

Galperian epistemology, human thought, and artificial intelligence in education

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ABSTRACT

This theoretical review examines the relationship between Piotr Galperin's epistemology, the development of human thought, and the incorporation of artificial intelligence (AI) in education. The analysis is organized around five issues: the stage-by-stage formation of mental actions, the zone of proximal development as oriented mediation, the pedagogical role of AI, the ethical and cultural risks of automation, and practical principles for educational design and regulation. The review synthesizes contributions from historical-cultural psychology, activity theory, neuroeducation, ethics of technology, and recent AI-in-education studies in order to argue that AI should not be understood as a substitute for human thinking but as a mediated resource whose value depends on pedagogical intentionality, transparency, and cultural grounding. The paper's explicit novelty lies in articulating Galperin's orienting basis of action with current debates on AI design, educational policy, and ethical regulation, thereby moving from philosophical interpretation to concrete pedagogical criteria for practice. From this perspective, the teacher remains a reflective mediator, and education retains its formative responsibility to cultivate autonomy, critical judgment, and consciously regulated action.

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1. INTRODUCTION

Educational systems are currently confronted with a double demand: they must respond to accelerated technological change while preserving the formative mission of schooling. Artificial intelligence (AI) has expanded possibilities for feedback, personalization, automation, and decision support, yet it has also intensified concerns about surveillance, decontextualization, epistemic bias, and the weakening of reflective thought. For that reason, contemporary educational debate increasingly asks not only what AI can do efficiently, but also what kinds of human development it may support, distort, or displace [1]–[4].

Several recent studies have examined AI in education from complementary angles, including systematic reviews of higher education research, metacognitive scaffolding in AI-supported environments, ethical frameworks, and the promise of human-centered AI [1]–[4]. These works have clarified the scale of the phenomenon, but they often remain centered on technological functions, governance models, or implementation conditions. A conceptual gap remains regarding how a strong theory of thought formation can illuminate the pedagogical conditions under which AI contributes to conscious learning rather than merely to rapid task completion. Galperin's theory of the step-by-step formation of mental actions offers a

particularly relevant framework for closing that gap. Instead of treating cognition as spontaneous adaptation or isolated information processing, Galperin explains learning as the gradual transformation of external, materially organized, and verbally mediated action into internal, conscious, and self-regulated mental activity [5]–[7]. This perspective is especially valuable in the current context because AI-mediated learning environments are themselves systems of orientation, feedback, and symbolic mediation that may either strengthen or weaken the learner's active construction of meaning.

The novelty of this paper lies in explicitly connecting Galperin's orienting basis of action and staged formation of mental actions with current debates on educational AI design, policy, and ethics. The article does not simply restate historical-cultural psychology; it translates that tradition into practical principles for pedagogical transparency, cultural contextualization, and support for conscious reflection in AI-mediated education. In this way, the study contributes a theoretical bridge between philosophical-psychological foundations and concrete criteria for the responsible implementation and regulation of AI in educational settings.

This contribution matters for educational practice, policy, and AI development in distinct but related ways. For teaching practice, it clarifies why guided mediation remains indispensable even when intelligent systems provide immediate responses or adaptive sequences. For policy and technological development, it argues that educational AI should be evaluated not only in terms of efficiency and scale but also according to whether it protects teacher agency, learner autonomy, cultural relevance, and ethical responsibility.

The article therefore aims to analyze the relationship between Galperin's epistemology, the development of human thought, and AI in education through a conceptual review organized around five concerns. These concerns are the construction of thought, the zone of proximal development as oriented mediation, the pedagogical role of AI, the epistemic-ethical challenges raised by automation, and the practical principles that should guide educational design and regulation. By foregrounding guided, conscious, and culturally grounded mediation, the paper situates itself within current debates on AI's role in human development and offers a human-centered perspective for contemporary educational transformation.

2. METHOD

This study adopts a contemporary theoretical review design. The review is conceptual rather than empirical, but it follows an explicit selection and analysis strategy in order to ensure coherence, transparency, and relevance. The literature base was assembled from the references already developed in the source manuscript and prioritized five clusters of scholarship: Galperin and historical-cultural psychology, the zone of proximal development and activity theory, AI in education, ethics and datafication, and pedagogical innovation in higher and school education.

The selection process privileged sources that met at least one of three conditions. First, classical works were retained when they were indispensable for defining the theoretical architecture of the argument, as in the cases of [8]–[13]. Second, recent peer-reviewed studies and reviews published mainly from 2020 onward were prioritized when they clarified contemporary debates on AI, mediation, scaffolding, self-regulation, ethics, and policy [1], [2], [4], [14]–[17]. Third, regionally relevant works were incorporated when they helped situate the discussion in Latin American and Ibero-American educational concerns, especially around inclusion, teacher formation, and cultural diversity [18]–[22].

The analytical procedure was interpretive and comparative. Each source was read in terms of its central concept, its view of mediation, its implied model of the learner, and its implications for educational design, teacher action, and ethical regulation. The resulting synthesis identified convergences, tensions, and omissions across traditions, allowing the paper to formulate practical principles for AI in education from a Galperinian standpoint. Because this is a philosophical and conceptual review, it has limitations that must be acknowledged explicitly. The article does not test hypotheses with original data, does not report a formal systematic-review protocol, and does not measure outcomes across classrooms or platforms. Its value therefore lies in theoretical integration and critical clarification, not in causal verification, and future empirical studies should examine how the proposed principles operate in concrete instructional settings.

3. RESULTS AND DISCUSSION

3.1. Galperian epistemology and the construction of human thought

Galperin's epistemology belongs to the historical-cultural tradition that understands higher mental functions as socially and symbolically mediated rather than biologically pre-given. In this perspective, thought emerges through organized activity, cultural tools, and pedagogical guidance, and it becomes internal only after passing through external and verbalized forms of action [5], [7], [10]. This means that genuine learning requires more than exposure to information; it requires deliberate orientation that helps the learner grasp the structure, purpose, and criteria of the action being formed.

The central educational consequence of this view is that teaching is not the transfer of ready-made knowledge but the design of conditions for the conscious formation of action. Galperin's stages, together with related developments by Talyzina, Davidov, and contemporary interpreters, show that mental autonomy is built through carefully sequenced support, not through pedagogical improvisation [23]–[26]. This line of thinking converges with broader cultural and activity-based approaches that describe cognition as situated, tool-mediated, and directed toward socially meaningful objects [27], [28].

Seen from this angle, Galperin offers a strong alternative to both simplistic technological optimism and purely spontaneous models of learning. AI may provide prompts, classifications, and adaptive pathways, but none of these functions automatically produce conscious concept formation. The decisive question is whether the technology participates in an orienting process that helps students understand what they are doing, why they are doing it, and how they can transfer the action to new situations.

3.2. The zone of proximal development, oriented mediation, and teacher action

The zone of proximal development is frequently reduced to the idea of temporary assistance, yet a Galperinian interpretation makes the concept pedagogically more precise. The issue is not simply that the learner receives help, but that the help is organized, generalizable, and progressively internalized through the orienting basis of action [5], [15], [29]. The zone therefore becomes a space where teaching quality can be evaluated according to the clarity, completeness, and transferability of the guidance offered.

This interpretation has direct implications for teacher action. A teacher working from a Galperinian standpoint does not merely detect errors after performance; the teacher designs orientation in advance, makes criteria visible, provides structured verbalization, and gradually transfers regulation to the learner [21], [24], [25]. In school, university, and inclusive settings alike, this logic supports more stable learning because students build their own means of control instead of relying on momentary assistance [15], [19], [20].

The contemporary relevance of this approach is heightened by AI-supported environments that are often described as scaffolding systems. Those systems can indeed support proximal development, but only if they do more than automate hints or sequence tasks. They must make reasoning processes transparent, allow dialogic feedback, respect cultural and linguistic differences, and remain embedded within a broader pedagogical relation in which teachers interpret, redirect, and humanize mediation.

3.3. Artificial intelligence as mediated support rather than cognitive replacement

Recent literature on AI in education shows that intelligent systems can support feedback, recommendation, metacognition, and adaptive pacing when used within strong instructional designs [1], [3], [30], [31]. From a Galperinian perspective, these potentials are pedagogically significant because they can contribute to the orienting phase of action, help make criteria explicit, and provide opportunities for iterative reflection. However, such benefits appear only when AI is subordinated to educational purposes instead of being treated as an autonomous teaching agent.

This distinction is crucial because AI systems frequently operate at the level of task completion rather than concept formation. A system may generate a response, summarize a reading, or suggest a solution path, yet the learner may remain passive, opaque to the reasoning involved, and unable to generalize the action independently. When that occurs, technological mediation accelerates production but weakens the very processes of internalization, verbal regulation, and reflective control that Galperin considered central to the development of thought.

The discussion therefore supports a qualified view of AI as a mediating resource. AI can be educationally valuable when it expands dialogue, renders feedback more actionable, supports multiple representations, and enables learners to monitor their own thinking [32]–[34]. It becomes pedagogically problematic when it replaces explanation with prediction, substitutes probability for understanding, or turns the learner into a consumer of machine outputs instead of an active subject of conscious action.

3.4. Educational practice, policy, and ethical challenges

The philosophical insights have concrete implications for practice. In classrooms and university courses, AI raises questions about assessment integrity, authorship, feedback quality, attention, and dependency. These are not merely technical challenges, because they concern the formation of judgment, the meaning of academic work, and the extent to which learners are still being invited to think rather than merely to optimize performance [2], [16], [35], [36].

At the policy level, the growth of datafication and algorithmic governance introduces further tensions. If educational systems adopt AI primarily to classify students, standardize learning pathways, or intensify monitoring, they may weaken teacher professionalism and reproduce social inequities under the appearance of neutrality [17], [37]–[39]. A Galperinian reading is especially important here because it reminds policymakers that educational mediation is not interchangeable with automated decision-making and that developmental processes cannot be reduced to traceable outputs alone.

Ethically, the central issue is whether AI protects or erodes human dignity in education. Critical authors have warned that surveillance architectures, epistemic colonialism, bias in datasets, and the narrowing of dialogic space may undermine cultural relevance and moral responsibility [22], [40]–[43]. For that reason, any responsible educational use of AI must preserve the teacher as a conscious mediator, the student as a culturally situated subject, and schooling as a public space for reflection, not merely for automated performance management.

3.5. Practical principles for designing and regulating AI in education

The review allows the formulation of several practical principles for educational design. The first is pedagogical transparency, which means that students should be able to understand how AI-generated suggestions are produced, what criteria are being applied, and where the limits of the system lie. Without transparency, mediation becomes opaque and learners cannot transform external support into conscious and transferable intellectual action.

The second principle is cultural contextualization. AI tools used in education should be aligned with the linguistic, historical, ethical, and curricular realities of the communities they serve, rather than imposing uniform epistemic models that ignore local knowledge and diversity [19], [20], [22]. This principle is essential for avoiding decontextualized automation and for ensuring that mediation remains meaningful within specific social and educational settings.

The third principle is support for conscious reflection. Educational AI should be designed to provoke explanation, comparison, justification, revision, and self-regulation instead of simply producing fast answers. In practice, this means favoring prompts, formative rubrics, dialogic feedback, reflective logs, and teacher-guided discussions that help students verbalize their reasoning and gradually internalize criteria for autonomous judgment.

A fourth principle concerns shared governance and regulation. Institutions should evaluate AI not only in terms of cost and efficiency but also through protocols for privacy, bias review, teacher oversight, and student rights [2], [37], [38], [44]. This policy orientation keeps the focus on educational responsibility and prevents technological innovation from becoming detached from the ethical obligations of schooling and higher education.

Taken together, these principles translate a philosophical framework into an actionable agenda. They connect Galperin's emphasis on orientation with current demands for trustworthy, human-centered, and pedagogically defensible AI. They also offer a basis for future empirical work capable of testing how guided, conscious, and culturally grounded mediation can be enacted across real educational platforms and institutional policies.

4. CONCLUSION

This theoretical review has argued that Galperin's epistemology remains highly relevant for interpreting the educational meaning of AI. By focusing on the staged formation of mental actions, the orienting basis of action, and the pedagogical quality of mediation, the paper shows that the development of thought cannot be replaced by automation. AI may participate in education productively, but only when it is subordinated to formative purposes and integrated into ethically guided, culturally situated instructional designs.

The article's main contribution is to move from conceptual diagnosis to practical orientation. It identifies the novelty of reading contemporary AI debates through a Galperinian lens and uses that lens to formulate principles of pedagogical transparency, cultural contextualization, conscious reflection, and shared governance. These principles connect philosophical insight with educational practice, policy design, and the responsibilities of AI developers working in learning environments.

At the same time, the paper recognizes its own conceptual limits. It does not offer empirical evidence on specific platforms, school levels, or learning outcomes, and therefore should be read as a framework for critical interpretation and future inquiry rather than as a definitive evaluative model. Even so, the review makes a clear claim: if education is to remain a humanizing practice in the age of AI, then guided, conscious, and culturally grounded mediation must remain at the center of pedagogical design and institutional regulation.

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C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nvestigation

R : **R**esources

D : **D**ata Curation

O : Writing - **O**riginal Draft

E : Writing - Review & **E**editing

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest related to this manuscript. This statement is retained because the source version reports no financial, professional, or personal conflict that could have influenced the review. If any relationship could reasonably be perceived as relevant, it should be disclosed in the final version.

INFORMED CONSENT

Informed consent is not applicable to this study because the manuscript is a theoretical review and does not report intervention with human participants. No interviews, surveys, experiments, or identifiable personal data are included in the present article. For that reason, no participant consent procedure was required.

ETHICAL APPROVAL

Ethical approval is not applicable because the manuscript is conceptual and does not involve human or animal experimentation. The revised article therefore retains a non-applicable ethics statement rather than inventing procedural information not present in the source manuscript. If future empirical extensions are conducted, the relevant ethics committee approval should be reported explicitly.

DATA AVAILABILITY

Data availability is not applicable in the strict sense because this paper did not generate or analyze a new dataset. The argumentative basis of the article rests on published sources that are listed in the reference section and can be consulted independently by readers. Accordingly, the revised statement clarifies that the evidentiary base is bibliographic and not archival or experimental.

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