

Learning technologies and configurations of the “Algorithmic Self” An exploratory study in an inclusive virtual museum between meaningful learning, learning communities and artificial intelligence

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Abstract: This paper presents the results of an exploratory study conducted with a university class during an experience of visiting and designing an inclusive virtual museum, interpreted through the lens of co-evolution pedagogy. In the context of transformations in work and skills (World Economic Forum, 2025–2026), higher education is increasingly required to support individuals capable of negotiating algorithmic action without uncritical delegation or technophobia. Drawing on embodied and distributed cognition and Actor-Network Theory, the virtual museum is conceptualised as a socio-technical device in which mind, environment and technologies co-produce practices, meanings and forms of participation. The research design integrates a pre-test, a post-test and a group worksheet, analysed through descriptive statistics and thematic analysis. Results show a moderately high perception of meaningful learning and, above all, a significant increase in the sense of community during the activity; representations of inclusion emphasise relational and cooperative dimensions rather than accessibility alone. With regard to AI, a pragmatic attitude prevails: AI is perceived as a support for organising ideas and enriching the experience, alongside concerns related to replacement and reliability. Implications are discussed for a radically extended pedagogy aimed at making algorithmic action visible and fostering reflective agency in immersive and non-formal learning contexts.

Keywords: co-evolution pedagogy; inclusive virtual museum; meaningful learning; learning community; AI; Flipped Inclusion.



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1. Introduction

The intersection of digitalisation, automation and artificial intelligence (AI) has produced a structural transformation of educational contexts, affecting not only tools but the very conditions of educational experience, attention and self-construction (Aiello, Giaconi, 2024). From a sociomaterial perspective, technologies are not neutral supports of teaching action but participate in the organisation of practices, mediating what becomes visible and relevant and co-determining criteria of evaluation (Fenwick, Edwards, & Sawchuk, 2012). Consequently, the pedagogical issue cannot be reduced to assessing the effectiveness of AI on learning outcomes, but concerns the forms of

subjectivity and agency co-produced within increasingly pervasive socio-technical networks (Latour, 2005). Within this framework, the Future of Jobs Report (World Economic Forum, 2025) highlights continuous changes in professions and skill profiles, emphasising the inseparability of technical-digital skills and human capacities. Alongside competencies related to AI, big data and cybersecurity, the report reiterates the centrality of analytical thinking, creativity, resilience, leadership and lifelong learning. These trends, reaffirmed in the 2026 WEF discussions, point to a transition that is not merely technical but cultural and educational, requiring pedagogies capable of integrating digital literacy with critical judgement and responsibility. Education is thus called to prepare individuals to operate in environments where decisions, timings and criteria of validity are distributed among people, interfaces and algorithmic systems (Hutchins, 1995; Clark & Chalmers, 1998). In this context, it becomes relevant to problematise the possible emergence of an “algorithmic self”: a form of subjectivation oriented towards delegation, optimisation and reliance on automated suggestions, where experience is recalibrated according to efficiency and predictability. Critical perspectives on digital societies warn against attention-capturing dispositifs and the outsourcing of thought, which may weaken agency and responsibility. Pedagogically, this raises a crucial question: how can education foster cooperation with AI without ceding judgement and responsibility to algorithmic systems? To address this question, this study adopts co-evolution pedagogy as a theoretical framework, conceiving learning as an emergent dynamic arising from the coupling between organism and environment, mind, body, tools and contexts. This perspective dialogues with enactivism (Maturana & Varela, 1987; Varela et al., 1991) and embodied cognition (Berthoz, 1997; Gomez Paloma, 2013), as well as with distributed cognition, which interprets intelligence as a property of human-artifact systems (Hutchins, 1995). Within this framework, inclusive virtual museums are considered a particularly fertile field of investigation. They are not mere digital reproductions of physical museums but devices that reconfigure perceptual scales, temporalities and interaction, enabling immersive experiences while making algorithmic mediation observable. As “third spaces” between formal and informal learning, they can activate practices of exploration, narration and sharing, supporting learning communities and linking inclusion (Sibilio, 2014), relationship and agency. The present exploratory study, conducted at the University of Salerno, investigates a workshop centred on a virtual museum experience, focusing on: (a) perceived meaningful learning; (b) cooperative dimensions and sense of community; (c) representations and concerns regarding educational AI. In line with WEF trajectories, the aim is not simply to assess satisfaction, but to understand how digital cultural devices can function as laboratories of co-evolution, fostering both technical competencies and critical, relational dispositions.

Theoretical framework

Co-evolution pedagogy assumes that educational processes consist of reciprocal transformations between subjects and environments. Learning is understood as an emergent phenomenon shaped by the interaction of contextual constraints, social practices and biographical trajectories, rather than as linear transmission or individual internalisation. This perspective avoids both reductionist and deterministic interpretations, focusing instead on mediations that render educational experience situated and historically contingent. A first theoretical axis is embodied and situated cognition,

which posits that mental processes are grounded in bodily action and perception, dissolving Cartesian separations between mind and body (Damasio, 1995; Berthoz, 1997). Enactivism further conceptualises knowledge as arising from structural coupling between organism and environment, where knowing consists in enacting a world through action (Maturana & Varela, 1987). In digital and immersive environments, these assumptions are particularly relevant, as interfaces and protocols actively shape perception and experience (Di Tore, 2019). Distributed cognition complements this view by conceptualising intelligence as a property of systems composed of people, artefacts and representations. Tools do not merely assist cognition but reorganise it, redistributing tasks and transforming what becomes possible or relevant (Hutchins, 1995; Clark & Chalmers, 1998). This framework is especially useful for analysing AI-mediated educational scenarios, shifting attention from technological effects to the configuration of practices: what is delegated, simplified or rendered invisible, and what new forms of collaboration may emerge. Actor-Network Theory further contributes by conceptualising social action as an effect of heterogeneous networks of human and non-human actors (Latour, 2005; Di Tore & al. 2023). In education, this entails recognising that teaching orders and participation patterns are stabilised through platforms and infrastructures, and that technological innovation implicitly reorganises roles and agency. AI thus acts as a mediator influencing relevance, credibility and desirability. The literature on AI in education calls for embedding intelligent systems within explicit curricular, ethical and political choices, avoiding both techno-solutionism and technophobia (Holmes et al., 2019; Selwyn, 2019). While AI may support feedback, tutoring and design (Luckin, 2018), its educational value depends on reflective practices that preserve responsibility and judgement. Within this framework, inclusive virtual museums can be interpreted as third spaces where cultural experience becomes an opportunity to exercise interpretative agency and critical literacy. Universal Design for Learning (CAST, 2018) provides necessary principles for accessibility, but inclusion also concerns belonging, recognition and participation. The Flipped Inclusion model (De Giuseppe, 2020) aligns with this view, promoting bottom-up, participatory educational designs. Finally, museum learning literature emphasises the situated and co-constructed nature of meaning-making (Falk & Dierking, 2000; Hein, 1998). Transposed to virtual environments, these insights highlight the importance of pedagogical framing, tasks and dialogue in preventing experiences from degenerating into mere consumption.

2. Materials and Methods

2.1 Context and participants

The study conducted as part of a university class, through a workshop device that involved cooperative work in small groups (3–4 students). Twenty-eight students (mainly between 21 and 29 years old) responded to the pre-test, while 15 students completed the post-test.

2.2 Device and tools

Referring to the Flipped Inclusion model and the E.I.P.S. phases (explore-ideate-design-experiment), the activity involved: 1) exploration of an inclusive virtual museum; 2/3) ideation and design of an inclusive micro-guide oriented towards participation and the comparison of perspectives; 4) experimentation through

the guided use of generative AI to support the description of the experience and the construction of discussion questions.

The data collection tools were:

- a pre-test questionnaire with sections on personal data, previous experiences, perception of meaningful learning in digital activities, sense of community in the course and attitudes towards AI;
- a post-test questionnaire with items on meaningful learning during the visit, sense of community in the activity, and confidence in the use of AI, as well as open-ended questions on inclusion and AI
- a group worksheet focused on the choice of museum object, inclusion criteria, and ethical reflection on AI;

2.3 Data analysis

Quantitative data were analysed using descriptive statistics (frequencies and means on a 5-point Likert scale). Qualitative data (open-ended questions and worksheets) were analysed using thematic analysis (Braun & Clarke, 2006), constructing initial codes and aggregating them into interpretative themes consistent with the co-evolutionary framework.

Table 1. Sample characteristics (pre-test)

Variable	Categories	n	%
Gender	female	18	64.3
Gender	male	10	35.7
Age	17-20	8	28.6
Age	21-29	17	60.7
Age	30-40	3	10.7
Role	University student	27	96.4
Role	other	1	3.6
Virtual museum experience	Yes	8	28.6
Virtual museum experience	No	18	64.3
Virtual museum experience	Don't know	2	7.1

3. Results

3.1 Quantitative results

In the pre-test, most participants had never visited a virtual museum (64.3%). Among those who reported previous experience, the evaluation was predominantly positive (52.6% “interesting” and 21.1% “engaging”). As for the perception of meaningful learning in digital classroom activities (B1), the average was 3.64/5; similarly, the sense of belonging to a learning community in the course (B3) returned an

average of 3.57/5. The attitude towards AI in education (B4: “I am more excited than concerned”) shows a moderately positive trend ($M = 3.21/5$) with a strong concentration on intermediate positions. In the post-test, the visit to the virtual museum was perceived as a meaningful learning experience (A1: $M = 3.73/5$). The most relevant data concerns the sense of community during the activity (A2: $M = 4.07/5$), which was higher than the baseline value recorded in the pretest. Confidence in the use of AI in education after the experience (A3) was also high ($M = 3.73/5$).

3.2 Qualitative outcomes: inclusion and community

The open-ended responses in the pretest show that the expression “inclusive virtual museum” is mainly associated with “accessibility”, “open to all”, “for all”, with less frequent references to community dimensions or co-construction practices. In the post-test, when asked what made the experience inclusive, relational elements emerged strongly: collaboration, listening, comparing points of view, the possibility for “everyone” to participate through group work. Technical accessibility (absence of physical barriers, access from anywhere) is present, but tends to be reported as an enabling condition, not as an exhaustive criterion.

3.3 Qualitative outcomes: educational AI between empowerment and fear

The post-test responses describe AI as a pragmatic support: “it makes everything easier”, “it organises ideas”, “it enriches the experience with immediate and personalised explanations”. At the same time, concerns are highlighted regarding the replacement of the human role, the reliability of information and the risk of simplification. In the worksheet, the groups stated that they had used AI to explain the museum's features, generate keywords and construct discussion questions; AI was considered useful and, in this specific case, did not raise any explicit ethical concerns. An example of inclusive design

One group selected the MAV - Virtual Archaeological Museum (Ercolano, Napoli) and the reconstruction of the eruption of Vesuvius in 79 AD, motivating their choice with the immersive nature and emotional-cognitive impact of the experience. The proposed inclusive micro-guide includes phases of individual observation, plenary sharing, working in pairs to identify details and connections, and collective feedback aimed at enhancing different perspectives and activating metacognition on “what I have learned” by listening to others.

Table 2. Likert indicators (pretest).

Item	N	M	note
Meaningful learning in digital classroom activities (B1)	28	3.64	Scale 1-5
Sense of learning community in the course (B3)	28	3.57	Scale 1-5
AI in education: enthusiasm > concern (B4)	28	3.21	scale 1–5 (estimate)

Table 3. Likert indicators (post-test).

Item	N	M	note
Meaningful learning during the visit (A1)	15	3.73	Scale 1-5
Sense of community during the activity (A2)	15	4.07	Scale 1-5
Confidence in the use of AI in education after the experience (A3)	15	3.73	Scale 1-5

4. Discussion

The results, despite the limitations inherent in an exploratory design and non-equivalent pre- and post-samples, suggest some relevant avenues for interpretation that warrant further investigation. First and foremost, the inclusive virtual museum experience seems to promote not only perceived learning, but above all an increased sense of community during the activity. This indicates that the immersive environment, when embedded in a cooperative and reflective device, does not produce isolation but can intensify dynamics of belonging and co-construction. In co-evolutionary terms, learning emerges as a property of the system: it does not reside in individuals or in the tool, but in the configuration of actions, rules, roles and artefacts that make participation possible. Secondly, the notion of inclusion appears to “shift” in the pre/post transition: initially defined as accessibility (“for all”), it is re-described as relational practice (“teamwork”, “listening”, “discussion”). This shift is pedagogically significant because it signals that inclusion is not only a design requirement of the interface, but also an experience of recognition and agency. The design of the micro-guide, with phases of discussion and metacognition, stages inclusion as the construction of “spaces for speech” and the legitimisation of differences. Thirdly, AI is perceived as an asset for generating ideas and structuring content, while concerns highlight the need for epistemic control and the centrality of the educational relationship. This picture is consistent with the literature, which calls for avoiding the replacement of teachers with automated systems and instead promoting critical integration based on transparency, responsibility and educational goals (Holmes et al., 2019; Selwyn, 2019). In this context, the concept of the “algorithm-self” can be reinterpreted not as destiny, but as an educational task: to train individuals to consciously inhabit algorithmic mediation. This implies making the “traces” of the algorithm visible: what data is mobilised, what implicit criteria guide suggestions and responses, and what alternatives are excluded. A virtual museum, integrated with moments of discussion and design activities, offers a concrete context for such an operation. In line with what emerged, including in the panel’s reflections, we propose the idea of a “radically extended pedagogy”: a pedagogy that recognises the extension of educational experience beyond the classroom, takes technology as an

environment and not just as a tool, and builds practices of reflective agency. According to Actor-Network Theory, we need to educate people to “reassemble” networks: to understand how actions and decisions are composed, and how it is possible to step in to redistribute power and responsibility (Latour, 2005). From a design perspective, the data indicate certain conditions: (a) structuring authentic tasks (exploring, choosing, narrating, guiding); (b) setting up cooperative roles and moments of feedback that make participation observable; (c) using AI as an object of reflection, not just as an operational “shortcut”, introducing practices of verification and discussion on reliability; (d) orienting inclusion towards a convergence between accessibility, belonging and the possibility of contributing (CAST, 2018). Finally, the study points to the need for further research: larger samples, longitudinal designs, measures of learning beyond perception, and finer analyses of discursive practices in groups. A promising trajectory is to examine how the use of generative AI changes the distribution of attention and the quality of argumentation, and how Flipped Inclusion devices can support equity and participation in immersive environments (De Giuseppe, 2020).

5. Conclusions

Based on the data collected, we would like to outline some operational implications consistent with the theoretical framework of reference:

- Designing the experience as an ecology of practices. The virtual museum alone does not guarantee inclusion or learning: it becomes educational when it is embedded in a web of practices (choice, guided exploration, narration, discussion, metacognition) that make students co-authors of the experience. From an ecological-systemic perspective, the unit of analysis is not the individual, but socially organised activity; this recalls socio-cultural approaches that see learning as participation in meaningful practices (Vygotsky, 1978; Wenger, 1998) and as the transformation of activity systems (Engeström, 1987).
- Shaping “strong” inclusion. Students' responses show that inclusion is recognised when everyone can contribute and when difference becomes an interpretative resource. This results in a “strong” inclusion criterion: not only access to experience (reduction of barriers), but also distribution of opportunities to speak, responsibility and visibility of contributions. In this perspective, the UDL guidelines (CAST, 2018) can be integrated with attention to the community dimension: for example, setting up rotating roles (facilitator, observer, narrator, verifier), co-evaluation tools and feedback moments that publicly recognise contributions.
- Making AI a subject of critical literacy. The use of generative AI in the laboratory served as scaffolding for the production of keywords and questions; however, its very “convenience” can fuel epistemic delegation. To prevent this risk, recurring teaching practices are recommended: comparing AI responses with authoritative sources; explaining prompts and discussing their influence; identifying errors and distortions; analysing the “tone” of responses and implicit assumptions. In short, it is not enough to use AI: we need to teach people to “dialogue” with AI in a competent and responsible manner.

- Making algorithmic action visible in immersive contexts. In virtual museums, many decisions are embedded in the interface (sequences, zooms, suggested routes, reconstructions). A co-evolutionary pedagogy can enhance these elements by raising questions: who decides what is “central”? Which alternatives are marginalised? What data and models support the reconstruction? This problematisation translates ANT into educational practice: students learn to read the network of mediations that makes the experience possible (Latour, 2005).
- Train teachers and trainers as “environment designers”. If learning is co-evolutionary, the educational role is not reduced to transmission, but consists in designing conditions and curating the quality of interactions. In this sense, inclusive virtual museums also represent a useful space for initial and in-service training: they allow for the safe experimentation of facilitation strategies, discussion management, formative assessment and technological mediation. The Flipped Inclusion model (De Giuseppe, 2020) offers a reference point for designing pathways in which the class becomes a community of practice and in which technologies are integrated within an ethic of participation.

In conclusion, the exploratory study shows that the inclusive virtual museum, embedded in a cooperative and reflective device, can activate perceived meaningful learning and, above all, strengthen the sense of community during the experience. Representations of inclusion tend to shift from a predominantly technical-accessible definition to a relational and participatory definition. AI is welcomed as a useful support, but requires epistemic control practices and critical awareness. Taken as a whole, the experience suggests that a pedagogy of co-evolution can find in inclusive virtual museums a privileged laboratory for training individuals capable of negotiating algorithmic action: an “Algorithmic Self” not reduced to delegation, but oriented towards responsibility, interpretation and care for relationships.

References

- Aiello, P., Giaconi, C. (2024). *L'Agire inclusivo. Interfacce pedagogiche e didattiche*. Scholé
- Berthoz, A. (1997). *Le sens du mouvement*. Odile Jacob.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- CAST. (2018). *Universal Design for Learning Guidelines version 2.2*. CAST.
- Clark, A., & Chalmers, D. (1998). *The extended mind. analysis*, 58(1), 7-19.
- Corona, F., De Giuseppe, T. (2017). *Flipped Inclusion. Innovazione didattica e Universal Design for Learning*. Milano: FrancoAngeli.
- Damasio, A. R. (1995). Review: toward a neurobiology of emotion and feeling: operational concepts and hypotheses. *The Neuroscientist*, 1(1), 19-25.
- De Giuseppe, T., & Corona, F. (2017). Flipped inclusion per una didattica trasformativa. In P. Magnoler, A. M. Notti, & L. Perla (a cura di), *La professionalità degli insegnanti: La ricerca e le pratiche* (pp. 551–570). Pensa Multimedia.

- De Giuseppe, T. (2020). The transformativity of the Flipped Inclusion model, between anthropocentric ergonomics of social capital and ecological-systemic empowerment. *Information*, 11(8), 398. <https://doi.org/10.3390/info11080398>
- Di Tore, P. A. (2019). *Embodied Education e tecnologie. Corpo, media e ambienti di apprendimento*. Milano: FrancoAngeli.
- Di Tore, P. A., Sibilio, M., Todino, M. D. (2023). *Corpo, media e ambienti inclusivi. Prospettive pedagogiche e tecnologiche*. Roma: Carocci.
- Di Tore, P. A., Di Tore, S., Todino, M. D., Schiavo, F., Iannaccone, A., & Sibilio, M. (2023). Accessibilità, Digital Twin e Philosophy of Design: Il progetto ScanItaly tra nuove prospettive di accesso al patrimonio storico, artistico e culturale e nuove questioni semiotiche. *Italian Journal of Special Education for Inclusion*, 11(2), 35–40.
- Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Orienta-Konsultit.
- Falk, J. H., & Dierking, L. D. (2000). *Learning from museums: Visitor experiences and the making of meaning*. AltaMira Press.
- Fenwick, T., Edwards, R., & Sawchuk, P. (2012). *Emerging Approaches to Educational Research: Tracing the Socio-Material* (1st ed.). Routledge. <https://doi.org/10.4324/9780203817582>
- Gomez Paloma, F. (2013). *Embodied cognition science. Atti incarnati nella didattica*. Edizioni Nuova Cultura.
- Hein, G. E. (1998). *Learning in the museum*. Routledge.
- Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.
- Hutchins, E. (1995). *Cognition in the wild*. Cambridge, MA: MIT Press.
- Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford University Press.
- Luckin, R. (2018). *Machine learning and human intelligence: The future of education for the 21st century*. UCL IOE Press.
- Maturana, H. R., & Varela, F. J. (1987). *The tree of knowledge: The biological roots of human understanding*. New Science Library/Shambhala Publications.
- Rivoltella, P. C. (2012). *Neurodidattica: Insegnare al cervello che apprende*. Raffaello Cortina.
- Selwyn, N. (2019). *Should robots replace teachers? AI and the future of education*. Polity Press.
- Sibilio, M. (2014). *Didattica per i bisogni speciali. Prospettive inclusive per l'apprendimento*. Roma: Carocci.
- Varela, F. J., Rosch, E., & Thompson, E. (1991). *The embodied mind. The embodied mind: Cognitive science and human experience*.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.
- World Economic Forum. (2025). The Future of Jobs.