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When machines imagine. A pedagogy of artificial imagination for educational engagement

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Abstract: Generative artificial intelligence intervenes in the domain of imagination by making images, narratives, and possible worlds immediately available, often preceding the learner's own exploration and elaboration. Drawing on theoretical analysis and empirical evidence, this paper brings Munari's distinction among fantasy, invention, creativity, and imagination into dialogue with sociocultural approaches and theories of material engagement. It conceptualises artificial imagination as a transformation of the symbolic and material environment in which human imaginative activity unfolds, without attributing imagination, in the human sense, to AI systems. Techno-material plasticity describes the twofold influence of technological devices: they shape the conditions of generation and enable subsequent transformations of generated forms. Research on learning, engagement, and creativity indicates educational potential alongside risks of fixation, homogenisation, and delegation. On this basis, the paper outlines a pedagogy of engagement centred on learners' interpretive agency: autonomous elaboration before generation, critical examination of errors and impossibilities, manipulation and recomposition of outputs, and reflective documentation of processes. The educational value of generation depends on treating outputs as material for further elaboration while preserving the time required for experience, judgement, and learner authorship.

Keywords: Generative artificial intelligence; artificial imagination; techno-material plasticity; educational engagement.

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1. Image, Imagination, and Experience: A Pedagogical Genealogy of the Possible*

Imagination constitutes a mode of processing experience through which memory, perception, affectivity, and knowledge converge in the configuration of possibilities that do not coincide with the immediately given. Its combinatorial activity does not unfold in an abstract space; rather, it takes shape within historically situated symbolic repertoires, languages, practices, and tools. The sociocultural perspective has restored its relational, individual, and collective nature, recognising in the model of the imagination loop a recursive dynamic: experience nourishes imaginative elaboration, while the resulting configurations, as they become sedimented in artefacts and practices,

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feed back into the cultural environment and reshape the conditions for subsequent acts of imagination (Zittoun et al., 2020).

The centrality of images in the production and circulation of meaning renders this relationship particularly significant. Visual representation is not a neutral support for already elaborated content: it helps organise the field of the visible, directs attention, and makes available repertoires through which the world is recognised and narrated. Visual literacy, in its theoretical complexity and situated, multimodal nature, therefore concerns the cultural practices through which visual meanings are produced, interpreted, and negotiated (Avgerinou & Ericson, 1997; Serafini, 2017). Educating the gaze entails interrogating representational conventions, contexts of production, and the perspectives that delimit what can be seen and thought.

The technical transformation of images introduces a discontinuity that affects the very status of perceptual experience. Reproducibility alters the relationship between artwork, reception, and tradition, reconfiguring the conditions under which the visible circulates and is appropriated; Benjamin's notion of the optical unconscious further identifies the capacity of devices to disclose dimensions of reality that elude ordinary perception (Benjamin, 2011). In Berlin Childhood around 1900, memory is instead composed through constellations of places, objects, and sensory details in which the material trace reactivates the past in the present (Benjamin, 2007). Remembrance thus assumes a critical function, escaping the linearity of biographical reconstruction. The category of Denkbild, whose attribution to Benjamin has been problematised by critical reception (Koenig, 2017), makes it possible to examine configurations in which the visible prompts an activity of thought that exceeds its own self-evidence.

Deleuze's distinction between the movement-image and the time-image further articulates the relationship between the organisation of the visible and the temporality of experience. The sensory-motor linkage, in which perception extends into action, is countered by the crisis of the action-image, which gives rise to configurations that interrupt immediate response and make perceptible durations and temporal relations no longer subordinated to action (Deleuze, 1984, 1989). Without transferring these categories directly to the analysis of generative systems, they allow us to conceive of the image as a device of temporalisation: it may reinforce established perceptual patterns or suspend their automatic operation, opening interpretive intervals and unexpected connections.

The distinction between the reproductive and combinatorial activity of imagination (Vygotskij, 1972) reconnects this genealogy with the constitutive relationship between experience and the production of the possible. Combination does not introduce elements ex nihilo; rather, it reconfigures acquired materials, altering their relations and potential uses. Imagination is rooted in reality precisely insofar as it exceeds its sedimented configurations; this excess depends on the diversity of experience, the availability of cultural repertoires, and the mediations through which they are reworked. Sociocultural developments of the Vygotskian perspective have further examined the role of mediation and educational conditions in the development of creativity (Ayman-Nolley, 1992; Gajdamaschko, 2005).

The recursive relationship between imagination and reality acquires further significance when the configurations produced become sedimented in material and cultural forms that re-enter experience, modifying the repertoires from which subsequent elaborations emerge (Zittoun et al., 2020). It is within this circularity that algorithmic

generation introduces a specific problem: it makes configurations available without traversing the experiential and intentional processes proper to human imaginative activity. The issue is not to attribute a faculty of imagination to these systems, but to investigate how generated images enter experience and reconfigure its possibilities. They may prompt appropriation and transformation or anticipate the subject's own elaboration, narrowing the search to forms that have already been configured. The tension between the technical availability of representations and interpretive autonomy provides the premise for a pedagogy of artificial imagination.

2. The Technological Matter of Imagination: Before and After the Image

The transition from workshop practices to generative environments requires an examination of the role of technology in the constitution of imaginative activity. Tools establish the conditions within which certain possibilities become accessible. Malafouris's (2013) Material Engagement Theory recognises the constitutive participation of artefacts in cognitive processes; Ingold (2019) understands making as a correspondence between subjects and materials, in which form emerges through interaction.

Technology operates before the image appears: every tool makes certain operations available and orients the field of possible solutions without determining their outcome. Simondon (1958/2017) moves beyond a merely instrumental conception of the technical object, situating it within its own genesis and its relationship with the associated milieu; Aires (2025) extends this perspective to computational models. In generative systems, training data, architecture, interface, and parameters configure the field of production. Manovich (2026) identifies in probabilistic generation a tension between variability and control, together with a tendency to reproduce conventions sedimented in training repertoires. The image therefore bears the traces of a technical and cultural configuration that precedes the user's intervention.

Technology's function continues after generation. An image may be selected, cropped, annotated, broken down, juxtaposed with other representations, or translated into different languages; the resulting form thus becomes a new point of departure. Manipulation intervenes in the conditions through which the object is perceived and thought (Malafouris, 2013). It is within this subsequent temporality that the distinction between generation and co-creation emerges: the former may end with a prompt and the receipt of a result, whereas the latter entails a sequence of exchanges in which the subject formulates intentions, evaluates responses, introduces corrections, and reorganises the work. Drawing on three studies of human–GenAI co-creation, Luan, Kim, and Zhou (2025) show that joint creativity does not automatically follow from repeated interactions, but depends on the shared development of ideas, the exchange of feedback, and iterative refinement.

This paper proposes the term techno-material plasticity of imagination to describe the relational condition through which tools and devices intervene both in configuring the possibilities available to imagination and in transforming the forms produced. The antecedent dimension concerns the technical, symbolic, and operational conditions that configure the field of generation; the subsequent dimension concerns the operations through which images are interpreted, modified, and recomposed. The concept designates neither an intrinsic property of technology nor a faculty attributable to artificial systems; rather, it identifies the dynamic through which subjects, cultural repertoires, devices, and materials jointly organise and rework the field of imagination.

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The abundance of available forms does not in itself entail an expansion of imaginative experience. When a result is accepted without interpretation, selection, and transformation, the speed of generation may contract the time required for elaboration; when an image is treated as incomplete and modifiable material, it can reopen the process and prompt further configurations. This issue is situated within the broader transformation of algorithmic mediation and datafied educational environments (Malara & Sammarro, 2025; Panciroli & Rivoltella, 2023). Techno-material plasticity thus brings the problem back to pedagogical responsibility: making technical mediations intelligible, interrogating the repertoires made available, and establishing conditions in which generation supports, rather than absorbs, the subject's initiative.

3. Artificial Imagination in Educational Research: Possibilities and Evidence

Evidence on the use of GenAI in learning and creativity is heterogeneous in terms of constructs, tasks, and contexts. It is necessary to distinguish product performance from process quality: increased efficiency or output does not necessarily document the development of the subject's competences.

Meta-analyses report generally favourable effects, although these are conditioned by contextual and methodological variables. Synthesising 68 experimental and quasi-experimental studies, Han, Peng, and Liu (2025) identify a positive effect of GenAI, moderated by educational level, discipline, and intervention duration. Based on 57 university-level studies, Chen and Cheung (2025) report improvements in language skills, academic performance, motivation, and some higher-order thinking components, but no significant effect on metacognition. Improved performance, therefore, is not equivalent to the development of the capacity to regulate one's own learning autonomously.

Across 17 studies involving 1,735 students, the meta-analysis by Heung and Chiu (2025) identifies a moderate positive effect of ChatGPT on behavioural, cognitive, and emotional engagement, while also pointing to the risk of disengagement associated with dependence on the tool. Feedback and personalised materials may support participation; the immediacy of responses may instead reduce cognitive investment when the system takes over problem formulation and evaluation. Engagement cannot be inferred from the frequency of interactions, but from the quality of the activity they sustain.

Studies of divergent thinking yield significant but circumscribed findings. Comparing 151 participants with GPT-4 across three tasks, Hubert, Awa, and Zabelina (2024) report superior model performance in originality and elaboration. This finding concerns standardised tests and cannot be equated with the creative process as a whole, which also involves problem definition, selection, and contextualisation. In a university course on creative thinking, Habib et al. (2024) find that ChatGPT-3 can support certain dimensions of divergent thinking, while also potentially affecting creative confidence negatively and excessively directing students' elaboration.

Design fixation makes the ambivalence of generative stimuli particularly evident. In an experiment involving 60 participants, Wadinambiarachchi et al. (2024) observe that the use of generated images may increase fixation on an initial example: the richness of a stimulus does not necessarily expand the range of solutions. At the collective level, Doshi and Hauser (2024) find that AI-generated ideas improve the evaluation of individual stories while making the resulting products more similar. Individual gains may therefore be accompanied by a contraction of diversity.

Co-creation depends on the configuration of interaction and the distribution of initiative. McGuire, De Cremer, and Van de Cruys (2024), in their studies of poetry writing, show that interface design affects creativity and self-efficacy; Luan et al. (2025) highlight the role of feedback and the iterative development of ideas. Collaboration, therefore, is not an automatic property of human–machine interaction.
A joint reading of these findings requires a distinction among assisted performance, competence development, and the quality of the educational experience. A more elaborate product does not necessarily document a greater capacity for elaboration; frequent interaction does not attest to reflective engagement. Limited samples, short interventions, and experimental tasks also constrain the generalisability of the findings: divergent-thinking tests measure specific components of creativity, not the complexity of imaginative processes. The evidence warrants neither a celebratory reading nor a pre-emptive rejection: it shows that the device may support some components of learning while interfering with others when the availability of answers anticipates the subject's own elaboration. The educational value of technological expansion depends on the operations performed on the available forms.

4. Practices of Artificial Imagination: A Pedagogy of Engagement

The pedagogical proposal treats algorithmic generation as material to be incorporated into processes of interpretation and transformation. An image acquires educational significance when the subject formulates intentions, compares alternatives, exercises judgement, and attributes meaning to the forms encountered, within an interpretive dynamic in which tools and symbolic repertoires participate in the construction of meaning (Bruner, 2001; Ricoeur, 1989).
UNESCO's framework organises students' AI competences around human-centred, ethical, technical and applied, and system-design dimensions, across the levels of understanding, application, and creation (Miao et al., 2024). The Council of Europe's Recommendation CM/Rec(2026)12 integrates human, technological, and practical dimensions, foregrounding dignity, autonomy, social agency, and equity (Council of Europe, 2026). Critical literacy therefore encompasses the recognition, understanding, use, evaluation, and ethical navigation of AI systems (Veldhuis et al., 2025).
A first strand of practice preserves an interval of elaboration prior to generation: starting from a theme or narrative situation, students develop an autonomous representation and only afterwards compare it with the system's output. This comparison makes discrepancies, omissions, stereotypes, and unexpected solutions observable, while documenting the initial intention. Delaying algorithmic intervention responds to evidence concerning fixation induced by exposure to generated images during ideation (Wadinambiarachchi et al., 2024).
A second strand takes the impossible and error as heuristic devices. Contradictory prompts or scenarios that depart from representational conventions make the repertoires mobilised by the model observable; inconsistencies and stereotypes are interrogated before the prompt is reformulated. Error thus becomes an indicator of the technical and cultural conditions of generation and reactivates Munari's distinction between fantasy and invention (Munari, 2017).
A third strand concerns the transformation of the output: treated as a provisional form, the image may be cropped, annotated, drawn over, recomposed, or translated into other languages. Manipulation may extend to narrative construction, by examining what precedes or follows the scene and what it leaves undetermined. The system

may be brought back into the process, provided that prompts derive from reasoned decisions. The generated form thus re-enters experience as material for further elaboration (Malafouris, 2013; Munari, 2017).

Assessment should take the process as its unit of observation: the aesthetic quality of the generated image is insufficient, since the product also depends on the system's capabilities. It is necessary to document intentions, prompts, alternatives, decisions, and transformations. Five observational dimensions are proposed—initiative, interpretive and comparative capacity, decision-making autonomy, revision of solutions, and awareness of the device's limitations—as indicators to be empirically tested, not as an already validated scale. A portfolio may collect initial work, outputs, revisions, and reflective annotations, making the trajectory of the activity reconstructable.

Teacher mediation involves designing the conditions for exploration, selecting tools, and safeguarding data, image rights, and equity of access. Engagement is thus understood in terms of the quality of participation and the possibility for students to assume an interpretive and authorial position. Generation becomes pedagogically meaningful when it keeps the process open to further decisions and transformations.

5.Conclusions. Inhabiting Possibilities: A Pedagogical Responsibility

Artificial imagination designates the transformation of the symbolic and material environment within which imaginative activity unfolds, not a faculty attributable to generative systems. Techno-material plasticity describes the role of technology in configuring possibilities and transforming the forms produced. Evidence shows that the expansion of generative resources may support learning and creativity, while also fostering fixation, homogenisation, and delegation: outcomes depend on the structure of the activity and the distribution of initiative.

The pedagogical stake lies in the possibility of transforming generation into experience while preserving the time required for elaboration, interpretive responsibility, and the capacity to intervene in representations. Engagement is not measured by the quantity of outputs or the frequency of interactions, but by the quality of the operations through which subjects formulate intentions, exercise judgement, and produce further meanings. The question is not what a machine is capable of imagining, but what human beings remain capable of imagining when the forms of the possible become immediately available. In the distance between generation and interpretation, between produced form and meaning, education can preserve the space in which a possibility is taken up, discussed, rejected, and transformed.

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