Immersive technologies for inclusion: A Special Pedagogy protocol for the co-design of inclusive educational training paths

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Abstract
Contemporary social and cultural transformations set forth the need to reframe education as a dimension of care, ensuring equal participation opportunities for all learners. In this context, immersive learning environments can be reinterpreted not merely as technological settings, but as pedagogical ecosystems where knowledge creation, participation, and accessibility are co-constructed through situated approaches. The present contribution proposes the application of a co-design protocol grounded in Special Pedagogy frameworks and aimed at developing inclusive educational training paths that see immersive technologies as inclusive educational and didactic supports. The pilot study presented in this paper makes it possible to reinterpret immersive learning environments as spaces capable of activating new processes of supportive educational relationships and new opportunities for self-determination.

Key words: Special Pedagogy; Immersive educational technologies; People with disabilities; Co-design; Immersive room.

First submission: 15/04/2026, accepted: 11/06/2026

1. Introduction

The most recent technological advancements, paired with ongoing social and cultural transformation, are currently reshaping the boundaries of traditional teaching and learning processes, calling for the need to orient education towards a dimension of care and personalisation (Giaconi et al., 2023; d'Alonzo & Giaconi, 2024). As a consequence, ensuring equal learning

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Doi: 10.3280/ess1-2026oa22561

opportunities in heterogeneous classrooms represents a challenging yet essential objective of contemporary educational systems, requiring schools to rethink established policies and practices to acknowledge diversity and promote social justice (Cottini, 2019; Bocci, 2020; Aiello & Giaconi, 2024). As highlighted by scientific literature (Giaconi et al., 2023; Giaconi & Del Bianco, 2025), creating and inhabiting inclusive learning ecosystems brings forth the need to design educational environments that can promote collaboration, reciprocity, and the active engagement of all students. In this direction, Special Pedagogy studies underline the relevance of creating opportunities for social inclusion that embrace diversity and personalisation, acknowledging the potential impact of tangible and intangible factors that might act as facilitators or barriers to active participation and community belonging (Canevaro, 2006; Lepri, 2011; Giaconi, 2015). Such a multidimensional approach therefore envisions the relational nature of teaching and learning processes, shifting the focus towards the dynamics through which educational settings are co-created and experienced by all people, including those with disabilities (Aiello & Giaconi, 2024; d'Alonzo & Giaconi, 2024). Accordingly, scientific literature evidences the need to foster equity and participation of all learners by rethinking learning spaces through a dynamic and transformative lens, able to reflect a bio-psycho-social approach (WHO, 2001; UN, 2006, 2015; Cottini, 2019; Bocci, 2020).

Following these considerations, the introduction of innovative educational technologies holds significant potential for the creation of inclusive learning ecosystems, offering unprecedented opportunities to enhance both the flexibility of educational strategies and the personalisation of learning experiences (Pinnelli & Fiorucci, 2019; Fiorucci, 2021). However, to draw on the guidance offered by special pedagogical principles and practices, the design and development of technology-based learning resources should follow a perspective on accessibility that goes beyond technical standards to embrace a human rights perspective (Titchkosky, 2011; Healey, 2025). As noted in the Item 5 (b) (i) of the Conference of States Parties to the Convention on the Rights of Persons with Disabilities Provisional Agenda (2024), technologies can be framed as key enablers for social inclusion and active participation, supporting the transition towards an inclusive future when adequately designed. Accordingly, the discussion highlights the need to overcome existing barriers – such as limited accessibility of systems and contents, and insufficient inclusive design practices – by promoting coordinated, rights-based strategies that are grounded in universal design principles, the empowerment of people with disabilities and a multi-stakeholder collaboration (Giaconi et al., 2024; UN, 2024). To this end, by interpreting accessibility as a pedagogical resource that can guarantee wellbeing and participation "in all aspects of life" (UN, 2006, p.

6), Special Pedagogy frameworks can orient the design of technology-based learning solutions that are able to embrace diversity and promote higher levels of Quality of Life for people with disabilities (Schalock & Verdugo Alonso, 2002, 2006; Giaconi, 2015).

In light of these challenges, this contribution proposes a co-design protocol grounded in Special Pedagogy frameworks for the creation of inclusive training paths for immersive educational environments. After presenting the protocol, the paper illustrates, as a concrete application scenario, the co-design and development of an inclusive learning experience related to abstract art in the immersive room "I.D.E.A. 360", built within the Department of Education, Cultural Heritage and Tourism of the University of Macerata. By reframing immersive learning environments as accessible and relational spaces, the study will highlight how Special Pedagogy knowledge and practices can inform and orient the design of innovative training paths to place educational experiences at the intersection of learning, participation, and social care, promoting the inclusion of all students, including those with disabilities.

2. Immersive technologies and inclusive environments: research background

The analysis of contemporary educational contexts highlights how schools are increasingly engaged in processes of digital transformation (Braga, 2017), which raise the need to recognise and critically understand both the opportunities and risks associated with educational technologies in the construction of inclusive learning environments. Indeed, the use of innovative, educational technologies can provide numerous benefits for learning when appropriately designed for educational contexts, highlighting how "technological advancements have the power to significantly enhance inclusivity for, and the empowerment of, individuals with disabilities by [...] fostering greater participation in society" (UN, 2024, p. 2). Specifically, it is possible to emphasise technology's versatility for inclusive teaching, enabling the use of multiple means of representation and communication formats, and supporting the design and delivery of diversified and customisable learning materials (Rose & Meyer, 2002; Cottini, 2019; Caldarelli et al., 2023). Specifically, innovative technologies can serve as essential resources for social educational care by fostering inclusive environments that support communication, social competence, and equitable participation for children with special needs, breaking down barriers to interaction and learning and ensuring that all students have the opportunity to engage and contribute to their

communities on an equitable basis (Pinnelli & Fiorucci, 2020; Wyeth et al., 2023).

Within this framework, scientific studies underline how immersive technologies, based on the integration of the real-world environment with digital contents (Wellner et al., 1993; Craig, 2013), can offer significant advantages for the development of innovative and customisable educational mediators. In particular, existing studies highlight how immersive technologies enable the design of learning pathways that can be characterised by the complementarity between traditional resources and innovative tools (Heintz et al., 2021), integrating various types of multimedia content with a high degree of flexibility (Dhaas, 2024), and creating meaningful and engaging learning experiences for all students (Anderson, 2019; Garzón & Acevedo, 2019; Lester & Hofmann, 2020; Garzón, 2021). As highlighted in related literature, immersive technologies have the potential to promote quality, inclusion, and sustainability in everyday teaching practices (Aguayo & Eames, 2023; Khlaif et al., 2024), fostering students' motivation and active engagement (Fugate et al., 2025). These aspects are particularly relevant in relation to the need to ensure equitable learning opportunities for all learners (UN, 2006), supporting the development of innovative mediators capable of offering multiple means of representation and engagement (Anderson, 2019; Gill et al., 2024), in alignment with the principles of the Universal Design for Learning (UDL) framework (Rose & Meyer, 2002; Izzo, 2012; Rose et al., 2014) and the Quality of Life (QoL) model (Giaconi, 2015).

However, general findings appear to be optimistic but preliminary: as noted by recent review studies (Poggianti et al., 2025; Santilli et al., 2025), the majority of existing studies do not explicitly apply UDL and QoL principles in the assessment of immersive and inclusive educational technologies. Alongside the potential offered by these technologies for the development of innovative learning environments, it is important to consider several critical issues that might limit their effective integration into everyday teaching practices, thus highlighting the need for the development of informed and competent approaches to their application (Freese et al., 2023; Nikou et al., 2024). In general, studies highlight accessibility and usability challenges that, still to this day, represent open questions for scientific research (Dudley et al., 2023; Creed et al., 2023a, 2023b). Among these, the lack of specific training pathways, shared implementation protocols, and operational guidelines prevents teachers from developing coherent and pedagogically grounded practices for the use of such tools (Howard & Davis, 2023), often resulting in fragmented and unsystematic uses that overlook instances related to accessibility, participation, and inclusion (Lasica et al., 2020). In this regard, studies identify a gap in teacher training and in the resources needed to support the integration of these

tools into curricula and school environments, emphasising the need to provide professional development opportunities, practical guidelines, and structured support to effectively leverage these technologies in learning contexts (Marín-Díaz et al., 2022; Howard & Davis, 2023; Nikou et al., 2024). As highlighted in Creed et al. (2023a), the removal of technical, societal, and economic barriers represents an act of citizenship and community building in contemporary societies that addresses the full participation of all people, not only those with disabilities.

In general, the adoption of immersive technologies brings to the fore critical questions about their capacity to embrace learner diversity and respond effectively to individual needs within an inclusive framework, issues that remain largely unresolved. Building on this complex picture, the need to develop guidelines and protocols to ground immersive technology in sound pedagogical principles appears to be evident, with the aim of sustaining teachers' work, fostering full participation in digital environments, and promoting a relational understanding of education and inclusion (Hankey et al., 2017; Starkey, 2020; Sánchez-Cruzado et al., 2021; Fischer et al., 2022; Potestio, 2022).

3. Research protocol: co-design of immersive and inclusive environments

As anticipated in the introduction, this study aims to propose a research protocol for the development of inclusive contents to support learning within immersive environments. Moving beyond a purely technological perspective, the protocol is grounded in a participatory research approach (Hall, 1975; Cornwall & Jewkes, 1995; May, 2024), advocating for the active involvement of people with disabilities in the co-creation of inclusive learning experiences. In this sense, the study integrates the theoretical and operational frameworks of Universal Design for Learning (UDL) (Savia, 2016; Bochicchio & Pennazio, 2024) and co-design (Steen, 2013; Giaconi et al., 2020, 2024), leveraging them to support the integration of inclusive educational technologies as an act of educational care (Wyeth et al., 2023; UN, 2024).

Specifically, the integration of UDL and co-design is motivated by their complementary potential in designing inclusive learning environments. In the first place, UDL provides a foundational paradigm to situate learning processes within complex and relational ecosystems, emphasising the role of design practices, pedagogical strategies, and multimodal supports in fostering inclusion across formal and non-formal contexts (Rose & Meyer, 2002; Izzo, 2012; Savia, 2016; Bochicchio & Pennazio, 2024). Drawing on the principles of Universal Design (Mace, 1985; Goldsmith, 2007), UDL enables the creation

of flexible and accessible learning pathways that respond to diverse needs, promoting participation through an accessibility-by-design approach. Within immersive learning environments, this perspective supports the development of personalised and meaningful experiences, where technologies can act as mediators of learning, engagement, and cultural access thanks to multimedia features (Giaconi et al., 2021). Complementing this, co-design can be understood as a collective and situated process of knowledge production, where multiple actors are actively involved in exploring needs, imagining alternatives, and co-creating solutions (Titchkosky, 2011; Steen, 2013). Accordingly, co-design represents an epistemological stance that gives researchers the opportunity of questioning dominant narratives and embracing plural and often marginalised perspectives (Healey, 2025). Through participatory practices, stakeholders are engaged in the co-construction of learning experiences (e.g., narratives, representations, interaction modes), contributing to the emergence of more culturally responsive and inclusive educational experiences (Giaconi et al., 2020, 2021, 2024). From this perspective, the co-design process becomes a space of care, understood as a distributed pedagogical responsibility that integrates attention to relationships, subjectivities, and wellbeing within the design of learning environments, generating situated knowledge and transformative possibilities (Sarmiento-Pelayo, 2015; Del Bianco et al., 2024).

Overall, the integration of UDL and co-design can ensure the alignment with accessibility principles while opening spaces for the recognition of diverse experiences, identities, and forms of knowledge. This approach supports the development of immersive learning environments that are not only technically accessible, but also socially grounded, culturally responsive, and oriented towards social justice, ultimately fostering inclusive, participatory, and care-based educational practices.

Figure 1 illustrates the research protocol that was adopted, which consists of four main phases: the identification of UDL requirements (Phase #1 - Identification of UDL requirements in the application scenario), a preliminary creation of the content (Phase #2 - Preliminary prototype creation), an iterative process of testing and refinement (Phase #3 - Testing, Joint solution, Refinement), and the creation of the inclusive learning experience (Phase #4 - Co-creation of the inclusive learning experience).

In general, the proposed protocol involves iterative phases of prototype development, participatory testing, and collective refinement of immersive contents (e.g., narratives, multimodal resources, interaction modalities), actively engaging stakeholders as co-researchers. Particular attention is devoted to the co-construction of culturally responsive and accessible narratives, capable of integrating multiple epistemologies and fostering recognition of diverse identities and experiences. As anticipated, the proposed research

protocol was tested for the design and development of inclusive educational training in an immersive room setting aimed at supporting situated and accessible learning experiences. To this end, the protocol was applied in the design and development of narratives, representations, and multimodal interaction strategies that can support learning within immersive educational environments, as will be illustrated in the following section.

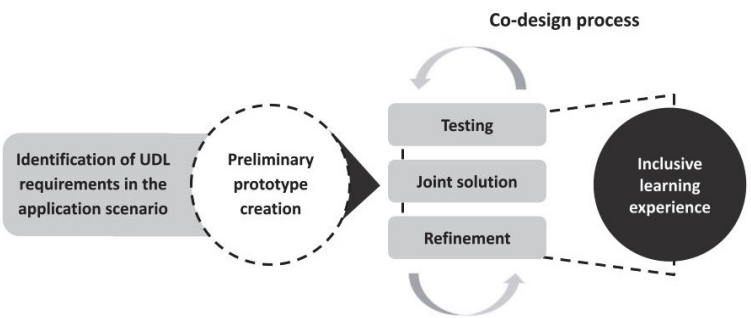

Fig. 1 - Co-design protocol

4. Co-design application scenario

The co-design protocol was applied for the design and development of an inclusive learning experience in the immersive room "I.D.E.A. 360", built within the Department of Education, Cultural Heritage and Tourism of the University of Macerata. From a technical standpoint, the immersive room is equipped with an integrated technological system that combines the following infrastructures:

- Visual projection infrastructure: seven short-throw 3LCD laser projectors (positioned on the floor and walls of the room);
- Audio reproduction infrastructure: one amplifier and four surround sound speakers (positioned on the upper corners of the room);
- Environmental mapping infrastructure: four LiDAR sensors (positioned on the floor and walls of the room);
- Workstation infrastructure: two desktop PCs with a high-performance graphics card, 64 GB RAM, and a high-end Intel processor.

The specific content chosen for this pilot study was the artistic vision, painting style and works of Russian painter Vasilij Kandinskij (1866-1944), who is recognised as a pioneer of abstract art and widely acknowledged as a

foundational figure in the development of non-representational painting in the early twentieth century. The artist is renowned for his use of colours and shapes to convey emotion and spirituality, often drawing on his experience of synesthesia, in which he perceived colours as closely linked to music (Kandinskij, 1912/2005).

4.1 Identification of UDL requirements and preliminary prototype creation

On this basis, the research team analysed Kandinskij's foundational work "Concerning the Spiritual in Art" (1910), in which he conceptualises his artistic vision, illustrating the emotions and musical instruments he associates with each colour of the spectrum. The objective of the analysis was to translate the artist's conceptual and sensory correspondences into a multisensory experience leveraging the technologies of the immersive room (Phase #1). By doing so, the research team aimed at applying UDL principles in order to convey the learning content in a format that is both engaging and accessible, allowing for the exploration of Kandinskij's artistic style, emotional language, and synesthetic associations through a combination of visual, auditory, and spatial stimuli.

According to this framework, Phase #2 consisted in developing the first prototype of the immersive learning experience by structuring it around three main representation/interaction channels:

- Visual storytelling: graphic animations;
- Musical storytelling: musical arrangements;
- Literary storytelling: book interpretive reading.

The first feature involved the creation of custom graphic animations starting from a vector graphics digital twin of Kandinskij's painting "Several Circles" (1926). Using animation software, immersive animations were developed not only for the complete painting, but also for each colour of the spectrum (yellow, blue, green, red, orange, purple, white, and black), integrating visual elements drawn directly from the original artwork. The animations were created in order to visualise the dynamic relationships between colour, shapes, sound and emotion, allowing an interactive exploration within the immersive environment. The second feature involved the composition of custom musical arrangements through sound design software and a MIDI keyboard. Musical arrangements were created for the complete artwork and for the colour animations by sampling the specific musical instruments Kandinskij associates with each colour in his book. Melodic scores were designed to reflect the emotions and expressive qualities described by the artist, translating his synesthetic associations between colour and sound into a multisensory auditory experience. The audio was engineered to incorporate spatialisation techniques

in order to enhance immersion within the environment, distributing the sound sources across the space of the immersive environment. The third feature involved recording interpretative readings of selected passages from Kandinskij's book, highlighting the specific sections in which he articulates his artistic vision and conceptualises the musical, emotional, and symbolic significance of each colour. The readings were not conceived as neutral recitations, but were developed through a narrative approach aimed at conveying the expressive and affective nuances of the original text, paying attention to voice modulation, rhythm, and intonation. The recordings were integrated into the immersive environment, providing a narrative layer to complement the visual and musical components. Table 1 provides an example of the integration of three representation/interaction channels for the colour blue.

Tab. 1 - Accessible storytelling prototyping

Visual storytelling	Music storytelling	Literary storytelling
	D Major melody with a lavish sound. Layered orchestration including piano, cello and woodwinds.	"The inclination of blue to depth is so strong that its inner appeal is stronger when its shade is deeper. Blue is the typical heavenly colour".
	Melody moves to a lower register and gets more sombre and intense. Organ is added to the layered orchestration.	"When it sinks almost to black, it echoes a grief that is hardly human".
	Melody moves to a higher register and gets gentler and more subdued. All instruments stop playing except for piano.	"When it rises towards white, its appeal to men grows weaker and more distant".

The elements were then embedded into the immersive room through programming software that allowed the design of an interactive system through block-based programming. Specifically, the interactive system allows people to activate one or more storytelling features by touching the walls of the immersive room, allowing learners to engage with Kandinskij's art through visuals, sounds, and narrative separately or simultaneously.

4.2 Testing, refinement and co-creation of the inclusive learning experience

Phase #3 (Testing, Joint solution, Refinement) involved a total of 21 participants aged between 20 and 80 years, with a balanced distribution between male (11) and female (10) participants. The sample included one participant with a physical disability resulting from a rare disease, four participants with different types of visual disabilities, two participants with different types of hearing disabilities, and four participants with different types of intellectual disabilities. Participants were recruited on a voluntary basis with the support of local associations and provided informed consent for their participation in the study. Divided into four groups, participants were able to assess the accessibility of the immersive technologies implemented in the room and share their thoughts and suggestions via focus groups (Liamputtong, 2011). This method allowed for an in-depth exploration of their perspectives, understanding critical challenges and viable solutions to ensure inclusion within technology-supported learning environments. Insights and suggestions were analysed through Thematic Analysis (Clarke & Braun, 2017), organising recurring thematic dimensions that emerged across the collected narratives. To facilitate the focus group discussion, participants were asked the following question: *Based on your experience in the immersive room, what aspects would you revisit to improve its accessibility?* This phase was conceived not as a mere technical validation process, but as a situated and participatory space in which diverse perspectives, experiences, and forms of knowledge are engaged to critically inform the design of the immersive environment, in line with principles of inclusion, care, and epistemic plurality.

In general, participants with and without disabilities recognised that the integration of multiple modes of representation, interaction, and storytelling enhanced their sense of engagement and participation, enabling a meaningful and immersive cultural experience. Participants noted how the multimodal configuration, based on dynamic visualisation, sound interpretation and guided textual narration, enabled a deeper and more layered understanding of the artwork and its conceptual foundation, allowing for an accessible and intuitive learning experience. The experience was also perceived as an effective introduction to immersive technology as a means that can have a potential

positive impact on future educational and cultural practices for equal access and participation.

The feedback collected during the focus groups was grouped into two main thematic dimensions: *Highlighted needs to improve accessibility* and *Co-designed solutions*. Together, these dimensions capture the key issues raised by participants and the corresponding solutions developed through the co-design process, which informed the implementation of three main accessibility-oriented interventions (Table 2).

Tab. 2 - Highlighted needs and co-designed solutions

Highlighted needs to improve accessibility	Co-designed solutions
Need to support the perception and conceptual understanding of the artwork.	Design and creation of customised tactile supports reproducing the artwork.
Need to enhance the accessibility of narrative storytelling content.	Adaptation of interaction instructions and narrative descriptions into Easy-to-Read format.
Need to manage and regulate sensory load to moderate the level of immersion.	Integration of lighting and audio volume control functions.

In the first place, participants with visual disabilities highlighted the need to strengthen the conceptualisation of the original artwork. In the absence of visual cues, this aspect represents a fundamental trajectory to increase autonomous interaction and learning. To address this need, the co-design process led to the development of a 3D printed tactile replica of the original artwork, presenting different textures according to colours and a braille legend, to serve as a complementary reference. This tactile artefact can support learners in exploring the composition and structure of the painting while supporting the association between colours and sounds (Figure 2).

In the second place, participants shared the importance of developing accessible narrative content, capable of conveying the artist's vision with a language that is not overly complex or difficult to understand. In response to this need, the joint research team proposed the co-design of an Easy-to-Read[1] version of the literary storytelling, directly involving people with intellectual disabilities in order to develop a narrative that can support understanding for diverse audiences while preserving the core artistic and cultural meanings. Table 3 illustrates the Easy-to-Read text designed to present the artwork, co-

[1] easy-to-read.inclusion-europe.eu.

developed and validated with the contribution of participants with intellectual disabilities.

Fig. 2 - Example of 3D printed support for the learning experience

Tab. 3 - Example of Easy-to-Read adaptation

Original version	Easy-to-Read version
This artwork, titled Several Circles, was created by Vasilij Kandinskij, a pioneering figure in the development of abstract art. Kandinskij explored the relationship between colour and sound, conceiving colours as capable of evoking auditory sensations. Interact with the artwork to explore these connections and discover his artistic language.	This painting is called “Several Circles”. This painting was painted by Kandinskij. Kandinskij is the artist who invented abstract art. For Kandinskij, every colour has a sound. Touch the artwork to begin exploring Kandinskij’s art.

Lastly, some participants reported the need to moderate the level of immersion and regulate sensory load caused by the simultaneous presence of visual and auditory stimuli. This aspect was particularly relevant for participants with intellectual disabilities, as well as for those who preferred not to be fully immersed in the darkened environment of the immersive room, particularly when engaging in sign language communication. As a result, participants suggested the integration of adjustable parameters for both lighting and audio volume, allowing people to regulate the perceptual load according to individual preference, while supporting communication needs in case of collective learning experiences. Together, the proposed solutions contribute to enhancing the inclusiveness and accessibility of the immersive learning environment, leading to the creation of the final accessible training path (Phase

#4). Figure 3 illustrates the complete co-designed immersive learning experience overview.

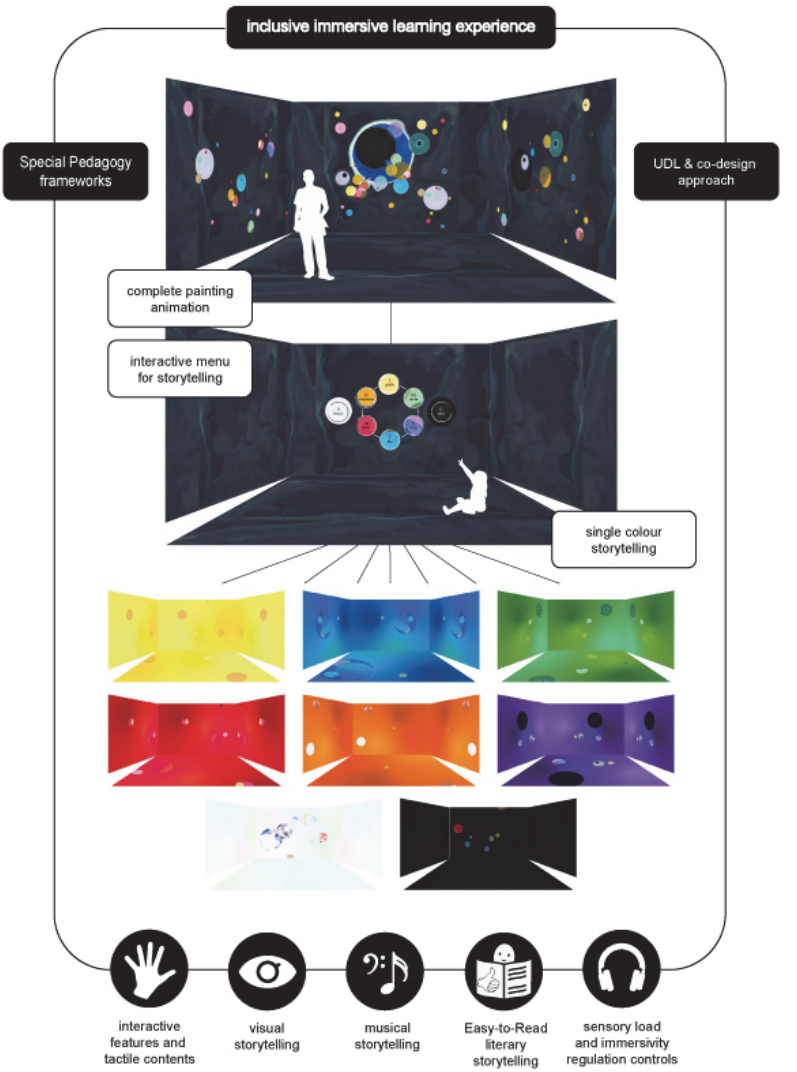

Fig. 3 - Inclusive immersive learning experience overview

5. Conclusions and future perspectives

This research experience highlights how immersive environments can represent privileged spaces for the creation of inclusive educational ecosystems, aimed at ensuring accessibility, participation, and meaningful engagement for all learners when designed according to pedagogical principles. Moving beyond techno-centric approaches, the research interrogates how knowledge can be represented, mediated, and to what extent it enables meaningful participation for diverse learners. Within this perspective, the proposed co-design protocol was found to be a useful resource in supporting the development of inclusive educational training paths, leveraging immersive technologies while maintaining a person-centred and relational approach to learning. By providing a structured yet flexible framework to guide the use of tools such as video projection, 3D printing, interactive sensors, and multimodal interfaces, the proposed protocol can serve as a scalable and transferable resource for teachers, educators, and institutions engaged in the design of immersive learning experiences, ensuring critical inquiry, epistemic plurality, and inclusion (Shogren et al., 2022; Del Bianco et al., 2024; Giaconi et al., 2024).

In this direction, it is important to note that the act of reconfiguring immersive environments not merely as technological settings but as dynamic pedagogical spaces follows a community-based approach, in which inclusive educational agency embraces and values co-constructed knowledge, plural perspectives, and situated experiences (Aiello & Giaconi, 2024; d'Alonzo & Giaconi, 2024; Giaconi & Del Bianco, 2025; Giaconi et al., 2025). This echoes the idea that an engaged community of experience and practice can foster social and educational care (Fabbri, 2007; De Mutiis & Amatori, 2023; Gulisano, 2023; Wyeth et al., 2023; Aiello & Giaconi, 2024), articulating innovative technologies as tools for sustainable development where digital, sensory, relational, and spatial dimensions converge.

Accordingly, immersive learning environments can function as mediating spaces that support the development of interconnected, inclusive, and sustainable educational processes, with a perspective of complementarity with traditional educational resources. Such an approach thus reinforces the understanding of learning as a relational and situated process, which represents an opportunity for innovation, participation, and Quality of Life (Giaconi, 2015; Giaconi et al., 2023; Aiello & Giaconi, 2024; d'Alonzo & Giaconi, 2024; Giaconi & Del Bianco, 2025). However, the results obtained in this study should be considered as a first step in the development of inclusive educational applications for immersive rooms. Specifically, future lines of research could focus on the development of pedagogically sound frameworks for different

training contents, testing the suitability of these technologies for the teaching and learning of diverse forms of knowledge and culture (Giaconi et al., 2023). Additionally, further research should understand how these systems can meet the needs of people with complex disabilities, with particular attention to alternative and augmentative communication strategies, movement-tracking functions, and key parameters for the design of responsive immersive environments (D'Angelo, 2020). These efforts can further reinforce the idea that immersive educational spaces can be conceived as inclusive environments for shared meaning-making, care, and empowerment.

From a methodological perspective, the co-design process presented in this contribution further confirms how technological innovation, when framed within the theoretical foundations of Special Pedagogy and enacted through active community involvement, can represent a powerful driver for inclusion, opening innovative pathways of research and experimentation (Giaconi et al., 2024). The integration of UDL principles with participatory methodologies enabled the co-construction of immersive contents that are original and meaningfully accessible for diverse learning needs (Rose et al., 2014; Cottini, 2019; Caldarelli et al., 2023; Giaconi et al., 2021, 2024). Although the number of participants involved in the study appears adequate to reach data saturation in qualitative research (Braun & Clarke, 2013), the heterogeneity of the sample requires caution in interpreting the findings. While participants' diversity enriched the analysis by capturing a broad range of perspectives, future research involving larger samples could further explore the inclusive potential of immersive spaces. In general, these results suggest how the involvement of people with disabilities plays a crucial role in bridging technological development with social impact, contributing to the identification of needs and the refinement of inclusive solutions to ensure that pedagogical principles are grounded in feasible practices.

In this perspective, the dimension of educational care transforms accessibility from a technical requirement or add-on into a dynamic and relational process that can foster empowerment and self-advocacy (Del Bianco, 2024), promote equal rights and social impact (Taddei, 2017), and strengthen a sense of belonging within the educational community (Titchkosky, 2011; Shogren et al., 2022). As highlighted in previous studies (Giaconi et al., 2020, 2021, 2024), participatory approaches enable the generation of context-sensitive and effective solutions, reshaping life environments to embrace diversity as a generative stance (Healey, 2025). In this direction, participatory processes can generate "some better, more lively and imaginative ways to conceive of a collective's version of problems as well as its versions of answers or solutions" (Titchkosky, 2011, p. 131).

In conclusion, the development of inclusive immersive learning experiences represents a complex challenge which calls for an ecological and systemic vision, capable of connecting micro-level practices (such as co-design activities) with broader institutional strategies to ensure the pedagogical grounding of innovative technologies in contemporary educational systems (Giaconi et al., 2023; Giaconi & Del Bianco, 2025). Within this dynamic scenario, technologies should not be conceived as substitutes for traditional educational practices, but rather as amplifiers that can promote social inclusion through innovative means, supporting learners' participation and engagement. The stance of Special Pedagogy, indeed, pushes us to continuously interrogate relationships, practices, environments, and practical tools, questioning whether they should be reoriented towards the person and their unique needs to support their existential path (Giaconi & Del Bianco, 2025). The intersection between Special Pedagogy, technological innovation, and participatory research thus represents a promising pathway for the design of inclusive and meaningful learning environments, enhancing Quality of Life (Giaconi, 2015) and fostering interconnected, sustainable, and care-oriented educational processes.

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