ALGORITHMIC RHYTHMS AND HUMAN LEARNING: A PEDAGOGY OF AFFECTIVITY IN THE AGE OF AI

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ABSTRACT
The article critically examines the transformations of educational experience in the age of Artificial Intelligence, interpreting them through the lens of "algorithmic beats," understood as an accelerated and predictive temporality that reshapes cognitive, affective, and formative processes. Through a dialogue between logos and pathos, it highlights how the pervasive integration of intelligent systems alters not only the tools of learning but also the relationship between the subject, knowledge, and time, with implications for cognitive depth and the emotional dimension. To address the risk of reducing human thought to computational models, the article proposes digital affective literacy as an epistemological and pedagogical competence capable of integrating emotion and cognition while fostering critical autonomy. This perspective advocates a pedagogy of complexity that restores centrality to the holistic formation of the subject and to meaning as the foundation of education.

KEYWORDS
Artificial intelligence; digital affective literacy; *logos* and *pathos*; critical autonomy; pedagogy of complexity.

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1. Transformations of Educational Experience in the Horizon of "Algorithmic Rhythms"

The integration of Artificial Intelligence (AI) within educational contexts is still frequently interpreted merely as a technological advance, reducing it to a matter of updating digital competencies or introducing instrumental innovation. However, recent international scholarship converges in recognising that we are confronting a paradigmatic transformation, which affects not only learning tools but also the deeper structures of cognitive and educational experience (Holmes et al., 2022; Luckin et al., 2016; Selwyn, 2019). International policy documents, including the UNESCO guidance on generative AI (Miao & Holmes, 2023) and the OECD analysis of education policies (OECD, 2024), highlight the growing attention devoted to the integration of artificial in telligence into educational systems, particularly in relation to adaptive learnin g, intelligent tutoring, and learning analytics. This quantitative data in itself signals a qualitative shift: it is not only the instruments of learning that are changing but the very rhythms of educational experience—its "beats"—which are increasingly synchronised with computational logics (Knox et al., 2020; Williamson, 2017).

In this context, the term "algorithmic rhythms" signifies far more than a simple or novel metaphor; it denotes a genuine interpretative category capable of capturing the transition from an educational experience grounded in long temporalities of reflection, waiting, and gradual, non-linear maturation, to an accelerated, predictive, and efficiency-oriented temporality (Rosa, 2013), in which cognitive latency tends to be perceived as inefficiency to be minimised.

The growing pervasiveness of intelligent systems—those capable of anticipating needs, suggesting responses, adapting content, and guiding learning pathways—thus establishes a new regime of relation between the learner and knowledge. Empirical studies on the use of Intelligent Tutoring Systems, for

example, demonstrate that such systems can enhance students' immediate performance by up to 30% (Kulik & Fletcher, 2016; Ma et al., 2022; VanLehn, 2011), while simultaneously raising significant questions concerning the depth of cognitive processing, the internalisation and personalisation of acquired knowledge, and its transferability to real-life contexts. Indeed, the digital environment is far from being a mere external support; rather, it asserts itself as an ontological and generative space, an "extended cognitive environment" (Clark & Chalmers, 1998) actively participating in the construction of experience. In these circumstances, knowledge tends to shift from being the product of a reflective and discursive process to becoming an immediate, accessible, and pre-processed response (Carr, 2010).

A review of the most recent studies in digital cognitive sciences reveals that the instantaneous availability of information alters memory and attentional processes: already in 2011, Sparrow et al. (2011) indicated this trend. These findings have been corroborated by subsequent research (Storm & Stone, 2015; Ward, 2021), reaffirming that ease of access to information diminishes internal memorisation while promoting forms of "digital transactive memory". Consequently, there is a profound redefinition of the relationship between knowledge and time: whereas human thought proceeds through suspensions, hesitations, and returns, algorithmic functioning privileges continuity, speed, and linearity (Stiegler, 2016), thereby inducing a progressive compression of processing times.

This transformation significantly impacts not only cognitive dynamics but also—and arguably even more profoundly—the affective dimension of educational experience. Contemporary neuroscience has extensively demonstrated the structural interdependence of emotion and cognition. Research by Damasio (1994) and, more recently, studies by Immordino-Yang (2016) and Immordino-Yang et al. (2019) indicate that decision-making

and learning processes are intrinsically embedded within affective dynamics: emotional activation is a necessary condition for the meaningful processing of experience. Within educational settings, this is confirmed by Social and Emotional Learning (SEL) models, whose effects were quantified in a meta-analysis of over 270,000 students (Durlak et al., 2011; Taylor et al., 2017), demonstrating an average 11% improvement in academic outcomes when the socio-emotional dimension is incorporated into teaching pathways. Educational research has long recognised affectivity as a generative condition for learning (Illeris, 2002; Nussbaum, 2001; Bruni, 2016), rather than as a mere supplementary element.

Closer scrutiny reveals that the algorithmic environment tends to operate in a direction divergent from this evidence. The predictive and adaptive logic of AI systems reduces uncertainty, anticipates responses, and, in many instances, neutralises cognitive conflict, which constructivist and socio-constructivist theories have identified as the driver of meaningful learning (Bruner, 1996; Piaget, 1975; Vygotsky, 1978). Supporting the essential role of the affective dimension in the construction of personal knowledge are recent studies in educational data mining, which show that highly adaptive environments minimise states of frustration and disorientation, albeit at the potential cost of reduced metacognitive strategies and cognitive resilience (Baker & Inventado, 2014; Roll et al., 2021). In other words, in the pursuit of optimising the learning pathway, there is a risk of depriving learners of affective tensions—doubt, uncertainty, desire—from which critical thinking emerges (Mezirow, 2000). Hence, there is a risk of progressive thinning of the affective experience as a space for meaning-making.

Simultaneously, the proliferation of digital media and social platforms has introduced increasingly pervasive and sophisticated forms of emotional engagement, predicated upon attention-economy models (Citton, 2014; Zuboff,

2019). According to recent data (DataReportal, 2025), adolescents spend on average more than seven hours per day in digital environments, with a significant proportion dedicated to platforms designed to maximise engagement through recommendation algorithms. Neuroimaging and media psychology studies indicate that such environments activate dopaminergic reward circuits, contributing to behavioural addiction and continuous modulation of emotional states (Alter, 2017; Montag & Diefenbach, 2023). In other words, digital platforms, through massive data analysis and predictive profiling, can intercept and shape moods, desires, and behaviours, creating hyper-personalised environments.

Thus, a structural paradox arises: while the digital sphere mobilises increasingly effective strategies for emotional activation, formal educational systems continue to rely predominantly on rationalist models, in which the emotional dimension remains marginal or implicitly excluded (Biesta, 2020). This disjunction between experiential regimes produces a significant fracture in educational processes, particularly during adolescence. OECD data (2022) reveal a marked decline in school engagement: approximately 30% of students in industrialised countries report feeling disinterested or disengaged from school activities. Simultaneously, levels of anxiety and emotional distress are rising, with the World Health Organization (2022) reporting a 25% increase in mental health disorders among young people in the post-pandemic period. Students thus experience a dual belonging: immersed in contexts that continuously stimulate their emotional sphere, while concurrently participating in educational pathways in which they struggle to recognise experiential and epistemic meaning. Within this tension lies one of the most pressing contemporary challenges: understanding how the integration of Artificial

Intelligence is redefining not only the modalities of learning but the very foundations of educational experience, including its affective, temporal, and relational dimensions.

2. Logos, Pathos, and the Algorithm: Towards a Critical Reappraisal of Educational Rationality

To gain a deep understanding of the implications of the ongoing transformation, it is necessary to interrogate the epistemological foundations of education, placing at the centre the relationship between *logos* and *pathos*. In the Western tradition, *logos* has represented the organising principle of knowledge, the device through which communities have constructed and transmitted knowledge, values, and models of coexistence. Already in Heraclitus, logos is conceived as a universal law structuring becomi ng (Kahn, 1979), whereas in Plato, logos takes the form of rational dialogue ori ented towards truth, as explored in the Theaetetus (Platone, 2009). However, this discursive and rational dimension of thought has never existed in a pure form. In Aristotle, particularly in the Rhetoric (Aristotele, 2014), it becomes evident that *logos* cannot be divorced from *pathos*, as every act of cognition and communication involves an affective disposition that guides judgement and understanding. The desire to know—which Aristotle himself identifies in the *Metaphysics* (Aristotele, 2004) as an original trait of humanity ("All men by nature desire to know")—refers to a pathic dimension that precedes and underpins the exercise of rationality. Similarly, in Plato, *thaumazein*, or wonder, constitutes the origin of philosophising (*Theaetetus*).

The history of pedagogy and the human sciences has progressively recognised this interdependence, moving beyond reductionist views that rigidly separated cognition from emotion. From Vygotsky's (1978) cultural psychology, which highlights the dynamic unity of thought and language mediated by social and

emotional experience, to the latest findings in affective neuroscience, the concept of an embodied and situated mind emerges strongly (Immordino-Yang, 2016). Damasio's (1994) research demonstrates that decision-making processes are deeply rooted in somatic markers, while Immordino-Yang (2016) and Immordino-Yang et al. (2019) show that meaningful learning always entails profound emotional engagement. Empirically, a meta-analysis on Social and Emotional Learning (SEL), conducted with over 270,000 students and subsequently expanded, demonstrates that the systematic integration of the socio-emotional dimension produces an average improvement of 11% in academic outcomes (Durlak et al., 2011; Taylor et al., 2017). Further OECD data indicate that competencies such as emotional self-regulation and empathy are strongly correlated with academic success and long-term wellbeing (OECD, 2021, 2023). In this sense, affectivity is not an obstacle to rationality but its generative matrix and the very condition of its efficacy (Nussbaum, 2001; Illeris, 2002).

A broad convergence of research in neuroscience and education confirms that cognitive and decision-making processes cannot be understood independently of the affective dimension. In particular, LeDoux's (1996) studies highlight the crucial role of emotional circuits in modulating cognitive responses, while Barrett (2017) emphasises how emotional experiences actively contribute to meaning-making. In the educational domain, Pekrun's (2014) research on achievement emotions demonstrates that emotions directly influence motivation, attention, and academic performance.

Empirically, systematic reviews confirm that Social and Emotional Learning programmes produce significant improvements both in learning outcomes and in prosocial behaviours, with effects stable over time (Durlak et al., 2011; Taylor et al., 2017). Simultaneously, international reports promoted by the OECD

highlight that dimensions such as emotional regulation, perseverance, and empathy constitute robust predictors of academic success and individual wellbeing in the long term (OECD, 2021, 2023).

From this perspective, the affective dimension is not an ancillary or disruptive element in relation to rationality, but a structural condition that guides it and renders its effective exercise possible.

Within this framework emerges Artificial Intelligence, which introduces a radically different form of rationality, founded on calculation, statistical correlation, and the processing of vast quantities of data (Floridi, 2014). The algorithm operates without intentionality, without experience, and without engagement of the human affective dimension: it does not understand in the hermeneutic sense, but recognises patterns and produces outputs based on probabilities. As Arendt (1978) observed, human thought is intrinsically linked to the capacity for judgement and the attribution of meaning—dimensions that cannot be reduced to a computational process. More recently, Floridi (2014) spoke of an *onlife*experience, in which the intertwining of the human and the artificial redefines the epistemic conditions of knowledge, without, however, eliminating the ontological difference between human and artificial intelligence.

This leads to the assertion that the risk does not lie in the mere presence of this new form of intelligence, but in its gradual adoption as an implicit model of human cognitive functioning. When educational processes are oriented towards speed, efficiency, standardisation, and prediction, they tend to emulate algorithmic logics (Selwyn, 2019; Williamson, 2017). Referring to studies in the field of learning analytics, it is evident that intensive use of predictive systems can improve short-term outcomes but tends to favour forms of superficial learning (Siemens & Baker, 2022). Recent research also shows that continuous

exposure to recommendation systems reduces students' inclination to explore unsuggested content, thereby limiting epistemic curiosity (Chaney et al., 2018; Nguyen et al., 2022; Pariser, 2011; Sunstein, 2017; OECD, 2023).

A subtler yet equally significant dynamic accompanies this: the progressive marginalisation of the affective dimension in educational models. Despite theoretical recognition of the role of emotions, teaching practices often remain anchored to transmissive and evaluative paradigms. According to the OECD (2021) report, less than 40% of school systems systematically integrate emotional education programmes into curricula. This statistic is particularly critical when compared with the digital environment, which, conversely, makes emotion its primary operational device (Zuboff, 2019). Digital platforms are indeed founded on affective computing models capable of analysing and modulating users' emotional states (Montag & Hegelich, 2024).

Thus, a structural distortion recurs: on one hand, the algorithmic environment activates and exploits emotions; on the other, the educational system tends to neutralise them, depriving itself of a fundamental resource for the construction of knowledge. It therefore becomes imperative to rethink educational rationality in non-reductive terms, recovering a complex vision of learning that integrates cognitive and emotional dimensions, individual and social aspects, reflective and experiential processes.

3. Towards Digital Affective Literacy: Perspectives for a Pedagogy of Complexity

The contemporary educational problem cannot be reduced to a methodological or didactic issue, nor can it be addressed through a mere update of tools. It refers, in a more radical sense, to a cultural crisis that affects the very foundation of education: the progressive loss of meaning of the idea as an organising principle of the formative experience. In the absence of a shared

symbolic and value-based framework, schools and universities risk being reduced to functional devices, incapable of providing orientation or supporting the construction of critical subjectivities.

This crisis, however, not only persists but is now significantly amplified by the pervasive diffusion of Artificial Intelligence. The introduction of systems capable of producing texts, responses, and cognitive simulations brings about a profound transformation in the ways knowledge is accessed and constructed. If not accompanied by appropriate pedagogical reflection, such transformation risks accentuating the already existing fragility: knowledge may appear increasingly available, immediate, and decontextualised, while the demand for meaning that justifies its acquisition is weakened. In other words, AI tends to make the fracture between information and formation even more evident—and at the same time more problematic.

In this scenario, it becomes crucial to examine the relationship between the formation of thought and the drive for knowledge. Education that takes students' genuine interests as its starting point—not in a reductively psychological or utilitarian sense, but as a situated expression of questions of meaning—creates conditions for an active, rather than delegated, exercise of reflection. When the individual is engaged in learning processes that acknowledge and reinterpret their experiential horizons, they do not merely receive answers but develop the capacity to generate questions, to problematise, and to dwell within complexity. In this perspective, Artificial Intelligence is not experienced as a device imposing the timing, rhythm, or modes of thought, but is integrated as an opportunity for cognitive expansion: a tool with which to engage critically, capable of broadening—not replacing—the possibilities of reflection. It is within this tension between interest,

intentionality, and the construction of meaning that authentic epistemic autonomy is grounded, capable of counteracting forms of passivity induced by algorithmic environments.

It is precisely within this critical space that the proposal for digital affective literacy is located, understood not as an ancillary skill but as a structural response to the ongoing crisis. It is defined as the ability to recognise, interpret, and orient the emotional and cognitive processes activated in technological environments, integrating them into a reflective experience of knowing. In this way, literacy recovers its original cultural dimension, configuring itself as a practice of integral formation of the subject.

This perspective is grounded in the pedagogical tradition that, from Dewey to contemporary neuroscience, has emphasised the unity of the knowledge experience (Dewey, 1934). Affectivity is not a marginal element, but the very condition of thinking: it directs attention, structures memory, and guides judgement. Damasio highlights how rationality is intrinsically connected to emotional systems (Damasio, 1994), while Nussbaum recognises in emotions forms of evaluation that contribute to the construction of meaning (Nussbaum, 2001). Complementing these perspectives are the contributions of embodied cognition (Varela, Thompson & Rosch, 1991; Gallagher, 2005), which show how thought emerges from the dynamic interaction between body, environment, and action.

In the digital context, this interplay assumes even greater relevance. Contemporary media environments do not merely convey content but organise experience through algorithmic logics that guide attention, desire, and engagement (Zuboff, 2019; Pasquale, 2015). Artificial Intelligence, in particular, introduces further opacity: automated content generation makes it more difficult to distinguish between authentic processing and artificial generation,

between understanding and simulation. Recent studies on so-called cognitive offloading (Risko & Gilbert, 2016) demonstrate how systematic delegation to external devices can profoundly alter the dynamics of memory and reasoning.

Educating in this context therefore means developing a critical competence capable of making such dynamics visible. Digital affective literacy constitutes an epistemological competence that enables the interrogation not only of content but also of the conditions of possibility of knowing. In line with the complexity perspective (Morin, 1999) and theories of metacognition (Flavell, 1979; Kuhn, 2000), it promotes a form of thought capable of monitoring its own processes, connecting different levels of experience, and resisting the simplifications induced by technological systems.

The metaphor of education as an artistic practice allows for a further deepening of this approach. As in the aesthetic experience described by Gadamer (1960), the formative process implies a transformation of the subject that exceeds mere acquisition of information. To know is to interpret, compose, and ascribe meaning. In this regard, Goodman (1978) interprets knowledge as the construction of symbolic worlds, while Eco (1962) emphasises the open and inexhaustible nature of the work. More recently, Bruner (1996) has highlighted the central role of narrative in learning processes.

Transposed into the educational context, this openness implies the need to support the subject's narrative capacity. As Ricoeur emphasises, identity is constructed through processes of configuration that give unity to the multiplicity of experience (Ricoeur, 1990). Faced with the fragmentation and acceleration inherent in digital environments—further intensified by AI—digital affective literacy allows the transformation of dispersion into meaningful patterns, preserving continuity and orientation.

Against this backdrop, a clear perspective emerges for integrating Artificial Intelligence into formative processes. AI should not be assumed as a substitute for thought but as a critical device that renders its processes visible. Its educational use acquires value only if oriented towards strengthening, rather than weakening, the capacity for judgement. In line with recent reflections on augmented intelligence (Floridi et al., 2018), technology can be understood as an extension of human capacities, provided it remains situated within an ethical and pedagogical framework.

This entails a redefinition of the educator's role, configured as a cultural mediator and designer of experiences. In a context in which access to information is potentially unlimited, the value of education increasingly resides in the capacity to orient, select, and interpret. In line with Schön (1983) and theories of reflective practice, educational practice is conceived as reflection-in-action, a process in which knowledge emerges from the interaction between experience and interpretation.

Digital affective literacy thus assumes an ethical and political significance. As Habermas (1981) suggests, the quality of the public sphere depends on the possibility of activating communicative processes oriented towards understanding. In the digital context, this implies the formation of subjects capable of participating critically and responsibly, recognising the implications of their actions. Complementing this are Fricker's (2007) reflections on epistemic injustice, which highlight how access to speech and recognition is a central issue even in digital environments.

Ultimately, the pervasiveness of Artificial Intelligence makes the recovery of the original meaning of *paideia* even more urgent: not mere instruction, but the integral formation of the human, the construction of mental and value-based frameworks capable of guiding existence. In an era marked by the risk of

technologist self-referentiality and the spread of new forms of educational poverty, to educate means to restore centrality to the question of meaning.

The challenge does not lie in adapting humans to machines, but in preserving what makes thought authentically human: the capacity to question, to imagine, to feel, and to initiate (Arendt, 1958). In this sense, digital affective literacy constitutes an existential stance: a mode of being in the world that allows one to inhabit complexity without being overwhelmed, transforming even the presence of Artificial Intelligence into an opportunity for awareness rather than delegation.

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