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Slow Tech Innovation

AI, Ethics and New Teaching Methods

Integrating UDL Principles with Multimodal AI for Diverse Learning Needs

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OER 4.3.1: Integrating UDL Principles with Multimodal AI for Diverse Learning Needs
Reference Module: Module 4 – Prompt Engineering for Inclusive Education
Related Video-Pill: Video 4.3 - Applying UDL and Inclusive Personalisation
Authoring partner: Liceo "don Milani" di Acquaviva delle Fonti - sede associata "Da Vinci" di Cassano delle Murge
Topic / Thematic Focus: UDL principles integration, multimodal AI and diverse learning needs

Introduction and Learning Objectives

This resource accompanies, together with OER 4.3.2, video-pill 4.3 'Applying UDL and Inclusive Personalisation' and constitutes its methodological in-depth study. Its subject is the encounter between the principles of Universal Design for Learning (UDL) and the use of multimodal artificial intelligence, in order to respond to the diverse learning needs present in every classroom.

The starting point is a simple but profound observation: exclusion in the classroom almost always arises from design, not from intention. Materials devised for an average student who does not exist end up marginalising those who need different channels. UDL responds to this challenge by designing for variability; multimodal AI, guided by the teacher, offers a powerful tool to multiply the routes of access. The text links to DigComp 3.0 (Cosgrove & Cachia, 2025).

By the end of the reading the teacher will be able to:

recognise the three UDL principles - engagement, representation, action and expression - and apply them to design;

use multimodal AI to produce alternative representations of content addressed to different needs;

reflect critically on the difference between simplifying access and impoverishing the cognitive challenge.

1. Exclusion arises from design

Let us imagine an ordinary scene: the teacher photocopies a worksheet - compact text, few images, questions numbered one after another - and hands it out to the whole class. For many students it works; for others it is a barrier. The student with dyslexia takes three times as long and misreads the instructions; the visually impaired student has to bring the sheet close to their eyes; the student who has come from a migration background stumbles over the vocabulary, not over the reasoning. No one wanted to exclude anyone: the material was simply designed for an average user who does not exist.

From this diagnosis moves Universal Design for Learning, the framework developed by CAST, which starts from the variability of students as the norm, not the exception. In an international document, CAST defines UDL as an educational framework based on evidence about how human beings learn, and identifies its goal in learner agency: the student's autonomy as an active subject of their own learning (CAST, 2024). It is not one pedagogical

preference among others, but an approach with a scientific basis and a precise ambition: to design environments in which everyone can participate.
The stakes are high, and not only didactic. International research on the effectiveness of UDL documents positive effects on learning that extend to the whole class, not only to students with specific needs (Capp, 2017). This is an important confirmation: designing for variability does not 'slow down' the more able, it helps them like everyone else. Accessibility, in short, is not a cost, but an investment.

2. The three UDL principles

The UDL principles are organised around three fundamental questions, which are also the three dimensions of every learning process. Engagement concerns why one learns: motivation, interest, the ability to persevere. Representation concerns what one learns: the ways in which the content is presented. Action and expression concern how: the ways in which the student demonstrates what they have learnt.
Three clarifications avert the most common misunderstandings. First: UDL is not a methodology for the few, but an architecture for all - the strategies devised for the student with dyslexia (more readable text, clear instructions, more time) also benefit the rest of the class. Second: it is not 'simplifying' the content, it is multiplying the routes of access: the cognitive challenge remains, the channels change. Third: it is not an opinion, it is an evidence-based approach, as documented by research on the effectiveness of UDL (Capp, 2017).
CAST stresses, moreover, that the most recent version of the guidelines responds to the field's call to address barriers rooted in prejudice and systems of exclusion, and to do so for all students, with and without disabilities (CAST, 2024). It is a framing that shifts attention from the characteristics of the student to the characteristics of the environment: if the barrier lies in the design, the design is also the solution.

3. The European regulatory framework

This philosophy is not only a pedagogical recommendation: in Europe it has become a legal requirement. Directive (EU) 2019/882, the European Accessibility Act, sets out the accessibility requirements for a range of digital products and services placed on the market; for schools it is important for its definition of disability, which shifts attention from the person to the interaction with barriers:
«'persons with disabilities' means persons who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others.» (Direttiva (UE) 2019/882, Art. 3, punto 1)
Disability, in this reading, does not lie in the person, but in the encounter between a person and an environment full of obstacles. The directive justifies the intervention with an argument that concerns the whole of society:
«The demand for accessible products and services is high and the number of persons with disabilities is projected to increase significantly. An environment where products and services are more accessible allows for a more inclusive society and facilitates independent living for persons with disabilities.» (Direttiva (UE) 2019/882, Considerando 2)

Two elements make the directive a useful tool also for reasoning about teaching materials, even though it was not conceived for schools. The first are the 'functional performance' criteria: questions about functioning - does the product or service offer a mode of use without sight? with limited vision? with cognitive limitations? The directive asks, for example:
«Usage with limited cognition. The product or service shall provide at least one mode of operation incorporating features that make it simpler and easier to use.» (Direttiva (UE) 2019/882, Allegato III, criterio (j))
The second element is the indicative examples of concrete solutions, which translate directly into practice: files readable by screen readers, subtitles in videos, textual descriptions of diagrams, text that can be enlarged and with adjustable contrast. They are not rules for schools, but a ready-to-use grammar for anyone designing learning materials.

4. Multimodality with AI: the same content, many entry points

This is where the UDL principles and the European guidelines concretely meet artificial intelligence. Multimodality does not mean adding a decorative image: it means that every important concept is presented through several channels - written word, spoken word, image, diagram, concrete example - because different students have different entry points, and no one should depend on a single one.
Multimodal AI makes this operation quick. From a single starting text, the teacher can request versions rewritten at different levels, a glossary of difficult terms, a summary in bullet points, a concept map, the textual description of an image, an audio reading track. CAST itself recognises the value of offering multiple ways of perceiving information and of illustrating concepts through several media (CAST, 2024). AI, guided by a well-constructed prompt, is an accelerator of that multiplication.
The directive offers examples that translate directly into didactic practice: ensuring files that can be read by screen readers, or allowing the text to be enlarged and the contrast increased, so that people with visual disabilities can perceive the information (Directive (EU) 2019/882, Annex II). To these are added the moves of the UDL tradition: describing in words what a diagram shows, subtitling videos, offering the instructions both in writing and orally, varying the modes of response. The content remains the same; the channels change, and the cognitive challenge remains intact.

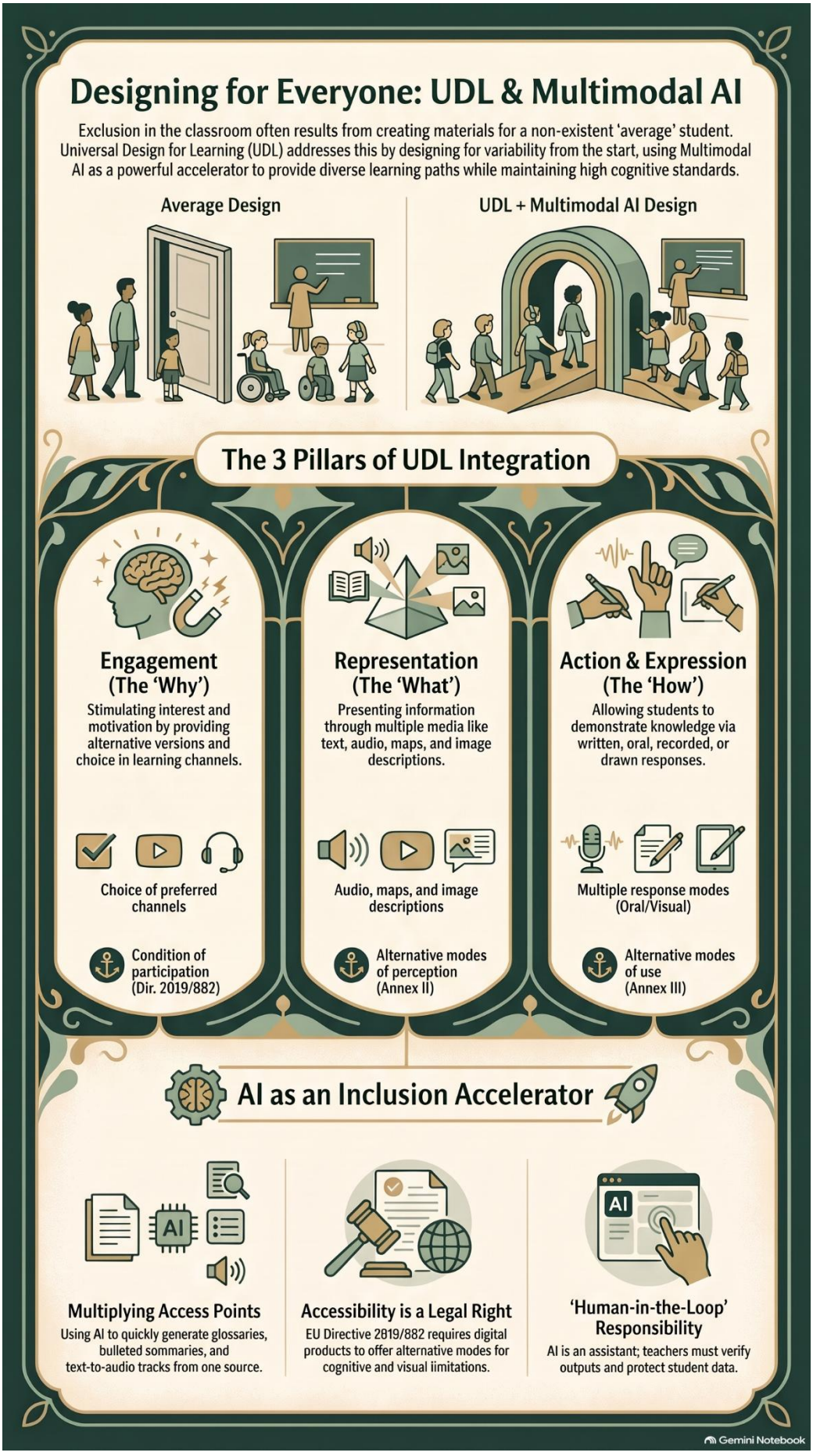
5. From access to inclusion: limits and responsibility

Multimodality is powerful, but it is not automatically inclusive. Three cautions are indispensable. The first: multiplying the channels does not mean lowering the bar. A simplification that eliminates the conceptual challenge betrays the purpose of UDL, which is to open doors, not to empty the content. The second: accessibility is not improvised with a tool; it requires design and verification criteria, such as those the European directive offers in the form of functional questions.
The third caution concerns responsibility. AI is an assistant, not a substitute for pedagogical judgement: outputs must be read, verified and corrected; students' data must not be entered into unauthorised tools; no judgement about the student should be delegated to the machine. The direction remains with the teacher, consistent with the project's human-in-the-loop logic.
On a broader scale, the international framework recalls why all this matters. UNESCO's Global Education Monitoring Report 2020, dedicated to inclusion as a question concerning

the entire school population, places inclusion at the centre of the global education agenda: inclusion as a process concerning all students, not as a set of accommodations for specific categories (UNESCO, 2020). It is the institutional context that gives meaning to the UDL approach: designing environments, curricula and materials so that no one is left out. The idea that all students count, and not only some, sums up the entire stake.

UDL principle	Guiding question	Multimodal response with AI	Regulatory anchor
Engagement (the why)	Is the student motivated and supported?	Alternative versions of the same content; choice of the preferred channel	Accessibility as a condition of participation (Directive (EU) 2019/882)
Representation (the what)	Is the content accessible to all?	Text, audio, map, glossary, description of images	Alternative modes of perception (Directive (EU) 2019/882, Annex II)
Action and expression (the how)	Can the student demonstrate what they know?	Multiple modes of response: written, oral, recorded, drawn	At least one alternative mode of use (Directive (EU) 2019/882, Annex III)

Visual Scaffolding



Conclusions and Metacognitive Reflection Prompts

This resource has shown how the three UDL principles - engagement, representation, action and expression - offer an architecture for designing materials accessible to all, and how multimodal artificial intelligence makes the multiplication of the routes of access quick. We have seen that exclusion arises from design; that accessibility is a requirement, not a courtesy, as Directive (EU) 2019/882 reminds us; and that research documents positive effects of UDL for the whole class.

But the underlying message remains an invitation to moderation: multiplying the channels does not mean impoverishing the content. The cognitive challenge must be preserved, AI must be used under the teacher's direction, and the ultimate aim remains the one indicated by the international framework: an education that includes all students, leaving no one behind.

To transfer these core ideas into one's own practice, the following prompts for reflection are proposed:

- At what point in your design does student variability come into play: before choosing the materials, or after you have already prepared them?
- Which design barrier - in the text, in the format, in the channels - could you remove in your next activity without changing the content?
- How would you distinguish, concretely, a simplification that opens access from one that impoverishes the cognitive challenge?

Technical Metadata Sheet

Metadata Field	Specification / Parameter Value
Identifier	OER 4.3.1
Title	Integrating UDL Principles with Multimodal AI for Diverse Learning Needs
Creator	Liceo "don Milani" di Acquaviva delle Fonti - sede associata "Da Vinci" di Cassano delle Murge
Description	The resource explores the meeting point between Universal Design for Learning and multimodal artificial intelligence in order to address the diverse learning needs present in every classroom. It presents the three UDL principles — engagement, representation, action and expression — and the European normative frame, showing how to produce alternative representations of content with AI. The critical focus is the difference between simplifying access and impoverishing the cognitive challenge.
Keywords	Universal Design for Learning; multimodal AI; inclusion; engagement; representation; action and expression; accessibility; cognitive challenge
Language	EN (English)
Affiliation	Liceo "don Milani" di Acquaviva delle Fonti - sede associata "Da Vinci" di Cassano delle Murge
Contributor	STIAEM Transnational Scientific Board (peer review, Rhodes validation protocol)
Media Format	Text; Infographics
Genre	Training Manual; Educational Guide
URL	
Citation	Capp, M. J. (2017). The effectiveness of universal design for learning: A meta-analysis of literature between 2013 and 2016. International Journal of Inclusive Education, 21(8), 791-807. https://doi.org/10.1080/13603116.2017.1325074 CAST (2024). Universal Design for Learning Guidelines version 3.0. CAST. https://udlguidelines.cast.org/

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Educational Level	Secondary School
Associated Module / MOOC Video Lesson	Module 4 - Prompt Engineering for Inclusive Education / Video 4.3 - Applying UDL and Inclusive Personalisation
Learning Objectives	recognise the three UDL principles - engagement, representation, action and expression - and apply them to design; use multimodal AI to produce alternative representations of content addressed to different needs; reflect critically on the difference between simplifying access and impoverishing the cognitive challenge.
Rights	Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0)
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References and Webography

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