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Inclusive instructional co-design through an Artificial Intelligence-based device: a pilot study in an upper secondary school

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Abstract: The engagement of students with Special Educational Needs (SEN) depends on instructional design that reduces barriers without lowering cognitive challenge, yet personalisation is often hard to sustain in everyday teaching. This paper reports a pilot study in a vocational upper secondary school, where a Large Language Model-based mediation device, combining a «low-impact» micro-design template, a SEN Matrix anchored to ICF descriptors and an engineered prompt, supported co-design between the subject teacher and the special education teacher. Through an exploratory multiple case study, we examine the match between recorded barriers and generated mediators and the experience reported by two students with individualised plans following an equivalent curriculum after a lesson designed with the device. The mediators addressed the instructional barriers in the Matrix, but not the relational or home-study ones; the students reported benefits, no distraction and the sense that the lesson had been designed for them. We discuss the researchers' role in producing the materials, the study's limitations and the prospect of agents that support the design dialogue between teachers.

Keywords: engagement; inclusive design; Universal Design for Learning; Artificial Intelligence; co-design

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1. Introduction[1]

Designing inclusive learning environments today requires reconciling two demands that tend to become separated in school practice: the personalisation of learning pathways for students with heterogeneous functioning profiles and the sustainability of teachers' instructional design work (Aiello & Giaconi, 2024; Mitchell & Sutherland, 2020). Within the Italian regulatory framework, the ICF-based Individualised Education Plan (IEP) assigns shared responsibility to subject and special education teachers for translating the Functioning Profile into concrete instructional decisions (Interministerial Decree No. 182/2020; World Health Organization, 2001).

[1] The article is the result of the joint work of the authors. For attribution purposes, Catia Giaconi wrote paragraph 1, Noemi Del Bianco wrote paragraph 2, Aldo Caldarelli wrote paragraphs 3, 5, and 6, and Ilaria D'Angelo wrote paragraph 4.

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However, co-teaching research repeatedly identifies a lack of shared planning time as a major barrier to effective collaboration (King-Sears et al., 2021; Strogilos et al., 2023), with the risk that personalisation becomes merely a documentary requirement.

Against this backdrop, generative Artificial Intelligence (GenAI) has rapidly entered the debate in special education, both as an object of critical reflection and as a potential resource for accessibility (Besio et al., 2025; Fiorucci & Bevilacqua, 2025; Pagliara et al., 2024). Existing reviews predominantly describe student-facing applications, including adaptive tutors, assistive technologies and communication systems, while studies examining AI as support for teachers' instructional design remain scarce (Hopcan et al., 2023; Rice & Dunn, 2023; Harkins-Brown et al., 2025). Rice and Dunn (2023) also identify a tendency to portray AI as a way of 'lightening the workload' associated with students with disabilities rather than as a means of promoting their participation: a tension that special education research must explicitly address.

This paper contributes to this line of inquiry by presenting initial findings from a pilot study carried out at a vocational school in the Marche region of Italy. A mediation device based on a Large Language Model (LLM) was used as a 'cognitive partner' in co-design between the subject teacher and the special education teacher, rather than as a substitute for professional judgement (Kasneci et al., 2023; Miao & Holmes, 2023). The paper is organised as follows: Section 2 establishes the theoretical framework; Section 3 describes the design, device and instruments; Section 4 presents the findings, which are discussed in Section 5; and Section 6 considers the pilot nature of the study, its limitations and directions for further research. The appendices contain the prompt used and an example of the model interaction matrix.

2. Theoretical framework

2.1. Engagement and participation from a special education perspective

In international research, engagement is understood as a multidimensional construct encompassing behavioural, emotional and cognitive components (Fredricks et al., 2004), subsequently expanded to include an agentic dimension: the intentional, proactive contribution students make to the instructional process (Reeve, 2013). The second edition of the Handbook of Research on Student Engagement consolidates this understanding and emphasises that engagement is malleable and sensitive to contextual features and the quality of instructional relationships (Reschly & Christenson, 2022). For students with special educational needs (SEN), the picture is more complex: in a study of 1,020 secondary school students, Pérez-Salas et al. (2021) found higher cognitive and emotional engagement among students with SEN alongside greater cognitive and behavioural disengagement. They identified teacher–student relationships and opportunities for participation as particularly promising intervention targets.

Italian special education scholarship situates these dimensions within an ecological, quality-of-life perspective, in which participation depends on the interaction between individual functioning and contextual factors, following the ICF biopsychosocial framework (World Health Organization, 2001; Aiello & Giaconi, 2024). From this perspective, instructional design becomes an 'inclusive device': an organised set of decisions able to translate the facilitators and barriers identified in the Functioning Profile into actual teaching and learning conditions (Giaconi et al., 2024a). Here, the term 'device' refers to the philosophical tradition describing it as a network of heterogeneous elements intended to produce effects on practices and subjects (Deleuze, 1989; Agamben,

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2006). This offers a useful basis for conceptualising AI not as an isolated tool but as a component of a design system.

2.2. Universal Design for Learning and the sustainability of personalisation

Universal Design for Learning (UDL) provides the main operational framework for designing in anticipation of learner variability, reducing barriers upstream instead of making adaptations downstream (CAST, 2024). Version 3.0 of the guidelines strengthens the connection with engagement by including the recognition of interests and identities, support for effort and emotional capacity among the design options, and explicitly establishing learner agency as a goal (CAST, 2024). Meta-analyses suggest positive effects of UDL on learning processes, although the evidence regarding outcomes is less robust (Capp, 2017; Almeqdad et al., 2023). European reviews also note that empirical research has mainly focused on higher education, with limited evidence from schools (Ewe & Galvin, 2023). The central challenge remains translating principles into sustainable daily practice: workload, heterogeneous classes and limited co-planning time often turn personalisation into an additional task rather than the core of instructional design (Mitchell & Sutherland, 2020; Strogilos et al., 2023).

2.3. Generative AI as an instructional mediation device

Reviews of AI in special education describe a rapidly expanding but methodologically fragile field. Reviewing 29 studies published between 2008 and 2020, Hopcan et al. (2023) identify the predominance of technical over educational models and a particular focus on autism spectrum disorders. Paglialunga and Melogno (2025), examining interventions for students with learning disorders, emphasise uneven evidence quality and the risk of bias; Chalkiadakis et al. (2024) identify costs, technical barriers and teacher preparedness as barriers to adoption. In Italy, the scoping review by Pagliara et al. (2024) and studies in the special issue of the Italian Journal of Special Education for Inclusion (Besio et al., 2025) show growing interest in AI as a mediator and learning environment, alongside significant concern about ethical implications (Bonavolontà et al., 2025; Borsini & Giaconi, 2025).

Of more direct relevance to the present study are initiatives using GenAI to create instructional mediators or design according to UDL principles. Monchietto and Ballestra Caffaratti (2024) document the use of language models to construct inclusive mediators in teacher education and propose understanding GenAI as an 'assistant' within a critical, human-centred approach (Ballestra Caffaratti & Monchietto, 2024). Cersosimo and Pennazio (2025) test AI-supported UDL design in primary teacher education. Other studies investigate the creative and inclusive potential of machine learning in schools (Lecce & Di Tore, 2025), the combination of AI and augmented reality to improve access to cultural heritage (Todino et al., 2024), and advanced technologies for people with intellectual and multiple disabilities (D'Angelo, 2025b). At the methodological level, AI is also discussed as an aid to qualitative research, with cautions regarding procedural transparency (Marfoglia & Caldarelli, 2025a). However, the issue underpinning this study remains underexplored: using a suitably instructed LLM to connect subject-specific design by the subject teacher with functioning information gathered by the special education teacher (Merino-Campos, 2025; Marino et al., 2023).

3. Materials and methods

3.1. Objectives and research questions

The overall project protocol, approved by the ethics committee, includes three research questions. The third concerns teachers' perceptions of the device's sustainability. The present paper does not address this question, which requires systematic collection of teachers' perspectives and will be investigated in a second, larger multicentre study. Instead, the present study focuses on the intersection between the device's responses and the students' needs, as well as their perceptions, and addresses two questions:

RQ1. How do the mediators proposed by the device respond to the needs, facilitators and barriers recorded for students with SEN?

RQ2. What perceptions do students with SEN report regarding engagement, participation and the accessibility of the lesson designed using the device?

3.2. Research design

The research adopts an exploratory multiple-case study design (Yin, 2018), with two cases—two female students—in the same classroom setting, and a descriptive mixed-methods approach. The protocol comprises three phases. In Phase A, the subject teacher delivered a lesson designed independently, without the device; in Phase B, a lesson was designed with the device's support and enriched with personalised mediators; in Phase C, students' experiences were collected through a semi-structured interview instrument. Lesson A is not used as a quantitative baseline or metric comparator: it provides a descriptive, qualitative background to ordinary classroom practice and helps establish the design approach from which the device proceeds. The lessons differed in content, activities and assessment methods; accordingly, the study makes no causal claims about the device's effects.

3.3. Setting and participants

The study was conducted in a fifth-year class at a vocational upper secondary school specialising in food services and hospitality in Italy's Marche region, within the Italian Language and Literature curriculum. The SEN Matrix completed by the special education teacher describes four students with IEPs: two following personalised pathways with equivalent assessments (Pathway B) and two following differentiated pathways (Pathway C). The latter were excluded from the analysis because they did not attend both lessons: one female student had stopped attending school during the year, while another student was absent from one lesson. In addition to this practical reason, there was a pedagogical one: differentiated pathways involve individual learning objectives and assessments that are not directly aligned with the class curriculum, and the five-point interview response scale would have required a simplified version, which was not administered in this setting. The device nevertheless processed the entire Matrix and generated suggestions for these students' profiles as well; these remain part of the output analysed in Section 4.1.

The analysis therefore concerns the two female students following Pathway B, identified by codes AR0602 and AG0603, both aged 19. AR0602, who has a mild intellectual disability, demonstrates good interpersonal skills, appropriate behavioural self-regulation and motivation to achieve good results, alongside difficulties with

working memory, understanding complex texts and abstract reasoning. The Matrix identifies reduced attention span, limited abstraction skills, test anxiety in oral and written assessments, and a relatively disengaged class group as barriers. AG0603, who has mixed disorders of scholastic skills comorbid with an anxiety–depressive condition and borderline cognitive functioning, demonstrates adequate vocabulary, creativity in guided production and good procedural skills, but also reduced attention span, difficulties presenting in front of the class, conflictual peer relationships, low self-esteem and no home study. For both students, the Matrix lists concept maps, formula sheets, summaries, outlines and guiding questions as compensatory tools, and prioritises communicative effectiveness over formal accuracy in assessment.

3.4. The device and the researchers' role

The device integrates three components. The first is a 'low-impact' micro-design template that the subject teacher can complete in a few minutes, recording the topic, up to five key concepts, slide text or speaking notes, anticipated difficult terms and activities. The second is the SEN Matrix, a structured form based on descriptors from the Functioning Profile and IEP, completed by the special education teacher to systematise each student's facilitators, barriers, compensatory tools, exemptions and assessment methods. The third is an engineered prompt that assigns the model the role of an expert in special education and UDL, directs it to cross-reference the two sources, and asks for methodological suggestions, personalised mediators and accessibility adaptations for each profile, subject to constraints concerning immediate applicability, teacher-facing language and protection of students' sense of belonging. The full prompt appears in Appendix A; Appendix B illustrates the input–instruction–output interaction matrix with an example.

Lesson B used the Qwen3.6-Plus model (Alibaba Cloud), accessed through the Qwen Chat web interface in May 2026. In line with the protocol, the model choice is not regarded as decisive: the object of study is the device as a whole. As this was a proprietary cloud service, data were transmitted exclusively in pseudonymised form using unique codes, without student, teacher or institutional names, diagnoses, ICD codes or other identifying information. The research team submitted the prompt, instructed the model and received its output. Importantly, the researchers—not the practising teachers—also translated the suggestions into tangible mediators: a visual glossary, a symbol-supported version of the poem, an activity sheet, an audio recording and a concept map. Teachers received the completed materials and used them during the lesson. This departure from the protocol, which had assigned the selection and production of materials to teachers, is discussed in Sections 5 and 6.

In Phase A, the teacher delivered a lesson on Giovanni Pascoli and the poetics of the 'little child' (fanciullino), using brainstorming prompted by images of natural landscapes and inductive reading of the essay, followed by a written textual analysis. It was a participatory lesson, but without mediators systematically tailored to individual profiles. In Phase B, the lesson on Eugenio Montale and the 'pain of living' (male di vivere) involved collecting and categorising images associated with 'well-being' and 'suffering' using Mentimeter, as a bridge to the concept of the objective correlative, followed by an oral assessment. The planning document identified 'Montale, the pain of living, objective correlative' as key concepts, which the device cross-referenced with the SEN Matrix.

3.5. Instruments and analysis

Three data sets were considered: the textual output generated by the device for Lesson B and the materials actually produced; the two students' responses to the Student AI-Enhanced Lesson Experience Scale (SAIELES), a semi-structured interview instrument developed by the research team and administered individually after Lesson B; and, as contextual information, results of the two lessons' routine assessments. Table 1 describes the instrument's composition.

Table 1. Composition of the Student AI-Enhanced Lesson Experience Scale (SAIELES).

Dimension	Closed-ended items	Content	Open-ended questions
1. Familiarity with digital tools and AI (covariate)	S1.1–S1.4 (4)	Previous use of digital tools and AI; comfort with digital technology	Q.S1
2. Integration of tools	S2.1–S2.5 (5)	Understanding and naturalness of materials use; time, explanation, quantity	Q.S2
3. Classroom climate and relationships	S3.1–S3.5 (5)	Atmosphere, peer respect, teacher presence, sense of belonging to the group	Q.S3
4. Emotional well-being	S4.1–S4.5 (5)	Comfort, anxiety, motivation, calmness, positive emotions	Q.S4
5. Perceived benefits	S5.1–S5.4 (4)	Understanding, assessment preparation, independence, ease of studying	Q.S5
6. Perceived barriers (reverse-coded items)	S6.1–S6.5 (5)	Difficulty of use, remaining difficulties, stigma, distraction, lack of personal relevance of materials	Q.S6
7. Self-efficacy	S7.1–S7.4 (4)	Perceived ability, confidence, expectations, feeling that one's needs were considered	—
8. Areas for improvement	—	Desired changes, missing supports, additional comments	Q.S8a–c (3)

Response scale for closed-ended items: 1 = strongly disagree; 2 = somewhat disagree; 3 = moderately agree; 4 = largely agree; 5 = completely agree. Total: 32 Likert items and nine open-ended questions, preceded by a section of control variables completed by the interviewer (attendance at Lesson A, assessment result, school year, customary compensatory tools, SEN category and presence of the special education teacher). Administration took place individually after Lesson B, as an interview in a room separate from the classroom as specified by the protocol, with responses recorded on the form.

Given that this was a multiple-case study involving two participants, closed-ended responses were not summarised using means or other aggregate indices; instead, individual item scores were reported and descriptively examined within each dimension. The device's output was analysed by comparing the barriers and facilitators recorded in the Matrix for each profile against the proposed mediators. Open-ended responses underwent reflexive thematic analysis (Braun & Clarke, 2019), limited, given the brevity of the material, to identifying recurrent themes.

3.6. Ethical considerations

The project was approved by the Research Ethics Committee of the authors' affiliated university on 8 April 2026 (Ref. [REDACTED]). The protocol provides for participants' informed consent. Students are identified by unique codes; functioning data were processed only to the minimum extent necessary for research purposes and transmitted to the language model solely in pseudonymised form.

4. Results

4.1. From the SEN Matrix to instructional mediators

The device's output, addressed to the teacher as an operational guide, consists of a summary of the four classroom profiles; six methodological suggestions for the whole class (including a visual agenda, a dual digital-and-paper Mentimeter activity, reading at three levels of access, and explanations of abstract concepts grounded in concrete experience); five mediators to prepare before the lesson; a barrier–solution mapping table; individual intervention sheets; and a concluding checklist. Based on these proposals, the research team created a visual glossary, a symbol-supported version of the poem, an 'Emotions and Objects' activity sheet, an audio recording of the text and a concept map. Table 2 compares the information recorded in the Matrix for the two students with the device's suggestions.

Table 2. Correspondence between barriers and facilitators recorded in the SEN Matrix and mediators proposed by the device for Lesson B.

Profile	Barriers (SEN Matrix)	Facilitators and compensatory tools (SEN Matrix)	Mediators proposed by the device
AR0602	Reduced attention span; limited abstraction skills; performance anxiety in oral and written tests; relatively disengaged class group	Adapted and personalised materials; peer tutors; concept maps, summaries, outlines and guiding questions	Three-branch map (who Montale was, what the poem is about, what it means); text with highlighted keywords and margin guiding questions; explaining the objective correlative through concrete experiences; think–pair–share and a three-point outline for the oral test; designated peer; content-focused assessment
AG0603	Reduced attention and poor self-regulation; conflictual peer relationships; perceived ineffectiveness and low self-esteem; absence of home study	Teacher attention; group activities; personalised materials; peer tutors; maps, formula sheets, outlines and guiding questions	Guided paraphrasing and visual glossary; concept map with visual multiple-choice questions; map-supported presentation and option of a short written answer; micro-step activities with visual timer and checklist; assessment focused on communicative effectiveness. No proposal concerning home study

Source: SEN Matrix completed by the special education teacher; device output for Lesson B. Authors' synthesis.

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Two findings emerge from this comparison. First, the device's suggestions largely reproduce the facilitators and compensatory tools already included in the IEP, such as maps, outlines and guiding questions, while adapting them to the specific lesson content: rather than a generic map, the result is a three-branch organiser focusing on Montale and the objective correlative. Second, the responses concentrate on instructional barriers—abstraction, attention and test anxiety—whereas relational barriers (AG0603's conflictual peer relationships) are addressed only indirectly through pair work, and the barrier related to home study receives no proposal. The suggested assessment criteria are also consistent with the IEP, prioritising content and communicative effectiveness over form.

4.2. Students' reported experiences

Table 3 presents each student's individual item scores, grouped by dimension. Perceived barriers are reported in their original coding: lower values indicate that a barrier is perceived as absent or minor.

Table 3. Individual SAIELES item scores (1–5 scale).

Dimension (items)	AR0602	AG0603
Familiarity with digital tools and AI (S1.1–S1.4)	1 · 4 · 3 · 2	2 · 3 · 3 · 4
Integration of tools (S2.1–S2.5)	3 · 4 · 3 · 5 · 3	3 · 4 · 3 · 4 · 4
Classroom climate and relationships (S3.1–S3.5)	3 · 3 · 5 · 3 · 3	3 · 2 · 3 · 3 · 3
Emotional well-being (S4.1–S4.5)	3 · 5 · 4 · 3 · 3	3 · 3 · 4 · 3 · 4
Perceived benefits (S5.1–S5.4)	3 · 3 · 3 · 4	4 · 3 · 4 · 3
Perceived barriers* (S6.1–S6.5)	2 · 3 · 1 · 1 · 1	3 · 2 · 3 · 1 · 1
Self-efficacy (S7.1–S7.4)	3 · 3 · 4 · 4	3 · 4 · 4 · 5

Scores are presented in the item order shown in the first column. * Perceived barriers are not reverse-coded: 1 = barrier absent. On two items (AR0602, S6.5; AG0603, S6.4), the student corrected an answer on the form; the uncrossed response was used.

The two distributions reveal different profiles. AR0602 places most responses at the 'moderately agree' level, with some peaks: the maximum score for experiencing less anxiety than usual (S4.2), perceiving the teacher as more present and available (S3.3), and clarity of explanations on using the materials (S2.4). High scores (4) were assigned to ease of studying compared with Lesson A (S5.4), confidence in upcoming assessments (S7.3), and the perception that the lesson had been prepared with her needs in mind (S7.4). At the opposite end, her previous familiarity with digital tools at school was minimal (S1.1), and items concerning stigma ('I felt different', S6.3), distraction (S6.4) and materials not designed for her (S6.5) all received the minimum score.

AG0603 gives the maximum score to the statement 'the teacher prepared the lesson thinking about me and my needs too' (S7.4), and high scores to understanding the topic (S5.1), keeping pace without constantly asking for help (S5.3), confidence when answering guiding questions (S7.2) and experiencing positive emotions (S4.5). She gives intermediate scores to reduced anxiety (S4.2), ease of using the materials (S6.1) and feeling different from her classmates (S6.3), and a low score for perceived respect from

classmates during group activities (S3.2). Neither the distraction nor the sense that the materials were unrelated to her received more than the minimum score.

The open-ended responses confirm and clarify these findings. Both students identify the concept map as the most useful material: AR0602 because 'it helped me understand many things I couldn't remember', and AG0603 because it made 'the topic fairly clear'. AR0602 describes feeling 'strangely calmer than usual' and reports that the lesson 'helped us get along with our classmates'; AG0603 describes herself as 'calm'. Neither requests changes to the materials ('everything was clear as it was'; 'it was all simple'), although AG0603 acknowledges that 'sometimes' she did not understand how to use them. Three themes emerge: the concept map as an anchor for understanding, reduced emotional tension, and recognition of instruction designed with one's own needs in mind.

4.3. Contextual assessment data

For contextual purposes only, Table 4 presents the results of the routine assessments completed by the class after the two lessons.

Table 4. Contextual data: results of routine assessments for the two lessons.

Profile	Lesson A – Pascoli (written textual analysis)	Lesson B – Montale (oral examination)
AR0602	5/10	6–/10
AG0603	7/10	6/10

The two assessments are incommensurable: they differ in content (Pascoli/Montale), format (written textual analysis/oral questioning), and marking criteria. These scores do not constitute a pre/post comparison and cannot be interpreted as effects of the device; they are included solely to describe the students' ordinary assessment pathways.

5. Discussion

Regarding RQ1, the findings suggest that the device mediated between two forms of knowledge that tend to remain separate in schools: the subject teacher's disciplinary planning and the special education teacher's knowledge of student functioning (Strogilos et al., 2023). The output does not introduce tools unrelated to the IEP but recontextualises its facilitators and compensatory measures in the lesson content—a step that the UDL literature regards as both crucial and demanding (CAST, 2024; Capp, 2017). In this sense, AI functions as a component of a wider design device, consistent with approaches that regard it as a mediator rather than a replacement for the teacher (Ballestra Caffaratti & Monchietto, 2024; Monchietto & Ballestra Caffaratti, 2024; Bonavolontà et al., 2025).

Comparison with the Matrix also reveals a structural limitation: the proposals focus on barriers to accessing content while giving less attention to relational barriers and independent study, although the ICF framework regards these as key factors in participation (World Health Organization, 2001; Aiello & Giaconi, 2024). This aligns with observations by Rice and Dunn (2023) and Hopcan et al. (2023) concerning AI systems' tendency to operate at the level of the individual and task rather than the wider context, highlighting the need for pedagogical interpretation to complement their output (Pagliara et al., 2024; Borsini & Giaconi, 2025).

Regarding RQ2, students' responses speak to the emotional and cognitive dimensions of engagement and the quality of instructional relationships: reduced anxiety reported by AR0602; the concept map's role in retrieving and organising knowledge; and the perception of a more present teacher and of a lesson designed with the student in mind (Fredricks et al., 2004; Reschly & Christenson, 2022). The latter finding matters in light of evidence identifying teacher–student relationships as among the variables most closely associated with engagement among students with SEN (Pérez-Salas et al., 2021). By contrast, the agentic dimension, understood as students' proactive contribution to the lesson (Reeve, 2013), is poorly represented in the instrument and the data, and should be addressed in subsequent phases, especially as UDL 3.0 explicitly identifies it as a goal (CAST, 2024).

The case of AG0603 calls for caution. Alongside high perceived benefits, she reports an intermediate sense of being different from classmates and low perceived respect during group work—areas the Matrix identifies as problematic, along with speaking in front of the class. The device also suggested alternatives to oral assessment, but the study does not document the extent to which these were adopted. The risk of stigma associated with 'tailored' materials, discussed in the literature (Rice & Dunn, 2023; Harkins-Brown et al., 2025), therefore warrants careful monitoring, particularly when mediators are visibly intended for individual students.

A final issue concerns the device's actual sustainability. In this study, researchers instructed the model and converted its suggestions into ready-to-use mediators; teachers were required only to complete the planning document and Matrix and use the materials in class. Thus, the findings concern an 'assisted' device and do not yet establish how much work a practising teacher would need to turn textual AI output into a visual glossary, symbol-supported poetry text or audio recording. It is precisely this transition, rather than generating suggestions, that risks recreating the burden the device seeks to reduce (Aiello & Giaconi, 2024b; Strogilos et al., 2023; Mitchell & Sutherland, 2020). The question remains open and requires specific measurement under conditions in which teachers themselves select, adapt and produce the materials, as envisaged by the protocol (Ballestra Caffaratti & Monchietto, 2024; Cersosimo & Pennazio, 2025).

6. Conclusions, limitations and research directions

This pilot study's findings must be interpreted as exploratory indications. Its primary limitation is the very small sample of two students in one class, which precludes generalisation. The lessons differed in content, activities and assessment format, so Lesson A was not treated as a comparator. SAIELES has not yet been validated, was administered only after Lesson B, and includes comparative items susceptible to social desirability and novelty effects. Two students following differentiated pathways were excluded from the analysis. Crucially, researchers rather than teachers transformed the AI's suggestions into tangible mediators. The study therefore cannot estimate the teachers' actual workload, which is the decisive test of sustainability. Teachers' perspectives (RQ3) will be examined in a subsequent multicentre study.

Despite these limitations, the experience suggests that pedagogically grounded uses of GenAI may help bridge the gap between UDL principles and everyday instructional design, provided that teachers retain control of the output and attention extends beyond content-access barriers to the relational and agentic dimensions of participation (CAST, 2024; Miao & Holmes, 2023; Aiello & Giaconi, 2024). Subsequent phases will involve

additional settings, systematic collection of teachers' perspectives, teacher-led production of materials with time tracking, and equivalent assessments across conditions.

Looking ahead, the findings suggest moving from a device that generates an output to one that supports a process. The most interesting result is not any individual mediator but the connection the device facilitates between two forms of professional knowledge. This opens a path for investigating agent-based products—systems in which several AI components with distinct roles interact with one another and with users—capable of fostering genuine design dialogue between subject and special education teachers. One agent could represent subject-specific planning, another the Functioning Profile and IEP, and a third could highlight convergences, conflicts and decisions requiring negotiation, leaving decisions to teachers while also assisting with materials production. Early research on multi-agent instructional design systems and teacher–AI classroom co-design, still largely available as preprints, indicates the feasibility of this direction (Wang et al., 2025; Liu et al., 2025). It should be explored from a special education perspective, with attention to co-design as shared professional responsibility (King-Sears et al., 2021; Strogilos et al., 2023) and to these tools' contributions to the agency of students with SEN (Reeve, 2013; Lecce & Di Tore, 2025).

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Appendix A. Engineered prompt used in Phase B

The prompt is reproduced in full, with typographical errors corrected. It was followed by the SEN Matrix (containing unique codes only) and the Lesson B planning document, both pasted as text.

Role: Act as an expert in special education, inclusive teaching and assistive technologies. Your goal is to support a teacher in personalising a lesson to make it fully accessible and inclusive, following Universal Design for Learning (UDL) principles.

Context: You have access to two key documents, which I will provide below:

1. SEN Matrix: Contains anonymised profiles of students with special educational needs in the class (e.g., type of disorder, strengths, barriers and compensatory tools already in use).

2. Lesson B Plan: Contains the topic, key concepts, slide text/notes, materials and activities planned by the subject teacher.

Task: Analyse the data in the Matrix and Lesson Plan and generate:

1. Methodological suggestions: Identify the teaching strategies best suited to engaging the students specified in the Matrix without isolating them from the rest of the class. Where students follow a differentiated IEP, suggest inclusive, participatory teaching strategies that allow them to retain at least an understanding of the task culture.

2. Personalised instructional mediators: Suggest the creation of specific materials based on the lesson content (e.g., speech synthesis, simplified concept maps, audio descriptions, glossaries of difficult terms or advance organisers).

3. Accessibility adaptations: Based on the barriers and facilitators listed in the SEN Matrix for each student with a disability/disorder, also identify potential barriers in the lesson text and propose ways to overcome them (e.g., rephrasing complex sentences, using icons or visual supports, easy-to-read guidelines or other approaches).

Output constraints:

– Keep suggestions practical and immediately applicable within a one-hour lesson.

– State at the outset whether alternative materials are needed, such as concept maps, audio descriptions, explanatory videos or anything else recommended by UDL.

– Ensure that the proposals foster a sense of belonging among students with SEN.

– Avoid excessively technical language; address the teacher who will implement these recommendations directly.

– For every person listed in the SEN Matrix (who may be referred to by their anonymised unique code), specify in detail the inclusive instructional intervention to implement.

– Convert this response into an HTML file that can then be exported as a PDF.

Appendix B. Example of the model interaction matrix

Table B1 illustrates the mediation process for one profile (AR0602): from input elements through the prompt instructions processing them, to the model output and the mediator actually produced.

Table B1. Input–instruction–output interaction matrix for profile AR0602 (Lesson B).

Input	Prompt instruction	Model output (summary)	Mediator produced
Lesson plan: key concepts "Montale, pain of living, objective correlative"; Mentimeter activity. Matrix: limited abstraction skills; facilitators include maps and guiding questions	Personalised instructional mediators based on lesson content	Three-branch map (who Montale was; what the poem is about; what it means), with icons and large font	Concept map
Lesson plan: poem "Spesso il male di vivere ho incontrato". Matrix: difficulty understanding complex texts	Accessibility adaptations: barriers within the lesson text	Reading at three levels of access; text with highlighted keywords and guiding questions in the margin; glossary with icons for difficult words	Visual glossary; audio recording of the text
Matrix: performance anxiety in oral assessments; equivalent assessments emphasising communicative effectiveness	Detailed intervention for each profile; promote a sense of belonging	Peer tutoring with a designated classmate; three-point presentation outline; content-focused assessment	Oral-test outline (use of map while presenting)

Source: Lesson B planning document, SEN Matrix and model output.