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Gesture, Matter and Media in Learning: an Ecological-Embodied Approach.

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Abstract: The paper argues that learning emerges from the interplay of gesture, materials and media within extended pedagogical ecologies. From an enactive perspective, knowledge is generated through embodied action and the history of organism–environment couplings (Varela, Thompson, & Rosch, 1991), and is further clarified by an ecological view of mind that understands the brain as mediating a relational field distributed across the body and across social and material interactions (Fuchs, 2021). Empirically, the paper reports data from 325 teachers enrolled in the fifth cycle of the 30-CFU qualifying courses (ex art. 13) at e-Campus University, using aneight-dimension instrument. Findings show broad agreement on the importance of integrating body and movement, but also reveal limited specialist training and a gap between the value attributed to embodied approaches and their actual use; classroom climate, participation and inclusion are associated with the perceived quality of gesture–matter–media co-ordination (Maggi, Balestra, & Zappa, 2025). Operationally, the paper proposes design criteria aligned with UDL and backward design to make inclusive forms of participation observable and practicable (CAST, 2018; Wiggins & McTighe, 2005; Rose & Meyer, 2002).

Keywords: Embodied learning, Enactive design, Extended learning ecologies

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1. Introduction

In recent years, pedagogical and didactic reflection has intensified its attention to the ways in which learning environments shape not only access to content, but also the quality of experience, participation and students' sense of belonging. Within this framework, the body does not represent one "channel" among others; rather, it is the concrete condition through which experience takes form: perceiving, moving, and coordinating with others and with objects are constitutive parts of knowing and of making sense of what one does in the classroom (Merleau-Ponty, 2003; Sheets-Johnstone, 2011).

Taking this position seriously also entails moving beyond two recurring simplifications: on the one hand, dualism, which separates mind and body as though they were independent domains; and on the other, reductionism, which tends to identify experience solely with brain activity. The embodied and ecological perspective instead situates cognition within a space of relations: the mind is not an "internal" entity, but a process that takes shape through transactions among body, environment, tools and social practices (Fuchs, 2021; Varela, Thompson, & Rosch, 1991). In the same direction, a logic of integration invites us to understand learning as at once embodied

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(incarnate) and embedded (situated within practices and the socio-material mediations of the environment) (Bertagna, 2022).

Within this framework, Embodied Education can be understood as a design-oriented approach that translates the idea of the embodied mind into observable pedagogical choices. In particular, it considers how time is organised, what kinds of tasks are proposed, which materials and media are made available, and which routines support shared attention and elaboration. Building on these assumptions, this paper aims—through empirical data—to clarify the extent to which teachers recognise the value of such practices, how consistently they adopt them, and which conditions facilitate or hinder their everyday feasibility (Maggi, Balestra, & Zappa, 2025; Shapiro, 2011).

2. Theoretical framework

Within the enactive paradigm, cognition is not described as a system that processes representations of an already-defined external world; rather, a meaningful world emerges from embodied action and from the history of sensorimotor couplings between organism and environment. This orientation changes how we conceive learning, leading us to argue that the act of understanding is grounded in gestures, postures, explorations and co-ordinations, and that knowledge stabilises as situated competence rather than as mere transferable "content" (Varela, Thompson, & Rosch, 1991; Shapiro, 2011).

A distinctive feature of Varela–Thompson–Rosch's proposal is the methodological dialogue between cognitive science and phenomenology: lived experience is treated as an investigable field, not as an irrelevant subjective residue. Within this framework, reflection on attention and awareness—including through contemplative practices—is not an "extra-scientific" addition, but a way of making more rigorous the relationship between what we study (cognition) and how we study it (the methods and categories through which we describe experience). This yields a circularity whereby science guides the interpretation of experience while, at the same time, experience reorients the questions of science (Varela, Thompson, & Rosch, 1991; Merleau-Ponty, 2003). Starting from related assumptions, Fuchs situates embodiment within an explicitly ecological perspective: the brain is not denied, but repositioned as an organ of mediation within a wider system. On this view, consciousness and competence are not "produced" in isolation; rather, they emerge from an ongoing resonance among bodily processes, the material environment and intersubjective relations. The subject is understood as a person-in-the-world, and the mind as a distributed field that traverses body, practices and contexts (Fuchs, 2021).

This shift is particularly fruitful in education because it allows many difficulties to be read not as "individual deficits", but as frictions within the ecology of action: rigid spaces, tasks poorly integrated with experience, routines lacking opportunities for reworking, and media used merely for content delivery can reduce opportunities for co-ordination, participation and mutual recognition. In other words, designing environments and activities means intervening in conditions of possibility, not only in personal dispositions or motivation (Fuchs, 2021; Hill, Wilson, & Watson, 2004).

If cognition is embodied action, then gesture, materials and tools should not be thought of as separate "ingredients" added after the fact. Gesture supports thought by making relations, quantities and transformations visible and manipulable; mat-

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ter—natural or artificial—introduces affordances and resistances that guide exploration; and media, both analogue and digital, can extend and render shareable processes that would otherwise remain ephemeral. From this perspective, meaning takes shape in an entanglement: it does not "pass" through a channel, but emerges from the orchestration of doing (Gibson, 1979; Goldin-Meadow, 2003; Malafouris, 2013). This approach also helps to clarify why the multisensory dimension is not a mere enrichment: the literature shows benefits of sensory integration for learning and memory, especially when perceptual modalities are aligned with the task and with the conceptual structure being built. Multisensoriality, however, requires direction: it is not enough to multiply stimuli; actions and representations must be co-ordinated so that experience becomes intelligible and socially shareable (Shams & Seitz, 2008; Skulmowski & Rey, 2018).

The move towards design can be framed as the construction of extended pedagogical ecologies—namely, environments that integrate indoor and outdoor settings, moments of exploration and moments of formalisation, bodily mediations and artefacts, while maintaining continuity between experience and conceptualisation. Within this framework, space is not a neutral backdrop but a pedagogical device, insofar as it arranges bodies and gazes, makes certain forms of interaction possible or impossible, and stabilises routines and classroom cultures (Hill, Wilson, & Watson, 2004; Gomez Paloma, Damiani, & Borrelli, 2019). To translate this vision into practicable routines, research on embodied learning proposes principles that help avoid two opposing risks: on the one hand, reducing embodiment to merely "decorative" movement; on the other, piling up bodily activities that are not integrated with cognitive aims. The key issue is the integration of body and task—in other words, the extent to which bodily engagement is functional to conceptual construction and is incorporated into cycles of representation, reflection and checking (Lindgren & Johnson-Glenberg, 2013; Skulmowski & Rey, 2018).

In this scenario, inclusion does not coincide with post-hoc adaptation, but with a quality of design: preventing barriers means multiplying routes for access, expression and engagement without losing intentionality and evidential criteria. UDL provides a grammar for building environments that acknowledge variability and turn it into a resource; linking it to backward design makes it possible to define authentic performances and observable goals, avoiding the risk that embodiment remains a generic label (CAST, 2018; Rose & Meyer, 2002; Wiggins & McTighe, 2005).

From this perspective, gesture–matter–media become inclusive levers because they enable students to enter the task with different perceptual styles and to make thinking visible through plural forms of action. Embodied design can thus support, in a non-stigmatising way, students with SEN and disabilities, broadening channels of participation and fostering a more co-operative classroom climate that is less centred on standardised verbal performance (CAST, 2018; Maggi, Balestra, & Zappa, 2025).

3. Aims, research questions and hypotheses

The overall aim is to explore how teachers perceive the value and practicability of Embodied Education, with particular attention to the co-ordination between gesture, materials/artefacts and media, and to its implications for relational climate, participation and inclusion. More operationally, the study seeks to: (a) describe levels of familiarity with the construct and the presence of specific training; (b) identify the frequency of use of embodied and multisensory practices; (c) pinpoint recurring

barriers linked to setting and school culture; and (d) examine associations between the perceived quality of practices and indicators of inclusive participation (Maggi, Balestra, & Zappa, 2025; Shapiro, 2011).

Consistent with the theoretical framework, the guiding hypothesis assumes that a more intentional co-ordination between gesture, matter and media is associated with more positive perceptions of classroom climate, engagement and inclusion, and that this relationship is moderated by contextual factors (training, spatial configurability, routines). In this formulation, climate is not a mere "outcome", but a condition of possibility that either supports or weakens the translation of pedagogical intentions into stable practices (Fuchs, 2021; Maggi, Balestra, & Zappa, 2025).

4. Method

An exploratory study with a predominantly quantitative orientation was conducted, integrating open-ended responses, with teachers enrolled in the qualifying pathways (325 teachers enrolled in the fifth cycle of the 30 CFU qualifying courses (ex art. 13) at e-Campus University). The design is descriptive–correlational: it aims to provide a snapshot of perceptions and practices and to identify relationships between variables, without making strong causal claims, consistent with the self-reported nature of the data (Maggi, Balestra, & Zappa, 2025; Skulmowski & Rey, 2018).

The sample comprises 325 teachers. The distribution by school level is used in comparative analyses to explore differences in perceptions of the value of multisensoriality and in the adoption of embodied practices, with particular attention to the distinction between primary and secondary education (Maggi, Balestra, & Zappa, 2025).

Data were collected through a questionnaire structured around eight dimensions, designed to measure: knowledge of the term and specific training; the importance attributed to integrating body and movement; frequency of use of embodied practices; perceptions of relational climate; indicators of participation and inclusion; barriers related to space and professional context; and the role of materials and media as mediators of activity. The scale shows good overall reliability (Maggi, Balestra, & Zappa, 2025).

Descriptive statistics were used to examine response distributions; comparative analyses (ANOVA) to test differences across school levels; and Spearman correlations to explore associations between perceived importance and frequency of use, as well as between the perceived quality of practices and variables related to climate, participation and inclusion. Open-ended responses were read thematically to identify recurring themes related to tasks, routines and setting constraints (Maggi, Balestra, & Zappa, 2025; Hill et al., 2004).

5. Results

The findings show that only a minority of teachers have undertaken specific training in Embodied Education (16.8%), and that familiarity with the term concerns 39.8% of the sample. Despite this, there is very strong endorsement of the importance of integrating body and movement within teaching–learning processes (97.3%), alongside a high mean rating for the importance of multisensory components (4.3/5). This pattern suggests a widespread "intuitive" awareness that is not always supported

by formalised theoretical frameworks (Maggi, Balestra, & Zappa, 2025; Shapiro, 2011).

Analysis by school level indicates that primary teachers attribute significantly greater "synesthetic" value than their colleagues in lower and upper secondary education ($p < 0.05$; Cohen's $d = 0.67–0.77$). This result can be interpreted as an effect of differing pedagogical cultures: in primary education there is a stronger orientation towards integrating experience, objects and languages, whereas in secondary education disciplinary and organisational arrangements can constrain embodied design and make it less practicable (Gomez Paloma et al., 2019; Maggi, Balestra, & Zappa, 2025).

The Spearman correlation between perceived importance and the reported frequency of embodied activities is positive but moderate ($\rho = 0.2254$; $p = 0.0076$). This is noteworthy because it shows that valuing an approach does not automatically translate into implementation: moving from conviction to practice requires design competencies, resources and stable routines that make embodiment an ordinary part of classroom work (Lindgren & Johnson-Glenberg, 2013; Maggi, Balestra, & Zappa, 2025).

Teachers who attach greater value to embodied and synesthetic practices also report a more positive relational climate; moreover, students' participation is described as more active and engaged when gestures, materials and media are intentionally co-ordinated within activities. In parallel, embodied/multisensory practices are perceived as important levers for including students with different perceptual styles, supporting those with SEN and disabilities, and broadening modes of access, expression and engagement. Overall, classroom climate, participation and inclusion are positively associated with the perceived quality of gesture–matter–media ecologies (CAST, 2018; Maggi, Balestra, & Zappa, 2025).

6. Discussion

Taken together, the data present a picture that is consistent with the relevant literature: embodiment is perceived as relevant and promising, yet it encounters difficulties in becoming a regular practice. The moderate correlation between perceived importance and frequency of use, together with differences by school level, suggests that the issue concerns not only individual attitudes but also the interaction between training, institutional culture and contextual configurations. In other words, adopting embodied practices is not a one-off "choice", but a shift in pedagogical ecology (Gomez Paloma et al., 2019; Maggi, Balestra, & Zappa, 2025).

Read through an enactive lens, this gap can be interpreted as a difficulty in stabilising coherent couplings between experience and formalisation: when tasks remain predominantly verbal and representational, gesture and matter are reduced to accessories; when they are integrated into the structure of the activity, they support the emergence of meaning and make thinking shareable. The challenge, therefore, is not simply to "do more movement", but to design actions that are pertinent to the content and to accompany them with routines for elaboration and reflection (Skulmowski & Rey, 2018; Varela, Thompson, & Rosch, 1991).

Fuchs' contribution allows the problem to be specified further by emphasising that many barriers can be read as fractures in the ecology of the person-in-context. If mind and learning are distributed processes, then rigid spaces, compressed timetables and limited opportunities for material manipulation reduce occasions for resonance and co-ordination, with effects on classroom climate and participation. This suggests

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that training and organisational policies should act on the conditions that mediate experience, rather than merely prescribing "innovative" methods (Fuchs, 2021; Hill et al., 2004).

Finally, alignment with UDL and backward design offers a route to making Embodied Education more observable and assessable: defining authentic performances, evidential criteria and multiple options for access and expression can transform embodiment from a general framework into a concrete design strategy, with direct implications for inclusion and for the quality of classroom climate (CAST, 2018; Rose & Meyer, 2002; Wiggins & McTighe, 2005).

7. Design implications: operational criteria for co-ordinating body, spaces and media

A first implication concerns the design of *gesture-first* tasks: starting the learning pathway from action and gesture (exploration, manipulation, simulation) and then progressively moving towards formalisation makes it possible to maintain continuity between experience and concept, reducing the risk of "disembodied" knowledge that is difficult to transfer. In this direction, body–task integration must be high: movement is not a backdrop, but part of the activity's cognitive structure (Lindgren & Johnson-Glenberg, 2013; Varela et al., 1991).

Second, materials and spaces should be treated as co-agents: surfaces, objects, artefacts and tools (including digital ones) introduce constraints and possibilities that can support, guide or hinder competent action. Designing extended ecologies means making these elements intentional: selecting materials that "make one think", setting up flexible spatial configurations, and alternating indoor/outdoor settings in relation to objectives, so as to distribute opportunities for participation (Gibson, 1979; Malafouris, 2013; Hill et al., 2004).

A third criterion concerns the use of media for documentation and sharing: photographs, videos, maps, graphic traces and recordings do not serve merely to "preserve" experience, but to make it an object for debriefing, reflection and the negotiation of meaning. When integrated into the task, such documentation makes it possible to render visible classroom transformations and differences in ways of understanding, thereby supporting inclusion and metacognition (Goldin-Meadow, 2003; Shams & Seitz, 2008; Skulmowski & Rey, 2018).

Finally, UDL and backward design help translate these criteria into verifiable design by defining evidence of learning, using a participation rubric, and offering multiple options for representation and action that engage students with diverse profiles without reducing complexity. In this sense, the gesture–matter–media ecology becomes a device for equity and broadens legitimate ways of "being in the task", reducing reliance on a single expressive mode (CAST, 2018; Rose & Meyer, 2002; Wiggins & McTighe, 2005).

8. Limitations, future directions and conclusions

The study has limitations related to the nature of the sample (non-probabilistic and drawn from a single training context) and to the predominance of self-report measures; the reported practices are not triangulated with direct observations, and the findings should be read as a snapshot of teachers' "embodied/synesthetic awareness"

rather than as an exhaustive measure of teaching effectiveness (Maggi, Balestra, & Zappa, 2025; Skulmowski & Rey, 2018).

Future directions concern, first, longitudinal and quasi-experimental studies using multimodal instruments sensitive to the perceptual, gestural and environmental dimensions of learning. In addition, the analysis of teacher profiles (bodily routines, spatial configurability, attitudes towards materials and media) appears promising for supporting situated training and personalised professional development. Finally, the integration of indoor–outdoor learning warrants further investigation as a lever for continuity between experience and formalisation, and as an inclusive resource (Hill et al., 2004; Maggi & Balestra, 2025; Maggi, Balestra, & Zappa, 2025).

In conclusion, the paper confirms that Embodied Education is widely recognised by teachers as a crucial dimension of learning, yet translating it into regular practice requires clear ecological conditions—for example, theory–practice training, reconfigurable spaces, "thinking" materials, routines for reworking experience, and a use of media oriented towards documentation and sharing. In this direction, the enactive framework and the ecology of mind help us to read learning as a distributed process, showing why intervening on environments and mediations is not a logistical detail but a central pedagogical action (Fuchs, 2021; Varela et al., 1991). Co-ordinating gesture, matter and media means designing conditions in which meaning can emerge and circulate within the group, supporting participation and inclusion not as ancillary aims but as indicators of the quality of the educational experience. Connecting this work to UDL and backward design makes such design observable and demonstrable, fostering an embodied pedagogy capable of stabilising in everyday practice and of engaging with the demands for equity and complexity in contemporary schooling (CAST, 2018; Rose & Meyer, 2002; Wiggins & McTighe, 2005).

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