THE ALGORITHMIC HEARTBEAT:
THE IEP AS AN AFFECTIVE DEVICE IN AI-ENHANCED HYBRID LEARNING ENVIRONMENTS

Riccardo Mancini
Unilink
r.mancini@unilink.it

Sara Pellegrini [1]
Unilink
s.pellegrini@unilink.it

Riccardo Sebastiani
Uniostrava
r.sebastiani@unilink.it

Filippo Gomez Paloma
Unicas
filippo.gomezpaloma@unicas.it

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ABSTRACT
This qualitative documentary study examines 18 IEPs in six longitudinal series (2003–2025). Qualitative content analysis distinguishes within-case changes from regulatory developments, particularly D.I. 182/2020 and D.I. 153/2023. Findings show qualitative differences in document structure, participation, context, and shared responsibility. AI systems were not analysed; AI-enhanced environments are considered only as a prospective theoretical framework.

KEYWORDS
Individualized Education Plan; ICF; documentary analysis; inclusive education; educational planning.

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[1] Writing—Original Draft Preparation: S. Pellegrini (Introduction), F. Gomez Paloma (Section 2), R. Mancini (Section 3) and R. Sebastiani (Section 4 e 5). Conceptualization, Review and Editing: all authors. All authors have read and agreed to the published version of the manuscript.

1. Introduction

In the present study, however, artificial intelligence is not an empirical object of investigation. AI-enhanced environments are considered exclusively as a theoretical and prospective context within which future developments in inclusive educational planning may be examined.

For the purposes of this study, the concept of *algorithmic heartbeat* refers to the dynamic process through which educational information, relational interactions, contextual observations, and planning decisions circulate across human and technological actors within inclusive educational ecosystems. Rather than describing a technological mechanism, the construct identifies a pedagogical function that sustains continuity, coordination, adaptation, and shared responsibility among educational stakeholders. In this sense, the IEP functions as a mediating infrastructure capable of connecting human intelligence, professional expertise, family knowledge, and digitally supported forms of educational governance (Figure 1).

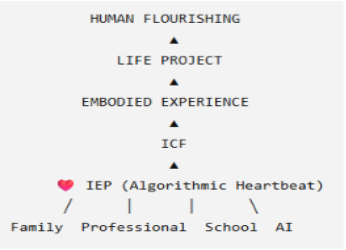


Figure 1. Epistemological Architecture of the IEP as an Algorithmic Heartbeat. The figure illustrates the IEP as the connective and regulatory core of inclusive educational ecosystems. By integrating ICF-based functioning, embodied experience, Life Project trajectories, contextual resources, and digitally mediated and prospective AI-enhanced environments, the IEP transforms

distributed information into shared educational meaning, fostering participation, self-determination, and human flourishing. The figure represents the theoretical framework of the study and should not be interpreted as an empirical finding concerning artificial intelligence.

This shift invites a reconsideration of the IEP through a broader theoretical lens that integrates the International Classification of Functioning, Disability and Health (ICF), Embodied Cognitive Science (ECS), and the Life Project (Progetto di Vita). Together, these perspectives offer a multidimensional framework for understanding inclusion as a dynamic process of participation, meaning-making, and human flourishing.

The ICF developed by the World Health Organization (2001) provides the scientific language through which functioning, disability, and participation can be described within a biopsychosocial perspective. Rather than locating disability solely within the individual or within social structures, the ICF conceptualizes human functioning as the result of continuous interactions among personal characteristics, activities, participation opportunities, and environmental conditions. From this perspective, educational planning becomes an exercise in identifying and enhancing the facilitators that support participation and learning.

As Ghedin (2009) observes, the adoption of the ICF represented a significant turning point in the culture of inclusion because it enabled educational systems to move beyond the traditional opposition between medical and social models of disability. The emphasis shifted from deficits to capabilities, from limitations to participation, and from categorization to educational responsibility. In this sense, the ICF provides the grammar through which schools, families, healthcare services, and communities can establish a shared framework for dialogue and collaboration.

At the regulatory level, a specific discontinuity must be considered. Interministerial Decree 182/2020 introduced national IEP models and related guidelines, while Interministerial Decree 153/2023 subsequently amended the decree, the models, and the guidelines (Ministero dell'Istruzione, 2020; Ministero dell'Istruzione e del Merito, 2023). These regulatory changes are treated in the present study as external historical conditions affecting document structure and terminology and are analytically distinguished from transformations occurring within individual educational trajectories.

However, a language alone is insufficient if it is not embodied within lived experience. The classificatory precision of the ICF risks remaining detached from the realities of educational relationships unless translated into the experiential and affective dimensions of learning. It is precisely here that Embodied Cognitive Science offers a complementary perspective. Drawing on the work of Clark (1999), Barsalou (2008), Varela, Thompson and Rosch (1991), cognition is understood not as an internal computational process but as a situated, embodied, and relational phenomenon emerging through interactions among body, environment, and others.

Within AI-enhanced learning environments, this embodied perspective acquires renewed significance. While algorithmic systems can process data, identify patterns, and personalize instructional pathways, they cannot fully replace the affective, ethical, and intersubjective dimensions that characterize educational encounters. Learning remains rooted in lived experience, emotional resonance, and relational participation.

Beyond its documentary function, the IEP may be conceptualized as a socio-technical infrastructure capable of regulating the circulation of information, meanings, decisions, and educational intentions among human and technological actors. In this sense, the metaphor of the algorithmic heartbeat does not merely describe a digital process but identifies a pedagogical mechanism through which educational ecosystems sustain continuity, adaptation, and shared responsibility.

Recent studies on ICF-based educational planning have progressively reinforced this relational interpretation. Lascioli and Pasqualotto (2018) conceptualized the IEP as a pedagogical device of shared responsibility; the PETRA digital platform (Scapin et al., 2025) demonstrated how technological infrastructures can support collaborative and dynamic educational planning. Similarly, Unterhalter (2009) connected inclusion, guidance, and Life Project within a holistic framework oriented toward self-determination and active citizenship. The algorithmic dimension refers not merely to artificial intelligence systems but to the capacity to organize, connect, and generate meaningful pathways from multiple sources of information. The heartbeat, conversely, symbolizes the affective and human dimension that animates these processes through care, reciprocity, and shared intentionality.

The resulting epistemological architecture is therefore triadic and interdependent. The ICF represents the language of functioning; Embodied Cognitive Science provides the relational and experiential grammar through which meaning is constructed; and the Life Project constitutes the educational message oriented toward future possibilities and personal flourishing. Within this framework, the IEP becomes the affective interface connecting these dimensions, transforming hybrid educational environments into spaces where

technological innovation and human care converge in support of inclusive participation and meaningful life trajectories.

1. The Anthropological Vision: The IEP as an Ecosystemic Device

The discussion developed in this section has a theoretical and interpretive function. References to artificial intelligence and AI-enhanced environments define a prospective framework and do not describe technologies empirically investigated in the present study. From a pedagogical perspective grounded in complexity, the human being cannot be understood as an isolated entity but rather as an open system that continuously constructs its identity through interactions with others, with living environments, and with the cultural and technological tools that mediate experience. Inclusive education therefore emerges as an ecosystemic process in which learning, participation, and development arise from the dynamic interplay of biological, cognitive, emotional, social, and contextual dimensions. Such a perspective aligns with a conception of education as the shared generation of worlds, where meaning is not transmitted but co-constructed through action, participation, and relational engagement (Rossi, 2011).

The emergence of artificial intelligence and hybrid learning environments further amplifies this complexity. Intelligent technologies are no longer merely supportive tools; they increasingly function as active components of educational ecosystems, contributing to the collection, interpretation, and circulation of information concerning learning, participation, and inclusion. Recent scholarship on artificial intelligence in education has highlighted how intelligent systems increasingly function as mediators of learning ecosystems,

supporting personalization, feedback generation, and collaborative decision-making processes (Holmes et al., 2022; Miao & Holmes, 2023). Such developments reinforce the need to reinterpret educational planning as a distributed and ecosystemic practice rather than as an individual administrative task. Within this scenario, the Individualized Education Plan (IEP) acquires a renewed pedagogical significance. Rather than being viewed as a procedural or administrative document, it can be understood as an ecosystemic device capable of connecting individuals, contexts, languages, technologies, and life trajectories within a coherent vision of human development.

The International Classification of Functioning, Disability and Health (ICF) provides the scientific language through which human functioning and environmental interactions can be described. However, as Gomez Paloma (2013) argues, functioning acquires educational meaning only when interpreted within the relationships that connect individuals to their environments. Classification alone is insufficient to grasp the complexity of educational experience unless it is accompanied by an embodied understanding of learning processes.

Embodied Cognitive Science offers a decisive contribution in this regard. Knowledge emerges through the continuous interaction of body, mind, environment, and culture; knowing is inseparable from acting in the world and transforming it through situated participation (Clark, 1999; Barsalou, 2008). The body thus becomes the epistemological locus of experience, the threshold through which perception and action intertwine in the construction of meaning. This perspective finds its philosophical roots in Merleau-Ponty's phenomenology of perception (1945/2012), according to which the body is not an object among objects but the primary condition through which the world

becomes meaningful and accessible. Human understanding therefore emerges through embodied engagement with the environment, reinforcing the educational significance of participation, experience, and situated interaction. Cognition is no longer conceived as an internal and individual process but as a distributed, relational, and context-dependent phenomenon.

Within this framework, the IEP is not simply a repository of goals or educational procedures. It becomes a generative node of relationships, an ecosystemic device capable of integrating information originating from different systems—schools, families, healthcare services, communities, territories, and digital technologies—and transforming such information into opportunities for participation, agency, and growth. Its function is therefore not merely organizational but profoundly epistemological, as it enables dialogue among multiple forms of knowledge: the scientific knowledge embedded in the ICF, the experiential knowledge of individuals and families, the professional knowledge of educators, and the emerging knowledge generated through intelligent technological systems.

From this perspective, the IEP may be interpreted as the "algorithmic heartbeat" of the inclusive ecosystem. The metaphor of the heartbeat evokes the capacity to maintain communication among diverse elements, ensuring continuity, adaptation, and regulation. The adjective algorithmic does not imply a delegation of educational decision-making to technology; rather, it refers to the capacity to orchestrate complex flows of information, observations, interpretations, and meanings across the educational system. As Bocci (2021) suggests, it is precisely through the dynamic interactions among institutions, individuals, and contexts that new possibilities for inclusion emerge. The pedagogical value of the IEP lies in its ability to transform data and

observations into shared meanings and educational decisions oriented toward human flourishing.

The enactive reflections proposed by Aprile (2012) are particularly relevant in this context. Learning emerges as a process of shared interpretation in which reading, re-reading, highlighting, discussing, and rewriting experiences constitute fundamental practices for knowledge construction. The transformation of information into educational purposes can be understood as a continuous negotiation of meaning through which schools, families, and students progressively build a shared understanding of reality.

Within this process, family involvement acquires not only educational but also epistemic significance. Parents' experiential knowledge intertwines with teachers' professional expertise and with information generated by observational and digital systems, giving rise to a common language in which the vocabulary of the ICF is gradually translated into lived experience. Teachers do not merely inform; they interpret, listen, and co-construct. Families are not recipients of educational plans but active partners in the generation of educational meaning. This dynamic reflects what Aprile (2012) describes as a structural coupling among different systems that, through interaction, co-evolve and generate new educational equilibria.

The school environment consequently becomes an adaptive ecosystem in which human beings and technologies participate in the co-construction of knowledge. Complexity is not a problem to be eliminated but a condition to be pedagogically inhabited. In this perspective, educators assume the role of ecosystemic mediators, capable of directing the potential of artificial intelligence toward goals of human development, participation, and inclusion.

This interpretation resonates with Berthoz's (2011) principle of simplexity, according to which complex systems develop adaptive strategies that make complexity manageable without reducing it. Similarly, the IEP does not simplify human diversity by eliminating its richness; rather, it organizes and renders intelligible the multiple relationships that shape an individual's functioning. The plasticity of the brain and the plasticity of the Life Project converge within a continuous process of adaptation, learning, and transformation.

The Life Project represents the transformative horizon of this ecosystem. It emerges from the encounter between the descriptive language of the ICF, the embodied language of lived experience, and the future-oriented dimension of educational planning. The Life Project can therefore be understood as the dynamic outcome of an ongoing negotiation among personal aspirations, environmental opportunities, and educational supports. In this sense, the IEP becomes the device through which such integration becomes possible, translating the complexity of interconnected systems into concrete pathways of self-determination, participation, and active citizenship.

Drawing upon Capitini's (1964) philosophy of openness and co-presence, the ultimate value of this process lies in its capacity to generate shared responsibility and relational belonging. Inclusion does not consist in adapting individuals to environments; rather, it involves creating ecosystems capable of evolving together with the people who inhabit them. The IEP thus emerges as an ecosystemic device of connection, regulation, and transformation, sustaining the dialogue between human intelligence, artificial intelligence, and life planning while orienting the entire educational system toward personal and collective flourishing

2. Methodology and Research Design

3.1 Research Design and Research Question

The study does not investigate artificial intelligence systems directly. Rather, AI-enhanced environments constitute the socio-technical background within which the epistemological transformation of the IEP is interpreted.

This study adopts a qualitative longitudinal multiple-case documentary design aimed at examining changes in the structure and language of Individualized Education Plans between 2003 and 2025. The design distinguishes transformations occurring within individual educational trajectories from changes associated with the evolving historical and regulatory framework.

Building upon the theoretical framework outlined in the previous sections, the research conceptualizes the IEP as the *algorithmic heartbeat* of inclusive educational ecosystems. Within this perspective, the IEP is not understood merely as a planning tool but as a dynamic infrastructure through which information, meanings, experiences, and educational intentions circulate among schools, families, support services, communities, and technological systems. The study therefore explores the transformation of the IEP from a static documentary instrument into an ecosystemic device that supports participation, co-construction of meaning, and Life Project development.

The research is guided by the following question:

How did the structure and language of the analysed IEPs change between 2003 and 2025, and which changes can be interpreted as transformations within individual educational trajectories rather than as effects of the evolving national regulatory framework?

This overarching question is articulated through four specific objectives:

1. To analyse the historical evolution of IEP structures, educational languages, and pedagogical paradigms from 2003 to 2025;
2. To distinguish within-series transformations from historical and regulatory discontinuities, with particular reference to Interministerial Decrees 182/2020 and 153/2023;
3. To examine how functioning, participation, contextual factors, family involvement, assessment, and Life Project orientation are represented in the documentary corpus;
4. To discuss the IEP as a potentially ecosystemic coordinating device, while treating AI-enhanced environments exclusively as a prospective theoretical framework.

3.2 Documentary Corpus and Selection Criteria

The study was conducted in a Comprehensive School located in Central Italy and involved special education teachers, school leaders, and families of students with disabilities engaged in school-to-adulthood transition processes.

A longitudinal and comparative approach was adopted through the analysis of Individualized Education Plans produced over a period exceeding twenty years. This approach allows the identification of changes in educational documentation and underlying pedagogical assumptions.

The corpus consisted of 18 IEPs distributed across six longitudinal case series, with three documents analysed for each educational trajectory (initial, intermediate, and final phase). This structure enabled the identification of

developmental continuities, discontinuities, and shifts in educational planning practices over time.

Case selection followed purposive sampling criteria aimed at maximizing longitudinal variation across educational levels and disability profiles. The selected cases included students presenting cognitive, motor, communicative, and multiple disabilities, allowing the investigation of diverse educational trajectories and planning practices. This sampling strategy was adopted to explore how the evolution of the IEP unfolded across different educational needs and contexts. Documents were included if complete, dated 2003–2025, traceable to an educational trajectory, and suitable for analysis. Incomplete or untraceable documents were excluded. Within-series changes were analysed separately from cross-period changes, which were interpreted in relation to D.I. 182/2020 and D.I. 153/2023. The six IEP series were analysed not merely as administrative records but as educational artefacts reflecting the evolution of inclusive cultures, pedagogical paradigms, and ecosystemic forms of collaboration. The six IEP series were compared in relation to document structure, educational language, participation, contextual factors, assessment, and forms of collaboration across periods.

3.3 Analytic Procedure

Qualitative content analysis was adopted as the primary analytical approach (Schreier, 2012). The documentary analysis was organized around five initial analytical dimensions:

- evolution of document structure;

- transformation of educational language;
- changing forms of family participation;
- integration of contextual and environmental factors;
- emergence of digital and ecosystemic dimensions of educational governance.

Open, axial, and selective coding were applied sequentially to identify, organize, and synthesize documentary patterns. Thematic analysis (Braun & Clarke, 2021) was used only at the final interpretive stage. Coding was conducted manually; the coding matrix and audit trail were managed using Microsoft Word and Excel. The analysis focused on identifying changes in educational vocabulary, representations of functioning, forms of participation, and relationships among educational actors. The analysis also considered documentation mode, distinguishing earlier local formats from the national model and treating PEI informatization as an institutional context rather than as evidence of artificial-intelligence use (Table 1).

Table 1. Distribution and characteristics of the documentary corpus

Series	School years (I–M–F)	School level	Document format	Main characteristics
S1	2003–04 / 2004–05* / 2005–06*	Primary	Local PEI	Discipline-based structure; task- and performance-oriented objectives.
S2	2006–07 / 2007–08* / 2008–09*	Primary	Local PEI	Growing attention to autonomy, relationships and small-group participation.
S3	2009–10* / 2010–11 / 2011–12*	Primary	Local PEI	Functional areas, autonomy, observation and systematic assessment.
S4	2012–13* / 2013–14* / 2014–15	Primary	Structured local PEI	Relational regulation, awareness and inclusive teaching strategies.
S5	2014–15 / 2015–16* / 2016–17*	Primary	Structured local PEI	Participation, interaction, self-regulation and collective assessment.
S6	2022–23* / 2023–24* / 2024–25*	Primary	National ICF-based PEI	Context, barriers/facilitators, GLO participation, review and Life Project linkage.

Tab. 1. I = initial phase; M = intermediate phase; F = final phase. Series codes are pseudonymous. Years marked with an asterisk are provisional and must be verified against the original archive before publication. Identifying, diagnostic and institutional information was omitted to protect privacy.

3.4 Focus-Group Component

To complement the documentary analysis, an asynchronous online focus group was designed involving teachers, school leaders, parents, and educational professionals. The focus group functioned as an ecosystemic space for collective reflection and knowledge generation. Participants provided written responses over seven consecutive days through Google Forms, under researcher moderation. The platform did not provide direct participant-to-participant interaction; the activity is therefore treated as an asynchronous written consultation rather than as evidence of a dialogic focus-group process.

Five thematic discussion threads were proposed:

1. embodied experiences of inclusion and school–family collaboration;
2. transformation of technical language into relational language;
3. perceptions of the digital IEP as a reflective and participatory environment;
4. the role of embodiment in Life Project construction;
5. the defining features of a shared grammar for educational co-responsibility.

For the present article, focus-group material is not included in the empirical results because the available research record does not provide a complete auditable transcript, an interaction log, a finalized focus-group codebook, and verifiable anonymized quotations. Consequently, the focus group is not used to support a claim of methodological triangulation.

3.5 Ethics and Data Governance

The IEPs were analysed in de-identified form. Names, dates of birth, diagnoses, and combinations of contextual information that could permit re-identification were not reproduced in the analytical dataset or in the manuscript. Full IEPs are not made publicly available because they contain sensitive educational and health-related information. Access to the IEP archive was institutionally authorized. Data were securely stored for three weeks, in accordance with applicable data-protection procedures.

4 Results

4.1 Documentary and Temporal Patterns

The documentary analysis identified differences in the structure and language of the IEPs across the examined periods. Earlier documents were mainly organized around subject-specific objectives and individual performance, whereas later documents showed greater attention to functional areas, autonomy, relationships, participation, and systematic review.

In the most recent national ICF-based model, contextual observation, barriers and facilitators, GLO participation, and review procedures are explicitly structured. These differences were interpreted by distinguishing changes within individual trajectories from changes associated with the regulatory framework introduced by D.I. 182/2020 and D.I. 153/2023.

4.2 Illustrative Documentary Indicators

Table 2 provides de-identified examples used to anchor the qualitative categories. The excerpts are illustrative indicators and are not treated as frequency counts.

Document/period	Illustrative indicator	Analytic category
2003–2004	"Progredire nella capacità di ascolto…"	Subject-specific objectives; performance-oriented planning
2006–2007	"potenziare l'autonomia motoria, emotiva, personale e sociale"	Autonomy, relationships, and participation
2010–2011	"Saper svolgere semplici attività in autonomia"	Functional areas; autonomy; systematic review
2014–2015	"partecipazione attiva"; "maggiore interazione"; "autoregolazione esecutiva"	Participation, interaction, and self-regulation

Document/period	Illustrative indicator	Analytic category
National-model comparator	Dedicated sections on barriers/facilitators, GLO participation, and review	Regulatory/contextual architecture

Tab 2. The national-model row is a regulatory comparator and is not treated as a separate empirical case.

5 Discussion

The findings of this longitudinal case study reveal that the evolution of the Individualized Education Plan (IEP) cannot be interpreted merely as a process of administrative modernization or documentary standardization. Rather, the documentary differences observed between 2003 and 2025 are consistent with a broader shift toward more contextual, participatory, and relational approaches to inclusive educational planning, while also reflecting changes introduced by the evolving regulatory framework.

The documentary comparison suggests differences between earlier performance-oriented planning and later forms that more explicitly represent relational and participatory dimensions. Earlier documents more often foreground individual objectives and competencies, whereas contextual and relational elements become more visible in later documentary structures. These differences should not be read as a single linear progression because document architecture was also shaped by regulatory change.

Later documents display a more explicit organization around functional domains, participation, family involvement, and contextual factors. This pattern is consistent with the growing influence of ICF-based planning, but part of the difference is attributable to the national PEI model itself. The findings

therefore support a layered interpretation in which within-case change coexists with regulatory standardization.

An additional pattern concerns the broader formal involvement of educational actors. Teachers, families, healthcare professionals, and support services are represented with increasing structural visibility in recent planning formats; this is interpreted as a documentary feature rather than as evidence of greater participation in practice.

The informatization of the PEI provides an institutional context for recent documentation. Ministry Note no. 1690/2024 refers to ANS/SIDI functions for online PEI drafting and management (Ministero dell'Istruzione e del Merito, 2024). This administrative digitization should not be interpreted as evidence of artificial-intelligence functionality, which was not examined in the present study.

Within this scenario, the IEP emerges as a strategic pedagogical infrastructure that supports not only individualized planning but also the co-evolution of schools, families, communities, and learners across the lifespan.

The study therefore contributes to a reconceptualization of the IEP as an ecosystemic device of connection, regulation, and transformation. Rather than being viewed as a bureaucratic requirement, it can be understood as a dynamic and living architecture of participation that sustains human flourishing within increasingly complex and technologically mediated educational environments.

These findings suggest that the digitalization of educational planning should not be interpreted as a process of technological substitution but as an opportunity to strengthen human-centred forms of collaboration, reflection,

and shared decision-making. The future of inclusive education depends not on replacing human expertise with artificial intelligence, but on developing educational ecosystems in which technological innovation supports participation, dialogue, and collective responsibility.

6. Conclusion

The documentary analysis identifies changes in the structure and language of the Individualized Education Plan between 2003 and 2025. Earlier documents in the analysed corpus tend to foreground disciplinary objectives, tasks, and individual performance, whereas later documentary forms make contextual factors, participation, barriers, facilitators, shared responsibility, and review procedures more explicit. These differences cannot be attributed to a single process: they reflect both transformations within educational trajectories and changes in the national regulatory and documentary framework.

Across the analysed documents, later formats make participation, contextual factors, and shared responsibility more explicit than earlier documents. These differences should not be interpreted as a single linear progression, as they reflect both changes within educational trajectories and the historical-regulatory standardization of the IEP. Within this process, the ICF emerges as a shared language of functioning that enables communication among educational, clinical, social, and family systems. However, the findings suggest that the descriptive power of the ICF acquires educational meaning only when interpreted through embodied experiences, relational practices, and future-oriented educational trajectories. In this regard, Embodied Cognitive Science provides the experiential grammar through which educational actors transform information into shared understanding, while the Life Project offers the transformative horizon toward which educational planning is directed,

supporting collaboration among educational stakeholders, and fostering continuity across life transitions. Recent PEI informatization provides an institutional framework for traceable and longitudinal documentation; however, these digital functions were not evaluated empirically in the present study.

From this perspective, the metaphor of the *algorithmic heartbeat* provides a meaningful interpretation of contemporary inclusive education. The heartbeat symbolizes the continuous circulation of information, relationships, experiences, and educational intentions throughout the ecosystem. The algorithmic dimension does not imply the replacement of human judgment by artificial intelligence; rather, it refers to the capacity to organize, connect, and regulate increasingly complex flows of educational information. Human intelligence, professional expertise, family knowledge, and digital systems become interconnected components of a broader ecology of learning and participation. AI-enhanced environments may support documentation, personalization, and collaboration when guided by pedagogical and ethical principles.

Ultimately, the future of inclusive education may depend on the capacity of schools to move beyond bureaucratic models of planning and toward ecosystemic forms of educational governance. In such a scenario, the IEP becomes more than a document: it becomes the algorithmic heartbeat of inclusive educational ecosystems, continuously connecting functioning, embodied experience, Life Project trajectories, and technological mediation.

The contribution of this study lies in proposing a conceptual model in which the ICF provides the language of functioning, Embodied Cognitive Science offers the grammar of lived experience, the Life Project represents the educational

horizon of transformation, and the IEP functions as the ecosystemic device that connects these dimensions. Such a framework opens new avenues for research on inclusive education and digital governance and provides a theoretical basis for future empirical investigation of artificial intelligence in educational planning.

7. Limitations and Future Research

This study presents several limitations. First, the findings derive from a single institutional context and a limited number of longitudinal cases, which restricts the transferability of the results. Second, the interpretative nature of the analysis does not allow causal inferences concerning the impact of digital IEPs on educational outcomes. Third, the study primarily focuses on documentary evolution and collaborative processes rather than on direct measures of educational effectiveness. Future research should involve multiple educational contexts, comparative international datasets, and empirical investigations of AI-supported planning practices across different educational levels and disability conditions. AI-enhanced environments were not an empirical object of the present study and remain a prospective context for future research.

References

Aprile, F. (2012). L'alunno furgoncino e l'alunno carrarmato. *Una didattica enattiva per ridurre gli errori in educazione*. Armando.

Barsalou, L. W. (2008). Grounded cognition. Annual Review of Psychology, 59, 617–645. https://doi.org/10.1146/annurev.psych.59.103006.093639

Berthoz, A. (2011). Simplexity: Simplifying principles for a complex world (G. Weiss, Trans.). Yale University Press. (Original work published 2009)

Bocci, F. (2021). Pedagogia speciale come pedagogia inclusiva. Itinerari istituenti per una scuola democratica. Guerini Scientifica.

Braun, V., & Clarke, V. (2021). *Thematic analysis: A practical guide*. SAGE.

Capitini, A. (1964). La compresenza dei morti e dei viventi. Il Saggiatore.

Clark, A. (1999). An embodied cognitive science? Trends in Cognitive Sciences, 3(9), 345–351. https://doi.org/10.1016/S1364-6613(99)01361-3

Gallagher, S. (2017). Enactivist interventions: Rethinking the mind. Oxford University Press.

Ghedin, E. (2009). Ben-essere disabili. Un approccio positivo all'inclusione. Liguori.

Gomez Paloma, F. (2013). Embodied cognitive science. Atti incarnati della didattica. Edizioni Universitarie Romane.

Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. Center for Curriculum Redesign.

Holmes, W., Persson, J., Chounta, I. A., Wasson, B., & Dimitrova, V. (2022). Artificial intelligence and education: A critical view through the lens of human rights, democracy and the rule of law. Council of Europe.

Lascioli, A., & Pasqualotto, L. (2018). *Il piano educativo individualizzato su base ICF: Strumenti e prospettive per la scuola*. Carocci.

Malafouris, L. (2013). How things shape the mind: A theory of material engagement. MIT Press.

Merleau-Ponty, M. (2012). Phenomenology of perception. Routledge. (Original work published 1945)

Miao, F., & Holmes, W. (2023). *Guidance for generative AI in education and research*. UNESCO.

Ministero dell'Istruzione e del Merito. (2023). *Decreto interministeriale 1 agosto 2023, n. 153*.
Ministero dell'Istruzione e del Merito. (2024, May 24). *Nota prot. n. 1690. Informatizzazione del Piano Educativo Individualizzato e nuove funzionalità nella Partizione separata dell'Anagrafe nazionale studenti*.

Pinnelli, S., & Fiorucci, A. (2021). Individualized educational planning ICF based: Testing and monitoring of the IEP-ICF UniSalento model. *Form@re – Open Journal per la Formazione in Rete, 21*(1), 204–218. https://doi.org/10.13128/form-10456

Rossi, P. G. (2011). Didattica enattiva. Complessità, teorie dell'azione, professionalità docente. FrancoAngeli.

Scapin, C., Cramerotti, S., Von Prondzinki, S., Folegani, P., Frascari, A., & Martinuzzi, A. (2025). "PEI-ICF PETRA": a smart web platform to foster cooperation in drafting the individualized Education Plan (IEP) for students with disability. *Cogent Education*, *12*(1), 2560616.

Schreier, M. (2012). *Qualitative content analysis in practice*. SAGE.

Unterhalter, E. (2009). What is equity in education? Reflections from the capability approach. *Studies in Philosophy and Education, 28*(5), 415–424. https://doi.org/10.1007/s11217-009-9125-7 United Nations. (2006). Convention on the Rights of Persons with Disabilities. United Nations.

Varela, F. J., Thompson, E., & Rosch, E. (1991). The embodied mind: Cognitive science and human experience. MIT Press.

World Health Organization. (2001). International classification of functioning, disability and health (ICF). World Health Organization.