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ARTIFICIAL INTELLIGENCE AND SCHOOL ASSESSMENT: FORMATIVE POTENTIAL, TEACHER MEDIATION, AND ETHICAL CHALLENGES IN CONTEMPORARY EVALUATIVE PRACTICES

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ABSTRACT: The incorporation of artificial intelligence (AI) into educational systems has expanded the possibilities for monitoring learning, producing feedback, and personalizing instruction. In school assessment, however, the adoption of these technologies requires more precise conceptual distinctions between different AI paradigms and a critical analysis of their pedagogical and ethical effects. This study aims to analyze the impacts of AI on school assessment processes by examining its formative potential, epistemological limits, and the ethical challenges involved in its use. Methodologically, this is a qualitative bibliographic study with an analytical and interpretive orientation. Rather than presenting itself as an exhaustive systematic review, the study explicitly adopts the format of an analytical bibliographic review, organized around academic literature and institutional documents relevant to the topic. The analysis is guided by the articulation between formative assessment theory and a critical sociotechnical reading of educational datafication. The study shows that the effects of AI on assessment are not homogeneous: rule-based systems tend to operate better in structured tasks; models supported by learning analytics and educational data mining expand monitoring and diagnostic capacity; and generative systems open new possibilities for open-ended tasks, but still show instability, opacity, and a persistent need for human oversight. The article concludes that AI can contribute to more continuous, responsive, and formative assessment practices, provided that its use remains subordinated to teachers' pedagogical judgment, data protection, algorithmic transparency, and principles of equity.

Keywords: Artificial intelligence. School assessment. Formative assessment. Learning analytics. Educational ethics.

1 INTRODUCTION

School assessment occupies a central position in the educational process, as it participates in the interpretation of learning, the regulation of teaching, and pedagogical decision-making. When reduced to isolated, predominantly classificatory instruments, it tends to privilege the product over the processual monitoring of student development. For this reason, educational literature has reiterated the need to

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understand assessment as a formative, diagnostic, and pedagogically oriented practice, rather than merely as a mechanism for measurement or selection (LUCKESI, 2011).

In recent decades, the expansion of digital technologies has intensified the production of data on teaching and learning and reconfigured the way educational institutions track school trajectories. Within this movement, artificial intelligence has come to occupy a prominent position in educational platforms, adaptive systems, response classification mechanisms, intelligent tutoring environments, and automated feedback tools (HOLMES; TUOMI, 2022; ZAWACKI-RICHTER et al., 2019). However, much of the public debate and even part of the academic literature still treats AI as a homogeneous block, without adequately distinguishing its different technical paradigms and their specific effects on assessment.

This generalization produces two analytical problems. The first consists of attributing to any AI application a transformative pedagogical potential, without considering the nature of the assessed task, the type of data mobilized, and the degree of human supervision required. The second lies in displacing to algorithmic systems expectations that ultimately belong to the domain of pedagogical judgment, teacher mediation, and curricular organization. As a result, potential benefits, ethical risks, and epistemological limits tend to appear in simplified form.

In the specific field of school assessment, this distinction is decisive. Rule-based systems operate differently from machine learning models oriented toward prediction, and both differ from recent generative applications aimed at producing feedback or scoring open-ended responses. Each of these arrangements entails its own possibilities and constraints regarding the validity of evaluative inferences, the transparency of criteria, data protection, and teacher autonomy (BAKER; INVENTADO, 2014; HOLMES et al., 2022; PACK; BARRETT; ESCALANTE, 2024).

Furthermore, recent literature has demonstrated that the ethical challenges of educational AI are not limited to the abstract risk of "algorithmic error." They also involve the opacity of systems, the reproduction of biases, the intensive datafication of school life, the handling of sensitive data, and the redefinition of the role of teachers in increasingly automated environments (O'NEIL, 2016; HAKIMI; EYNON; MURPHY,

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2021; GOUSETI et al., 2025). In normative documents and synthesis studies, transparency, fairness, accountability, and human oversight appear as central conditions for the ethically defensible educational use of AI (UNESCO, 2021; FLORIDI et al., 2018; HOLMES et al., 2022).

Considering this scenario, this article is guided by the following research question: in what ways can different artificial intelligence paradigms affect school assessment, and what pedagogical and ethical tensions emerge from this process? The general objective is to analyze the impacts of AI on school assessment processes. As specific objectives, the study seeks to: a) conceptually distinguish different AI paradigms applied to education; b) examine their potential for formative assessment; c) discuss risks associated with opacity, bias, and data protection; and d) make explicit the role of teacher mediation and contextual conditions in the incorporation of these technologies.

The contribution of this study is not empirical but analytical-conceptual. Instead of generically reiterating that AI "transforms" assessment, the text proposes a differentiated reading of the technologies involved and articulates the discussion with formative assessment theory and a critical sociotechnical perspective on educational data. In doing so, it aims to offer a more precise framework for the debate on school assessment in the age of AI, avoiding undue extrapolations and preserving the link between technology, pedagogy, and ethical responsibility.

2 THEORETICAL-ANALYTICAL FRAMEWORK

2.1 Conceptual delimitation of artificial intelligence in the educational field

Artificial intelligence can be understood, in a broad sense, as the field dedicated to the development of systems capable of performing tasks associated with human cognitive processes, such as learning, inference, pattern recognition, and decision-making (RUSSELL; NORVIG, 2021). However, this broad definition does not eliminate the internal heterogeneity of the field. In the educational domain, Holmes and Tuomi (2022) observe that "AI in education" encompasses very diverse applications that vary in terms of operational logic, the type of data mobilized, decisional autonomy, and the role attributed to human agents.

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A first relevant distinction involves rule-based systems. In these cases, the operation of the tool depends on previously programmed structures with stable criteria for recognizing patterns or classifying responses. In evaluative contexts, such systems tend to perform better in structured tasks, objective questions, closed-response exercises, or scenarios in which correction criteria can be explicitly formalized. This type of application resembles traditional forms of educational automation, in which the predictability of the system's performance is linked to the predictability of the task itself.

A second technological family involves models supported by machine learning, educational data mining, and learning analytics. In these cases, the focus is on the analysis of large volumes of data generated throughout students' interactions with digital environments. Baker and Inventado (2014) show that educational data mining and learning analytics share a concern with the interpretation of learning patterns, albeit with distinct emphases: while the former tends to prioritize the development of computational methods and models, the latter emphasizes the use of data to support pedagogical and institutional decisions. In evaluative terms, these systems expand the capacity for continuous monitoring, difficulty detection, and support pedagogical intervention.

A third, more recent strand concerns generative systems based on large language models. In this domain, AI moves beyond merely classifying closed responses or identifying interaction patterns and begins to produce text, synthesize information, generate discursive feedback, and, in some cases, assign scores to open-ended responses. This shift expands the possibilities for using AI in evaluative practices that have traditionally been more dependent on human judgment, such as the assessment of written production, but it also introduces new problems of validity, stability, and explainability (PACK; BARRETT; ESCALANTE, 2024).

The synthesis literature reinforces the need for this differentiation. In reviewing AI applications in higher education, Zawacki-Richter et al. (2019) identify diverse fields such as prediction, intelligent tutoring systems, adaptive personalization, and automation of evaluative procedures. Although some of this evidence derives from other educational levels, the typology is useful for the school context because it avoids

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the erroneous assumption that all forms of AI operate in the same manner or produce the same pedagogical effects.

Thus, before discussing advantages and risks, it is necessary to delimit the object. In this article, the expression "AI in school assessment" does not refer to a singular technology but to a set of tools with distinct architectures and implications. This clarification is essential to support more rigorous analyses of pedagogical validity, teacher responsibility, and the ethical boundaries of the educational use of AI.

2.2 Formative assessment, pedagogical mediation, and educational datafication

The analysis developed in this study adopts formative assessment as its first theoretical axis. In Luckesi (2011), assessing does not equate to merely measuring or classifying; rather, it involves interpreting the learning process in order to guide pedagogical decisions that promote student development. Within this framework, assessment assumes a diagnostic, regulatory, and emancipatory function, distancing itself from an exclusively certifying logic.

This understanding dialogues with the cultural-historical tradition. In Vygotsky (2007), learning develops through social and cultural mediations, such that the monitoring of students must consider not only what they already accomplish autonomously but also what they can accomplish with qualified support. When transposed to the debate on AI, this perspective shifts the central question: the pedagogical value of technology does not lie in replacing the teacher but in its potential capacity to expand mediations, provide diagnostic cues, and make didactic intervention more responsive.

Bates (2017) also contributes to this discussion by emphasizing the role of timely and pedagogically oriented feedback in learning within digital environments. From this standpoint, technologies capable of providing rapid feedback on performance can contribute to more continuous evaluative practices, provided that the feedback is comprehensible, contextualized, and articulated with formative objectives. The mere speed of the technological response, therefore, does not in itself guarantee pedagogical quality.

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In the realm of AI applications, Paixão (2025a) argues that the personalization of teaching represents one of the most promising fronts for the educational use of these technologies, especially when associated with the identification of specific difficulties and the adaptation of learning pathways. For school assessment, this possibility is relevant because it allows a shift in focus from isolated verification events to more sustained monitoring processes. Nevertheless, personalizing does not mean individualizing in an atomized manner, nor does it mean reducing the student to an algorithmic profile.

It is precisely at this point that the second theoretical axis of the article emerges: a critical sociotechnical reading of educational datafication. Selwyn (2019) warns that learning analytics systems are not neutral; they are shaped by political, economic, and cultural decisions and can reinforce patterns of control, exclusion, and commodification of education. Rather than treating educational data as a transparent mirror of learning, this perspective proposes understanding them as partial constructions, produced in specific contexts and permeated by modeling and governance choices.

The articulation between formative assessment and the critical sociotechnical perspective thus makes it possible to avoid two recurrent reductionisms: technicism, which assumes that more data necessarily leads to better decisions; and technophobia, which preemptively rejects any algorithmic mediation. The analytical challenge consists of examining under what conditions AI can effectively support formative evaluative practices without producing new opacities, asymmetries, or forms of school surveillance.

2.3 Transparency, bias, privacy, and pedagogical responsibility

Ethical debates about AI in education have emphasized that the discussion cannot be limited to the operational efficiency of tools. Floridi et al. (2018) propose an ethical framework for AI based, among other aspects, on beneficence, non-maleficence, autonomy, justice, and explainability. Although formulated in broader terms, this framework is particularly pertinent to education, since evaluative decisions affect school trajectories, self-esteem, recognition, and future opportunities.

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Among the most discussed problems, algorithmic opacity stands out. O'Neil (2016) and Pasquale (2015) show that automated systems frequently operate as black boxes: they process data and produce classifications without making the criteria underpinning their inferences intelligible to users. In the context of school assessment, this implies a dual risk. On one hand, teachers and students may not understand why a certain result was generated; on the other, the appearance of technical objectivity may hinder the questioning of erroneous or unjust classifications.

Holmes et al. (2022), in synthesizing contributions from leading researchers in educational AI, argue that the educational use of AI requires a community-wide framework of principles and practices. Among the points emphasized are the need for meaningful human oversight, consideration of implementation contexts, protection of the individuals involved, and the refusal of the idea that algorithmic performance can, by itself, substitute pedagogical judgment.

The issue of privacy and data governance also assumes centrality. Hakimi, Eynon, and Murphy (2021) demonstrate that the educational use of digital traces raises recurring problems related to consent, data protection, vulnerability, power asymmetries, and institutional accountability. In school environments, these challenges acquire special relevance because they frequently involve children and adolescents, that is, individuals in the process of formation and with lesser bargaining power vis-a-vis platforms and institutions.

In a recent review specifically focused on the K-12 context, Gouseti et al. (2025) observe that the ethical dilemmas of school AI are distributed around themes such as algorithmic fairness, surveillance, transparency, teacher education, and governance. This reinforces the need to delimit the context of the present discussion: although part of the AIEd literature has been produced in university settings, decisions about assessment in basic education require additional caution, precisely because they involve greater age-related sensitivity, inequalities of access, and school relationships marked by institutional asymmetries.

In this direction, Paixão (2025b) maintains that the ethical use of AI in educational contexts depends on critical mediation by teachers, institutional regulation, and transparent criteria for tool selection. Coelho et al. (2025) add that the expansion

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of AI reconfigures the role of teachers: far from making them dispensable, it increases the need for professionals capable of interpreting data, contextualizing results, intervening pedagogically, and resisting the uncritical delegation of educational decisions to automated systems.

Finally, the UNESCO Recommendation (2021) consolidates a relevant normative horizon by emphasizing human rights, equity, transparency, and accountability in the development and use of AI. For the field of school assessment, this means that the legitimacy of a tool cannot be assessed solely by its technical capacity to classify, predict, or generate feedback. It must also be judged by its effects on educational justice, pedagogical autonomy, student protection, and the intelligibility of decision-making processes.

3 METHODOLOGY

This research is characterized as qualitative, bibliographic in nature, and analytical-interpretive in orientation. The study does not adopt the format of an exhaustive systematic review nor does it claim adherence to the PRISMA protocol. Instead, it is explicitly framed as an analytical bibliographic review, aimed at the critical interpretation of academic literature and institutional documents related to artificial intelligence in education, school assessment, learning analytics, and digital ethics. This methodological redefinition is important to preserve the coherence between the scope of the corpus and the type of inference presented in the text.

From the standpoint of objectives, the investigation combines exploratory and descriptive dimensions. It is exploratory because it seeks to deepen the understanding of a topic still under consolidation in the educational debate, especially when circumscribed to school assessment. It is descriptive because it organizes, systematizes, and compares theoretical contributions from different strands of the literature, making explicit convergences, tensions, and analytical gaps (GIL, 2021; VERGARA, 2022).

The analytical corpus was composed of books, peer-reviewed journal articles, and institutional documents with recognized thematic relevance. The selection prioritized texts capable of supporting four axes of the investigated problem: a)

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definition and typologies of AI in education; b) formative assessment and pedagogical mediation; c) learning analytics, educational data mining, and personalization; and d) ethics, transparency, bias, and data governance. The choice of this scope sought to preserve thematic coherence rather than pursue quantitative exhaustiveness.

The analysis proceeded in three complementary stages. In the first, an exploratory reading and selection of key works for the conceptual delimitation of the topic was carried out. In the second, an analytical reading of the selected texts was conducted, identifying recurrent categories and points of tension between technicist, pedagogical, and ethical approaches. In the third, an interpretive synthesis was produced, guided by three analytical categories: i) AI paradigms and their evaluative implications; ii) formative potential and teacher mediation; and iii) ethical tensions, limits, and conditions of use.

Regarding scope, the article focuses on school assessment, particularly at its interface with basic education. However, when the specific literature at this level of education proved limited, contributions from widely cited reviews and studies in AIEd and learning analytics were drawn upon, provided they were useful for conceptual construction and without automatically extrapolating their results to all school contexts. This delimitation seeks to avoid undue generalizations and responds to the need to make explicit the conditions of validity of the argument developed.

The procedure adopted allowed for the construction of a consistent analytical framework for discussing AI in school assessment without resorting to empirical inferences unsupported by the corpus. For this reason, the study's conclusions are presented in a prudent key: they indicate conceptual possibilities and limits but do not replace field investigations focused on the concrete implementation of these technologies in specific school contexts.

4 RESULTS AND DISCUSSION

4.1 AI paradigms and distinct implications for school assessment

The first finding derived from the examined literature is that there is no single "evaluative AI." The pedagogical implications of technology depend on the technical paradigm in operation and the nature of the school task involved. In rule-based

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systems, for example, automation tends to be more effective when the correction criteria are clear, stable, and previously formalizable. In such cases, the main contribution lies in processing agility and rapid feedback on structured tasks, without this necessarily representing deep pedagogical innovation.

In systems supported by learning analytics and educational data mining, the focus shifts from the immediate correction of a response to the longitudinal analysis of participation, performance, and progression patterns. Baker and Inventado (2014) show that these approaches expand the ability to identify recurrent behaviors, learning trajectories, and indicators of difficulty. Siemens (2013), in turn, emphasizes that the consolidation of learning analytics as a field stems precisely from the attempt to transform large volumes of educational data into support for more informed decisions. In evaluative terms, this means strengthening diagnostic and preventive dimensions, allowing for more timely interventions.

Generative systems, in turn, introduce a qualitative inflection. By producing language, synthesizing texts, and elaborating discursive commentary, they approach tasks traditionally associated with human interpretation. However, this functional expansion does not eliminate reliability problems. Pack, Barrett, and Escalante (2024), in analyzing language models applied to the assessment of written production, identify differences in validity and stability between models, as well as variations over time. Consequently, although such systems can support feedback and scoring in specific contexts, their use requires reinforced human oversight, especially when high-stakes decisions are involved.

From this set of evidence emerges an important analytical conclusion: the debate about AI and school assessment loses precision when it does not differentiate technological architectures, pedagogical tasks, and levels of decisional risk. Tools useful for objective exercises are not necessarily adequate for inferring complex conceptual understanding; systems capable of detecting interaction patterns are not equivalent to valid instruments for attributing pedagogical meaning to those patterns; and models that produce convincing textual feedback do not, by that fact alone, become reliable autonomous evaluators. The contribution of AI, therefore, varies

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according to the combination of educational problem, type of data, pedagogical design, and degree of teacher mediation.

4.2 Potential for formative assessment and the centrality of teacher mediation

The second finding of the study is that AI can strengthen formative evaluative practices when employed as support for the continuous monitoring of learning. In this regard, its greatest potential does not lie in replacing teacher-conducted assessment, but in expanding the availability of evidence about the student's trajectory, making the early identification of difficulties and the provision of timely feedback more feasible. Such use aligns with the conception of assessment advocated by Luckesi (2011), for whom assessing implies interpreting processes and reorienting pedagogical action.

The combination of continuous monitoring, rapid feedback, and activity adaptation can favor more responsive interventions, especially in digital learning environments. Bates (2017) emphasizes that immediate feedback tends to be pedagogically relevant when it helps students understand their errors and reorganize their strategies. In Vygotskian terms, such feedback only acquires full educational value when it functions as a mediating orientation for development, rather than as a mere mechanical indication of correctness or error (VYGOTSKY, 2007).

From this perspective, AI-supported personalization can be pedagogically fruitful, provided it does not reduce students to rigid statistical profiles. Paixão (2025a) argues that systems capable of identifying specific difficulties and adjusting formative pathways can contribute to a more individualized monitoring of learning. However, the usefulness of these systems depends on the teacher's ability to critically interpret the data produced, articulating them with the curriculum, the student's school history, and the concrete conditions of teaching.

Coelho et al. (2025) reinforce this point by observing that the growing presence of AI reconfigures, but does not eliminate, the centrality of teaching work. In school assessment, this means that human mediation remains indispensable for deciding the pedagogical weight of an indicator, contextualizing a performance, considering factors not captured by the system, and transforming information into educational action. AI

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can assist in reading the process, but it does not replace the teacher's interpretive responsibility.

Consequently, the formative potential of AI is fully realized only when there is coherence between technology, learning objectives, and the conception of assessment. When used to exclusively reinforce control, ranking, and productivist acceleration, technology tends to reproduce the classificatory logic that the formative perspective seeks to overcome. When subordinated to diagnostic, responsive, and inclusive purposes, it can contribute to making assessment more processual, responsive, and pedagogically meaningful.

4.3 Ethical tensions, limits of validity, and conditions of use

The third dimension evidenced by the analysis concerns the ethical tensions and limits of validity of the use of AI in school assessment. The literature is consistent in indicating that technical performance does not automatically equate to pedagogical legitimacy or evaluative fairness. A system may process data with high efficiency and still produce opaque classifications, reinforce historical biases, or induce simplistic interpretations of learning.

Algorithmic opacity constitutes one of the most recurrent risks. O'Neil (2016) and Pasquale (2015) warn that automated systems can influence high-impact decisions without providing intelligible criteria to the affected users. In schools, this compromises both the possibility of contestation and the educational function of assessment itself. If students do not understand the foundations of the result obtained, and if teachers likewise cannot adequately explain them, the evaluative practice loses transparency and formative value.

Data protection and information governance represent another critical axis. Hakimi, Eynon, and Murphy (2021) demonstrate that the exploitation of digital traces in education raises issues of consent, privacy, fairness, and accountability. In school contexts, these problems intensify because the data collected may pertain to minors, who are frequently afforded little choice regarding the use of platforms. The UNESCO Recommendation (2021) reinforces that the ethical treatment of AI requires safeguards related to human rights, equity, and accountability.

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The risk of bias and reinforcement of inequalities also merits attention. The critical sociotechnical perspective reminds us that educational data are not neutral: they reflect institutional practices, social conditions, and modeling criteria that may privilege some groups over others. Selwyn (2019) warns that the advancement of learning analytics can deepen logics of surveillance and status quo reproduction if there is no public debate about its values, interests, and political economy. In the school environment, this means recognizing that AI can both support inclusive practices and consolidate new forms of exclusion and labeling.

The most recent reviews on the ethics of AI in basic education confirm this scenario. Gouseti et al. (2025) show that concerns about algorithmic fairness, transparency, surveillance, and teacher education are not ancillary but structural to the debate. Holmes et al. (2022) proceed in the same direction by arguing that meaningful human oversight and the participation of the educational community are indispensable conditions for the development of ethically acceptable systems.

These tensions impose an important interpretive brake on technological enthusiasm. The available literature remains uneven across contexts, educational levels, and types of application. Zawacki-Richter et al. (2019) indicate, for example, that much of the research in AIEd has historically been conducted from technical perspectives that are not always centered on properly educational problems. Therefore, when addressing school assessment, it is advisable to avoid strong generalizations about "transformative impacts" and to replace universalizing statements with analyses conditioned by the uses, contexts, and forms of pedagogical mediation that are effectively present.

4.4 Analytical contribution of the study

Considering the analyzed material, the main contribution of this article consists of offering a more precise interpretive key for the debate on AI and school assessment. First, the study differentiates technological paradigms frequently grouped under the same generic designation of AI. Second, it articulates these paradigms with formative assessment theory, highlighting that the pedagogical relevance of a tool depends on its capacity to support mediations and not merely to automate tasks. Third, it

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incorporates a critical sociotechnical perspective that shifts the focus from technical efficiency to questions of justice, transparency, governance, and responsibility.

This synthesis allows for a more analytically balanced position. AI should be understood neither as an autonomous solution to the limits of traditional assessment nor as a threat intrinsically incompatible with school education. Its legitimacy depends on the conditions of design, implementation, use, and contestation. In other words, the central question is not simply whether schools should or should not use AI in assessment, but under what purposes, with what safeguards, and to what extent such tools remain subordinated to the formative horizon of education.

5 FINAL CONSIDERATIONS

The present study analyzed the impacts of artificial intelligence on school assessment processes based on an analytical bibliographic review guided by two complementary axes: the formative perspective of assessment and a critical sociotechnical reading of educational datafication. The analysis led to the conclusion that the incidence of AI on assessment is not homogeneous and varies according to the technological paradigm employed, the type of school task considered, the quality of the data mobilized, and the degree of human oversight present in the process.

Rule-based systems tend to be more suitable for structured tasks and stable criteria; learning analytics and data mining applications expand diagnostic capacity and continuous monitoring; and generative systems open new possibilities for feedback production and the handling of open-ended responses, although they still present problems of stability, opacity, and validity that preclude their uncritical adoption in higher-stakes decisions. In all cases, the literature converges on the centrality of teacher mediation.

From a pedagogical standpoint, AI can contribute to making assessment more processual, responsive, and formative, especially when it facilitates faster and better-informed interventions. From an ethical standpoint, however, the adoption of these technologies demands rigorous attention to transparency, data protection, algorithmic fairness, explainability, and institutional accountability. In school contexts, such

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requirements become even more relevant given the sensitivity of the data involved and the vulnerability of the individuals served.

It was also observed that the available literature presents significant asymmetries between educational levels and types of application. For this reason, the article avoided universalizing results and sought to make its limits explicit. As a bibliographic study, it does not offer direct empirical evidence on implementation in specific schools. Future research may advance through field studies that examine, in concrete contexts, how teachers interpret AI-generated results, how students perceive their legitimacy, and what governance mechanisms are necessary to regulate their use.

It is therefore concluded that AI holds relevant potential to support contemporary evaluative practices, but it cannot be converted into an autonomous instance of educational judgment. Its pedagogically legitimate use depends on clear formative purposes, meaningful human oversight, and ethical and institutional frameworks capable of protecting students, preserving teacher autonomy, and ensuring that technological innovation remains linked to the educational aims of the school.

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