INHABITING THE ALGORITHMIC PULSE: AFFECTIVE DIGITAL LITERACY AND CRITICAL CITIZENSHIP IN THE ERA OF THE FOURTH REVOLUTION

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ABSTRACT

This theoretical essay proposes Affective Digital Literacy (ADL) as the capacity to recognise, regulate and narrate the emotions elicited by digital systems while decoding the devices that exploit them. After analysing profiling, attention capture, polarisation and generative AI, and discussing the embodied reading of affective learning, it outlines a curricular orientation for secondary school along three axes, aimed at a critical algorithmic citizenship.

KEYWORDS

Affective digital literacy; algorithmic citizenship; critical media education; embodied education; ethics of artificial intelligence.

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1. Introduction: the Byerley enigma and the maimed master

Eighty years ago, in the short story *Evidence* (Asimov, 1946/1950), Isaac Asimov wrote not only about robotics; he sketched the archetype of a dilemma that today inhabits our classrooms: the distinction between the human being and its perfect simulation. The figure of Stephen Byerley, a man no one has ever seen eat or sleep, suspected of being an automaton indistinguishable from a person, serves as a mirror in which today's generative artificial intelligence systems are reflected. With almost unsettling foresight, Asimov imagined a "brain" around which a body is built, trained to become everything its creator could no longer be: an old, maimed master, whom no one ever sees, operating behind the scenes of technology.

This image of the "maimed master" is a particularly apt metaphor for the contemporary educational transition. We are witnessing a race between those who, metaphorically, "rush to grab their pitchforks", the so-called fundamentalists of the human, ready to denounce in every algorithm a new "Frankenstein complex", and, on the opposite side, the enthusiasts of the D-Generation, who embrace without reservation the total automation of knowledge and of learning processes. While public debate remains largely stuck on questions of computational power, the real challenge is played out on the terrain of empathy and affectivity.

If we return to Alan Turing's reflections on imitative capacity (Turing, 1950), an uncomfortable question emerges: if a machine can exhibit forms of human-like behaviour capable of satisfying a student's need for care and to be heard, does the "artificial" nature of that process necessarily invalidate its educational value? Technology has now reached a level of sophistication able to satisfy the need for emotional mirroring. Artificial intelligence no longer merely answers logical queries: it performs affective narratives, modulates its tone, and offers an unlimited availability that human figures, often overburdened and "maimed" by bureaucratic and social contingencies, struggle to sustain.

The risk is not that machines will become human, but that humanity will grow accustomed to a form of synthetic affectivity, devoid of the weight of the body and of the responsibility inherent in relationship. It is in this interstice that the present essay locates its thesis: twenty-first-century education cannot confine itself to an instrumental literacy of devices, but must become Affective Digital Literacy (ADL), that is, the capacity to navigate critically and emotionally the affective interactions mediated by digital systems. The aim is not to erect barriers to halt machine-learning systems, but to learn to inhabit progress and contribute to the construction of new forms of meaning.

The essay develops this perspective through a theoretical-hermeneutic path that analyses the contemporary condition, the devices of algorithmic manipulation, the neuroscientific evidence and the embodied interpretations that can be brought to bear on affective learning, and their curricular implications. It does not seek to validate a model empirically, nor does it present a tested curriculum: it outlines a theoretical-curricular orientation whose soundness is to be assessed in terms of the internal coherence of the argument and of the traceability of its categories to the sources invoked, while its didactic implications are advanced as hypotheses to be developed operationally and verified empirically in future research. The school context is secondary education (students aged roughly 11 to 19), where, in Italy, digital citizenship is already a curricular object within civic education (Law 92/2019); the framework may nonetheless be adapted to the final years of primary school. The research question is: how can Affective Digital Literacy develop students' critical thinking and emotional awareness in relation to algorithmic manipulation in social media and generative AI systems, while supporting a critical algorithmic citizenship grounded in body, relationship and responsibility? The procedure brings media education, AI ethics, embodied education and digital citizenship into dialogue, taking conceptual soundness and pedagogical relevance as criteria of adequacy.

2. The Fourth Revolution as anthropological mutation

Today, the notion of the Fourth Revolution is used in at least two complementary senses. In the economic-industrial reading (Schwab, 2016), it designates the convergence of cyber-physical systems, artificial intelligence, the Internet of Things and biotechnologies that is redrawing productive processes and forms of work. In the philosophical-informational reading (Floridi, 2014), by contrast, the Fourth Revolution denotes a change in human self-understanding: after the revolutions that displaced humanity from the center of the cosmos, biology, and the psyche, the informational revolution redefines us as interconnected informational organisms sharing the infosphere with artificial agents capable of autonomous action.

From this perspective, the sharp distinction between online and offline dissolves into an "onlife" condition (Floridi, 2014), in which everyday experience is constitutively hybrid. For the school, this entails a profound repositioning: the learning environment is no longer separable from the digital ecosystem that traverses it, and citizen formation cannot dispense with understanding the logics that govern that ecosystem. The mutation, however, is not only cognitive: it is affective. Digital environments do not merely transmit information; they orchestrate emotional states, modulate attention, elicit intermittent gratifications and construct reputational identities.

It is therefore reductive to think of the transformation under way as a mere matter of technical skills. What is at stake is the way the younger generations construct their own inner life in their relationship with devices designed to maximise engagement. The calculative rationality that presides over digital environments tends to translate every experience into data, every relationship into a metric, every desire into predictable behaviour. Pedagogical thought is called to interrogate this translation critically, in line with the education to

complexity Morin (1999) advocates, restoring depth to what exceeds measurement: fragility, ambivalence, the slow time of understanding, the fertile opacity of the other.

The school thus faces a twofold responsibility. On the one hand, it must provide the conceptual tools to understand how algorithmic systems work; on the other, it must cultivate those emotional and ethical dispositions that allow one not to be acted upon by devices, but to act upon them knowingly. The first responsibility belongs to the order of knowledge; the second, to the order of the formation of the self. Affective Digital Literacy is precisely the task of holding the two dimensions together.

The affective mutation is, moreover, inscribed within a broader transformation of the techniques of power. Whereas disciplinary societies operated through prohibition and constraint, the contemporary forms of governing conduct act through seduction, motivation and voluntary self-exploitation. The subject is no longer merely repressed from without, but solicited from within towards continual performance, exposure and sharing. Digital psychopolitics does not forbid: it incentivises (Han, 2014). For this reason, critical education must cultivate the capacity to recognise induced desires: it is a pedagogy of inner freedom even before it is one of external protection.

3. From digital literacy to Affective Digital Literacy

The tradition of media education has progressively broadened its object (Buckingham, 2003; Rivoltella, 2019): from instrumental literacy, centred on the technical mastery of devices, to critical literacy, attentive to the languages, powers and economies that structure the media. Contemporary digital literacy integrates skills for searching, evaluating, and producing information, but still

tends to privilege the cognitive dimension. The hypothesis advanced here is that this framework, though necessary, proves insufficient in the face of technologies that act primarily on the emotional plane.

We define Affective Digital Literacy as the capacity to recognise, understand, regulate and narrate the emotions that arise in interactions mediated by digital systems, together with the critical capacity to decode the technical, economic and rhetorical devices that elicit and exploit those emotions. It lies at the intersection of three traditions: socio-emotional education, which has thematised awareness, self-regulation and empathy; critical media education, which has unmasked the ideological and commercial constructions of messages; and the ethics of artificial intelligence, which interrogates the accountability, transparency and fairness of automated systems. These five components, recognising, understanding, regulating, narrating and decoding, are taken up in Section 7 (Table 1), where they are related to the four algorithmic devices analysed in Section 4 and to the three curricular axes.

Unlike a generic emotional intelligence (Goleman, 1995), ADL does not regard emotions as internal variables to be managed for the sake of performance, but as relational and situated phenomena, traversed by relations of power and by design architectures. To know that a notification has been calibrated to generate anticipation, that a feed is ordered to maximise dwell time, that a chatbot is trained to mirror our mood, is not neutral knowledge: it is a condition of freedom. ADL aims to transform the emotionally exposed user into an emotionally aware citizen.

This redefinition entails a change in the very idea of competence. It is not enough to know how to use, nor to criticise in the abstract: one must know how to feel critically, that is, to inhabit one's affective reactions while retaining the possibility of interrogating them. Emotional awareness thus becomes a form of embodied critical thinking, which does not oppose reason and feeling but

interweaves them in a practice of discernment. The educational aim is not the suspension of emotions, unrealistic and impoverishing, but their conscious cultivation within contexts that systematically tend to instrumentalise them.

The relationship between Affective Digital Literacy and already consolidated competence frameworks should also be clarified. DigComp 2.2 articulates information literacy, communication, collaboration, content creation, safety and problem solving, and progressively includes awareness of interaction with AI systems (Vuorikari et al., 2022). ADL does not replace such frameworks but integrates them, making explicit the affective and relational dimension they often presuppose. Mature digital competence, on this reading, is not only knowing how to do and how to evaluate, but also knowing how to feel and how to stand in relationship within environments designed to act upon the emotions.

4. An anatomy of algorithmic manipulation

To ground effective educational pathways, one must first describe with precision the mechanisms that ADL seeks to render intelligible. Four devices appear particularly relevant: profiling, attention capture, polarisation and interaction with generative AI systems. They are selected because each engages, in a distinctive way, one or more of the components of ADL defined above: profiling bears mainly on understanding and decoding, attention capture on recognising and regulating, polarisation on regulating and narrating, generative AI on all of them at once, in the relational register. They do not operate in isolation, but reinforce one another within an economy that has made attention and behaviour its raw materials.

4.1. Profiling and surveillance capitalism

Profiling consists in constructing predictive representations of the individual from the behavioural traces he or she disseminates. Every interaction, a like, a pause of the gaze, a search, a geolocation, feeds models that anticipate preferences, vulnerabilities and propensities. Critical literature has shown (Zuboff, 2019; Crawford, 2021) how this extraction of behavioural data constitutes the core of a new economic order, in which human experience is treated as free raw material destined for the prediction and modification of conduct. On the affective plane, this means that systems often know our emotional states better than we know them ourselves, and can steer them.

For students, understanding profiling means demystifying the apparent gratuitousness of digital services and recognising the economic value of their own inner life. It is not a matter of feeding paranoia, but of restoring awareness: emotional data are not innocuous by-products but contested resources. An education for algorithmic citizenship must include the understanding that automated decisions based on profiles can reduce the individual to a statistical projection (O'Neil, 2016), with concrete effects on opportunity, visibility and access.

4.2. Attention capture and intermittent reinforcement

The attention economy designs environments that hold the gaze for as long as possible. Infinite scrolling, automatically playing videos, notifications, likes and unpredictable rewards are designed to keep the expectation of gratification high. These mechanisms stimulate the brain circuits linked to motivation and reward, leading users to prolong their interaction and making it harder to stop using the platform voluntarily. The result is a fragmentation of inner time that undermines the very possibility of study, deep reading, and reflection.

On the educational plane, the stakes are twofold. First, these mechanisms must be made visible, so that the student can recognise when his or her attention is being captured rather than freely directed. Second, the conditions of deep attention must be actively cultivated: silence, duration, single-focus concentration, fruitful boredom. Attention is not only a cognitive resource but a moral faculty: it is what allows us to turn towards the other, to care, to remain. To defend attention is to defend a condition of relationship.

4.3. Polarisation and architectures of reactivity

Recommender systems tend to privilege content that generates intense reactions, since emotional intensity correlates with engagement. Outrage, fear, and tribal identification perform particularly well in the platform's metrics. The result is a progressive selection of polarising content that narrows the informational horizon and radicalises positions. So-called filter bubbles and echo chambers (Pariser, 2011) are not mere side effects, but outcomes consistent with an architecture oriented towards maximising reactivity.

To educate for citizenship in this context means cultivating the capacity to dwell in complexity, to tolerate ambiguity, to recognise the legitimacy of dissent without yielding either to tribal fusion or to contempt for the adversary. Emotional awareness proves decisive here: to recognise the wave of outrage that a piece of content provokes, to name it, to grasp its strategic function, is the first step towards not being acted upon by it. Democratic citizenship rests on a pedagogy of the political emotions (Nussbaum, 2010) capable of transforming reactivity into deliberation.

4.4. Interaction with generative AI and conversational affectivity

The advent of generative conversational systems introduces an unprecedented dimension: no longer merely content to be consumed, but interlocutors to keep company with. Such systems produce fluent language, empathetic in tone, tirelessly available. They can take on the role of a tutor, a confidant, even an emotional support. Their capacity to mirror the user's mood, to confirm, console and indulge, answers a deep anthropological need for recognition. It is precisely here that the risk of synthetic affectivity lurks: the progressive substitution of demanding, asymmetrical and unpredictable relationships with smooth interactions, infinitely patient and devoid of real otherness (Turkle, 2011).

As far back as the 1960s, the ELIZA program had shown (Weizenbaum, 1976) the human tendency to attribute understanding and intentionality to systems devoid of both. That effect, today amplified beyond measure, poses a crucial educational question: how to guide young people to use such tools as resources without eroding the capacity and the desire for embodied human relationship. The point is not to demonise interaction with machines, but to form a discernment able to distinguish mirroring from reciprocity, the simulation of listening from responsible listening.

These four devices share a structural feature: they operate below the threshold of full reflective awareness, acting on rapid, automatic and emotional processes. To make the invisible visible, to bring to words what acts in the silence of automatism, to restore to the subject a margin of suspension between stimulus and response: this is the heart of Affective Digital Literacy applied to the critique of devices. It is not a matter of promising an impossible immunisation, but of widening the space of conscious choice, that is, the space of freedom.

In the school context, generative AI also raises unprecedented questions of authenticity and of process. When a system can produce an essay, a summary, or an argument in a few seconds, the exercise's value no longer lies in the product, but in the cognitive and emotional process it activates. The challenge is not to prohibit the use of the tools, a choice as futile as it is miseducative, but to rethink tasks so that they retain formative value: to privilege personal reworking, the justification of one's reasoning, metacognitive reflection, connection with lived experience. Generative AI, used consciously, can become a cognitive partner, to be questioned, corrected, contested, rather than an oracle from which to draw answers. But this presupposes precisely the critical posture and affective awareness that ADL sets out to form, in a virtuous circle in which the tool becomes the occasion for the competence that enables its mature use.

5. The learning body: neuroscientific evidence, embodied interpretations, pedagogical implications

This section must keep three levels distinct: the neuroscientific evidence, the theoretical interpretations built on it, and the pedagogical theses this

essay derives from those interpretations. The thesis of Affective Digital Literacy does not rest on the neurosciences as on a proof; it draws from them, and from the embodied cognitive sciences, a set of interpretive resources whose theoretical status is made explicit here.

On the level of evidence, mirror neurons were identified in the ventral premotor cortex of the macaque as neurons that discharge both when the animal performs an action and when it observes the same action performed by another; in humans, the existence of an analogous mirror mechanism is supported mainly by indirect evidence from neuroimaging and neurostimulation studies (Rizzolatti & Craighero, 2004; Rizzolatti & Sinigaglia,

2006). These data show that observing an action engages a portion of the motor circuits involved in its execution. They do not, by themselves, establish that understanding others proceeds primarily by motor resonance rather than by inference, nor that this mechanism extends to the understanding of emotions: these are interpretations, and they are contested. The theory of embodied simulation (Gallese, 2005), according to which the understanding of the other, including his or her emotions, is rooted in a shared corporeality that precedes conceptual representation, is one such interpretation; alternative accounts explain mirror responses as products of associative learning (Heyes, 2010) or question their explanatory reach altogether (Hickok, 2014). The present essay adopts the embodied interpretation as its theoretical assumption, while acknowledging that it is a reading of the evidence rather than its direct content.

On this assumption, a pedagogical thesis can be formulated, but its status is that of a theoretical proposal rather than an empirical finding. To the extent that empathy and emotional understanding rest, at least in part, on bodily processes of resonance, an affective education can hardly be purely verbal or fact-based, and has good reason to involve the body, gesture, gaze, and proximity. It is here that mediated interaction reveals a limit that, on the embodied reading adopted here, appears structural rather than contingent: however sophisticated, it withdraws from relationship the density of the body, the synchronisation of affects, the reciprocal vulnerability of presence. Whether, and to what degree, the bodily resonance that may be activated between two co-present persons finds an equivalent in interaction with a system that possesses neither body nor lived experience is an open empirical question; the position taken in this essay is that, in the current state of knowledge, no such equivalence has been demonstrated, and that the difference is pedagogically significant.

The perspective of embodied education, developed in the Italian context (Sibilio, 2014), has translated these premises into a didactics that values corporeality, variability and adaptation. The notion of simplexity, borrowed from the physiologist Alain Berthoz (2009), the property of living systems that makes it possible to address complexity through solutions at once rapid, elegant and effective, offers a framework for thinking of didactic action as the creative management of complexity, irreducible to algorithmic linearity. The simplex teacher does not apply standardised procedures but reads the situation, anticipates, reconsiders and adapts, mobilising a bodily and relational knowledge that no automatism can replicate.

From this standpoint, learning is a bodily-emotional phenomenon before it is an abstractly cognitive one. Research in the affective neurosciences has offered substantial support to the thesis of the inextricable interweaving of reason and emotion (Damasio, 1994): far from being a disturbance of rationality, emotion is a condition of judgement, an orientation of value, a signalling of meaning. A school that wishes to form critical thinking cannot, therefore, neglect emotional formation, on pain of producing a disembodied rationality, fragile and easily manipulable precisely because it is blind to its own affective roots.

The centrality of the body in learning is also bound up with the mediated and social nature of higher cognitive processes. The cultural-historical tradition (Vygotskij, 1934) has argued how psychical functions develop first on the interpersonal plane, in relationship with the other, and only subsequently are internalised on the intrapersonal plane. Learning is therefore constitutively relational: it occurs in a zone of proximal development that opens only in the encounter with another who is more competent and affectively attuned. Technological mediation can support this process, but cannot stand in for the quality of the relationship that makes it possible. A system that individualises

the pathway but isolates the subject risks optimising the transmission of content while at the same time impoverishing the relational fabric within which content acquires meaning and formative value.

6. Synthetic affectivity and embodied affectivity

The question raised by Turing can today be reformulated in an affective key. We no longer ask only whether a machine can think, but whether it can care, and above all whether the simulation of care can stand in for its substance. The answer proposed here is not metaphysical but pedagogical and relational. Embodied affectivity is distinguished from synthetic affectivity not by the degree of sophistication of the behaviour displayed, but by the presence of something at stake: the body that can be wounded, the time that does not return, the responsibility that binds, the asymmetry that resists.

Human care is costly: it requires patience, exposes one to frustration, carries the risk of misunderstanding and the labour of repair. Synthetic affectivity, by contrast, is designed to be low-friction: always available, never offended, infinitely adaptable. It is precisely this reduced friction that constitutes the formative danger. A generation accustomed to frictionless relationships might develop a lower tolerance for real otherness, which they perceive as cumbersome and inefficient compared with the comfort of algorithmic mirroring.

It is not, however, a matter of sterilely opposing the human and the artificial. Conversational systems can offer valuable support: practising languages, simulating interviews, providing personalised explanations, accompanying first forms of self-exploration. The decisive question is the educational framework within which such tools are placed. A conscious pedagogy values AI as an environment for practice and as an object of critical analysis, while reserving to embodied human relationship the irreplaceable task of affective formation.

The teacher is not replaced but repositioned: from transferring information, a function at which the machine excels, to witnessing a fragile and responsible humanity, irreducible to code.

In this sense, the educator's space is one of embodied emotional awareness, managing conflicts irreducible to code, and narrating the limits of human experience. For affective education not to remain an isolated lesson but to become the beating heart of a technologically advanced school, the following section proposes three orienting axes along which cognitive, ethical and emotional competences may be articulated; they are offered as a theoretical-curricular orientation, still to be developed and tested on the operational plane.

There is, finally, a deep reason why affective formation cannot be delegated to the artificial: to educate the emotions means to guide students to recognise and inhabit limit, loss and finitude. It is precisely the experiences the machine does not know, the waiting that frustrates, the conflict that wounds, the reconciliation that costs, that constitute the fabric of affective education. A system designed to avoid all friction cannot teach what is learned only by passing through friction. The witness of an adult who knows how to stand within limits, without feigning omnipotence or unlimited availability, remains an irreplaceable educational resource: here lies the difference between a formation that humanises and a training that optimises.

7. A curricular horizon: the three axes

As a theoretical-curricular orientation, to be further developed and verified on the operational plane, Affective Digital Literacy may be articulated along three mutually complementary axes: educational robotics, relational ethics and

emotionally aware environments. These are not juxtaposed modules, but integrated perspectives that cut across the disciplines and the life of the school community, with secondary school as the primary context of reference.

The relationship between the definition of ADL (Section 3), the four devices analysed (Section 4) and the three axes can be made explicit as follows. Each axis is designed to address specific devices and to develop specific components of the competence: educational robotics acts above all on understanding and decoding, and targets profiling and generative AI, since it makes the logic of automated systems intelligible from within; relational ethics acts on narrating and on responsibility, and targets polarisation and conversational affectivity, since it keeps the reality of the other alive where mediation tends to erase it; emotionally aware environments act on recognising and regulating, and target attention capture and polarisation, since they protect attention and cultivate the affective climate. Table 1 summarises this mapping, proposed as a design hypothesis rather than a validated model.

Table 1. Mapping between ADL components, algorithmic devices and curricular axes (design hypothesis).

Curricular axis	**ADL components mainly developed**	**Algorithmic devices mainly addressed**	**Illustrative practices (secondary school)**
Educational robotics and critical tinkering	Understanding; decoding	Profiling; generative AI	Building and "breaking" a classifier trained on biased data; unplugged algorithm games; interrogating a chatbot and documenting its errors
Relational ethics and responsibility	Narrating; decoding (ethical dimension); responsibility	Polarisation; generative AI (conversational affectivity)	Analysis of cases of algorithmic bias; structured debate; participatory rules of digital coexistence for the class
Emotionally aware environments	Recognising; regulating	Attention capture; polarisation	Naming the emotions elicited by a feed; protected time without notifications; reflective journals

7.1. Educational robotics and critical tinkering

Educational robotics, understood not as technical training but as an experience of construction and manipulation, offers privileged access to understanding how automated systems work. Dismantling, programming, letting an artefact go wrong and correcting it makes it possible to demystify the opacity of the machine, restoring to the student the posture of one who designs rather than one who is designed. The value of this axis is at once cognitive and emotional: the relationship with error, the frustration of failure and the joy of the solution constitute training grounds for affective regulation. To understand the logic of an algorithm from within is the first antidote to its mythologisation.

From this perspective, tinkering, the exploratory fiddling with materials and devices, becomes a practice of citizenship: those who have experienced that a classification system can err, that distorted training data produce distorted outcomes, that behind every automated decision lie human choices, develop a mature and non-magical relationship with technology. Educational robotics, moreover, lends itself to a collaborative dimension that interweaves technical and relational competences, since the shared project requires negotiation, task division, and managing tensions.

It is worth clarifying that educational robotics does not limit its value to manipulating kits and physical devices. It includes a broader pedagogy of the computational, which may also draw on “unplugged” approaches, free of technology, that let students experience the principles of algorithmic logic through play and bodily movement. This ensures accessibility and equity, preventing algorithmic competence from remaining the preserve of those who can afford costly tools, and it reaffirms the primacy of the body and of experience over the device. Understanding what an algorithm is, a finite sequence of instructions that transforms an input into an output (Wing, 2006), is the precondition for grasping both its power and its limits, and for unmasking the rhetoric that presents its outcomes as objective and neutral.

7.2. Relational ethics and responsibility

The second axis concerns relational ethics, that is, reflection on the responsibilities that arise in mediated interactions. Not an abstract ethics of principles, but a situated ethics that begins from the concrete questions students encounter: what it means to respect the other in a digital space; what effects our traces produce on others; how responsibility is configured when an action is amplified or automated. Relational ethics places care at the centre (Mortari, 2015): to care for oneself, for the other and for the common informational environment becomes the guiding criterion of conduct.

In dialogue with the ethics of artificial intelligence, this axis introduces students to key themes of transparency, fairness, algorithmic non-discrimination, and distributed responsibility. It does so, however, starting from experience, avoiding abstraction: the analysis of a case of algorithmic bias, the discussion of a real dilemma, the participatory construction of rules of digital coexistence for the class are occasions for exercising ethical judgement as a living practice. The aim is to form subjects capable of assuming responsibility, not mere executors of norms imposed from above.

Relational ethics is distinct from a mere education in the rules of online conduct. It does not aim to inculcate prohibitions, but to bring out responsibility as a constitutive dimension of the bond. In an environment where the other is often absent, reduced to a profile or a number, the educational challenge is to keep alive the perception of his or her reality and vulnerability. The practice of dialogue, the exercise of taking the other's point of view, reflection on the distant consequences of one's actions constitute the foundations of a citizenship that does not allow itself to be anaesthetised by mediation. Responsibility, in this perspective, is not an imposed burden, but the mature recognition of one's capacity to affect the lives of others.

7.3. Emotionally aware environments

The third axis concerns the design of emotionally aware learning environments, in which the affective dimension is neither removed nor left implicit, but recognised and cultivated. This entails times and spaces for naming emotions, practices of listening and speech, community rituals, and attention to the relational climate. An emotionally aware environment is also an environment that protects attention: it defends long stretches of time, limits fragmentation, and values presence. In this sense, caring for the affective climate of the class is a concrete form of resistance to the attention economy.

This axis calls into play teacher training, whose emotional competence becomes a first-order professional resource. A teacher able to recognise and regulate his or her own emotions, to attune to those of the students, to hold the space of relationship even in conflict, constitutes the embodied model of what the school intends to transmit. The emotionally aware environment is built not with technological devices but with the quality of the relationships that inhabit it; technology, well governed, can support it, but cannot replace it.

The design of emotionally aware environments also affects the spatial and temporal dimensions of the school. The physical space of the classroom, its arrangement, the possibility of movement and encounter, affect the quality of relationships and affective regulation. Likewise, the management of time, the defence of unfragmented moments, the alternation of concentration and pause, the valuing of slow rhythms alongside rapid ones constitute a concrete form of education against the dictatorship of the instantaneous. In a digital ecosystem that compresses time and disperses attention, a school that knows how to safeguard duration and inhabit the space of presence offers young people an alternative experience, and with it the possibility of discovering different, richer, and freer ways of being in the world and with others.

8. Critical algorithmic citizenship

The three axes converge in the formation of a critical algorithmic citizenship: the capacity of subjects to understand, evaluate and influence the algorithmic systems that structure the public sphere, exercising agency in an informational ecosystem that tends to reduce them to objects of prediction and of nudging. Algorithmic citizenship is not a technical appendix to democratic citizenship, but a contemporary condition of it: where collective decisions, access to opportunity and the formation of opinion are mediated by algorithms, there is no full citizenship without critical algorithmic competence.

The tradition of critical pedagogy (Freire, 1970) provides valuable categories in this regard. Education is never neutral: either it domesticates towards adaptation, or it forms towards conscientisation, that is, towards the capacity to read the world critically in order to transform it. Transposed into the digital ecosystem, conscientisation becomes the capacity to read algorithmic architectures critically, to recognise the interests that orient them, to imagine alternatives. The critical algorithmic citizen is not one who rejects technology, but one who recognises its political nature and claims a voice in its design and its governance.

This perspective requires holding together three planes that often remain separate: the cognitive plane of understanding systems; the ethical plane of responsibility and value judgement; the emotional plane of awareness and affective regulation. Critical algorithmic citizenship is precisely the integration of these planes in a subject capable of embodied critical thinking. It is not enough to know how a recommender system works; one must also feel the effect it produces on one's own mood and assess its ethical and political implications. Affective Digital Literacy pursues this integration.

8.1. A systemic framework: competences, rights, governance

The formation of critical algorithmic citizenship cannot be left to teachers' goodwill alone; it requires a systemic framework. The most far-sighted education policies have placed digital competences and citizenship among their strategic objectives, recognising that the digital transformation of education concerns not only technological provision, but the formation of subjects capable of participating consciously in democratic life. In parallel, the ethical frameworks on data and AI, such as the UNESCO Recommendation (2021), introduce principles, transparency, minimisation, non-discrimination, human oversight, that can and must become the object of educational elaboration.

Translating such principles into a widespread culture is itself a formative task. To know the right not to be subject to purely automated decisions (Regulation (EU) 2016/679, Art. 22), to understand the meaning of algorithmic transparency, to know that there are domains in which certain uses of automated systems are restricted or forbidden (Regulation (EU) 2024/1689): all this is not a technical-legal knowledge reserved for specialists, but a component of contemporary citizenship. The school can become a place where digital rights are not only stated but experienced and discussed, so that young people grow up aware of being holders of rights and not mere users of services. In this perspective, the normative framework is not an external constraint on pedagogy, but a resource for rooting critical awareness within a horizon of shared rights and responsibilities.

9. Didactic implications and operational guidelines

At the level of didactic design, the proposed framework suggests several cross-cutting guidelines, formulated as design orientations rather than validated procedures. First, curricular integration: ADL is not a new subject to add to an already saturated timetable, but a perspective that runs through existing

disciplines. The critical analysis of a feed can find a place in language and civic education; the understanding of predictive mechanisms in mathematics and the sciences; ethical reflection in the historical-philosophical disciplines; the bodily and emotional dimension in physical, artistic and musical education.

Second, the centrality of experience: the most effective pathways begin from concrete practices, building, dismantling, simulating, discussing real cases, rather than from abstract definitions. Workshop-based methodology, structured debate, role-play, the analysis of media artefacts and the critical production of content constitute privileged devices. Third, the meta-reflective dimension: every experience must be accompanied by moments of reworking in which students name what they have felt, recognise the mechanisms at play and generalise their learning.

Fourth, authentic assessment: the assessment of ADL cannot be reduced to checking notions, but must capture competences in situation, the capacity to analyse a case critically, to regulate one's reactions, to argue ethically. Tools such as competence rubrics, reflective journals, real-world tasks and portfolios appear more suitable than standardised tests. Finally, teachers' training and support constitute the condition of possibility of the whole framework: there is no affective education of students without care for the affective and professional dimension of teachers.

Finally, the inescapable question remains: the relationship between school and families, and between school and social context. The digital ecosystem crosses institutional boundaries; effective education, therefore, requires broad educational alliances and shared responsibility among parents, local communities, and territorial actors. The school can become a place of shared elaboration, promoting a widespread culture of affective digital awareness that extends beyond its walls and contributes to the civic maturation of the whole community.

Finally, it is appropriate to warn against two opposing temptations that beset any educational innovation in this field. The first is technocentrism, which equates innovation with adopting tools, measuring progress by devices introduced rather than by competences matured. The second is defensive nostalgia, which rejects transformation wholesale in the name of a supposed lost authenticity. Both postures, though opposite, share the same error: treating technology as destiny rather than choice. Affective Digital Literacy places itself beyond this polarity, taking technology as a field of possibility to be inhabited critically, in which educational choices remain human choices, oriented by ends that the educating community must deliberate on.

10. Conclusions: inhabiting the pulse

The image of the algorithmic pulse condenses this essay's thesis. Digital environments have a rhythm, a pulsation that scans attention, emotion and relationship. We can undergo this pulse, letting ourselves be dragged into a reactivity devoid of awareness; or we can learn to inhabit it, recognising its logics, regulating our affects, exercising an embodied critical thinking. The difference between the two postures is not technical but educational and, ultimately, civic.

Affective Digital Literacy proposes itself as the keystone of this education. It does not oppose human and machine, nor does it yield either to reactionary refusal or uncritical enthusiasm, but seeks a third way: a humanity that integrates technology without being integrated by it, uses the artificial while safeguarding the embodied, and forms citizens capable of feeling critically. Asimov's maimed master will go on operating behind the scenes; the task of the school is to ensure that, before the stage, there remains a master who is whole, fragile, present, responsible, able to teach the young not only to understand the algorithmic pulse, but to inhabit it as free men and women.

It is in this safeguarding of the human within the hybrid that the democratic quality of the Fourth Revolution is measured. The school, if it can become the beating heart of a literacy at once critical and affective, will not be overwhelmed by the transformation but will become its conscious protagonist, offering the new generations not reassuring answers, but the most precious of competences: the capacity to ask questions, to feel, to choose.

The proposal's limits are those of its theoretical nature. The mapping between competences, devices and axes, and the pedagogical theses derived from the embodied reading of the neuroscientific evidence, call for operational development and empirical verification in secondary school settings: this is the direction of the research that the present essay intends to open.

References

Asimov, I. (1950). Evidence. In *I, robot*. Gnome Press. (Original work published 1946)

Berthoz, A. (2009). *La simplexité*. Odile Jacob.

Buckingham, D. (2003). *Media education: Literacy, learning and contemporary culture*. Polity Press.

Crawford, K. (2021). *Atlas of AI: Power, politics, and the planetary costs of artificial intelligence*. Yale University Press. https://doi.org/10.12987/9780300252392

Damasio, A. R. (1994). *Descartes' error: Emotion, reason, and the human brain*. G. P. Putnam's Sons.

Floridi, L. (2014). *The fourth revolution: How the infosphere is reshaping human reality*. Oxford University Press.

Freire, P. (1970). *Pedagogia do oprimido*. Paz e Terra.

Gallese, V. (2005). Embodied simulation: From neurons to phenomenal experience. *Phenomenology and the Cognitive Sciences, 4*(1), 23–48. https://doi.org/10.1007/s11097-005-4737-z

Goleman, D. (1995). *Emotional intelligence*. Bantam Books.

Han, B.-C. (2014). *Psychopolitik: Neoliberalismus und die neuen Machttechniken*. S. Fischer.

Heyes, C. (2010). Where do mirror neurons come from? *Neuroscience & Biobehavioral Reviews, 34*(4), 575–583. https://doi.org/10.1016/j.neubiorev.2009.11.007

Hickok, G. (2014). *The myth of mirror neurons: The real neuroscience of communication and cognition*. W. W. Norton.

Law 92/2019. Legge 20 agosto 2019, n. 92, Introduzione dell'insegnamento scolastico dell'educazione civica. Gazzetta Ufficiale della Repubblica Italiana, Serie Generale n. 195, 21 August 2019.

Morin, E. (1999). *Les sept savoirs nécessaires à l'éducation du futur*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000117740

Mortari, L. (2015). *Filosofia della cura*. Raffaello Cortina.

Nussbaum, M. C. (2010). *Not for profit: Why democracy needs the humanities*. Princeton University Press.

O'Neil, C. (2016). *Weapons of math destruction: How big data increases inequality and threatens democracy*. Crown.

Pariser, E. (2011). *The filter bubble: What the internet is hiding from you*. Penguin Press.

Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data (General Data Protection Regulation). Official Journal of the European Union, L 119, 4 May 2016.

Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence (Artificial Intelligence Act). Official Journal of the European Union, L, 12 July 2024.

Rivoltella, P. C. (2019). *Media education. Idea, metodo, ricerca*. Scholé.

Rizzolatti, G., & Craighero, L. (2004). The mirror-neuron system. *Annual Review of Neuroscience, 27*, 169–192. https://doi.org/10.1146/annurev.neuro.27.070203.144230

Rizzolatti, G., & Sinigaglia, C. (2006). *So quel che fai. Il cervello che agisce e i neuroni specchio*. Raffaello Cortina.

Schwab, K. (2016). *The fourth industrial revolution*. World Economic Forum.

Sibilio, M. (2014). *La didattica semplessa*. Liguori.

Turing, A. M. (1950). Computing machinery and intelligence. *Mind, 59*(236), 433–460. https://doi.org/10.1093/mind/LIX.236.433

Turkle, S. (2011). *Alone together: Why we expect more from technology and less from each other*. Basic Books.

UNESCO. (2021). *Recommendation on the ethics of artificial intelligence*. https://unesdoc.unesco.org/ark:/48223/pf0000381137

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The digital competence framework for citizens*. Publications Office of the European Union. https://doi.org/10.2760/115376

Vygotskij, L. S. (1934). *Myšlenie i reč'*. Gosudarstvennoe social'no-ekonomičeskoe izdatel'stvo.

Weizenbaum, J. (1976). *Computer power and human reason: From judgment to calculation*. W. H. Freeman.

Wing, J. M. (2006). Computational thinking. *Communications of the ACM, 49*(3), 33–35. https://doi.org/10.1145/1118178.1118215

Zuboff, S. (2019). *The age of surveillance capitalism: The fight for a human future at the new frontier of power*. PublicAffairs.