ARTIFICIAL INTELLIGENCE, UNIVERSAL DESIGN FOR LEARNING, AND ADAPTIVE LEARNING FOR STUDENTS WITH SPECIFIC LEARNING DISORDERS: A POSSIBLE SYNERGY?

INTELLIGENZA ARTIFICIALE, UNIVERSAL DESIGN FOR LEARNING E ADAPTIVE LEARNING PER GLI STUDENTI CON DISTURBI SPECIFICI DELL'APPRENDIMENTO: UN CONNUBIO POSSIBILE?

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ABSTRACT

This article explores the intersection between Universal Design for Learning (UDL), Adaptive Learning, and Artificial Intelligence (AI), focusing on their implications for the inclusion of students with Specific Learning Disorders (SLDs). The article discusses the potential of AI-supported personalization to complement the inclusive framework of UDL, highlighting both opportunities and critical challenges.

Questo articolo analizza i limiti e le potenzialità dell'integrazione tra Universal Design for Learning (UDL), Adaptive Learning e Intelligenza Artificiale (IA), con particolare attenzione all'inclusione degli studenti con Disturbi Specifici dell'Apprendimento (DSA). L'articolo discute il potenziale della personalizzazione supportata dall'IA come complemento al modello inclusivo dell'UDL, mettendo in luce sia le opportunità che le criticità.

KEYWORDS
Artificial Intelligence, Universal Design for Learning, Adaptive Learning, Specific Learning Disorders, Inclusive Education.

Intelligenza Artificiale, Universal Design for Learning, Adaptive Learning, Disturbi Specifici dell'Apprendimento, Educazione Inclusiva

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Introduction

The rapid evolution of Generative Artificial Intelligence (GAI) has had a significant impact on the educational landscape, enabling the emergence of innovative tools for personalized student support. The widespread accessibility of these technologies—particularly following OpenAI's decision to make ChatGPT freely available—has sparked a broad debate among educators and researchers (Bozkurt et al., 2023). As more users become familiar with these platforms, there is a growing need to rethink the educational strategies adopted by schools, universities, and training institutions.

GAI is not merely a technological advancement, but a transformation in how we conceptualize innovation and creativity (Skjuve et al., 2023). Advanced deep learning systems are now capable of generating texts, images, and music, and of engaging in conversational interactions, increasingly approaching human-level comprehension and linguistic production (Tlili et al., 2023). This shift calls for deep pedagogical reflection, especially in the context of special education, where adaptive and personalized tools can offer new learning opportunities for students with Specific Learning Disorders (SLDs). As highlighted by Benedetti et al. (2022), students with dyslexia often face persistent challenges related to reading, writing, organization, and self-esteem, which require tailored support tools and compensatory strategies to promote academic achievement and well-being.

Numerous studies have highlighted the benefits of integrating AI into education, demonstrating its potential to predict student performance, personalize learning pathways, enhance automated assessment, and optimize the overall teaching and learning experience (Ouyang et al., 2022). However, its use also raises critical ethical and pedagogical questions. While AI in Adaptive Learning systems can support instruction through real-time feedback and adaptive pathways (Li et al., 2024), concerns remain regarding equitable access, data privacy, and the redefinition of the teacher's role.

A central debate in special pedagogy concerns the relationship between Universal Design for Learning (UDL) and personalized learning. Although UDL is recognized for its ability to offer multiple means of engagement, representation, and expression (CAST, 2018), it may not fully meet the specific needs of students with SLDs. These students often require not only accessible content, but also dynamic and targeted learning strategies that adapt in real time to their cognitive challenges and individual learning styles.

Recent applications of AI in supporting students with SLDs suggest that the AI-supported model may offer a valuable balance between inclusion and personalization, while still preserving the essential role of the teacher. Nonetheless, key questions remain: Can AI truly enhance educational inclusion, or does it risk reinforcing pre-existing inequalities? What are the implications of technological dependency for students with SLDs? How can we ensure equity and accessibility without compromising privacy and data protection? And what role will teachers play in an educational context increasingly mediated by AI?

This contribution investigates the integration of AI within inclusive education, with a particular focus on students with SLDs. Furthermore, it examines the relationship between UDL, personalization, and AI, critically assessing the educational opportunities and ethical concerns emerging from the use of AI-based technologies. The goal is to develop a conceptual framework that reflects both the potential of Artificial Intelligence in Education (AIEd) and the challenges it presents in the field of special pedagogy, promoting a balanced approach between inclusion and personalization.

The structure of the article is as follows: Section 1 outlines the theoretical foundations of UDL and its relevance to inclusive education. Section 2 discusses the need for tailored strategies for learners with SLDs, how AI may support these adaptations and Italian case studies and experimental projects on AI in education. Section 3 presents the three paradigms of AI in education and analyzes their pedagogical implications. The conclusion offers key reflections about the possible synergy of UDL, AI and adaptive learning.

1. The Role of UDL in Supporting Students with Specific Learning Disorders

1.1. The Universal Design for Learning Framework and Its Role in Inclusive Education

Universal Design for Learning (UDL) is a pedagogical approach aimed at ensuring accessibility and participation for all students through flexible and adaptable teaching strategies. This model derives from the broader concept of Universal Design, which refers to the design of environments, tools, and practices in ways that make them usable by the widest possible range of individuals, regardless of their abilities or disabilities (Wilson, 2017).

Applied to the educational context, UDL is based on the premise that learning environments should be designed to minimize barriers and enable all students to access content equitably and express their potential through differentiated instructional methods. According to the Center for Applied Special Technology (CAST, 2018), UDL is grounded in three core principles:

1. Multiple means of representation: students should be able to access content through various channels such as text, audio, images, or video.
2. Multiple means of action and expression: students should have the opportunity to demonstrate their knowledge through a range of modalities, including written essays, oral presentations, or visual representations.
3. Multiple means of engagement: learning should be motivating and personalized, through strategies such as gamification, cooperative learning, and interactive environments.

As Wilson (2017) emphasizes, UDL is supported by neuroscientific evidence showing that individuals with diverse backgrounds, abilities, and motivations have different learning needs. A rigid curriculum based on a single mode of teaching risks excluding part of the student population and failing to meet the educational needs of all learners.

UDL has been adopted in a variety of educational contexts with the aim of diversifying instruction and reducing barriers to learning. It recognizes the injustice of a "one-size-fits-all" approach to teaching, assessment, or curriculum design—an approach that often privileges specific student profiles at the expense of others. However, while UDL represents an important strategy for making education more inclusive, some studies suggest that students with SLDs may require more targeted adaptations that respond to their individual difficulties in a highly personalized way (Almufareh et al., 2024; Martin et al., 2020).

1.2 The Limitations of UDL for Students with Specific Learning Disorders

While the UDL model remains an important framework for inclusive education, recent studies have highlighted that students with SLDs often require more targeted strategies than those typically offered by standard UDL applications

(Almufareh et al., 2024; Martin et al., 2020). Several critical issues have emerged in this regard.

Firstly, accessibility vs. instructional effectiveness: Ensuring access to educational materials does not necessarily equate to providing effective strategies to compensate for the specific difficulties associated with SLDs. For instance, in the case of dyslexia, making a text available in digital format does not automatically mean that the student will be able to understand and process the content effectively (Snowling & Hulme, 2021).

Secondly, the need for highly personalized support: While UDL seeks to offer differentiated learning opportunities, some students with SLDs may require even more specific and individualized interventions. In the case of dyscalculia, for instance, visual representations alone are insufficient; effective support must include the strengthening of core numerical abilities and the use of targeted compensatory tools (Geary, 2013; Kucian & von Aster, 2015).

Thirdly, rigidity in instructional strategies: Although UDL promotes flexibility in teaching, its implementation can sometimes become overly standardized. The generalized application of the same strategies may fail to effectively address the individual needs of each student, ultimately limiting the personalization of educational interventions (Ciasullo, 2024; Martin et al., 2020).

Considering these limitations, there is a growing need to integrate tools and methodologies that enable a more advanced level of personalization, while preserving the core principles of accessibility and inclusion advocated by UDL.

1.3 The Contribution of Artificial Intelligence to UDL Personalization

AI may offer an innovative solution to overcome the limitations of UDL by providing advanced tools capable of personalizing learning in real time. Adaptive Learning technologies, for example, make it possible to analyze students' difficulties and dynamically adjust the learning path to meet their needs. An AI system can monitor the reading speed of a student with dyslexia, detect decoding challenges, and provide simplified text versions or adaptive audio support to enhance reading comprehension.

In addition to Adaptive Learning systems, another promising area is the use of AI-powered virtual assistants that can recognize individual learning styles and suggest

targeted strategies to optimize the learning process. For instance, a student with dyscalculia may benefit from an intelligent tutor capable of delivering interactive explanations of mathematical concepts through visual simulations and adaptive exercises.

The integration of AI and UDL may therefore represent a turning point in inclusive education, combining the principles of universal accessibility with a higher degree of adaptability to the specific needs of students with SLDs. However, for this synergy to be truly effective, it is essential to consider both ethical and pedagogical aspects, including data protection and the need for active involvement of teachers in the educational process.

2. Artificial Intelligence and Personalized Learning for Students with Specific Learning Disorders

2.1. The Need for Personalization in the Education of Students with SLDs and the role of AI in Personalized Learning

Research in the field of inclusive education has shown that students with SLDs benefit more from personalized teaching strategies than from universalist approaches (Dumitru, 2024). Although the UDL framework ensures accessibility to educational content (CAST, 2018), it does not always succeed in addressing the specific challenges faced by students with SLDs. Accessibility alone does not necessarily lead to effective learning: for instructional tools to be genuinely inclusive, they must be designed to dynamically adapt to the cognitive modalities and individual needs of each learner.

Students with SLDs present heterogeneous difficulties that vary depending on the type of disorder. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013), SLDs include specific deficits in reading, writing, and arithmetic skills that significantly interfere with academic performance and daily functioning. Specifically, dyslexia impairs the ability to decode and comprehend written text; dyscalculia hinders numerical ability and mathematical reasoning; and dysgraphia impacts fine motor control and the quality of handwriting (APA, 2013). SLDs are also associated with increased dropout risk and emotional distress, requiring early and tailored interventions to support not only learning, but also long-term academic engagement.

Although UDL provides strategies for instructional diversification, many of these difficulties require highly individualized and dynamic adaptation—an area in which AI can offer significant contributions. Indeed, AIEd enables the development of tools capable of analyzing students' learning behaviors, identifying strengths and weaknesses, and modifying content and modes of presentation in real time. The adoption of AI-based tools has fostered the development of advanced technologies, including Adaptive Learning systems, intelligent tutors, and virtual assistants (Martin et al., 2020), as well as models for analyzing learning styles.

Among the various AI-based solutions developed to support personalized learning, several approaches have gained particular prominence for their adaptability and responsiveness to students' evolving needs. One of the most widespread and promising among these is Adaptive Learning systems, which use machine learning algorithms to adjust the difficulty level and sequencing of content based on student progress. These tools are particularly beneficial for students with SLDs, as they can identify key learning difficulties and propose targeted content and instructional strategies. However, it is important to consider the potential risks associated with excessive automation of the learning process, which could reduce the human dimension of education and lead to overdependence on technology. In addition to Adaptive Learning, intelligent tutors and virtual assistants represent another area of AI application. These systems provide personalized support through interactions based on Natural Language Processing (NLP) models. They can assist students with dyslexia in improving their reading skills by suggesting decoding strategies and adapting the pace and format of text presentation to their needs. They can also support writing and text revision, offering grammatical and stylistic suggestions for students with difficulties in organizing written thoughts. Finally, AI is increasingly being used to analyze individual learning styles, offering educators advanced tools to better understand how each learner assimilates information and to design more

2.2 Italian Applications of AI in Inclusive Education: Emerging Initiatives and the Case of BESPECIAL

In response to the growing interest in the potential of AI to support inclusive education, several Italian initiatives have emerged, providing empirically grounded examples of AI integration within real-world, inclusive learning environments.

One notable contribution is offered by Lecce et al. (2024), who examined secondary school students' perceptions of AI and machine learning as tools for promoting inclusion. Their research engaged 185 students in hands-on workshops using Google's Teachable Machine to develop inclusive digital applications, including a sign-language recognition tool. Through thematic analysis, the study revealed that a majority of participants perceived AI as a transformative technology capable of enhancing inclusion, accessibility, and equity in education—provided it is applied critically and responsibly. While students acknowledged the potential of AI to support personalized learning, they also expressed concerns regarding privacy and the potential displacement of human roles. The authors argue that involving students in collaborative and reflective AI-based activities is crucial not only for developing digital competence but also for fostering ethical awareness and social responsibility in future users and designers of AI systems.

In a parallel line of research, Campitiello et al. (2024) investigated the development of AI-enabled educational robots aimed at enhancing socio-emotional learning in children with autism spectrum disorder (ASD). Their project, grounded in the principles of Design-Based Research, integrates affective computing and facial emotion recognition into an open-source robotic platform. The robot is designed to support children's emotional and communicative development through imitation and real-time feedback, incorporating software based on the Howlin program to facilitate the interpretation of emotions in social narratives. The findings highlight the dual role of AI in both scaffolding emotional learning and fostering engagement. However, the authors underscore the importance of human mediation, noting that while AI can enrich educational interventions, it must complement—and not replace—the relational and empathetic dimensions fundamental to inclusive education.

Building on this discourse, Marcuccio et al. (2023) further contribute to an analysis of ChatGPT's application in personalized learning environments in Italian secondary schools. Their two exploratory studies demonstrate that AI-driven tools, such as chatbots, can reduce teacher workload and support differentiated instruction, particularly in formative feedback. Nonetheless, the research highlights that the educational value of these tools is contingent upon continuous teacher oversight. The first study, involving university students in a design-based learning context, illustrates ChatGPT's utility in supporting instructional design while revealing its limitations in addressing local and nuanced educational needs. The second study,

focusing on secondary school teachers, shows that while AI-assisted evaluation can facilitate grammar correction and prompt feedback, it lacks the pedagogical judgment and contextual sensitivity required for effective formative assessment. The authors advocate for comprehensive teacher training and systemic support to ensure a critical and pedagogically grounded use of AI in schools.

Viola et al. (2024) explore another dimension of AI in inclusive education, focusing on the development of chatbots to enhance emotional literacy among teachers—particularly those working with students with special educational needs. Framing emotional intelligence as a foundational component of inclusive teaching, their study introduces a chatbot trained with rational-emotive education principles to help teachers recognize, understand, and regulate their emotions. Their mixed-methods research reveals both a strong perceived importance of emotional competence in educational contexts and a recognized gap in current teacher preparation. While participants' opinions on chatbot effectiveness varied, many highlighted the potential of such tools as accessible, non-judgmental environments for emotional reflection. The authors conclude that, when thoughtfully implemented, AI-powered chatbots can serve as valuable complements to traditional teacher training, supporting the creation of more empathetic and inclusive learning environments.

A further notable case study is presented by Di Tore et al. (2024), who document the development and early experimentation of the Personal Digital Tutor (PDT) at the University of Salerno. The PDT is a generative AI-powered non-playable character (NPC) designed to support doctoral students' learning processes. Built within a 3D environment and modeled on the voice and appearance of the course instructor, the PDT is equipped with a curated knowledge base comprising course texts, recorded lectures, slides, and transcripts of discussions between the professor and students. Serving as a conversational interface, the PDT enables students to access information and clarification beyond the temporal and spatial constraints of classroom teaching. Its strength lies in offering persistent, multilingual support within a defined academic domain, thus extending the continuity of learning. However, the authors are explicit in framing the PDT not as a replacement for human professors, but as a digital extension of their pedagogical presence. While the tool can assist in retrieving information and reinforcing content understanding, it cannot replicate the adaptive reasoning, relational engagement, or critical guidance that human educators provide. As such, the case highlights how

AI can be meaningfully integrated into higher education to enhance accessibility and student autonomy—while reaffirming the irreplaceable role of human academic mentorship.

Among the most innovative applications of AI in support of students with Specific Learning Disorders (SLDs), the BESPECIAL project—developed by Zingoni et al. (2021)—stands out for its integration of artificial intelligence and immersive technologies to foster inclusive and personalized learning. The system is specifically designed to assist students with dyslexia by combining an adaptive learning engine, Virtual Reality (VR) environments, and an intelligent tutoring system capable of dynamically adjusting instructional content based on real-time user data. These data include variables such as reading speed, word recognition accuracy, and cognitive workload, allowing the platform to tailor tasks to each student's individual needs and learning pace. BESPECIAL leverages a multimodal interaction framework that stimulates multiple sensory channels simultaneously, promoting deeper cognitive engagement and reducing the anxiety often associated with reading performance. The VR component offers immersive scenarios designed to simulate real-world contexts, making the learning experience more engaging and meaningful. Preliminary findings from pilot studies indicate that the system can enhance reading motivation and increase task persistence. It also appears to foster more positive emotional attitudes toward learning in students with dyslexia. Importantly, the authors emphasize that BESPECIAL does not aim to replace traditional pedagogical practices, but rather to complement them by offering a flexible, data-driven environment in which students can learn at their own rhythm, under the guidance of educators. The project exemplifies how AI, when aligned with inclusive design principles, can serve as a transformative tool. In particular, it supports neurodiverse learners within mainstream education by offering responsive, personalized learning experiences.

Collectively, these Italian initiatives illustrate a growing commitment to leveraging AI in support of inclusive education. They demonstrate how technological advancements can be meaningfully aligned with pedagogical objectives when implementation is guided by ethical considerations, attention to data privacy, and the active involvement of educators. Crucially, these experiences reaffirm that AI's role in education must be situated within broader frameworks of social equity, digital justice, and human-centered learning design.

2.3 Ethical and Pedagogical Challenges of AI-Based Personalization

The adoption of Artificial Intelligence in inclusive education raises fundamental ethical and pedagogical questions. One of the main risks is hyper-personalization, where students may be exposed exclusively to content and learning strategies that reinforce their existing preferences, without being challenged to develop new skills.

Another area of concern involves privacy and the protection of sensitive data. AI-based platforms collect detailed information on students' performance and difficulties (European Commission, 2024), raising questions about the security and transparency of data management. It is essential that educational institutions establish ethical guidelines to ensure that personalized learning does not compromise student confidentiality. Initiatives such as the EU's AI Act and the Digital Education Action Plan emphasize the need for transparent, ethical-by-design solutions that safeguard learners' rights.

Finally, a crucial issue concerns the role of the teacher. While AI can support teaching practices, it cannot replace the value of human interaction in the educational process. Teachers remain central to instruction and must receive appropriate training to critically and consciously integrate these technologies.

3. AI Models in Education: Implications for the Inclusion of Students with SLDs

3.1. The Relationship Between AI and Special Education: Balancing Personalization and Inclusion

The integration of AI into inclusive education raises critical questions about how to balance the benefits of personalization with the imperative of social and cognitive inclusion. While AI-based technologies allow for the adaptation of educational pathways to the individual needs of students with Specific Learning Disorders (SLDs), there is a risk that excessive personalization may lead to new forms of exclusion by limiting access to shared and interdisciplinary learning experiences. Moreover, the standardization of AI tools may overlook the importance of human mediation, which remains essential for socio-cognitive and emotional learning.

The three educational paradigms outlined by Ouyang and Jiao (2021)—building on the theoretical contributions of Skinner (1958), Bruner (1966), Vygotsky (1978), and Piaget (1966)—provide a valuable framework for understanding different modes of

AI integration in teaching. These models—AI-directed, AI-supported, and AI-empowered—reflect varying approaches to the use of technology in special education and offer important insights into their respective strengths and limitations.

3.2 AI-Directed Learning

The first paradigm, AI-directed learning, reflects a behaviorist approach, influenced by Skinner's (1958) theories on programmed instruction and positive reinforcement, that work on trial-and-error learning. In this model, AI takes on the role of directing the educational process, structuring pre-defined instructional paths that students are expected to follow sequentially.

While a rigid structure may benefit learners who thrive on predictability and systematic repetition, it presents significant limitations for students with SLDs, who often require greater flexibility and individualized learning strategies. Furthermore, AI-directed learning tends to neglect emotional and motivational dimensions, which play a crucial role in academic success (Martin et al., 2020). An implicit alignment with the AI-directed model can be observed in the application of ChatGPT described by Marcuccio et al. (2023), where the chatbot primarily assists in grammar correction and standard feedback provision. While helpful in reducing teacher workload, this use reflects a more rigid, procedural deployment of AI that lacks context sensitivity—illustrating the model's limits when applied to inclusive education.

3.3 AI-Supported Learning

The second model, AI-supported learning, draws from constructivist and sociocultural theories, particularly Bruner's (1966) and Vygotsky's (1978), which emphasize the co-construction of knowledge through interaction between the learner and the educational environment. In this model, AI functions as a responsive assistant that supports rather than directs the learning process, dynamically adapting instruction based on student input while maintaining a strong role for teacher mediation.

A key example of this paradigm is the BESPECIAL platform (Zingoni et al., 2021), which offers immersive and adaptive tools for students with dyslexia. By combining

real-time feedback, multimodal interaction, and an intelligent tutoring system, BESPECIAL provides targeted support while still relying on the educator to guide and contextualize learning. This makes it an exemplar of how AI can personalize instruction while fostering meaningful engagement through guided exploration. However, effective use of AI-supported tools requires that students possess certain levels of metacognitive and self-regulatory skills, and that teachers remain actively involved in interpreting AI outputs and adjusting learning strategies accordingly.

3.4 AI-Empowered Learning

The AI-empowered learning paradigm is informed by complexity theories and constructivist-active learning frameworks, especially Piaget's (1966) emphasis on learning through discovery, exploration, and self-regulation. In this model, AI becomes a powerful enabler of learner autonomy, equipping students with the tools and environments needed to navigate, manage, and shape their own learning trajectories.

A notable case aligned with this paradigm is the Personal Digital Tutor (PDT) (Di Tore et al., 2024). Designed as a non-playable character (NPC) within a 3D virtual environment, the PDT offers students persistent, on-demand access to academic resources, presented in multiple formats and languages. It facilitates autonomous exploration of course content, extending learning beyond the temporal and spatial limits of traditional instruction. Importantly, the PDT does not dictate learning paths but empowers students to retrieve, synthesize, and engage with knowledge at their own pace.

This paradigm is particularly promising for students with SLDs, who may benefit from self-paced, multimodal learning environments. However, it also presents challenges: learners must be capable of navigating complex systems independently, and educators must play a crucial scaffolding role in preparing students to make effective use of such autonomy. As noted by Li et al. (2024), without proper guidance, the very flexibility of AI-empowered tools may overwhelm some learners or lead to disengagement. Thus, AI-empowered learning represents a shift from reactive support to proactive autonomy—a transformation that holds great potential, but also demands careful implementation.

Conclusions

The integration of Artificial Intelligence into special education is transforming teaching and learning methodologies and offering new opportunities for supporting students with Specific Learning Disorders (SLDs). The interaction between Universal Design for Learning (UDL) and AI-driven Adaptive Learning demonstrates that accessibility and personalization are not opposing concepts, but rather complementary strategies. While UDL provides an inclusive theoretical framework, AI-supported Adaptive Learning allows the educational process to be fine-tuned in real time, adapting to students' individual characteristics.

The analysis presented in this paper suggests that AI tools such as intelligent tutoring systems and adaptive learning environments can serve as valuable resources to address the limitations of traditional teaching. Even national case studies and experimentations (see section 2.2) highlighted the evolving landscape of AI in Italian inclusive education. Nonetheless, the implementation of AI poses significant challenges. These include the risk of hyper-personalization, potential data privacy violations, and the marginalization of the teacher's role. Addressing these concerns requires clear policy frameworks, ethical guidelines, and robust teacher training programs. AI should be viewed not as a substitute for traditional education but as a tool to enhance pedagogical effectiveness, and as a driver of educational inclusion – rather than a source of new forms of technological dependency or inequality (Fiorucci & Bevilacqua, 2024). Teacher agency and critical awareness are essential in mediating technology's impact. Future research should focus on longitudinal evaluations of AI in inclusive contexts, particularly within Italy, to assess learning outcomes and ensure the alignment of innovation with inclusive educational values.

By combining theoretical reflection with practical insights from the Italian context, this study contributes to an informed, ethically grounded, and pedagogically relevant understanding of AI in education for students with SLDs.

A central aspect of the ongoing debate in Italy involves the role of the teacher. Rather than being marginalized by the increasing use of AI, educators must be trained and supported in their role as mediators between students and technology. Only through ongoing professional development and conscious integration of AI into teaching practices will it be possible to harness the full potential of these

innovations without compromising the value of human interaction. To address these challenges, pedagogical research must develop integrated educational models in which AI is conceived not as a substitute for traditional teaching, but as an enhancer of it. Evaluating the long-term effects of AI in special education will be essential not only to understand its actual impact on learning outcomes and the inclusion of students with SLDs, but also to assess its contribution to their academic success, emotional well-being, and overall quality of life. Furthermore, failing to invest in teacher training and in the holistic support of learners may risk exacerbating school and university dropout rates, undermining the inclusive potential of technological innovation.

In conclusion, the synergy between AI, UDL, and Adaptive Learning is not only possible—it is pedagogically promising. But it must be deliberately constructed through critical reflection, empirical research, and sustained investment in both human and technological capital. The future of inclusive education lies not in choosing between universality and personalization, but in designing systems where the two work in concert—ensuring that all students, including those with SLDs, can learn, thrive, and belong.

Author contributions

A. Lombardo Pontillo was responsible for the conceptualization of the study, the collection and analysis of literature, the drafting of the initial manuscript, and the preparation of the final version.
P. Oliva provided methodological supervision, contributed to the theoretical framing of the work, and revised the manuscript throughout its development.

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