the creation of search areas that the research had not anticipated. Second, following a preliminary search, final selection criteria were developed, expanding the sample to more thoroughly cover the phenomenon. The following criteria were developed.

Exploratory Criteria

(Publications over the past ten years on assistive technologies for remote learning that were created for primary and secondary schools (K–12) or higher education; (b) Studies that drew on the experiences of both teachers and students.

Final Criteria

(a) Distance education publications on assistive technologies created at all levels of education; (b) Policy analysis, empirical articles, systematic literature reviews, and design prototypes; (c) Research based on teacher and student experiences; (d) Publications published without time constraints.

Search Procedure

In order to investigate the scientific output related to assistive technology in distant learning, we used five globally recognized research databases: Web of Science (WOS), Scopus, ERIC, IEEE, and PubMed. In order to meet the final requirements, a search string was created that could bring together ideas about assistive technology and ideas that generally refer to the phenomenon of distant learning.

Results and discussion

Since they are required to fulfill the requirements of every student, instructors are taking on new duties and obligations from the standpoint of inclusive education. These educators, who are dedicated to the ideals of inclusivity, will make an effort to accept the difficulties of teaching remotely, create curricula that take into account all of their students, regardless of ability, and make use of all the benefits that the remote learning environment has to offer. The UDL rules offer a helpful framework for debate and are consistent with the inclusionary principles.

Although distance education has been used well in the past with a diverse group of students of all ages and skill levels, the abrupt requirement to replace in-person classroom interaction with technology and remote instruction for everyone seemed difficult. Students with special education needs can engage in a variety of learning activities online. While some obstacles are unavoidable, educators can actively get beyond them by applying the UDL structure and rules. It is the duty of educators to choose and apply the best solutions based on the needs of their pupils in order to meet learning objectives.

UDL is a framework that promotes inclusivity and provides a shared basis for educators and speech-language pathologists (S-LPs) to work together to effectively integrate speech, language, and communication support into the classroom, according to Frumos (2020). His study's goals were to find out how much S-LPs in Canadian schools thought they knew about UDL, whether they

thought they had the skills to implement UDL, and how easy or difficult it was for them to do so in their current role. A 25-minute anonymous online survey was filled out by ninety-one school-based S-LPs. A variety of subjects pertinent to school-based practice were covered in the survey, including UDL-specific questions. Findings: Most S-LPs knew what UDL was and how it was defined, and they did not believe that a lack of general knowledge about it would be a significant obstacle to its use. Regarding their proficiency in particular abilities required to apply UDL in the classroom, respondents were less certain. Regarding other considerations, the majority of S-LPs recognized administrative assistance, time, and chances to work with school staff as the main obstacles to implementing UDL. These impediments were confirmed by open-ended survey replies, which also revealed other ones. S-LPs noted numerous difficulties putting UDL into practice. Systemic change is necessary to promote S-LPs' participation in cooperatively implementing UDL, even though professional development would help them with specific implementation-related skills.

In order to guarantee fair access to instruction and support, inclusive distance education for children with speech-language pathology needs makes use of technology and customized strategies. This includes offering specialized online speech therapy services, putting UDL concepts into practice, and making use of assistive technologies. Specifically, using assistive technology - such as speech-generating applications and augmentative and alternative communication (AAC) devices – allows students with communication difficulties to access educational resources and engage in online learning activities. Furthermore, it is crucial to customize online learning experiences to each student's requirements and preferences. This could entail delivering flexible learning alternatives, individualized instruction, and content adaptation. Online classes can be made more dynamic and engaging by utilizing resources like virtual manipulatives and interactive whiteboards, especially for students who learn best visually and kinesthetically.

Agalyasri and Bhuvaneswari's (2024) experimental study examines the extent to which the UDL framework can support the language development of students with speech impairments. 112 people with speech problems, ages 18 to 20, participated in the study. The participants were split into two groups at random during the study: a control group (n=56) that received traditional teaching and an experimental group (n=56) that received speaking skills training utilizing the UDL framework. A pre-test was given to participants in both groups to gauge their starting speaking abilities. While the control group was exposed to conventional techniques, the experimental samples were instructed utilizing UDL. Both groups took a post-test to gauge their speaking abilities following the intervention. The results showed that the experimental group outperformed the control group in terms of speaking abilities on the post-test. The experimental group outperformed the control group in terms of performance. This study demonstrates how the UDL framework can help students with speech difficulties improve their speaking abilities.

To apply UD principles to educational fields, various methods have been developed over time; each has been given a distinct name, although they all suggest similar goals (Priyadharsini & Mary, 2024). The following are the primary methods and their terminology: Universal Design in Education (UDE); Universal Design for Learning (UDL); Universal Instructional Design (UID); and Universal Design for Instruction (UDI). Ensuring accessible learning for all students, with or without disabilities, in order to increase their chances of success, is the unifying objective of these four concepts. While UDE suggests applying the concepts of Universal Design to other domains that are connected to the educational process, such student services and libraries, UID, UDI, and UDL concentrate on the teaching and learning processes. Studies completed utilizing the UID, UDI, and UDE models have concentrated on university-level education, but, in contrast, the UDL is present at all education levels.

By encouraging inclusivity and accessibility, UDL principles can greatly improve distance learning for students with SEN. UDL seeks to offer adaptable learning experiences that accommodate a range of requirements and preferences by combining various forms of engagement, representation, and action/expression. The capacity to design stimulating and engaging learning environments that give access to contributors with comparable learning goals is one of the most important aspects of teaching and learning in distant education, and it is also one of UDL's most important roles.

The shift to an online classroom for inclusive education is both feasible and required in remote learning scenarios. Students with special education needs can engage in a variety of learning

activities online. Although some obstacles are unavoidable, educators can actively get beyond them by applying the UDL structure and rules. It is the duty of educators to choose and apply the best solutions based on the needs of their pupils in order to meet learning objectives. All students can gain from curriculum design that takes into account the needs of SEN kids and adheres to UDL standards. Teachers will help all students in their class study in this way (Frumos, 2020).

UDL represents a framework designed to maximize pedagogical adaptability to accommodate each student's unique demands. UDL recognizes and celebrates the distinct ways deaf students learn and their particular language preferences by combining flexibility, accessibility, and chances for fulfilling social interaction.

In order to better comprehend these children's needs in terms of distant education, Santamaria-López and Ruiz (2023) tried to provide a theoretical foundation. The authors conducted interviews with primary school teachers who work with children from vulnerable homes and/or those with disabilities in order to do this. Focus groups were employed as a means of information gathering in a qualitative research approach. In order to support their narratives on the educational practices they employ for children with disabilities and/or those from vulnerable homes, ten primary school teachers took part in an interview consisting of a series of open-ended questions. These narratives were then categorized. As a result of this study, the following tactics were gathered from the participating teachers: creating a virtual classroom environment that replicates the physical classroom experience, encouraging student camaraderie and friendship, creating engagement strategies, and taking into account the sociocultural factors that affect learning. The instructors gave their word that youngsters from vulnerable households and/or those with disabilities can benefit greatly from distant learning.

UDL is founded on three fundamental principles: 1. various ways of representation, 2. multiple means of expression, and 3. numerous modes of involvement. These concepts encompass the various ways in which students learn, how they traverse a learning environment, how they articulate their knowledge, and how they can be engaged or motivated to study. The UDL principles also encourage instructors to recognize each learner's unique background, interests, and strengths. In particular, when used successfully, UDL helps break down obstacles that typically impede deaf kids by creating an environment in which they can thrive intellectually and socially while also developing a strong identity. Too often, deaf kids endure social isolation and few opportunities to interact with classmates in typical learning settings. Educators who follow the principles of UDL foster a culture of achievement and autonomy by providing diverse engagement opportunities and employing differentiated teaching methods and formats that remove barriers to curriculum access (Levesque et al., 2024). Cooperative learning groups, performance-based assessment, project-based learning, and multimodal teaching are some of the pedagogical approaches that help deaf students gain independence, confidence, and empowerment.

Furthermore, novel digital elements of UDL in distance education for students with special needs include the use of technology to allow multiple modes of representation, engagement, action, and expression. This entails using tools such as virtual reality, AI-powered tailored learning, and easily accessible digital resources to accommodate a variety of learning styles and demands. The goal is to provide inclusive and engaging learning experiences that break down barriers and promote achievement for all students (Utami et al., 2025).

Using the UDL principles in a fully online pre-service teacher training unit, Garrad and Nolan (2023) describe how multiple means of engagement and multiple means of representation of the learning content were explicitly incorporated into the online unit design in an Australian context. This strategy sought to actively encourage every student's participation in an online learning environment. This study offers early proof that using UDL principles led to reduced student retention rates and increased levels of student engagement. Several approaches were taken to address the fundamental aspect of multiple means of representation. Students were given the option to select the assignment's context and focus. This involved selecting one of the four psychological theories that influence students to investigate in the first task. Additionally, students could contextualize their reflections according to the early childhood, primary, middle, or high school contexts in which they hope to teach. In the unit's second assignment, students were given the option to choose among 27 proven effective intervention strategies that may be used to address the needs of a

variety of learners in classroom settings. Students also have the option of submitting a recorded oral presentation, a PowerPoint presentation, or a formal written essay. One of the most interesting provisions of Garrad and Nolan (2023) study is Table, showing pre- and post-UDL unit design elements (see Table 1).

Table 1. Design components for UDL units before and after

Pre-UDL	Post-UDL
Pre-recorded lecture with oral material	Pre-recorded lecture with supplemental elements, such as movies and pictures Lecture slides Lecture transcripts (MS Word and Adobe PDF) Closed captioning Video Compression Audio-only version of the lecture
Weekly release of unit materials	Self-paced learning Hurdle quizzes for subject completion
Two written evaluations on the same preset topic	One written examination with a choice of four focus areas One assessment with the option of 27 foci Choice of educational context Selection of presentation format and style

Source: Garrad and Nolan (2023)

The essential dimension of Multiple Means of Representation was approached in a variety of ways. Students were able to choose the focus and context of their work. This entailed selecting one of four psychological theories affecting learners to investigate in the first assignment. Students could also frame their reflections according to their future or anticipated teaching setting, such as early childhood, primary, middle, or high school. The second assignment of the lesson offered students with the option of selecting any of 27 defined efficacious intervention methods (see Wong et al., 2015) that may be used to satisfy the requirements of different learners in classroom settings. Additionally, students had the option of submitting a formal written essay, a PowerPoint presentation, or a recorded oral presentation.

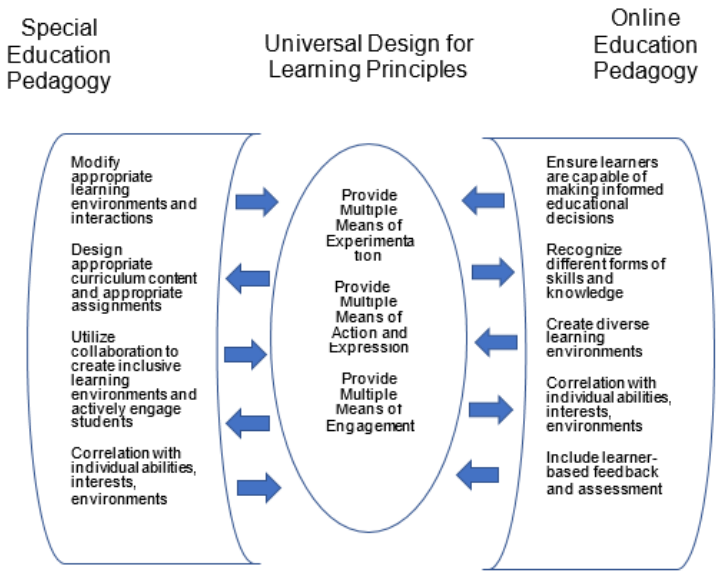
The UDL framework provides a comprehensive approach to addressing learner diversity, including techniques for reimagining the educational system and removing barriers to student success with learning impairments.

The three main neural networks involved in the learning process – recognition networks, which collect facts and categorize what we see, hear, and read; strategic networks, which organize and express our ideas; and affective networks, which relate the learning experience to an emotional background and determine motivation and engagement – are the foundation of UDL, according to neuroscience research (Baybayon, 2021). The neuro-psycho-linguistic-synergetic basis of adaptations is discussed by Cai et al. (2024). Yuan et al. (2017) also examine the difficulties that arise when neuroimaging-based evaluation and universal design for learning come together. The authors show how knowledge of psychology, neuroscience, and education are related.

Three guiding principles were developed to meet the needs of students: 1) offer a variety of representational options; 2) offer a variety of action and expression options; and 3) offer a variety of interaction options (Gronseth & Dalton, 2019). These principles are further subdivided into nine fundamental rules: self-regulation (engagement), recruiting interest, maintaining effort and persistence, language and expressions, comprehension (representation), physical action, communication and expression, and executive functioning (action and expression). UDL's primary objective is to assist teachers in addressing the disparities for every student, including those with learning impairments and those with notable academic skills (Gargiulo & Metcalf, 2016). UDL is a

framework that combines the best features of online and special education pedagogies. The focus on learner growth that is fundamental to UDL comes from online pedagogy and special education. In order to create synergy, pedagogy and UDL interconnection are shown in Figure 1.

Figure 1. Pedagogy-UDL Interconnectivity



Source: Scott and Temple (2017)

Accessibility is still a key component of this student-centered strategy for raising student engagement, even though UDL offers a more comprehensive framework that goes beyond simply giving access to knowledge and educational materials (Parra et al., 2018). UDL integration can greatly increase accessibility in online learning settings, offering a way to increase student learning and encourage involvement in online learning (Sheridan & Gigliotti, 2023).

The Universal Design for Learning diclusive (UDL diclusive) is a framework for teaching with digital technology in inclusive classrooms, according to Pannullo et al. (2025). When used for lesson design, it outlines many approaches to take into account the wide range of learners' innate differences in learning styles, requirements, and preferences so that every student may engage in class, follow the lessons, and complete the assigned tasks successfully. However, the UDL inclusive approach can assist in lowering or eliminating exclusionary risks and barriers that arise from the use of digital technology or from learning environments created for a relatively homogeneous student body (Nieminen & Pesonen, 2019). For instance, because digital technologies need more self-regulated and self-planned learning, students may get overburdened. Some students struggle with reading or have hearing issues. In this regard, the framework assists educators in offering suitable forms of digital technology-based learning support.

There are two theoretical foundations for the UDL diclusive. According to Pannullo et al. (2025), diclusion is a neologism created from the words inclusion and digital technology, and it refers to the combination of the two primary subjects of inclusion and the use of digital technology in classrooms (Schulz & Böttinger, 2022). Conversely, the Universal Design for Learning serves as its foundation. The four main tenets of inclusive teaching – equal access for all students, sensitivity to strengths and challenges, reflective practices, differentiated instruction, and an established community – are followed by this didactic concept, which has several fundamental principles to support learning. Collaboration is crucial in this community. Curriculums in schools typically target more or less uniform student groups. By improving deliberate lesson planning and individualized resources, UDL aims to address the various learning demands. With Universal Design for Learning (UDL), educators create lessons that allow all students – Including those with impairments or special learning needs – to access the content, show interest, and share their knowledge. Instead of concentrating on pupils' areas of weakness, the goal is to provide a variety of learning opportunities.

With this is mind, special attention should be paid to synergy of SEN pedagogy and online pedagogy within UDL landscape to avoid the occurrence of the phenomenon of diclusion, which can be regarded as an entropy in distance education for learners with SEN. UDL and SEN pedagogy should be interconnected within an inclusive ecosystem.

Specifically, when developed with Universal Design for Learning principles in mind, Learning Management Systems (LMS) can be effective instruments for establishing inclusive distant learning environments. Students with visual or other impairments can access content thanks to LMS platforms' capabilities, which frequently include screen reader compatibility, text size adjustments, and color contrast settings. It also fosters flexibility and inclusivity by allowing students to submit assignments in a variety of formats (e.g., text, audio, video), as well as offering online or offline options. Some LMS platforms enable teachers to construct personalized learning paths depending on student requirements and progress, thereby providing varied support and resources. Canvas and Blackboard Learn are two examples of profile-based learning management systems. In example, Blackboard Learn contributes significantly to inclusive remote education by providing a variety of accessibility features and tools. It seeks to provide an accessible platform for all students, not depending on their specific needs, and encourages teachers to provide inclusive learning experiences.

In turn, UDL and profile-based education are related concepts that seek to personalize learning experiences for all students. UDL is a paradigm that proactively creates adaptable learning environments and resources to suit varied learners. Understanding individual student capabilities, needs, and preferences is central to profile-based education, which tailors instruction and assistance accordingly. UDL concepts can be used to form a profile-based approach in which the learning environment is designed to be adaptable and sensitive to the specific needs found in individual student profiles. This combination should have a synergistic impact, as intended. This approach would allow for the creation of a novel e-learning platform that would accelerate and improve the learning process by reducing the emergence of problems, thanks to its enhanced functionality to dynamically plan lessons and personalize both communication and learning strategies. When a user accesses an educational platform, he is prompted to complete a series of surveys, cognitive tests, and performance assessments. These questions try to elicit some preliminary information about the user's preferences, talents, and personal aspirations. Using these features, the system generates an initial profile for the person. This profile divides each user into a specific group of users and assigns him unique features. Thus, user profile modeling occurs.

Designing of this combination – UDL and profile-based education – as an ecosystem is expedient to be carried out based on design thinking – a human-centered, iterative problem-solving strategy that prioritizes understanding user needs, quick prototyping, and creative idea development in order to create unique solutions.

The Design Thinking approach consists of five phases or stages, which are not usually in linear order and frequently overlap, and serve as a road map for identifying the requirements of SEN students, producing educational materials, and testing their effectiveness. The stages are the following:

Stage 1. Empathizing with and understanding the needs of the learner, as well as his worldview.

Stage 2. Defining the needs of student and objectives of the course.

Stage 3. Ideation – exploring and discovering potential solutions, creating sketches, scenarios, and storyboards for learning activities and experiences.

Stage 4. Prototype – creating authentic and meaningful learning activities and experiences.

Stage 5 Test – using rubrics to evaluate content and looking for diverse modes of presentation, engagement, and expression. Checking accessibility. Assessing pupils' comprehension, motivation, and attitudes.

The first iteration through these five steps will allow creating a kind of Minimum Viable Product (MVP) (Lortie et al., 2024) – a version of the product (customized LMS module) with just enough features to satisfy student' basic requirements and obtain feedback. Based on this feedback and evaluation of student' motivation and performance, the MVP can then be enhanced.

All things considered, the UDL can be utilized to deliver teaching that is suitable and to

ensure that every student has fair access to education. One distinction between UDL and assistive technology (AT) that best describes its advantages is that UDL is proactive, anticipating students' possible requirements, whereas AT is reactive, attending to students' needs as they emerge. All learners can benefit from the UDL because of this proactive approach. For instance, research has shown that since the majority of students benefit from subtitles, they can be employed as a sort of universal support.

Distance education has a lot of opportunities thanks to the creation and distribution of online courses. In addition to looking into the aforementioned queries, it's critical that the conversation regarding the most effective ways to create and deliver online courses goes on. For distance education programs hoping to have a positive and lasting effect on students, the conversation is both essential and helpful. Correct online course design and delivery are crucial for distant education programs, especially special education programs, to avoid lowering preparation standards.

Conclusion

Humans are inherently motivated to be independent, self-governing, and interconnected. SEN students are no exception. A key element of UDL practice is self-determination, which, when combined with strong educators and encouraging school communities, can significantly impact these students' lives. People who have self-determination can take charge of their lives, have their choices honored, and live the kind of life they want.

Applying UDL approaches to distant education courses is essential for educators as the number of students with disabilities enrolled in postsecondary settings rises. To completely comprehend the impact on this population, more study is required to determine the viability and efficacy of UDL models for distance learning delivery for people with severe developmental disabilities and high behavioral requirements.

References

AGALYASRI, G.; BHUVANESWARI, G. Enhancing linguistic ability to speaking impaired learners using Universal Design Framework: An experimental study. ***World Journal of English Language***, v. 14, n. 1, p. 260–270, 2024. DOI: https://doi.org/10.5430/wjel.v14n1p260.

ALAMRI, A.; TYLER-WOOD, T. Factors affecting learners with disabilities–instructor interaction in online learning. ***Journal of Special Education Technology***, v. 32, n. 2, p. 59–69, 2017. DOI: https://doi.org/10.1177/0162643416681497.

BAYBAYON, G. The use of Universal Design for Learning (UDL) framework in teaching and learning: A meta-analysis. ***Academia Letters***, n. 692, 2021. DOI: http://dx.doi.org/10.20935/AL692.

BLAIR, M. E.; GOLDMANN, H.; RELTON, J. Accessibility of electronically mediated education: Policy issues. ***Assistive Technology***, v. 16, n. 2, p. 85–93, 2004. DOI: https://doi.org/10.1080/10400435.2004.10132077.

BOZKURT, A.; ZAWACKI-RICHTER, O. Trends and patterns in distance education (2014–2019): A synthesis of scholarly publications and a visualization of the intellectual landscape. ***The International Review of Research in Open and Distributed Learning***, v. 22, n. 2, p. 19–45, 2021. DOI: https://doi.org/10.19173/irrodl.v22i2.5381.

CAI, J.; WEN, Q.; BI, M.; LOMBAERTS, K. How Universal Design for Learning (UDL) is related to differentiated instruction (DI): The mediation role of growth mindset and teachers' practices factors. ***Social Psychology of Education***, v. 27, n. 6, p. 3513–3532, 2024. DOI: http://dx.doi.org/10.1007/s11218-024-09945-9.

DANIELA, L. *Inclusive digital education*. **Springer,** 2022. DOI: https://doi.org/10.1007/978-3-031-14775-3.

ERICKSON, M. J.; LARWIN, K. H. The potential impact of online/distance education for students with disabilities in higher education. ***International Journal of Evaluation and Research in Education (IJERE),*** v. 5, n. 1, p. 76–81, 2016. DOI: https://doi.org/10.11591/ijere.v5i1.4525.

ESPADA-CHAVARRIA, R.; GONZÁLEZ-MONTESINO, R. H.; LÓPEZ-BASTÍAS, J. L.; DÍAZ-VEGA, M. Universal Design for Learning and instruction: Effective strategies for inclusive higher education. ***Education Sciences***, v. 13, n. 6, p. 620, 2023. DOI: https://doi.org/10.3390/educsci13060620.

FRUMOS, L. Inclusive education in remote instruction with Universal Design for Learning. ***Revista Romaneasca pentru Educatie Multidimensionala***, v. 12, n. 2Sup1, p. 138–142, 2020. DOI: http://dx.doi.org/10.18662/rrem/12.2Sup1/299.

GALKIENĖ, A.; MONKEVIČIENĖ, O. The model of UDL implementation enabling the development of inclusive education in different educational contexts: Conclusions. In: GALKIENĖ, A.; MONKEVIČIENĖ, O. (Eds.). *Improving inclusive education through Universal Design for Learning*. (Inclusive Learning and Educational Equity, v. 5). **Cham:** Springer, 2021. p. 313–323. DOI: https://doi.org/10.1007/978-3-030-80658-3_12.

GARGIULO, R.; METCALF, D. *Teaching in today's inclusive classrooms: A Universal Design for Learning approach*. **Boston:** Cengage Learning, 2016. Disponível em: https://books.google.com.ua/books/about/Teaching_in_Today_s_Inclusive_Classrooms.html?id=KLoaCgAAQBAJ.

GARRAD, T.-A.; NOLAN, H. Rethinking higher education unit design: Embedding universal design for learning in online studies. ***Student Success,*** v. 14, n. 1, 2023. DOI: https://doi.org/10.5204/ssj.2300.

GRONSETH, S.; DALTON, E. (Eds.). ***Universal access through inclusive instructional design:*** *International perspectives on UDL*. New York: Routledge, 2019. DOI: https://doi.org/10.4324/9780429435515.

HIRSCH, S. E.; GRIFFITH, C. A.; KELLEY, M. H.; CARLSON, A.; MCKOWN, G. Increasing preservice teachers' knowledge and skills using a mixed-reality simulator: The tale of two studies. ***Teacher Education and Special Education***, v. 46, n. 3, p. 204–222, 2023. DOI: https://doi.org/10.1177/08884064231154028.

IFENTHALER, D.; SAMPSON, D.; ISAIAS, P. ***Open and inclusive educational practice in the digital world.*** Cham: Springer, 2023. DOI: https://doi.org/10.1007/978-3-031-18512-0.

KOCDAR, S.; BOZKURT, A. Supporting learners with special needs in open, distance, and digital education. In: ZAWACKI-RICHTER, O.; JUNG, I. (Eds.). ***Handbook of open, distance and digital education.*** Cham: Springer, 2022. p. 881–886. DOI: http://dx.doi.org/10.1007/978-981-19-0351-9_49-1.

KOUSTRIAVA, E. Readiness of individuals with visual impairments for participation in distance education. ***British Journal of Visual Impairment***, v. 40, n. 2, p. 435–450, 2022. DOI: https://doi.org/10.1177/0264619621994865.

LEVESQUE, E.; SNODDON, K.; DUNCAN, J. Universal Design for Learning: A pathway to independence for deaf and hard of hearing learners. ***Deafness & Education International***, v. 26, n. 4, p. 299–300, 2024. DOI: https://doi.org/10.1080/14643154.2024.2417500.

LORTIE, J.; COX, K.; DEROSSET, S.; THOMPSON, R. Unpacking the minimum viable product (MVP): A framework for use, goals and essential elements. ***Journal of Small Business and Enterprise Development,*** v. 32, n. 1, p. 212–235, 2024. DOI: http://dx.doi.org/10.1108/JSBED-02-2024-0075.

MANGINA, E.; O'KEEFFE, E.; EYERMAN, J.; GOODMAN, L. Drones for live streaming of visuals for people with limited mobility. In: INTERNATIONAL CONFERENCE ON VIRTUAL SYSTEM & MULTIMEDIA (VSMM), 22., 2016, Kuala Lumpur. ***Anais***... IEEE, 2016. p. 1–6. DOI: https://doi.org/10.1109/VSMM.2016.7863162.

MARKELZ, A.; SCHEELER, M. C.; RICCOMINI, P.; TAYLOR, J. C. A systematic review of tactile prompting in teacher education. *T**eacher Education and Special Education***, v. 43, n. 4, p. 296–313, 2020. DOI: https://doi.org/10.1177/0888406419877500.

MOYLE, W.; MURFIELD, J.; LION, K. Therapeutic use of the humanoid robot, Telenoid, with older adults: A critical interpretive synthesis review. ***Assistive Technology***, v. 36, n. 5, p. 388–395, 2024. DOI: https://doi.org/10.1080/10400435.2022.2060375.

MULFARI, D.; MULFARI, S. Assistive technologies to support distance learning for students with disabilities. In: EAI INTERNATIONAL CONFERENCE ON SMART OBJECTS AND TECHNOLOGIES FOR SOCIAL GOOD, 4., 2018, Bologna. ***Proceedings***... New York: ACM, 2018. p. 312–313. DOI: https://doi.org/10.1145/3284869.3284927.

MYHILL, W. N.; SAMANT, D.; KLEIN, D.; KAPLAN, S.; REINA, M. V.; BLANCK, P. Distance education initiatives and their early 21st century role in the lives of people with disabilities. In: BAILEY, E. P. (Ed.). ***Focus on distance education developments.*** New York: Nova Science Publishers, 2007. p. 1–38. Disponível em: https://www.researchgate.net/publication/255645461.

NASCIMENTO, M. D. do; BRANDÃO, A. A.; OLIVEIRA BRANDAO, L. de; OLIVEIRA, F. C. de MB. Overcoming accessibility barriers for people with severe vision impairment in web-based learning environments: A literature review. In: IEEE FRONTIERS IN EDUCATION CONFERENCE, 2019, Cincinnati***. Anais***... IEEE, 2019. p. 1–8. DOI: https://doi.org/10.1109/FIE43999.2019.9028484.

NIEMINEN, J.; PESONEN, H. V. Taking universal design back to its roots: Perspectives on accessibility and identity in undergraduate mathematics. *Education Sciences*, v. 10, n. 1, p. 12, 2019. DOI: https://doi.org/10.3390/educsci10010012.

PANNULLO, L.; BÖTTINGER, T.; WINKELMANN, J. Inclusive and digital science education: A theoretical framework for lesson planning. ***Education Sciences***, v. 15, n. 2, p. 148, 2025. DOI: https://doi.org/10.3390/educsci15020148.

PARETTE, H. P.; STONER, J. B. Benefits of assistive technology user groups for early childhood education professionals. ***Early Childhood Education Journal,*** v. 35, n. 4, p. 313–319, 2008. DOI: https://doi.org/10.1007/s10643-007-0211-6.

PARK, J.; BAGWELL, A. F.; BRYANT, D. P.; BRYANT, B. R. Integrating assistive technology into a teacher preparation program. ***Teacher Education and Special Education***, v. 45, n. 2, p. 141–159, 2022. DOI: https://doi.org/10.1177/08884064211001447.

PRIYADHARSINI, V.; MARY, S. Universal Design for Learning (UDL) in inclusive education: Accelerating learning for all. ***Shanlax International Journal of Arts Science and Humanities***, v. 11, n. 4, p. 145–150, 2024. DOI: http://dx.doi.org/10.34293/sijash.v11i4.7489.

REISER, R. A.; DEMPSEY, J. V. ***Trends and issues in instructional design and technology.*** Boston: Allyn & Bacon, 2012. Disponível em: https://books.google.com.ua/books/about/Trends_and_Issues_in_Instructional_Desig.html?id=zOcyvgAACAAJ.

ROCHA, J.; ALEGRIA, R.; FREITAS, S. Distance education in speech-language therapy: Telepractice with children with speech and language disorders. In: DE MOURA, A.; REIS, P.; CORDEIRO, M. (Eds.). *Handbook of research on determining the reliability of online assessment and distance learning*. ***Hershey:*** IGI Global, 2020. DOI: https://doi.org/10.4018/978-1-7998-4769-4.ch018.

RUPPAR, A.; KURTH, J.; BUBASH, S.; LOCKMAN TURNER, E. A framework for preparing to teach students with extensive support needs in the 21st century. ***Teacher Education and Special Education***, v. 46, n. 1, p. 26–43, 2023. DOI: https://doi.org/10.1177/08884064211059853.

SÁNCHEZ, J.; REYES-ROJAS, J.; ALÉ-SILVA, J. What is known about assistive technologies in distance and digital education for learners with disabilities? ***Education Sciences***, v. 14, n. 6, p. 595, 2024. DOI: https://doi.org/10.3390/educsci14060595.

SANTAMARIA-LÓPEZ, T. M.; RUIZ, V. G. Distance education for children with a disability and/or from vulnerable families. ***Education and Information Technologies***, v. 28, p. 5297–5312, 2023. DOI: https://doi.org/10.1007/s10639-022-11347-3.

SCHULZ, L.; BÖTTINGER, T. Digitale Barrieren abbauen: Das diklusive Universal Design for Learning [Breaking down digital barriers: The universal design for learning diclusive]. In: SCHULZ, L.; KRSTOSKI, I.; LÜNEBERGER, M.; WICHMANN, D. (Eds.). *Diklusive lernwelten: Zeitgemäßes lernen für alle schülerinnen und schüler*. 1. ed. Hamburg: ***Visual Ink Publishing UG,*** 2022. p. 54–60. Disponível em: https://www.researchgate.net/publication/360104386_Digitale_Barrieren_abbauen.

SCOTT, L.; TEMPLE, P. A conceptual framework for building UDL in a special education distance education course. ***Journal of Educators Online***, v. 14, 2017. Disponível em: https://files.eric.ed.gov/fulltext/EJ1133749.pdf.

SHERIDAN, L.; GIGLIOTTI, A. Designing online teaching curriculum to optimise learning for all students in higher education. ***Curriculum Journal,*** v. 34, n. 4, p. 651–673, 2023. DOI: https://doi.org/10.1002/curj.208.

SILVA, A. L. da. Comparative analysis of accessibility for blind digital environments for learning management for distance education. In: IBERIAN CONFERENCE ON INFORMATION SYSTEMS AND TECHNOLOGIES, 5., 2010, Santiago de Compostela. ***Anais...*** IEEE, 2010. p. 1–5. DOI: https://ieeexplore.ieee.org/abstract/document/5556646.

SILVA, A. R. da; RAMOS, B. O.; BIAGIOTTI, B. D. A.; FADEL, L. M.; ULBRICHT, V. R. Gamification in the MOOC environment for the deaf: Promoting inclusion in distance education. ***Revista Educaonline***, v. 12, n. 3, p. 104–120, 2018. Disponível em: https://revistaeducaonline.eba.ufrj.br.

STÖTER, J.; BULLEN, M.; ZAWACKI-RICHTER, O.; PRÜMMER, C. von. From the back door into the mainstream: The characteristics of lifelong learners. In: ZAWACKI-RICHTER, O.; ANDERSON, T. (Eds.). *Online distance education – Towards a research agenda*. ***Athabasca:*** Athabasca University Press, 2014. p. 421–457. DOI: https://doi.org/10.15215/aupress/9781927356623.01.

TAYLOR, K.; YUKNIS, C. Universal Design for Learning supports distance learning for deaf students. ***American Annals of the Deaf,*** v. 168, n. 3, p. 41–54, 2023. DOI: https://doi.org/10.1353/aad.2023.a917249.

ULISSES, J.; OLIVEIRA, T.; ROCHA, E.; ESCUDEIRO, P. M.; ESCUDEIRO, N.; BARBOSA, F. M. Blind/Deaf Communication API for assisted translated educational digital content. In: EAEEIE ANNUAL CONFERENCE, 28., 2018, Hafnarfjordur. ***Anais***... IEEE, 2018. p. 1–9. DOI: https://doi.org/10.1109/EAEEIE.2018.8534217.

UNESCO. ***Global education monitoring report 2020***. Paris: United Nations Educational, Scientific and Cultural Organization, 2020. Disponível em: https://en.unesco.org/gem-report/report/2020/inclusion.

UTAMI, I.; GHUFRON, A.; ISHARTIWI, I. Universal Design for Learning in online education: A systematic review of evidence-based practice for supporting students with disabilities. *International Journal of Learning,* ***Teaching and Educational Research***, v. 24, n. 3, 2025. DOI: https://doi.org/10.26803/ijlter.24.3.5.

VLASENKO, Y.; VERTEL, A.; TATLILIOGLU, K.; SASINA, I.; GREBENIUNK, T. Asegurar el confort psicológico como condición para el desarrollo integral de los niños. ***Revista Eduweb***, v. 17, n. 3, p. 102–110, 2023. DOI: https://doi.org/10.46502/issn.1856-7576/2023.17.03.09.

YUAN, H.; RIPPETOE, J.; DING, L.; KANG, Z.; SHEHAB, R. L.; WEST, S. G. Universal design for learning in the framework of neuroscience-based education and neuroimaging-based assessment. In: INTERNATIONAL CONFERENCE ON BIO-ENGINEERING FOR SMART TECHNOLOGIES (BioSMART), 2., 2017, Paris. *Proceedings*... ***IEEE***, 2017. DOI: http://dx.doi.org/10.1109/BIOSMART.2017.8095338.

YUKNIS, C. Removing the disability from distance education. In: *Handbook of research on emerging priorities and trends in distance education: Communication, pedagogy, and technology*. Hershey: ***IGI Global Scientific Publishing***, 2014. p. 156–168. DOI: http://dx.doi.org/10.4018/978-1-4666-5162-3.ch011.

ZAWACKI-RICHTER, O. et al. Elements of open education: An invitation to future research. ***The International Review of Research in Open and Distributed Learning***, v. 21, n. 3, p. 319–334, 2020. DOI: https://doi.org/10.19173/irrodl.v21i3.4659.

Recebido em 7 e novembro de 2025
Aceito em 6 de janeiro de 2026