HOW TO ASSESS THE INCLUSIVENESS OF EDUCATIONAL TECHNOLOGIES: A PROPOSAL BASED ON THE UDL MODEL

COME VALUTARE L'INCLUSIVITÀ DELLE TECNOLOGIE EDUCATIVE: UNA PROPOSTA FONDATA SUL MODELLO UDL

Clarissa Lella
Università Telematica Pegaso & Smarted s.r.l.
clarissa.lella@unipegaso.it

Erika Inderst
Smarted s.r.l.
erika.inderst@smarted.it

Lucia Miranda
Università Telematica Pegaso & NeapoliSanit
lucia.miranda@unipegaso.it

Mariangela Cerasuolo
Neapolisanit
mariangela.cerasuolo@gmail.com

Double Blind Peer Review

Citation
Lella, C., Inderst, E., Miranda, L. & Cerasuolo, M. (2025). How to assess the inclusiveness of educational technologies: a proposal based on the UDL model. *Giornale Italiano di Educazione alla Salute, Sport e Didattica Inclusiva*, 9 (1).

Doi:
https://doi.org/10.32043/gsd.v9i1.1303

gsdjournal.it
ISSN: 2532-3296
ISBN: 978-88-6022-509-2

ABSTRACT

This study, part of the Erasmus+ IA-ME project, presents an AI-based tool to train special needs teachers in using inclusive technologies for students with SEN. Based on UDL principles, it evaluates and categorizes tools by accessibility, language support, and ability to overcome learning barriers. This underlines the importance of a tailored selection of the right technology according to a specific impairment. It promotes equitable education and effective technology integration in IEPs.

Questo studio, parte del progetto Erasmus+ IA-ME, presenta uno strumento basato sull'IA per formare insegnanti di sostegno all'uso di tecnologie per BES. Basato sui principi dell'UDL, valuta e classifica gli strumenti in base ad accessibilità, supporto linguistico e capacità di superare le barriere dell'apprendimento. Ciò sottolinea l'importanza di una selezione mirata della tecnologia adatta a ogni specifica disabilità. Promuove un'istruzione equa e un'efficace integrazione tecnologica nei PEI.

KEYWORDS
SEN, technology, IEP, personalised teaching, UDL
BES, tecnologia, PEI, didattica personalizzata, UDL

Received 23/04/2025
Accepted 16/06/2025
Published 20/06/2025

Introduction

In recent years, there has been a strong push toward integrating digital technology into educational settings, driven by initiatives such as the European Commission's Digital Education Action Plan (European Commission, 2021). This plan emphasizes the importance of fostering technologically advanced learning environments to equip schools and teachers with the digital skills necessary to enhance learning outcomes and promote inclusive education (Meyer, Rose, & Gordon, 2014). As digital tools become increasingly available, teachers are encouraged to leverage these resources to enrich their instructional practices, support diverse learning needs, and advance inclusion for students with special educational needs (SEN).

Educational technology plays a pivotal role in facilitating inclusive education, particularly when designed and selected based on the principles of Universal Design for Learning (CAST, 2018). UDL is a framework that promotes three essential principles to support diverse learners by providing: (1) multiple means of engagement to increase motivation and access to learning, (2) multiple means of representation to enhance understanding, and (3) multiple means of expression to allow students demonstrating their knowledge in varied ways. These principles offer a comprehensive approach to designing inclusive learning environments where all students, including those with SEN, can access and participate in learning (Rao, Ok, & Bryant, 2014).

As Marzia Mazzer wrote: "Technology can become a facilitator in the design of paths in balance between the individual and the collective because: 1) it allows diversification and calibrates the learning paths to the rhythms of each student; 2) it offers multiple and customisable communication channels; 3) it amplifies the possibilities of access to knowledge; 4) it stimulates motivation and curiosity because it is close to the culture of belonging of the students; 5) it encourages collaboration, sharing and development of skills" (Mazzer, 2018, p. 183).

It is well known that the more variety there is, the greater the opportunities for students to explore their individual learning styles (Roberts-Yates, C.; Silvera-Tawil, D., 2019). Indeed, technologies can facilitate collaborative mentoring and the creation of a curriculum that will be able to integrate diverse pedagogical theories according to the specific impairment embracing new technologies (Roberts-Yates, C.; Silvera-Tawil, D., 2019). But, this also means that pedagogy and technology have a close relationship, and pedagogy changes and evolves as technology does (Laurillard, 2013; Selwyn, 2012).

However, in a field marked by rapid technological advancements, educators often struggle to navigate and select digital tools that effectively support inclusion (Okolo & Diedrich, 2014). The vast array of educational technologies available, combined with the frequent updates and releases of new tools, can make it challenging for teachers to identify and apply digital resources that align with UDL principles and meet their students' specific needs (Flanagan, Bouck, & Richardson, 2013; Al-Azawei, Serenelli, & Lundqvist, 2016).

In this paper, we aimed to review and organise current educational technologies already used in the school context, or new ones that could be useful resources to achieve educational goals and improve school inclusion, through the lens of the UDL framework. This process is part of a broader Erasmus+ project entitled "Innovative methods and Artificial Intelligence in MOOC for special needs teacher Education" (IA-ME, project code: 2022-1-IT02-KA220-SCH-000087877, www.ia-me.eu), aimed to deal with three priorities: supporting school teachers; addressing diversity in learning and improving school inclusion. The IA-ME project is structured around three fundamental objectives aimed at advancing inclusive education through technology. Firstly, it seeks to enhance awareness among educational institutions regarding state-of-the-art inclusive technologies, thereby promoting their adoption to foster a more equitable and accessible learning environment for all students. Secondly, the project aims to provide educators with a sophisticated AI-based web-app, IA-CREATE (Innovative Application - Customized Resources for Educational Achievement and Tailored Experiences, www.ia-me.eu/ia-create/), designed to support them in drafting individualised educational plans for SEN students.

Finally, IA-ME is dedicated to strengthening teachers' professional competencies in effectively instructing and accommodating SEN students, through a Massive Open Online Course, freely available at the following link: https://enactgame.eu/moodle/. By equipping educators with specialized knowledge and pedagogical strategies, the project aspires to create a more supportive and adaptive educational framework that enhances learning experiences for students with diverse needs. Here, we described in detail the process of selecting and structuring a dataset for teachers, comprising technologies that may be beneficial for classroom use. These technologies are systematically categorized based on specific inclusivity criteria to ensure their relevance and effectiveness in supporting diverse student needs.

1. Methods

The European project Innovative methods and Artificial Intelligence in MOOC for special needs teacher Education (IA-ME, project code: 2022-1-IT02-KA220-SCH-000087877, www.ia-me.eu) aims to support teachers, educators and school workers in identifying the right path to follow in the field of inclusion, the best way to reach such a goal is to identify technological tools (hardware, software, applications) which will be able not only to include SEN students in the school life but also able to fulfil the short- and long-term objectives a student has according to their educational needs, impairment or disability (Melo-López et al., 2025; Frontiers in Education, 2025; UNESCO, 2023).

First of all, it is important to specify how these technologies for inclusion are provided: the IA-ME project developed a web application that allows users (teachers, support teachers, educators, and social workers) to identify students' needs, objectives, and how to proceed according to them. It starts with two screenings, a first-level screening which allows teachers to create a first student's profile according to their difficulties, and a second-level screening that allows them to better describe student's difficulties. After these two screenings teachers, support teachers, educators and social workers can continue with a questionnaire, which proposes questions according to what has been underlined during the two screenings.

This questionnaire is tailored to students' specific needs and general skills in the four key educational domains ensuring a more focused and relevant assessment, which is translate in an output that we can consider as a IEP that also contains a list of specific inclusive technologies.

It is fundamental to describe the methodology behind the technologies' selection and evaluation, and, consequently, how the table for technologies' evaluations has been created and how to read it (King-Sears et al., 2023).

The first question to answer is: how were these technologies selected? The IA-ME project partnership started from its own experience in the field of education and inclusion, starting from the partnership members' specific expertise and experience a first list of technologies was provided; after that in each consortium country were organised focus groups with teachers, these focus groups were useful to investigate the technological needs teachers have, and thanks to their experiences they helped to finalise the list of technologies.

The second step was to consult databases collecting inclusive and educational technologies and tools, to have an in-depth analysis of these technologies.

Lastly, to create the final list of technologies, it occurred also network sampling, in other words, once one technology was identified, others were spotted based on elements that emerged during the search for information on the latter.

After we collected these technologies, we posed the second question: analysing their inclusiveness. While the IA-ME project's selection and evaluation process is grounded in a bottom-up approach and rigorous criteria, some limitations must be acknowledged. The fast-paced evolution of educational technology and limited detailed information for certain tools can compromise the completeness and continuous updating of the database (Ertmer & Ottenbreit-Leftwich, 2010). Moreover, the use of numerical scores to assess inclusiveness, though useful for standardization, may not fully capture the qualitative nuances related to pedagogical effectiveness or contextual adaptability of the technologies (Rose & Meyer, 2020)."

The original number of technologies taken into consideration was greater than the actual one, the reason behind the list cutting is related to a lack of information for each of the elements considered to evaluate the inclusiveness of the selected technologies.

The criteria the partnership considered to assess the inclusiveness of each technology were internally discussed and it was decided to assign scores from 0 to 3 to the following analysis criteria:

- Access: there were considered three levels of accessibility
- Setting: there were considered two kinds of settings
- Language: the score was assigned taking into consideration seven possibilities related to languages
- Objectives: a technology should consider three points for each objective, gaining a maximum score of twelve
- UDL principles: a technology should consider three points for each UDL principle, gaining a maximum score of nine

In the results paragraph, it will be reported a detailed table with the specific sub-dimensions considered and the related score (table 1-scoring criteria). This table

will make clear why we chose these criteria and their sub-dimensions, but at this point, it is necessary to highlight why we are referring to UDL principles.

The UDL (Universal Design for Learning) is a psycho-pedagogical model that proposes personalized education through a flexible and inclusive approach. The decision to consider the UDL model instead of the UDI model was due to the lack of accessibility to the information needed to make a UDI-based assessment for each of the tools (CAST, 2025). The UDI model turns out to be complete and more specific, and it contains the UDL model. The mentioned criteria and their sub-dimension allow us to create a precise grid containing the level of inclusiveness of each technology and tool selected and inserted in the IA-CREATE web application.

By categorising these tools according to their inclusive potential, this study seeks to offer a practical resource that assists educators in choosing effective technologies, ultimately contributing to a more accessible and equitable educational landscape.

2. Results

In order to better analyse and describe the technologies provided by the system we created a table, which is divided into six columns. We are going to explain how it has been constructed and how to read it:

1) In the first column is present:
a) The name of the technology;
b) The link to the website where is possible to find additional information;
c) An icon that indicates if the technology is free or not as shown in Table1.

	The green icon indicates that the technology/tool is free to download/access and that all of its features and content can be accessed without payment.
	The yellow icon indicates that the technology/tool is free to download/access, but not in its full functionality and content. Full access requires payment.
	The red icon indicates that access to the technology/tool requires payment.

Table 1. Icons system that indicates if a technology is free or not

The green icon indicates that the technology/tool is free to download/access and that all of its features and content can be accessed without payment. The yellow icon indicates that the technology/tool is free to download/access, but not in its full

functionality and content. Full access requires payment. The red icon indicates that access to the technology/tool requires payment.

2) In the second column, it is present:
a) A brief description of the tool/technology
b) The type: low, mid or high technology.
c) An icon that indicates if the technology is recommended for individual or collaborative activities/settings.
d) An icon representing the languages in which the tool is available (if the number of the languages is less than ten, is present the flag of the languages available. If the languages are more than ten, is present an icon indicating the number of languages available). Language identification is closely linked to the need to identify technologies that consider the linguistic diversity present in modern educational contexts, considering that among special educational needs are also present needs linked to linguistic barriers.

3) The third column indicates the technology's suitable grade level. Although primarily intended for primary and secondary school teachers, the table indicates whether the technology is also suitable for other school levels. This information is useful for teachers to choose a technology that offers continuity of application across different school levels.

4) The fourth column is dedicated to the UDL (Universal Design for Learning) principles. Starting from the UDL model, for each technology shown in the table, it was reported how many, and which, UDL principles are respected. The three principles are summarized below:
a) Principle 1: Provide multiple means of engagement.
b) Principle 2: Provide multiple means of representation.
c) Principle 3: Provide multiple means of expression.
The dedicated column shows which principles are respected by the technology through numerical icons.

5) The fifth column indicates the learning barriers/difficulties the technology proposes/expects to overcome and the educational objectives that the technology in question contributes to achieving. Concerning objectives, four domains were considered in the examination of this element:
a) Cognitive, neuropsychological and learning dimensions;

b) Communicative and linguistic skills;
c) Orientation and autonomy dimension;
d) Relationship, integration and socialization dimension.

6) The sixth and last column shows the inclusiveness score obtained by each technology. The score obtained is based on the information collected in the Table2. Table 2 shows the scoring criteria:

ACCESS	*for a fee*	0 PT
	free with additional functions for a fee	1,5 PT
	free	3 PT
INDIVIDUAL OR IN-GROUP SETTING	*possibility of being used for group activities*	3 PT
LANGUAGES	*available only in one language*	0 PT
	2-10 available languages	0,5 PT
	10+ available languages	1 PT
	20+ available languages	1,5 PT
	30+ available languages	2 PT
	40+ available languages	2,5 PT
	50+ available languages	3 PT
UDL PRINCIPLES	*Principle 1*	3 PT
	Principle 2	3 PT
	Principle 3	3 PT
OBJECTIVES	*Cognitive, neuropsychological and learning dimensions*	3 PT
	Communicative and linguistic skills	3 PT
	Orientation and autonomy dimension	3 PT
	Relationship, integration and socialization dimension	3 PT

Table 2. Scoring criteria selected to calculate the total score achieved by a technology

As can be seen, a maximum value of three points was assigned to each of the elements considered in the evaluation (each of the UDL principles and each of the objectives were considered as individual elements). As there are a total of 10 elements to be considered, the maximum score achievable is 30. The purpose of this table and the work done is to provide a guide for the selection of technologies in the educational field, based on elements such as objectives and barriers, be they related to disabilities, disorders or different linguistic backgrounds. It is important to emphasise that this is a limited collection, intended as a starting point for teachers to explore the vast and varied world of inclusive learning technologies and tools.

3. Conclusions

The integration of educational technologies in schools, especially in the field of inclusion of SEN students, is an issue of increasing relevance, as highlighted by the Erasmus+ IA-ME project. The work presented underlines the importance of using technologies based on Universal Design for Learning (UDL) principles as one of the main methodologies to promote school inclusion. Although digital technologies offer numerous opportunities to promote school inclusion, challenges related to their effective implementation remain. Teacher training, availability of adequate resources, and the complexity of selecting truly effective tools represent significant barriers (Selwyn, 2016). Furthermore, it is important to acknowledge that technological adoption does not automatically guarantee improvements in learning outcomes or participation for students with special educational needs (Shakespeare, 2018). These considerations require critical reflection to ensure that technology integration goes beyond initial enthusiasm and leads to meaningful, lasting changes. According to the UDL framework, technologies must be able to support learning flexibly, through multiple modes of engagement, representation and expression, thus enabling every student, including those with BES, to fully participate in school activities (CAST, 2018).

The technology selection process described in the article shows how the analysis of teachers' needs, through focus groups and consultation of specialised databases, contributed to a considered choice of tools to be included in the IA-CREATE platform.

This methodology reflects the importance of a bottom-up approach in the selection of technology resources that take into account the real needs of educators and learners (Ertmer & Ottenbreit-Leftwich, 2010; Nikolopoulou & Gialamas, 2021). Furthermore, the approach of assessing the inclusiveness of technologies through parameters such as accessibility, available languages, and UDL (Universal Design for Learning) principles represents an advancement over more generic assessment models, such as those based on UDI (Universal Design for Inclusion), which may not provide sufficient information in diverse educational contexts.

One of the main challenges in using technology for inclusion concerns the variety and complexity of available resources. Despite the wide range of tools, the selection of the most suitable ones requires in-depth analysis, as highlighted in this paper, including an assessment of barriers to learning and educational goals. This is in line with what is suggested by other studies, which stated that the effectiveness of educational technologies depends not only on the functionality of the tool but also on their ability to adapt to the specific characteristics of the learners (Al-Azawei et al., 2016; Rose & Meyer, 2020; Ye, J.-H. et al.,2023)

Furthermore, the evaluation of 'inclusive technology' must not be limited to its ability to support students with SEN, but must also be extended to its applicability for all students, including those with higher abilities (gifted students). As emphasised by several authors, inclusiveness must be understood as a concept that promotes access and learning for all, without discrimination (Florian & Black-Hawkins, 2011; Slee, 2018). This approach is further supported by recent studies, such as that of Salas-Pilco, Xiao and Oshima (2022), which highlight how artificial intelligence and other new technologies can foster inclusive education, not only for students with special educational needs, but also for students from different socio-cultural minorities and those with higher abilities. According to these authors, inclusiveness in education should foster universal access and personalized learning, involving all kinds of learners, regardless of their characteristics.

Finally, the work of selecting and evaluating technologies makes an important contribution to improving educational practices by facilitating the identification of tools that can respond in a targeted and personalised manner to different educational needs. It is essential to underline that the introduction of inclusive technologies represents only one element within the complex educational system and cannot be separated from adequate professional development and organizational support for teachers. Literature highlights that the effectiveness of

technologies strongly depends on educators' capacity to integrate them meaningfully into pedagogy (Harris & Hofer, 2011). Therefore, without sustained investment in training and resources, the potential benefits offered by technologies risk being only partially realized, limiting their actual impact on school inclusion (Selwyn, 2016)." However, it is crucial to emphasise that technology adoption is not a panacea. The effectiveness of their implementation depends on how they are integrated into the educational context, the ongoing training of teachers, and the availability of adequate resources to support the use of technologies effectively (Harris & Hofer, 2011; Ertmer et al., 2012; Hattie, 2015).

Aknowledgments

We want to say thank you to the IA-ME Project partnership: Odyssea, Seadder, Association for Hungarian Digital Education, CREATIC, NeapoliSanit, Smarted, Istituto Comprensivo Statale Roccarainola - Tufino.

Author contributions

Authors contributed equally to the article.

References

Al-Azawei, A., Serenelli, F., & Lundqvist, K. (2016). Universal Design for Learning (UDL): A content analysis of peer-reviewed journal papers from 2012 to 2015. *Journal of the Scholarship of Teaching and Learning, 16*(3), 39–56. https://doi.org/10.14434/josotl.v16i3.19295

CAST. (2018). *Universal design for learning guidelines (Version 2.2)*. https://www.cast.org/

CAST. (2025). *Universal Design for Learning*. https://www.cast.org/what-we-do/universal-design-for-learning

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher Technology Change: How Knowledge, Confidence, Beliefs, and Culture Intersect. *Journal of Research on Technology in Education*, 42(3), 255–284. https://doi.org/10.1080/15391523.2010.10782551

European Commission. (2021). *Digital Education Action Plan 2021–2027: Resetting education and training for the digital age.* Publications Office of the European Union. https://education.ec.europa.eu/focus-topics/digital/digital-education-action-plan

Flanagan, S. M., Bouck, E. C., & Richardson, J. (2013). Middle school special education teachers' perceptions and use of technology in instruction. *Journal of Special Education Technology, 28*(1), 13–27. https://doi.org/10.1177/016264341302800102

Florian, L., & Black-Hawkins, K. (2011). Exploring Inclusive Pedagogy. *British Educational Research Journal*, 37(5), 813–828. https://doi.org/10.1080/01411926.2010.501096

Frontiers in Education. (2025). Inclusive education through technology: A systematic review of types, tools, and characteristics. *Frontiers in Education.* https://www.frontiersin.org/journals/education/articles/10.3389/feduc.2025.1527851/full

Harris, J., & Hofer, M. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology-related instructional planning. *Journal of Research on Technology in Education, 43*(3), 211–229. https://doi.org/10.1080/15391523.2011.10782570

Hattie, J. (2015). *Visible learning for teachers: Maximizing impact on learning*. Routledge.https://www.unesco.org/gem-report/en/articles/promoting-access-education-students-disabilities-through-inclusive-technologies

IA-ME. (n.d.). *Innovative methods and artificial intelligence in MOOC for special needs teacher education*. https://ia-me.eu/

King-Sears, M. E., et al. (2023). Effect of Universal Design for Learning (UDL) embedded project on student academic performance. *ERIC*. https://files.eric.ed.gov/fulltext/EJ1452787.pdf

Laurillard, D. (2013). Foreword to the second edition. In H. Beetham & R. Sharpe (Eds.), *Rethinking pedagogy for a digital age: Designing for 21st century learning* (2nd ed.). Routledge.

Mazzer, M. (2018). Technologies in school for an accessible, inclusive and competence-oriented education. *Education Sciences & Society*, *9*(1), 183. https://journals.francoangeli.it/index.php/ess/article/view/5963

Melo-López, V.-A., Basantes-Andrade, A., Gudiño-Mejía, C.-B., & Hernández-Martínez, E. (2025). The impact of artificial intelligence on inclusive education: A systematic review. *Education Sciences, 15*(5), 539. https://doi.org/10.3390/educsci15050539

Meyer, A., Rose, D. H., & Gordon, D. (2014). *Universal Design for Learning: Theory and practice.* CAST.

Nikolopoulou, K., & Gialamas, V. (2021). Bottom-Up Educational Technology Implementation: How Teachers' Voice Matters. *Education and Information Technologies*, 26, 555–574. https://doi.org/10.1007/s10639-020-10319-2

Okolo, C. M., & Diedrich, J. (2014). Twenty-five years later: How is technology used in the education of students with disabilities? *Journal of Special Education Technology, 29*(1), 1–20. https://doi.org/10.1177/016264341402900101

Rao, K., Ok, M. W., & Bryant, B. R. (2014). A review of research on Universal Design for Learning: The need for studies in inclusive educational settings. *Remedial and Special Education, 35*(3), 153–166. https://doi.org/10.1177/0741932513518980

Roberts-Yates, C., & Silvera-Tawil, D. (2019). Better education opportunities for students with autism and intellectual disabilities through digital technology. *International journal of special education*, *34*(1), 197-210.

Rose, D. H., & Meyer, A. (2020). *Teaching Every Student in the Digital Age: Universal Design for Learning*. ASCD.

Salas-Pilco, S., Xiao, Y., & Oshima, N. (2022). Artificial intelligence and educational inclusion: Supporting students with special educational needs and gifted students. *Journal of Educational Technology & Society, 25*(3), 85–98.

Selwyn, N. (2012). *Education in a digital world: Global perspectives on technology and education.* Routledge.

Selwyn, N. (2016). *Education and technology: Key issues and debates* (2nd ed.). Bloomsbury Academic.

Shakespeare, T. (2018). *Disability: The basics*. Routledge.

Slee, R. (2018). Inclusive Education Isn't Dead, It Just Smells Funny. *Educational Review*, 70(3), 315-331. https://doi.org/10.1080/00131911.2018.1465957

UNESCO. (2023). Promoting access to education for students with disabilities through inclusive technologies.

Ye, J.-H., Chen, X., & Liu, W. (2023). Adaptive Learning Technologies for Special Education: A Systematic Review. *Computers & Education: Artificial Intelligence*, 4, 100091. https://doi.org/10.1016/j.caeai.2023.100091