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Manifesto for a Quantum Pedagogy

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Abstract: Education has a habit it seldom examines: it turns activity into evidence, and evidence into judgement, and then forgets that it did so. This Manifesto asks education to look at its own instruments. Drawing on de Kerckhove's media ecology and on the quantum ecology he developed with Calzati, it organises the inquiry around three terms: phenomenon, apparatus, description. The quantum reference names a philosophical genealogy and a question for pedagogical work; it applies no quantum mechanics to learning. Five concepts carry the proposal. Educational configuration places an activity within the relations that sustain it. Intercontextuality follows the passages through which a representation acquires educational significance. The double movement joins analytical stabilisation to the reconstruction of its conditions. Epistemic simulacrum names authority that exceeds its warrant. The epistemic interval gives participants an organised opportunity to examine that warrant before a judgement is accepted. The Manifesto sets these concepts beside validity theory, epistemic injustice, reflective practice, evaluative judgement, feedback literacy and contestable AI. Twelve theses state its commitments. A hypothetical assessment case follows an AI-supported judgement to two honest endings, revision and confirmation. Four observable markers specify the interval; institutional requirements and conditions of disconfirmation frame a research programme.

Keywords: quantum pedagogy; intercontextuality; epistemic interval; generative artificial intelligence; educational responsibility

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1. Introduction: the record speaks first

A generated explanation, a recommended source, a dashboard of classroom activity: each arrives in an educational situation already inhabited by people, purposes, rules and expectations, and each quietly organises something about it. The platform decides which contributions become visible. The rubric gives names to the qualities of a performance. The generated response delivers a sequence of statements, ready to enter a discussion, a plan, an assessment. Education must account for the authority these representations acquire.

Here is the plain fact that organises everything that follows: a representation of an activity can now arrive before the person who performed it has had a chance to speak. The problem becomes consequential when a record stands for participation, when a fluent explanation stands for understanding, when an automated

classification directs a learner's next opportunity. These passages ask for reasons. The accuracy of a record and the coherence of an explanation do not, by themselves, justify every interpretation or use. A record is not a verdict. Pedagogical judgement is the work of asking what a representation supports, under which conditions and with what consequences.

We do not begin from nothing. Dewey (1938) joins experience and inquiry; Vygotsky (1978) shows how mediation works; Bateson (1972) and Morin (1990) teach us to read relations, feedback and complexity. These traditions settle that learning involves subjects, practices and environments. What is new is a pressure inside that history: algorithmic systems now organise the very representations through which educational activity becomes recognisable and actionable.

Assessment scholarship gives us an equally important starting point. Validity concerns the grounds of interpretations and uses, including the assumptions that connect observed performance to decisions (Messick, 1995; Kane, 2013). Critical research on educational technology places AI inside choices about values, professional work and institutional power (Williamson, 2017; Selwyn, 2019). The Manifesto takes these questions out of the literature and puts them into the activity itself: participants must have structured opportunities to examine how the representations concerning them are produced and used.

Our genealogy is de Kerckhove's media ecology and the quantum ecology he elaborated with Calzati (2024). Our contribution is an articulation of analytical operations, educational purposes and responsibilities. Five concepts carry it, and they connect the examination of mediations to a single sequence: judgement stays provisional, grounds are inspected, revision is actionable, reasons are documented.

The argument proceeds by conceptual analysis and one hypothetical assessment case. Sections 2 and 3 build the framework and place it among existing scholarship. Sections 4 to 6 develop epistemic authority, the interval and situated responsibility. Section 7 states twelve programmatic theses. Section 8 follows their implications through two assessment outcomes; Section 9 turns to practices, institutional conditions and a research programme. The position is direct: educational representations must remain answerable to the people, activities and purposes they concern.

2. Beyond the quantum metaphor: contexts and configurations

2.1. What the word "quantum" does, and what it does not

The expression quantum pedagogy takes its bearings from de Kerckhove's work on media and experience (1995, 1997, 2024, 2025) and from Quantum Ecology, written with Calzati (2024). In this trajectory media do more than carry messages: they take part in organising how a world becomes perceptible, describable and open to action. Languages, technologies and apparatuses enter the conditions of experience. The quantum reference points to a relationship among three terms: a phenomenon, the arrangements through which it becomes observable, and the description that acquires authority.

The designation has a job to do. Taken one by one, configuration, intercontextuality and reflection describe relations or operations. The quantum reference binds them to a recurring question: how does an apparatus take part in making a phenomenon determinate enough to describe, and what do we owe when

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we treat that description as educational evidence? The question is Bohrian in origin. For Bohr (1949), a phenomenon is describable only relative to the experimental arrangement that makes it observable, and Barad (2007) extends this into an account of how apparatuses help produce the distinctions they report. Here is the bridge between the quantum reference and educational evidence; Section 2.2 builds it. The justification of the label is therefore genealogical and interrogative. It names a lineage and a question, not an explanatory mechanism, and its value rests on the coherence of the analyses and practices assembled around that question. Educational writing has drawn on quantum physics before (for example Bonetta, 2017), and the expression "quantum pedagogy" has been used in writing studies in a different sense (Fishman, 2022); the Manifesto claims no priority for the term and distinguishes itself by the explicit limits it sets on the appropriation.

A guardrail keeps all this from sliding into mysticism. Quantum Ecology studies an emerging technological paradigm together with its philosophical implications; we appropriate the second. Digital platforms and generative AI are examined as sociotechnical arrangements, and no quantum computation is attributed to their operation. The formal models of quantum cognition (Busemeyer & Bruza, 2012) are a different project. The quantum reference names the philosophical problem through which educational evidence, mediation and responsibility are brought into relation, and nothing more.

Education needs shared descriptions. Concepts and criteria give knowledge enough stability to be discussed, taught and assessed. That stability is bought by selection: a rubric recognises particular qualities, a platform records particular activities, a generated response acquires significance within a task. The Manifesto requires that participants have access to the reasons behind these selections and to procedures through which consequential interpretations are examined.

Different traditions lend different instruments. Dewey (1938) and Vygotsky (1978) examine experience and mediation. Systems thinking follows relations and feedback (Bateson, 1972; Morin, 1990). Distributed cognition and the extended mind trace cognitive activity across people, artefacts and environments (Hutchins, 1995; Clark, 2008). Sociomaterial and posthuman research in education investigates materiality, agency and the production of boundaries (Fenwick & Edwards, 2010; Lenz Taguchi, 2010; Taylor & Hughes, 2016; Murris, 2016). Research on datafication shows how infrastructures turn selected traces into classifications with consequences (Williamson, 2017).

These contributions keep their differences, and we keep them too. Media ecology gives the Manifesto its organising genealogy. Systemic and cognitive approaches help follow activity through its relations and resources. Barad's agential realism directs attention to the constitution of boundaries and exclusions. The preprint by Calzati and de Kerckhove (2025), with its account of bodily and situated sensing, further questions the separation of knowing from the conditions of experience. The Manifesto brings these resources into a differentiated theoretical dialogue. Its commitments concern educational analysis, purposes and responsibility; they do not require agreement on a single ontology.

2.2. Apparatuses: the instrument is part of the observation

The relationship between quantum physics and educational inquiry runs on distinct levels of argument. Bohr (1949) examines the experimental arrangements

under which physical phenomena receive communicable descriptions: what can be said of a phenomenon depends on the apparatus through which it is observed. Barad (2007, 2022) turns this into an onto-epistemological account centred on apparatuses, intra-action and the production of determinate boundaries. The Manifesto takes up one question from it: how does an apparatus take part in producing the distinctions through which a description becomes possible? This is a conceptual appropriation, and its educational relevance depends on the processes it helps reconstruct.

The word "context" also has a precise technical sense in quantum theory. Under its mathematical assumptions, the Kochen–Specker theorem shows that values cannot be assigned to the relevant observables noncontextually and consistently with quantum predictions (Kochen & Specker, 1967); context there concerns compatible sets of observables. The Manifesto borrows the word and its question, whether a property can be specified independently of the arrangement that reveals it, without inferring educational claims from the theorem. A theorem is a theorem; an analogy is an analogy. Any pedagogical use of context must earn its own argument about educational processes.

In education, classifications have constitutive consequences. They enter expectations, opportunities for participation and learners' understandings of themselves. The framework examines these processes while keeping its claims situated. Educational observation and quantum measurement keep their own objects, methods and evidential requirements.

Consider a rubric, a platform and a dashboard. Each is a small operating system for recognition. The rubric specifies which qualities will count. The platform determines which actions leave a trace. The dashboard makes selected events readable as indicators. Together they do more than inform; they organise a field of visibility. Barad's agential cut prompts us to examine the distinctions and exclusions involved, and Bonetta's (2017) educational invisible recalls the processes that exceed that field. The pedagogical task is to establish what these arrangements reveal, what they omit and how their outputs are used.

The openness of educational outcomes has its own argument. Learners interpret tasks, negotiate meanings and transform relationships. The consequences of an intervention emerge through these activities and through feedback over time. Design therefore works with purposes and constraints while remaining answerable to developments it has not fully prescribed. This openness belongs to educational action; quantum indeterminacy belongs to a different explanatory domain.

2.3. Configuration as a unit of analysis

An educational configuration is a situated and dynamic set of relations through which an activity takes shape, participation becomes available and learning or performance becomes recognisable. People, cultural resources, bodily and material conditions, technologies, institutional rules and temporal arrangements enter the analysis through what they contribute to that activity.

Configuration is a bounded unit of pedagogical inquiry. The research question or the practical problem decides which relations to follow. An overlooked condition justifies redrawing the boundary when it changes the interpretation. The observer accounts for two things: the relations reconstructed, and the selection through which the account was produced.

In AI-assisted assessment, the inquiry follows the task, the available forms of contribution, platform records, rubric criteria and teacher decisions. Conditions of access enter when they affect the production or recognition of evidence. Section 8 develops this bounded inquiry through a hypothetical case.

Bodies belong in the configuration. A mode of expression, a sensory condition, a writing tool, a time limit: each affects how participation is lived and recognised. De Kerckhove's (2024) point-of-being brings tactile, proprioceptive and situated experience into view, and directs attention to the relations between embodied activity and the institutional records through which that activity is described.

Subjectivity is examined at this educational level. Learners bring histories, dispositions and capabilities to an activity; participation also changes their opportunities, commitments and self-understandings. A learner labelled a "low contributor" meets an institutional description that enters every later interaction. The Manifesto follows how such descriptions shape a learner's educational position, while recognising the learner's capacity to interpret and contest them. This grounds a relational account of subjectivity without prescribing a universal account of what a subject is.

Complexity follows from the organisation of these relations. An assessment changes participation; changed participation alters the next body of evidence; new evidence changes the teacher's interpretation. These feedback loops make complexity the ordinary condition of educational work (Bateson, 1972; Morin, 1990). The analytical response is selective and systematic: establish the relevant relations, follow their consequences, revise the design when effects diverge from purposes. Complexity asks for disciplined attention to connections, not for an exhaustive description of everything.

2.4. The double movement

Abstraction makes educational work shareable. Concepts support distinctions, criteria support discussion, indicators support assessment. Each operation lifts something out of an unfolding situation and gives it provisional stability. The double movement joins this analytical stabilisation to a return: back to the conditions, exclusions and consequences that made the description possible.

Recontextualisation already has a theoretical history. Bernstein (1990) uses the term for the selective appropriation, relocation and transformation of discourse into pedagogic discourse within institutional relations of power and control. Here it names a different operation: returning from an educational representation to the relations that conditioned it. The two uses inform each other where curricular classifications shape assessment and distribute authority over categories.

The movement is recursive. An indicator discloses a change in recorded activity. Interpreting it requires examining task demands, access, forms of contribution and opportunities for reflection. That examination justifies keeping the indicator, revising it or narrowing the conclusions drawn from it. Confirmation and revision are both legitimate outcomes, provided reasons support them.

Rigour runs through both movements. The first requires explicit constructs, appropriate methods, consistent criteria and accurate records. The second requires scrutiny of assumptions, counterevidence, exclusions and consequences. Documentation connects them by making the grounds of a decision available for

examination. Educational openness does not weaken rigour; it extends it, and asks for methodological accuracy together with accountable interpretation.

The double movement preserves analytical rationality and makes its products answerable to the situations in which they are used. The educational capacity at stake is the ability to work with a shared description while reconstructing the configuration that both enables and limits it.

2.5. Where the concepts stand among existing work

The Manifesto enters established debates about mediation, assessment and epistemic authority. Its contribution is to connect those debates in an explicit educational sequence. Table 1 states what each concept adds and where it relies on existing work, so that conceptual elaboration can be told apart from the renaming of familiar commitments.

Table 1. Positioning the five concepts within existing scholarship.

Concept	Existing accounts	What the Manifesto adds
Educational configuration	Systems thinking, distributed cognition and sociomaterial inquiry already examine activity across people, artefacts and rules.	A bounded assessment inquiry following activity, records, criteria and decisions: the unit within which the other four concepts operate.
Intercontextuality	Situated approaches and evaluative judgement recognise that meaning and quality depend on context; boundary-crossing and transfer research follow movement between settings.	A requirement to justify each change in the evidential status of a representation as it moves between contexts, such as from a logged action to evidence of contribution. The unit is the representation, not the community or the learner.
Double movement	Reflexive inquiry and argument-based validation examine assumptions supporting interpretations and uses.	A recursive sequence connecting provisional stabilisation with reconstruction of exclusions and consequences, made an educational activity for participants and not only a researcher's reflexive stance.
Epistemic simulacrum	Validity theory diagnoses inadequate construct representation and unsupported inferences; epistemic injustice examines wrongs to people as knowers.	A diagnosis of how apparent completeness acquires authority beyond its warrant, including outside formal assessment. Existing validity and justice analyses remain necessary.
Epistemic interval	Cognitive forcing, reflection-in-action, desirable difficulties and productive failure address different functions of interruption, challenge and reconsideration; contestable-AI design addresses the possibility of challenging automated decisions.	A pre-decision sequence requiring provisional acceptance, examination of grounds, effective revisability and documented reasons. These jointly specified markers distinguish the proposal from delay or reflection alone.

Messick's account names construct underrepresentation and construct-irrelevant variance as threats to validity; Kane examines the inferences and assumptions that connect observations to interpretations and uses (Messick, 1995; Kane, 2013). The Manifesto adopts these resources outright. Overlooking relevant oral contributions risks underrepresentation; undue dependence on typing speed risks construct-irrelevant variance. Consequences enter the evaluation of interpretation and use; they do not by themselves establish invalidity. "Epistemic

simulacrum" adds one question: how does apparent completeness authorise a representation despite these weaknesses?

Fricker's (2007) epistemic injustice concerns people wronged as knowers, through prejudicial credibility deficits and unequal resources for making experience intelligible. An omitted trace alone establishes neither. The Manifesto links scrutiny of representational authority to two further questions: whose testimony receives attention, and whose experience the categories accommodate.

Cognitive forcing interrupts automatic reliance (Buçinca et al., 2021); reflection-in-action examines and reframes unfolding practice (Schön, 1983). Desirable difficulties distinguish immediate performance from durable learning; productive failure places initial challenge inside a sequence followed by instruction and consolidation (Bjork & Bjork, 2011; Kapur, 2014). These are distinct research programmes, not interchangeable names for friction. The interval has a different object, the grounds of a consequential representation, and a documented route from examination to decision. Its contribution is this organisation of scrutiny. Research on contestable AI examines how systems can be designed so that people may challenge automated decisions (Almada, 2019; Alfrink et al., 2023); the interval shares that concern but places contestation in an educational procedure, attached to a decision not yet settled, and not in system design alone.

Evaluative judgement makes appraising quality an educational purpose; feedback literacy connects understanding information with judgement, affect and action (Tai et al., 2018; Carless & Boud, 2018). The Manifesto extends appraisal to the apparatus and to the inferences through which work becomes evidence. The extension is deliberate: the apparatus itself becomes an object of learning.

Critical accounts of datafication and AI already place classifications inside institutional and political choices (Williamson, 2017; Selwyn, 2019). The Manifesto connects that critique to a decision sequence with explicit responsibilities. Institutional power remains part of the problem; a classroom procedure cannot dissolve it alone.

2.6. Operational distinctions

The concepts do different jobs inside the same inquiry. Configuration defines the bounded activity to examine. Intercontextuality follows changes of significance across contexts. The double movement specifies how the inquiry proceeds (Table 2).

Table 2. Operational distinctions among the three analytical concepts.

Concept	Guiding question	Analytical focus	Operation
Educational configuration	Which relations make this activity and its recognition possible?	The bounded arrangement of participants, resources, rules, times and mediations.	Delimit and reconstruct relevant relations.
Intercontextuality	What changes when a representation enters another context?	The passage between contexts, purposes and criteria.	Identify and justify the change of meaning, evidential status or use.
Double movement	What supports this account, and what does its stabilisation leave outside?	A provisional description and the conditions of its production and use.	Stabilise, reconstruct, then confirm or revise.

These are not three themes standing side by side; they are one inquiry carried out at three levels. A single assessment needs all three: identify the configuration, examine the passage from activity to evidence, and reconsider the resulting judgement against its conditions.

3. Media ecology and the intercontextual subject

Media ecology reads cultural change through the relations among communication, experience and knowledge. Alphabetic culture and algorithmic environments are two orientations, each with its tensions, inside histories shaped by institutions, practices and material conditions. Orality, writing, print and digital media do not simply succeed one another; they coexist and transform one another (McLuhan, 1964; Ong, 1982; de Kerckhove, 1995).

A second guardrail, this time against technological determinism. The same medium supports different educational relations when ownership, curricular purposes, access and assessment rules differ; and similar regimes of control operate through different media. Historical explanation must reconstruct how technical affordances are taken up, organised and contested. A sequence of technologies cannot explain a sequence of subjectivities.

Alphabetic writing and reproducible texts sustained analysis, distance, sequential argument and relatively stable reference. A claim could travel beyond the occasion on which it was made. Readers could return to it, compare interpretations and inspect the grounds of a decision. These remain educational resources, and we do not propose to give them up. Dialogical, pragmatist, sociocultural and systemic traditions have developed accounts of relations and participation within these media environments.

Algorithmic systems enter this history through selection, classification, recommendation and generation. They help compose what users encounter, which actions receive attention and which records remain available. Generative AI brings apparently complete linguistic responses into inquiry, writing, design and assessment. Research on language models questions the inferences drawn from linguistic form to meaning and understanding (Bender & Koller, 2020; Bender et al., 2021). Their educational significance takes shape through the purposes and practices of their use.

In Connected Intelligence, de Kerckhove (1997) examines networks that connect minds at work through technical resources. The point-of-being (2024) puts embodied participation in the foreground, and the quantum human (2025) addresses orientation within distributed sociotechnical environments. This genealogy places generative AI inside a longer inquiry into the changing relations among bodies, media and knowledge. Education meets the ambivalence of connectivity: expanded access lives alongside dependence, saturation and unequal powers to organise participation.

In his manuscript on classical and quantum physics as media-ecological paradigms, de Kerckhove (n.d.) introduces intercontextuality through the relation between possibilities and the contextual conditions of their determination. The Manifesto develops its pedagogical significance as the relationship among the contexts through which an utterance, a performance or a decision acquires meaning, relevance and educational value. Personal histories, disciplinary practices,

institutional demands, material conditions and technical mediations can support one another or make conflicting demands.

We defend the concept on its own terms, against three neighbours. Transfer research asks whether learning carries over from one setting to another; intercontextuality asks what becomes of the evidential status of a representation when it is moved. Boundary crossing and boundary objects (Akkerman & Bakker, 2011; Star & Griesemer, 1989) concern how people and artefacts coordinate across communities of practice; here the unit is a single representation, a log entry, a rubric score, a generated explanation, and the question is whether the passage from one use to another is warranted. Context collapse (Marwick & boyd, 2011) describes the flattening of audiences; intercontextuality demands the opposite work: keeping contexts distinct and justifying each passage. The concept earns its place only where this question changes a decision, as in the move from a logged action to evidence of contribution (Section 8).

Intercontextual analysis follows these passages. Instructions and available resources shape a generated explanation. Its educational adequacy also depends on the problem, on what learners already know, on accessible forms of expression and on the purpose of the task. An introductory summary, a disciplinary argument and evidence of independent learning make different demands. Moving a response from one of these uses to another requires an account of what supports the move.

Education must make this work practicable. Learners examine how a representation changes significance, identify tensions among criteria and justify adaptations. Berger's (2022) context blindness names a neighbouring worry: delegating to context-responsive systems leaves users at risk of losing access to the conditions through which an interpretation was selected.

The intercontextual subject takes educational form through this activity. Learners bring capacities and histories into a situation, meet classifications and expectations, and exercise judgement in answering them. Their autonomy grows with their ability to understand and orient these relations. The double movement gives that work its discipline: use shared descriptions, inspect their conditions, accept responsibility for their consequences.

4. Plausibility at scale: generative AI and the epistemic simulacrum

A fluent explanation invites trust (Alter & Oppenheimer, 2009). Its sequence is intelligible, its vocabulary appropriate, its conclusion apparently ready for use. Generative AI supplies this discursive form at a speed that changes the relationship between producing an answer and examining its grounds. Education must make that relationship visible. The question is the authority a representation acquires when it enters teaching, learning or assessment.

The Manifesto calls a representation an epistemic simulacrum when it puts on the appearance of sufficiently grounded and complete knowledge while the reasons needed to justify its use in the situation remain unavailable, insufficient or shielded from examination. The concept names a relationship: the authority attributed to the representation, and the possibilities for checking its grounds, relevance and limits. It is a pedagogical elaboration informed by de Kerckhove's (n.d.) question about who authorises the real; it is not a term attributed to his existing vocabulary.

An accurate explanation becomes a problem when it is treated as sufficient evidence that a student understands. An automated assessment exceeds its warrant

when a partial record of activity acquires the authority of a comprehensive judgement. In each case the decisive passage lies between what the representation establishes and what others are prepared to infer from it. The simulacrum is the apparent completion that hides this passage. Authority slips its moorings: it drifts from grounds toward fluency.

Human-produced explanations, reports and classifications also acquire excessive authority. Knowledge depends on trust, testimony and a division of cognitive labour, and responsible reliance requires grounds proportionate to the purpose and consequences of use. A teacher assigning a formative task and an institution making a consequential classification face different evidential demands. The Manifesto therefore directs scrutiny to the interpretation being authorised, the grounds that support it and the responsibilities attached to its consequences.

This use is distinct from Baudrillard's (1981) broader philosophy of simulation. Misinformation concerns false or misleading content. Automation misuse concerns inappropriate reliance on a system (Parasuraman & Riley, 1997). Hicks et al. (2024) examine generated discourse in relation to truth-oriented assertion. Epistemic simulacrum names the educational situation in which apparent completeness carries more authority than the available grounds justify.

The validity and justice analyses introduced in Section 2.5 remain necessary. Missing evidence, irrelevant influences and unsupported inferences call for the tools of validity theory. Where prejudice diminishes a learner's credibility, or unequal interpretive resources obstruct the articulation of experience, scrutiny must also address epistemic injustice (Fricker, 2007). A representation's authority and a participant's standing as a knower belong in the same inquiry, each keeping its own analytical question.

The pedagogical response is to organise epistemic vigilance (Sperber et al., 2010) through purposeful friction: a task-relevant demand that interrupts immediate acceptance and requires participants to examine the grounds of a representation. Identifying a source, explaining an inference, comparing interpretations, considering counterevidence: these give the demand an educational object.

Research on learning separates the ease of immediate performance from the conditions of durable learning. Bjork and Bjork's (2011) account of desirable difficulties identifies challenges whose value depends on the learning processes they engage and on learners' resources for meeting them. Kapur's (2014) work on productive failure examines a specific instructional sequence in which initial solution generation prepares later instruction and consolidation. Both place the value of difficulty in the organisation of learning; neither treats effort as an educational good in itself.

Cognitive forcing offers a more direct link to AI-assisted judgement. Buçinca et al. (2021) examine interventions that require users to engage with a recommendation before accepting it, and find both reductions in overreliance and differences in the costs and distribution of benefits. The Manifesto draws a design requirement from this work: added effort must serve an identifiable epistemic operation, remain proportionate to the decision and be accessible to the participants.

The interval is not an invention of the AI age: the same four requirements would apply to a colleague's score or a dashboard rule. What generative and predictive systems change is how badly it is needed. They produce representations faster than anyone can examine them; they present them in a finished form that

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hides the selections behind them; and they can issue the same kind of classification across a whole cohort, so that an unexamined ground is repeated instead of isolated. Design must also keep the system open to challenge, since an interval is of little use where the output cannot be questioned (Almada, 2019; Alfrink et al., 2023). These three features, not a claim about machine intelligence, justify the weight the Manifesto places on the interval in AI-supported settings.

The epistemic interval gives this requirement its specific pedagogical form. Its object is the transition from an available representation to an authorised judgement. Provisional acceptance, examination of grounds, effective revisability and documentation of reasons specify the work that purposeful friction is meant to organise.

5. The interval: attention, time and self-regulation

An answer often arrives before the learner has formulated an initial explanation. Rapid completion and abundant alternatives reorganise the time available for inquiry. They support exploration and remove unnecessary work; they also make closure available at the very beginning of a task. Education must give learners a place inside this sequence: an opportunity to formulate, examine and justify a judgement.

De Kerckhove's (1995) discussion of the contraction of the interval between stimulus and response in television supplies an antecedent for this concern. The present proposal develops the educational relationship between the availability of a representation and its acceptance. Its focus is the organisation of attention and judgement within a task.

The epistemic interval is a pedagogically designed condition in which acceptance of a response, a representation or an assessment remains provisional while participants examine its grounds and the consequences of using it. The interval opens when a representation becomes available for consideration and closes when a decision is sufficiently justified for the task. Its duration follows the demands of the inquiry. A brief exchange and an extended review share the same function when they meet the same minimum requirements.

The four markers concern a bounded episode of judgement, from an initial interpretation to a reasoned decision. Observation follows what participants are entitled and enabled to do, the examination they undertake and how its results enter the decision. Table 3 sets out the markers.

Table 3. Minimum markers of the epistemic interval and how to recognise them.

Minimum marker	Observable evidence	Criterion for recognising the marker
1. Provisional acceptance	Task instructions, an initial assessment or a recorded exchange identifies the judgement as open and specifies an opportunity for examination before it is settled.	Participants know what remains open, when examination takes place and who is responsible for the decision. A provisional label alone is insufficient.
2. Examination of grounds	An annotation, exchange or comparison connects a claim or judgement with relevant evidence and criteria, addressing a limitation,	The activity examines why the representation warrants its proposed use. A generic instruction to "check the answer" supplies insufficient evidence.

	alternative interpretation or counterevidence where pertinent.	
3. Effective possibility of revision	A procedure identifies how relevant findings enter the decision, and the record shows their consideration by someone with authority to change the interpretation, evidence base or outcome.	Revision is actionable. Confirmation meets this requirement when relevant findings have been considered and the reasons support retaining the initial judgement.
4. Documentation of reasons	A concise written, oral or otherwise accessible record connects the final decision with the criterion and the evidence considered.	The grounds for confirmation or revision are reconstructable. Recording only that a review occurred is insufficient.

For each marker, an observation should distinguish three cases: evidence that the requirement was enacted, evidence that it was not enacted, and insufficient information to decide. Missing documentation does not automatically establish that an activity was absent. Equally, a stated procedure does not establish that participants were able to use it.

These distinctions let us examine the interval without collapsing its markers into a numerical score. The four requirements remain jointly necessary to the proposed design; a judgement about their enactment must identify the evidence on which it rests.

In classroom work, students first formulate an explanation, then examine a generated response against relevant sources, then record why they retain or change their account. The object of learning includes the relationship between the answer and its warrant. In assessment, the teacher explains how records have been interpreted against criteria and receives relevant evidence before settling the judgement. Section 8 develops both revision and confirmation within this sequence.

The interval draws on established educational resources. Self-regulated learning foregrounds monitoring and strategic control (Zimmerman, 2002). Cognitive forcing introduces requirements that interrupt automatic acceptance of AI advice (Buçinca et al., 2021), while research on automation bias examines the attentional conditions of reliance (Parasuraman & Manzey, 2010). Reflection-in-action addresses the practitioner's examination and reframing of a situation while acting within it (Schön, 1983). The interval connects these activities to an explicit transition in the authority of a representation, and requires a documented route to a decision.

Its educational purpose also includes the development of judgement. Evaluative judgement makes the appraisal of quality part of what students learn; feedback literacy addresses the understandings, dispositions and actions involved in using information to improve work (Tai et al., 2018; Carless & Boud, 2018). Inside an interval, learners examine both the work and the evidential arrangements through which it is judged. They practise identifying relevant criteria, interpreting information and responding with reasons.

Teachers must design access to this work. Oral dialogue, alternative formats, additional processing time and collaborative examination offer different ways to articulate a reason or to make evidence available. The task must tell competence in the subject apart from confidence in contesting a judgement. A learner's silence establishes neither assent nor the adequacy of the representation.

Proportionality belongs to the design. Cognitive load theory draws attention to the processing demands that instructional procedures add (Sweller, 1988). The interval therefore concentrates effort on consequential claims and decisions, removes redundant documentation and supplies the knowledge and resources needed for examination. Its four markers specify the work to be done; they prescribe neither a uniform duration nor a single classroom format.

6. Who answers: situated autonomy, design and responsibility

Autonomy grows through the capacity to recognise, evaluate and orient the interdependencies within which action becomes possible. Learners exercise it when they identify appropriate assistance, examine a source, explain a disagreement and give reasons for a choice. Their judgement requires access to knowledge, intelligible criteria and resources for participation.

This account preserves the learner's responsibility while locating its conditions. The demand to "verify the answer" becomes educationally meaningful only when the learner knows what requires verification, has access to suitable evidence and understands the purpose of the decision. Instruction must provide these conditions and progressively develop the capacity to use them.

Verification of this kind draws on inherited knowledge. Concepts, methods and disciplinary criteria are what allow a learner to ask whether a claim is supported, and they are transmitted, appropriated and contested through practice rather than discovered anew by each learner. This is why the Manifesto does not set the examination of representations against the teaching of a body of knowledge: without such a body the examination has no standard to apply, and an interval would shrink to a procedure without content (Section 5 makes the same point about the knowledge an interval requires).

Educational design gives purposes a practicable form. Resources, participation rules, temporal arrangements and mediations open some paths and close others. Learners interpret and transform these arrangements. Biesta's (2013) account of educational risk places this openness within the ethical conditions of education. Planning establishes a commitment to worthwhile purposes, with criteria for examining how those purposes take shape in practice.

The relational organisation of an activity leaves a normative task. Educators must justify which possibilities deserve support, how differences receive recognition and which consequences are acceptable. The configuration describes relations of action; responsibility requires an account of the duties and powers situated within them.

Learners, educators and institutions occupy different positions. Learners contribute interpretations, reasons and evidence. Teachers establish and explain criteria, assess the relevance of contributions and remain accountable for pedagogical decisions. Institutions select infrastructures, allocate resources and maintain the procedures through which consequential decisions are scrutinised. Technical mediation changes the conditions under which these duties are exercised; it does not make their attribution unnecessary.

The teacher acts as a node of orientation, connecting tasks with learner histories, disciplinary knowledge, classroom relations and institutional expectations. This role requires decisions about what to foreground, when to interrupt an activity and which evidence warrants a conclusion. Making those decisions intelligible is part

of teaching. The interval gives learners a structured role within that work, while preserving the teacher's obligation to make and justify the final assessment.

Here the ninth thesis finds its argument. Generative systems make the production of explanations, summaries and scores cheap and fluent. What they leave untouched is the decision whether a given product warrants use for these learners, under this criterion, with these consequences, and the obligation to answer for that decision. Pedagogical judgement cannot be reduced to content production because it consists of selecting criteria, weighing evidence and owning consequences, none of which a generated output performs by being produced. The claim is conceptual, not a forecast about what systems may become able to do: where a system is made to carry the decision, someone must still be identifiable as answerable for it.

The scope of participation must be explicit. Discussing the evidence behind a judgement is not the same as renegotiating every curricular purpose, or letting the most persuasive participant decide the outcome. Teachers announce which criteria are shared, which matters remain open and how contributions enter the decision. The grounds of assessment stay available for reasoned examination across these boundaries.

Institutional conditions decide whether such participation is practicable. AI-supported assessment raises questions about evidence and professional work that exceed an individual teacher's control (Swiecki et al., 2022). Accountability therefore extends to procurement, technical access, staff development, workload and routes for review. Critical accounts of educational AI place these arrangements within choices about values and power (Selwyn, 2019). The Manifesto requires institutions to make those choices explainable and open to appropriate scrutiny.

Situated responsibility joins these levels. It follows a decision through the relations that made it possible and identifies who had the authority, the information and the obligation to act. The practical commitment is to preserve an intelligible connection among educational purposes, evidential grounds and responsibility for consequences.

7. Twelve programmatic theses

Twelve theses state the commitments of the Manifesto. They are offered to be argued with.

1. The educational configuration is the unit of pedagogical analysis. Subjects, knowledge, tools and environments are to be examined through the relations that shape their possibilities for action and learning.
2. Learners bring histories and capabilities into educational activity, and participation in turn shapes their opportunities, commitments and self-understandings. Pedagogical inquiry must follow these bodily, symbolic, social and technical relations.
3. Autonomy is not self-sufficiency. It is the capacity to recognise, evaluate and orient the interdependencies within which action becomes possible.
4. Knowledge includes an inherited body of concepts, methods and cultural resources. Its educational value is sustained through situated practices of transmission, appropriation, production, validation, contestation and revision.
5. Complexity is not an accident to be eliminated. It is the ordinary condition of educational action, and it requires systems thinking.

6. To design is not to predetermine every step. It is to configure fields of possibility while keeping orientation, criteria and responsibility in place.
7. The indeterminacy of educational outcomes does not suspend rigour. Rigour means explicit criteria and methodological accuracy, and it extends to documentation, to the interpretation of feedback and to the justification and revision of choices.
8. Educational apparatuses organise conditions of visibility and recognition through criteria, records and classifications. Their consequences must be examined within the situated practices through which these representations inform action.
9. Artificial intelligence does not replace pedagogical judgement. Because it produces content cheaply and fluently, it shows that judgement cannot be reduced to the production of content.
10. Fluency is not knowledge. Pedagogy must reintroduce friction against epistemic simulacra and unverified plausibility.
11. Education must craft epistemic intervals in which acceptance remains provisional, grounds are examined, judgements are effectively revisable and reasons are documented.
12. Quantum pedagogy seeks forms of orientation that sustain participation, open educational judgements to reasoned challenge and assign responsibility for decisions and their consequences. Because no participant controls all the interdependencies involved, its purposes and criteria must remain explicit.

8. A hypothetical case: the feedback that sounded complete

8.1. A judgement that sounds finished

A class is engaged in collaborative inquiry. Students compare sources, develop an interpretation and justify it with evidence. The rubric, communicated before the activity, assesses contribution to inquiry and argumentation. Students work through classroom discussion, source annotations and a shared digital document.

The platform records discussion posts, changes to the document and comments attached to sources. An AI system organises these records and proposes formative judgements, each accompanied by a short narrative feedback text written in the vocabulary of the rubric. For one student, it suggests a low level of contribution and explains, in fluent and well-formed sentences, that the student engaged little with the sources and added little to the group's argument. The text rests on a single ground: few relevant actions appear in the platform record.

The teacher treats this proposal as provisional. The feedback reads as complete: it names the criterion, offers an interpretation and implies a next step, and nothing in its form signals that it never saw oral discussion or work outside the platform. Irony writes itself here: the fluent text is silent precisely about what it did not see. This is the situation that Section 4 calls an epistemic simulacrum. The immediate question is whether the available traces adequately represent the criterion. A logged action is evidence of activity within the platform; its significance for contribution to inquiry requires an additional argument.

Validity theory makes this passage explicit. The omission of relevant contributions raises construct-underrepresentation concerns. Dependence on conditions unrelated to the intended criterion, such as typing speed or unequal

technical access, raises construct-irrelevant-variance concerns. Kane's interpretation/use argument directs attention to the assumptions connecting records, interpretations and decisions (Messick, 1995; Kane, 2013).

The teacher therefore opens an epistemic interval. Students receive an explanation of the criterion and the evidence used. They have an accessible opportunity to supply relevant material or to point to an overlooked contribution before the judgement is settled. The teacher remains responsible for weighing the evidence and documenting the decision.

8.2. Variant A: the interval supports revision

The student submits comparative annotations made outside the platform. They identify a conflict between two sources and explain why the group adopted one interpretation. During discussion, the student reconstructs that reasoning and shows where it entered the final document.

The teacher examines the annotations, their relationship to the final work and observations recorded during classroom activity. Contributions from other group members help establish how the argument developed. Each item is assessed against the announced criterion; neither an individual claim nor group agreement decides the outcome on its own.

The resulting account establishes a relevant contribution that the platform record had omitted. The teacher revises the proposed judgement and the feedback text that accompanied it, and records why: the original evidence represented only part of the student's contribution to inquiry and argumentation.

The criterion stays where it was. What changes is the evidential basis and the inference drawn from it. The final record tells the platform's accurate description of logged activity apart from the broader educational judgement.

The teacher also revises the next activity. Students receive accessible ways to document contributions made through oral discussion and work outside the platform. The class examines why an adequate account of recorded activity first supported an inadequate interpretation of contribution. The assessment becomes an occasion to practise judgement about evidence.

8.3. Variant B: the interval supports confirmation

In a parallel version of the same activity, the student challenges the proposed low judgement and reports having contributed through source selection and oral discussion. The teacher invites the student to identify the sources, explain their relevance and reconstruct how the contribution entered the group's inquiry.

The submitted material contains source summaries, but they repeat information already available to the group and do not address the comparison the task requires. The student's reconstruction identifies no additional contribution to the argument. The teacher checks this account against contemporaneous observations, the shared document and the agreed division of work. These provide converging grounds for the limited judgement.

The teacher also examines whether access conditions, available formats or the organisation of group work restricted the student's opportunities. The evidence considered in this version supports the conclusion that the recorded contribution was limited under the announced criterion. The teacher confirms the initial

judgement, rewrites the generated feedback so that it states the grounds actually examined, records the reasons and identifies the support needed for the next task.

The conclusion stays specific: it concerns contribution to this inquiry. It gives no warrant for a general classification of the learner's intelligence, motivation or future potential.

Confirmation is legitimate because the process held a real possibility of a different outcome. The additional material was examined, the inference was tested and the grounds were documented. A ritual would keep the initial judgement whatever the evidence said, or merely record that the student had been "heard".

8.4. Objections and design responses

The interval must withstand the difficulties inherent in assessment (Table 4).

Table 4. Objections to the interval and the required design responses.

Objection	Required response
Students will use challenges strategically to obtain a better judgement.	Claims enter an evidential inquiry governed by announced criteria. The teacher examines their relevance and corroboration. The opportunity to contest creates no entitlement to a higher assessment. Strategic presentation is addressed through scrutiny, without treating every challenge as suspect.
Teacher–student power asymmetry makes contestation formally available but practically unsafe.	The procedure must offer different formats, make clear that reasoned disagreement carries no penalty and explain how challenges enter the decision. Consequential disputes require an institutional route to another reviewer. Silence supplies no evidence that participation was equitable.
The process adds unsustainable teacher workload.	Documentation and review must be proportionate. Brief records serve routine decisions; fuller examination is reserved for consequential or evidentially problematic cases. Shared prompts, scheduled review opportunities and institutional support distribute the work. Workload enters the evaluation of the design.

These responses define responsibilities that must be examined in practice. They also separate participation from persuasion: the quality of a claim depends on its relevance to the criterion and its evidential grounds, not on the confidence of its presentation. The opportunity to contest is not a courtesy; it is part of how the grounds get tested.

8.5. What the framework contributes

Configuration identifies the relations pertinent to the assessment. Intercontextuality follows the passage from recorded action to evidence of contribution. Epistemic simulacrum names the excess of authority that arises when fluent narrative feedback, built on a partial record, is treated as a complete account of contribution. The double movement joins provisional description to scrutiny of its conditions. The interval organises that scrutiny through the four markers specified in Section 5.

Validity theory remains the resource for examining construct representation and inferential support. Attention to consequences includes how the judgement shapes

subsequent participation and access to learning opportunities. Epistemic justice enters where credibility, prejudice or unequal interpretive resources affect whose contribution receives recognition.

The Manifesto articulates these analyses as educational work undertaken before a judgement is settled. Revision and confirmation are both accountable outcomes. In both variants the teacher must explain the relationship among criterion, evidence and decision.

9. From Manifesto to practice

9.1. Classrooms and teacher education

The Manifesto requires teaching arrangements in which learners work on the relationship between answers and their grounds. A short validation record identifies a consequential claim, its supporting source and the reason for retaining or revising it. Teachers select the claims worth examining and supply resources appropriate to the task.

Intercontextuality becomes an object of learning when students examine how the same response changes its adequacy across purposes. A text suitable for initial exploration faces further requirements when used as a disciplinary argument or as evidence of independent learning. Students must identify those requirements and justify the transition.

These activities connect to evaluative judgement and feedback literacy (Tai et al., 2018; Carless & Boud, 2018). The additional object of scrutiny is the arrangement through which work becomes evidence: the selected records, criteria and inferences that inform a judgement.

Teacher education must bring this scrutiny into professional practice. Participants compare a generated lesson plan with one developed collaboratively. They identify assumptions about learners, knowledge, resources and participation; enact a design; document selected consequences; and revise it against explicit purposes. Reflection addresses both the activity and the grounds on which its quality is judged.

The four markers give these settings a common language. An activity qualifies as an epistemic interval when acceptance is provisional, grounds receive examination, revision is actionable and reasons are documented. Its classroom form follows the purpose and the learners involved.

9.2. Institutional conditions

Institutions must make their choices of educational infrastructure answerable to purposes and consequences. Procurement criteria should address the relevance of collected data, the meaning of classifications, access to usable evidence and procedures for reviewing consequential decisions. Staff development, timetabling and workload policy must support the responsibilities assigned to teachers.

The European regulatory framework gives institutional responsibility a distinct legal dimension. Under the AI Act, systems intended to evaluate learning outcomes, including uses that steer learning processes, fall within the educational categories listed in Annex III, point 3(b). Their classification requires examination of the intended purpose and the conditions established by Article 6, including its

derogation criteria. Institutions must assess the role assigned to the system and its influence on decisions; the presence of a teacher in the workflow does not by itself settle the classification (European Parliament & Council, 2024).

Article 22 GDPR addresses decisions based solely on automated processing that produce legal or similarly significant effects, subject to specified exceptions and safeguards. Its relevance depends on how the decision is made and what consequences it carries. Institutions must therefore examine the actual decision process and the applicable safeguards, and not treat every use of AI in assessment as legally equivalent (European Parliament & Council, 2016).

The epistemic interval serves an educational purpose: participants examine evidence, practise judgement and contribute reasons before a decision is settled. Legal compliance requires a separate institutional assessment of applicable obligations, safeguards and remedies. The Manifesto requires these responsibilities to remain identifiable, with attention to the provisions and guidance applicable at the time of deployment.

This work also belongs within the Italian traditions of media education and of reflection on complexity. Rivoltella's (2001) account situates media education across critical inquiry, educational practice and professional formation. The collection edited by Bocchi and Ceruti (1985) is a reference for examining complexity across disciplinary boundaries. The Manifesto connects these resources to institutional decisions about mediation, participation and responsibility.

9.3. Limits, stated plainly

This is a conceptual and programmatic Manifesto: the hypothetical case illustrates the framework and supplies no empirical evidence of its effectiveness.

The proposal meets informational and organisational limits. Teachers and learners often have partial access to how a system operates, while time, resources and institutional rules restrict examination. Inquiry must concentrate on what is relevant to the decision and state the uncertainties that remain. When sufficient grounds are unavailable, reducing the system's role is a legitimate response.

The four markers are minimum design requirements, not a validated measurement instrument. Their presence must be established through enacted procedures and records, with attention to the gap between formal availability and actual use. They do not, by themselves, establish learning, fairness or appropriate reliance.

An interval also requires relevant knowledge, accessible evidence and support. Added documentation may become a burden detached from learning. Opportunities to contest may favour confident speakers and writers. Repeated demands for justification may discourage participation, or shift responsibility onto the learners least equipped to bear it. These consequences must enter the examination of the design.

The framework has analytical limits of its own. A configurational account may overlook significant relations. Naming several contexts adds little unless their relationship changes an interpretation. Calling a representation a simulacrum requires reasons for judging its authority excessive. The vocabulary must stay answerable to the explanatory and practical work it performs.

9.4. A research agenda with educational communities

Research with educational communities must examine the framework through cycles of design, observation and revision. Each study should specify the task, the participants, the intended judgement, the available evidence and the responsibilities before examining the interval's consequences.

Research should define the beginning and end of each episode and collect evidence proportionate to its significance. A minimum record identifies the initial judgement, the criterion and evidence examined, any relevant contribution to reconsideration, and the final decision with its reasons. Observation should compare the announced procedure with its enactment, including participants' access to the opportunity for examination. Collecting every interaction is unnecessary; the record must be sufficient to reconstruct the consequential passage from representation to judgement.

Comparative research must examine the educational contribution of the interval against established practices of reflection, feedback and evidence review. Studies should specify the expected contribution, the outcomes used to examine it and what would count as an educationally meaningful difference. Comparisons must account for task demands, available support and time devoted to the activity.

Relevant outcomes include identifying unsupported inferences, selecting pertinent evidence, justifying confirmation or revision, and exercising judgement in subsequent tasks. Their assessment requires criteria established independently of whether participants use the Manifesto's vocabulary. Participation and workload must also enter the evaluation, including the distribution of opportunities and burdens across learners.

Evidence would weaken the proposed pedagogical contribution if adequately supported implementations, with all four markers demonstrably enacted, repeatedly produced practically negligible benefits compared with simpler established practices. Consistent increases in erroneous decisions, unequal participation or workload without commensurate educational benefit would provide further grounds for revising or abandoning particular enactments. An inconclusive result must remain distinguishable from evidence of negligible benefit.

The analytical contribution is open to challenge as well. If configuration, intercontextuality and the double movement repeatedly fail to identify consequential relations or interpretive passages beyond those already disclosed by existing approaches, their additional usefulness shrinks. In that case the framework would need simplification or sharper specification.

Implementation difficulties and adverse findings require separate examination. Fidelity analysis establishes which requirements were enacted and which conditions were available; it must also permit the conclusion that the proposed organisation adds too little value. The normative commitment to accountable judgement remains open to different practical realisations. Evidence against one realisation must change what the Manifesto recommends.

Operational guidelines should emerge from this inquiry. Their role is to make purposes, choices and responsibilities intelligible while preserving the situated judgement on which educational work depends.

10. Conclusion

Quantum pedagogy places an educational commitment inside de Kerckhove's media-ecological genealogy. It asks how apparatuses take part in producing descriptions, and how those descriptions acquire authority. Education must make that passage available for examination.

Five concepts organise a connected sequence. Configuration identifies the relevant relations. Intercontextuality follows changes of significance across contexts. The double movement joins stabilisation to scrutiny of its conditions. Epistemic simulacrum names authority that exceeds warrant. The interval gives participants an effective role in examining the grounds before a decision is settled.

The twelve theses state the programme. Its institutional demand is that consequential representations remain answerable to evidence, educational purposes and the people they concern. Its pedagogical demand is that learners develop judgement through meaningful participation in that examination. Its research demand is that the proposed practices face comparison, adverse findings and revision.

The Manifesto commits education to purposes, grounds and responsibilities that remain intelligible across changing technical environments. Where a representation informs a decision, its authority must be justified. Where a decision affects participation, its consequences must be followed. Where new evidence changes the grounds, revision must be practicable.

References

Akkerman, S. F., & Bakker, A. (2011). Boundary crossing and boundary objects. Review of Educational Research, 81(2), 132–169. https://doi.org/10.3102/0034654311404435

Alfrink, K., Keller, I., Kortuem, G., & Doorn, N. (2023). Contestable AI by design: Towards a framework. Minds and Machines, 33(4), 613–639. https://doi.org/10.1007/s11023-022-09611-z

Almada, M. (2019). Human intervention in automated decision-making: Toward the construction of contestable systems. In Proceedings of the 17th International Conference on Artificial Intelligence and Law (pp. 2–11). ACM. https://doi.org/10.1145/3322640.3326699

Alter, A. L., & Oppenheimer, D. M. (2009). Uniting the tribes of fluency to form a metacognitive nation. Personality and Social Psychology Review, 13(3), 219–235. https://doi.org/10.1177/1088868309341564

Barad, K. (2007). Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning. Duke University Press.

Barad, K. (2022). Agential realism—A relation ontology interpretation of quantum physics. In O. Freire Jr. (Ed.), The Oxford handbook of the history of quantum interpretations (pp. 1031–1054). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780198844495.013.0043

Bateson, G. (1972). Steps to an ecology of mind. Chandler Publishing Company.

Baudrillard, J. (1981). Simulacres et simulation. Galilée.

Bender, E. M., & Koller, A. (2020). Climbing towards NLU: On meaning, form, and understanding in the age of data. In Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics (pp. 5185–5198). https://doi.org/10.18653/v1/2020.acl-main.463

Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the dangers of stochastic parrots: Can language models be too big? In Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency (pp. 610–623). https://doi.org/10.1145/3442188.3445922

Berger, E. (2022). Context blindness: Digital technology and the next stage of human evolution. Peter Lang.

Bernstein, B. (1990). The structuring of pedagogic discourse (Class, codes and control, Vol. IV). Routledge.

Biesta, G. J. J. (2013). The beautiful risk of education. Paradigm Publishers.

Bjork, E. L., & Bjork, R. A. (2011). Making things hard on yourself, but in a good way: Creating desirable difficulties to enhance learning. In M. A. Gernsbacher, R. W. Pew, L. M. Hough, & J. R. Pomerantz (Eds.), Psychology and the real world: Essays illustrating fundamental contributions to society (pp. 56–64). Worth Publishers.

Bocchi, G., & Ceruti, M. (Eds.). (1985). La sfida della complessità. Feltrinelli.

Bohr, N. (1949). Discussion with Einstein on epistemological problems in atomic physics. In P. A. Schilpp (Ed.), Albert Einstein: Philosopher–scientist (pp. 201–241). The Library of Living Philosophers.

Bonetta, G. (2017). L'invisibile educativo. Pedagogia, inconscio e fisica quantistica. Armando Editore.

Busemeyer, J. R., & Bruza, P. D. (2012). Quantum models of cognition and decision. Cambridge University Press. https://doi.org/10.1017/CBO9780511997716

Buçinca, Z., Malaya, M. B., & Gajos, K. Z. (2021). To trust or to think: Cognitive forcing functions can reduce overreliance on AI in AI-assisted decision-making. Proceedings of the ACM on Human-Computer Interaction, 5(CSCW1), Article 188. https://doi.org/10.1145/3449287

Calzati, S., & de Kerckhove, D. (2024). Quantum ecology: Why and how new information technologies will reshape societies. MIT Press.

Calzati, S., & de Kerckhove, D. (2025). The quantum ecology as an onto-epistemological framework: Toward an ecological theory of sensing [Preprint]. SSRN. https://doi.org/10.2139/ssrn.5444274

Carless, D., & Boud, D. (2018). The development of student feedback literacy: Enabling uptake of feedback. Assessment & Evaluation in Higher Education, 43(8), 1315–1325. https://doi.org/10.1080/02602938.2018.1463354

Clark, A. (2008). Supersizing the mind: Embodiment, action, and cognitive extension. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195333213.001.0001

de Kerckhove, D. (1995). The skin of culture: Investigating the new electronic reality. Somerville House.

de Kerckhove, D. (1997). Connected intelligence: The arrival of the Web society. Somerville House Publishing.

de Kerckhove, D. (2024). NaturArchy from the point-of-view to the point-of-being. New Explorations, 4(1). https://doi.org/10.7202/1111621ar

de Kerckhove, D. (2025). L'uomo quantistico. Mente, società, democrazia: dove ci porterà la prossima rivoluzione digitale. Rai Libri.

de Kerckhove, D. (n.d.). La fisica, classica e quantistica, come paradigmi delle ecologie dei media: Sulla migrazione del reale dal contesto-indipendente al contesto-dipendente [Unpublished manuscript].

Dewey, J. (1938). Experience and education. Macmillan.

European Parliament & Council. (2016). 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 and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Official Journal of the European Union, L 119, 1–88. https://eur-lex.europa.eu/eli/reg/2016/679/oj

European Parliament & Council. (2024). Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act). Official Journal of the European Union, 2024/1689. https://eur-lex.europa.eu/eli/reg/2024/1689/oj

Fenwick, T., & Edwards, R. (2010). Actor-network theory in education. Routledge.

Fishman, J. (2022). A quantum pedagogy. Intraspection, 5. Murray State University. https://sites.google.com/murraystate.edu/intraspection/home/all-issues/issue-5-2022/a-quantum-pedagogy

Fricker, M. (2007). Epistemic injustice: Power and the ethics of knowing. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198237907.001.0001

Hicks, M. T., Humphries, J., & Slater, J. (2024). ChatGPT is bullshit. Ethics and Information Technology, 26, Article 38. https://doi.org/10.1007/s10676-024-09775-5

Hutchins, E. (1995). Cognition in the wild. MIT Press.

Kane, M. T. (2013). Validating the interpretations and uses of test scores. Journal of Educational Measurement, 50(1), 1–73. https://doi.org/10.1111/jedm.12000

Kapur, M. (2014). Productive failure in learning math. Cognitive Science, 38(5), 1008–1022. https://doi.org/10.1111/cogs.12107

Kochen, S., & Specker, E. P. (1967). The problem of hidden variables in quantum mechanics. Journal of Mathematics and Mechanics, 17(1), 59–87.

Lenz Taguchi, H. (2010). Going beyond the theory/practice divide in early childhood education: Introducing an intra-active pedagogy. Routledge.

Marwick, A. E., & boyd, d. (2011). I tweet honestly, I tweet passionately: Twitter users, context collapse, and the imagined audience. New Media & Society, 13(1), 114–133. https://doi.org/10.1177/1461444810365313

McLuhan, M. (1964). Understanding media: The extensions of man. McGraw-Hill.

Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. American Psychologist, 50(9), 741–749. https://doi.org/10.1037/0003-066X.50.9.741

Morin, E. (1990). Introduction à la pensée complexe. ESF.

Murris, K. (2016). The posthuman child: Educational transformation through philosophy with picturebooks. Routledge.

Ong, W. J. (1982). Orality and literacy: The technologizing of the word. Methuen.

Parasuraman, R., & Manzey, D. H. (2010). Complacency and bias in human use of automation: An attentional integration. Human Factors, 52(3), 381–410. https://doi.org/10.1177/0018720810376055

Parasuraman, R., & Riley, V. (1997). Humans and automation: Use, misuse, disuse, abuse. Human Factors, 39(2), 230–253. https://doi.org/10.1518/001872097778543886

Rivoltella, P. C. (2001). Media education: Modelli, esperienze, profilo disciplinare. Carocci.

Schön, D. A. (1983). The reflective practitioner: How professionals think in action. Basic Books.

Selwyn, N. (2019). Should robots replace teachers? AI and the future of education. Polity.

Sperber, D., Clément, F., Heintz, C., Mascaro, O., Mercier, H., Origgi, G., & Wilson, D. (2010). Epistemic vigilance. Mind & Language, 25(4), 359–393. https://doi.org/10.1111/j.1468-0017.2010.01394.x

Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39. Social Studies of Science, 19(3), 387–420. https://doi.org/10.1177/030631289019003001

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. Cognitive Science, 12(2), 257–285. https://doi.org/10.1207/s15516709cog1202_4

Swiecki, Z., Khosravi, H., Chen, G., Martinez-Maldonado, R., Lodge, J. M., Milligan, S., Selwyn, N., & Gašević, D. (2022). Assessment in the age of artificial intelligence. Computers and Education: Artificial Intelligence, 3, 100075. https://doi.org/10.1016/j.caeai.2022.100075

Tai, J., Ajjawi, R., Boud, D., Dawson, P., & Panadero, E. (2018). Developing evaluative judgement: Enabling students to make decisions about the quality of work. Higher Education, 76(3), 467–481. https://doi.org/10.1007/s10734-017-0220-3

Taylor, C. A., & Hughes, C. (Eds.). (2016). Posthuman research practices in education. Palgrave Macmillan.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.

Williamson, B. (2017). Big data in education: The digital future of learning, policy and practice. SAGE Publications.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. Theory Into Practice, 41(2), 64–70. https://doi.org/10.1207/s15430421tip4102_2