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Open Education and Generative AI: Toward an Ethical and Inclusive Transformation of Pedagogical Strategies

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Abstract

Recent studies show that Generative Artificial Intelligence (GenAI) is profoundly reshaping educational paradigms, steering teaching systems toward open, inclusive, and context-sensitive practices. This study advances an integrative model combining Open Educational Resources (OER), Open Educational Practices (OEP), and GenAI to support an ethical and sustainable pedagogical transformation. A mixed-methods design was employed with 453 education-science stakeholders across 45 secondary, college, and university institutions in Cameroon and Chad. Quantitative results indicate a significant association between OER and equitable accessibility ($\beta = 0.61$, $p < 0.01$), between OEP and cognitive justice ($\beta = 0.54$, $p < 0.01$), and a positive effect of GenAI on personalization ($\beta = 0.49$, $p < 0.01$). The combined effect of the three dimensions strengthens pedagogical resilience ($\beta = 0.65$, $p < 0.01$). Qualitative evidence underscores the role of human mediation, locally collaborative governance, and contextual appropriation. Policy implications include inclusive governance of innovation, techno-ethical teacher training, and place-based anchoring of open education policies. The proposed model emerges as a strategic and tactical lever for pedagogical sustainability suited to the challenges of the hypermodern era.

Keywords: Generative artificial intelligence, Open education, Open educational resources.

1. Introduction

Generative Artificial Intelligence (GAI) is disrupting established educational reference points. Capable of autonomously producing content from algorithms trained on large corpora (Floridi & Chiriatti, 2020; Solaiman *et al.*, 2023), it engages education stakeholders on technical, ethical, and pedagogical fronts. This transformation poses acute challenges in fragile educational contexts marked by plurilingual settings, limited connectivity, and unequal resource distribution (Magdelaine *et al.*, 2024; McNally & Ludbrook, 2023).

Open education is grounded in expanded access to knowledge through Open Educational Resources (OER) and Open Educational Practices (OEP). It values transparency, participation, and cooperation (Farrow, 2017; Friedman & Hendry, 2019). Yet uptake remains limited in Francophone sub-Saharan Africa, where OER and OEP often struggle to meet local needs (Arnold *et al.*, 2024; Massou *et al.*, 2020; Taziri & Akkari, 2022).

GAI offers powerful levers for adaptation and pedagogical personalization. However, ungoverned use can exacerbate the digital divide, linguistic inequities, and algorithmic harms (Azilan, 2023; Chan, 2023). These risks call for an ethical reconfiguration of education grounded in cognitive justice, technological sovereignty, and inclusivity (Cisel & Laudier, 2024; de Hautecloque, 2024; Mignenan, 2025a).

Against this backdrop, our central question is as follows: How can open educational practice be operationalized—genuinely oriented toward inclusivity, equity, and sustainability—in the age of GAI, without lapsing into techno-centrism? To address this, we adopt a mixed-methods strategy: semi-structured interviews and a quantitative survey with 453 respondents (teachers, learners, and decision-makers) from 45 institutions in Cameroon and Chad. The data are used to validate a hybrid model integrating indicators of openness, inclusivity, cognitive justice, and pedagogical resilience.

The article is structured in four parts. Section 1 sets out the conceptual foundations of open education, cognitive justice, and GAI (Levin, 2024). Section 2 details the methodological approach. Section 3 presents the empirical results. Section 4 offers an analytical discussion, followed by concluding practical and theoretical recommendations.

1.1. Conceptual Foundations

In an era defined by the rapid rise of Generative Artificial Intelligence and the reconfiguration of educational dynamics, clarifying the conceptual underpinnings of an open, inclusive, and ethically oriented education is essential. This section establishes the theoretical landmarks guiding our inquiry. We begin with a rigorous

definition of open education, examining its foundational perspectives and associated challenges (1.1). We then analyze pedagogical transformations induced by GAI—especially in relation to access, personalization, and knowledge mediation (1.2). Subsection 1.3 probes the conditions for genuine inclusion through the lenses of cognitive justice and the ethics of learning in algorithmic environments. Finally, subsection 1.4 highlights persistent theoretical gaps and outlines an operational pathway for embedding shared values that can steer responsible educational transformation.

1.1.1. Open Education: Definitions, Ambitions, and Challenges

Open education is a paradigm centered on free access to knowledge and the active participation of learners (Farrow, 2017; Lachaîne, 2023; Magdelaine *et al.*, 2024). It aims at cognitive justice, epistemic equity, and the reduction of educational inequalities (Gottschalk & Weise, 2023; Holmes *et al.*, 2022). Its architecture rests on two principal pillars: Open Educational Resources (OER) and Open Educational Practices (OEP). OER comprise pedagogical contents released under open licenses, enabling use, adaptation, and redistribution (Miao *et al.*, 2016; Nguyen *et al.*, 2023). Their potential lies in the global mutualization of knowledge (Mignenan, 2025b).

OEP, for their part, engage learners in participatory processes, value situated knowledge, and recast the teacher's role as facilitator of learning (Mihovska *et al.*, 2021; Ossiannilsson *et al.*, 2016). This pedagogy seeks to be open, reflexive, and context-responsive. Yet adoption remains limited in fragile systems. Barriers include underdeveloped digital infrastructures, limited competencies, institutional resistance, and absent policy frameworks (Azilan, 2023; Zawacki-Richter *et al.*, 2020). Without contextualization, open education risks reproducing inequalities (Armstrong *et al.*, 2009; Floridi & Cowls, 2022; Nguyen *et al.*, 2023). Inclusivity therefore requires attention to linguistic, sociocultural, and material realities.

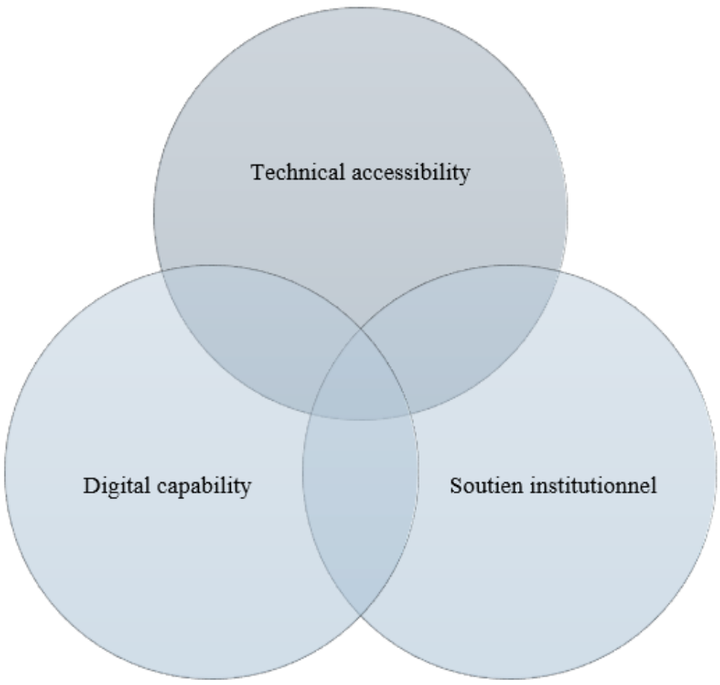

Figure 1. Critical Conditions for Equitable Open Education Implementation.

1.1.2. Technical Accessibility; Digital Capabilities; and Institutional Support

In addition, Tables 1 and 2 compare, respectively, the basic characteristics of OER and PEO. They thus highlight their points of convergence, their dissemination levers and the constraints of implementation in the French-speaking African context.

Table 1. Characteristics of Open Educational Resources (OER)

Dimensions	Definition	Examples	Issues
Open License	Allows use, adaptation, sharing	CC BY, CC BY-SA	Legal certainty
Accessibility	Free digital distribution	MOOCs, open books	Digital divide
Reusability	Content Modularity	Adaptable course modules	Language localization

This table presents three fundamental dimensions of OER: open licensing, accessibility, and reusability. The license guarantees rights of use and adaptation, thus ensuring a legal basis conducive to inclusive innovation. Accessibility, facilitated by digital technology, remains hampered by persistent technological divides. Reusability underlines the need for modular content, adapted to local contexts. These elements reflect the tensions between openness and systemic constraints, justifying inclusive governance, as shown in Table 2.

Table 2. Components of Open Educational Practices (PEOs).

Dimensions	Definition	Examples	Challenges
Participatory pedagogy	Co-Author Learner	Forums, collaborative wikis	Teacher training
Social inclusion	Valuing diversity	Intercultural learning	Implicit Prevailing Norms
Contextualisation	Adapting to local realities	Integrated endogenous knowledge	Lack of local resources

Table 2 highlights three pillars of Open Educational Practices (OEP): participatory pedagogy, social inclusion, and contextualization. These dimensions aim to democratize learning by valuing learner engagement, cultural

diversity, and the local embedding of knowledge. Their implementation is, however, hindered by limited teacher training, the persistence of exclusionary implicit norms, and a lack of contextualized resources. These constraints call for policies that recognize plurality and promote the local co-construction of content.

Far from being a merely technical instrument, open education is a political and cultural lever. It requires a repositioning of the learner's role and a redefinition of relationships to knowledge. Its development demands strong contextual anchoring, robust institutional support, and heightened ethical vigilance in the face of technocentrism and curricular standardization.

1.2. Generative Artificial Intelligence (GAI) and Pedagogical Transformation

GAI encompasses technologies capable of automatically producing diverse content from large datasets (Jakhlouti, 2025; Leyronas *et al.*, 2025; Many *et al.*, 2024). It reshapes the teacher's functions, redefines the learner's role, and reconfigures educational arrangements. In practice, it facilitates planning, the creation of differentiated materials, and formative assessment (Leyronas *et al.*, 2025). Its use supports the individualization of pathways, metacognition, and learner autonomy (Vanaubel, 2025).

GAI also strengthens educational accessibility by generating adapted resources—audio summaries, automatic translations, and visual or simplified content (Stéphan *et al.*, 2015; Vanaubel, 2025)—a crucial contribution in plurilingual environments across the Global South. Yet its deployment raises risks: algorithmic opacity, cultural bias, and infringements on privacy (Vesnic-Alujevic *et al.*, 2020; Vial, 2022). It may further marginalize the teacher's critical role (Ulnicane, 2022; Vanaubel, 2025; Zawacki-Richter *et al.*, 2020). Hence, its integration must be ethically articulated with Open Educational Resources (OER) and OEP to guard against technocentrism while reinforcing cognitive justice and educational sovereignty.

1.3. Inclusion, Cognitive Justice, and the Ethics of Learning in the Age of GAI

Educational inclusion seeks equitable access to learning regardless of social or cultural conditions (Zawacki-Richter *et al.*, 2020; Zhang, 2019). It presupposes adapting pedagogical environments to learner diversity and aligns with a broader logic of social justice (Nguyen *et al.*, 2023; Solaiman *et al.*, 2023). Cognitive justice, a critical extension of equity, affirms plural forms of knowledge and marginalized epistemologies (Ulnicane, 2022; Vanaubel, 2025; Zawacki-Richter *et al.*, 2020) and resists the uniformization imposed by dominant—often Western—models.

The integration of GAI into education generates tensions. While it can enhance personalization (Mihovska *et al.*, 2021; Mittelstadt, 2019), it may also reproduce inequalities. Biased, standardized training corpora can render local knowledges invisible (Taziri & Akkari, 2022; Ulnicane, 2022). Moreover, AI architectures frequently designed without stakeholders from the Global South jeopardize pedagogical sovereignty (Mignenan, 2025; Mihovska *et al.*, 2021; Mittelstadt, 2019), entrenching implicit normativity and narrowing alternative pathways. An ethical approach to GAI in education therefore requires shared governance, local co-design, and algorithmic transparency (Ananny & Crawford, 2018; Antoine Boudreau LeBlanc, 2021; Mignenan, 2025). Inclusion must move beyond the technological register alone to encompass cultural and epistemic dimensions.

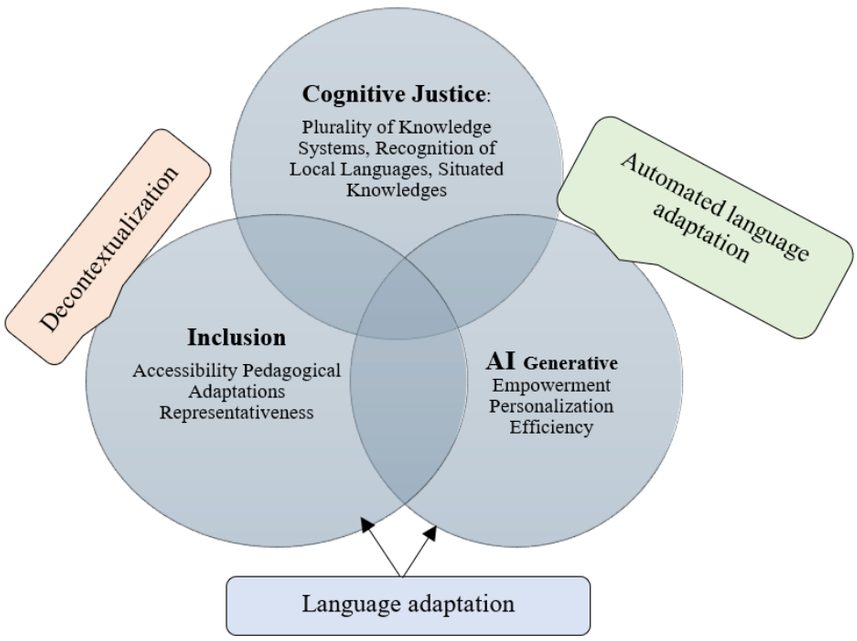

Figure 2. Tensions and synergies between inclusion, cognitive justice and generative AI.

Figure 2 illustrates the tensions between three essential poles of educational transformation: inclusion, cognitive justice and AGI. It reveals possible contradictions, such as cultural erasure or the decontextualization of knowledge, induced by standardized technologies applied to plural contexts.

However, it also shows synergies. A well-regulated AGI can facilitate language adaptation, personalization and accessibility. This tripolar model invites the design of ethical, localized and inclusive educational technology. The adoption of the AGI cannot be done without a critical, ethical and epistemological reading. It is a question of going beyond the sole logic of technological efficiency. Cognitive justice and respect for diversity must guide any pedagogical reform. It is at this price that the AGI will become a lever for an open, equitable and grounded education. Table 3 below provides a structured summary.

Table 3. Analytical comparison of the contributions and limitations of AGI in open education.

Dimension	Potential contributions	Identified risks
Accessibility	Machine translation, text-to-speech	Contextually biased or inappropriate content
Pedagogy	Instant feedback, adaptation of routes	Technological dependence, loss of teaching staff
Inclusion	Access to tools for marginalized audiences	Reinforcing inequalities in access to technology
Ethics	Support for plagiarism detection, assistance with wording	Lack of transparency of models, data collection

1.4. Theoretical Shortcomings and Operationalization of Shared Values

Despite the increasing research on open education and AGI, the integration of inclusive ethical values remains marginal. The majority of studies remain techno-centric, focused on algorithmic performance, to the detriment of cultural and contextual issues (Ananny & Crawford, 2018; Antoine Boudreau LeBlanc, 2021; Mignenan, 2025)

Some studies treat OER as simple vectors of diffusion, without questioning the pedagogical quality (Arnold et al., 2024; Azilan, 2023; Chan, 2023) Others neglect linguistic diversity or the constraints of low-resource contexts (Mignenan, 2025; Mihovska et al., 2021)

Faced with this segmentation, a question arises: how to combine cognitive justice, diversity and technological efficiency? Few studies articulate these dimensions in a coherent framework.

Our study fills that void. It proposes a hybrid model based on four pillars: recognition of situated knowledge, techno-pedagogical accessibility, sociolinguistic relevance and educational responsibility. This framework aims to bridge the divides between technology and equity, by providing an assessment grid rooted in marginalized educational realities.

For the purposes of summary, Table 4 below is developed.

Table 4. Synthetic grid of gaps identified in recent literature.

Dimensions analyzed	Common theoretical limitations	Examples of work
Ethics and responsibility	Prescriptive approaches, without real empirical anchoring	(Mignenan, 2025; Mihovska et al., 2021)
Inclusion and equity	Lack of measurable criteria in the Global South	(Chiappe & Adame, 2018; Holmes et al., 2022)
Justice cognitive	Invisibilization of situated knowledge	(Holmes et al., 2022; Mihovska et al., 2021; Ossiannilsson et al., 2016)
Appropriation of the AGI	Non-contextualized technocentric models	(Leyronas et al., 2025; Ulnicane, 2022)

This table highlights major gaps in the literature. The discourse often remains theoretical, disconnected from the realities specific to the countries of the South. Situated knowledge is invisibilized. The AGI is not very contextualized. These limits call for an epistemological refoundation. Figure 3 illustrates our model of ethical convergence, combining open education, IAG and territorial anchoring.

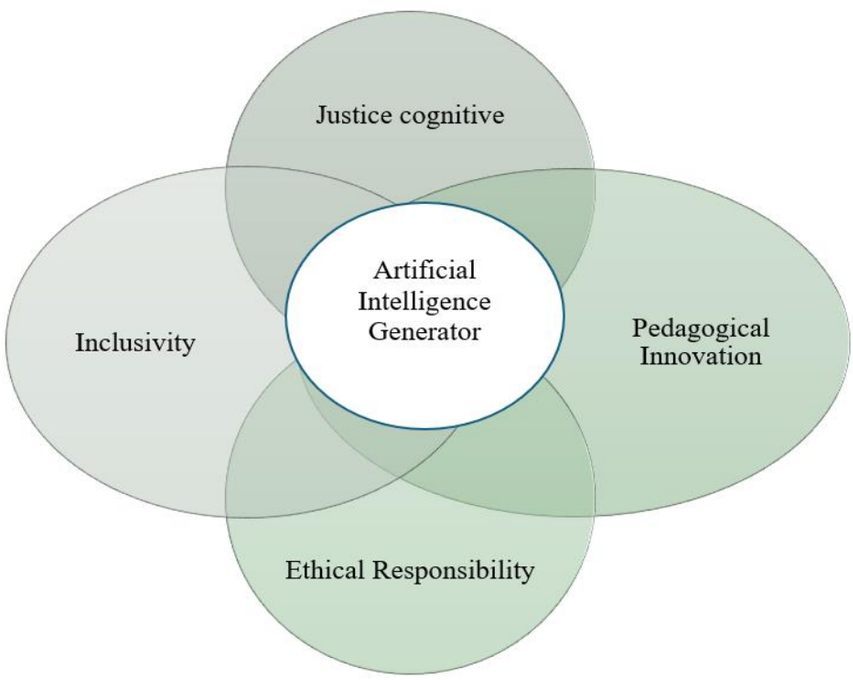

Figure 3. Conceptual framework for the operationalization of open education in the AGI era.

This figure presents the architecture of open education in the age of Generative Artificial Intelligence (GAI). It rests on four pillars: inclusivity, cognitive justice, ethical responsibility, and pedagogical innovation. GAI functions as a transversal lever. Inclusivity adapts learning arrangements; cognitive justice valorizes local knowledges; ethics governs uses; innovation secures pedagogical agility. GAI is not an end in itself but a means whose value depends on ethical and contextualized integration. The literature underscores strong synergies between GAI and open education, notably through enhanced personalization. Open Educational Resources (OER) and Open Educational Practices (OEP) reinforce equitable access to knowledge (Leyronas *et al.*, 2025; Ulnicane, 2022). Yet important limits persist: many studies remain instrumental and overlook issues of cognitive justice and sovereignty (Gottschalk & Weise, 2023; Holmes *et al.*, 2022); low-resource contexts are underexplored (Mignenan, 2025; Mihovska *et al.*, 2021); overall, the research landscape remains fragmented. No integrative evaluative framework

currently exists. This study addresses that gap by proposing a model anchored in marginalized educational realities, combining theoretical rigor with contextual relevance.

2. Conceptual Framework, Research Model, and Hypotheses

2.1. Conceptual Foundations

Contemporary open education builds on the articulation of OER, OEP, and the principles of inclusion and cognitive justice (Holmes *et al.*, 2022; Mignenan, 2025; Mihovska *et al.*, 2021; Mittelstadt, 2019; Nguyen *et al.*, 2023). In a GAI context, these elements must be conceived together. While GAI enables learning personalization, it also introduces risks—standardization, opacity, and dependency (Holmes *et al.*, 2022; Mittelstadt, 2019; Nguyen *et al.*, 2023).

The proposed model draws on systemic (Allouche, 2024; Grinbaum *et al.*, 2023; Lorre, 2025) and transdisciplinary approaches (Allouche, 2024) to theorize a transformation that is simultaneously ethical, inclusive, and context-anchored, along four axes:

- Axis 1: Inclusive access to open knowledge;
- Axis 2: Ethical responsibility in the use of GAI;
- Axis 3: Recognition of local and plural knowledges;
- Axis 4: Pedagogical adaptability and cognitive justice.

These axes converge on a central principle: shared educational value, understood as a system's capacity to respond equitably to diverse learner needs through open technologies.

2.2. Integrative Conceptual Model

As illustrated in Figure 4, the model rests on a dynamic interdependence among four constructs:

- Open Educational Resources (OER): a lever for opening knowledge content;
- Open Educational Practices (OEP): privileged vectors of collaboration;
- Generative Artificial Intelligence (GAI): an instrument for automation and personalization;
- Shared Values (SV): grounded in equity, diversity, and contextualization.

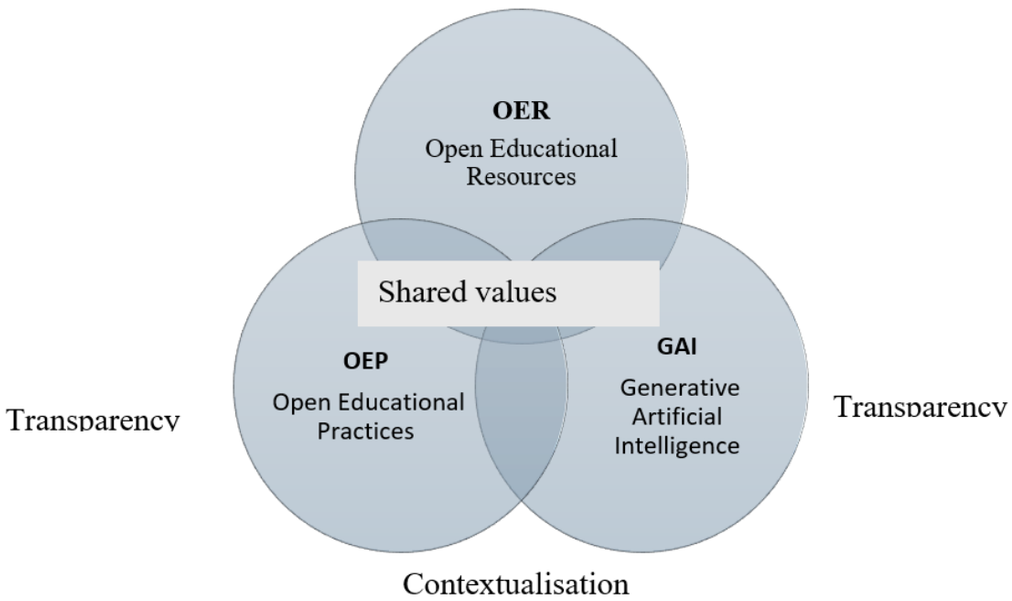

Figure 4. Conceptual model of educational transformation through OER, PEO and IAG.

Figure 4 shows convergent modeling focused on shared values integrating OER, PEO, and IAG. Each circle makes us discover an essential educational lever, interconnected with the others through the following indicators: accessibility, cognitive justice, contextualization, transparency. The whole reflects a systemic approach, between technology, open resources and participatory practices, in the service of ethical, inclusive and contextualized education.

In light of this integrative conceptual model presented in Figure 4, the following section proposes three hypotheses articulated around the interactional dynamics between OER, PEO and AGI. These hypotheses are suggested from a systemic perspective centered on shared values and indicators of ethical, inclusive and contextualized education.

2.3. Research Hypotheses

The model illustrated in Figure 4 allows us to formulate three research hypotheses in the following lines.

Hypothesis 1 (H1): *Learners' perceived cognitive justice is influenced by the level of integration of Open Educational*

2.3.1. Resources (OER) in Knowledge Production.

This hypothesis is based on the idea that OER, integrated in an inclusive way, values knowledge that is often excluded from the dominant curricula. For Piron (Piron, 2016) cognitive justice presupposes the recognition of plural epistemologies, particularly those from the Global South. OER contribute to this by making local content visible, translated into minority languages (Ossiannilsson et al., 2016; Piron, 2016; Schiff, 2022) Several authors (McNally & Ludbrook, 2023; Schiff, 2022; Vanaubel, 2025) confirm that OER democratize knowledge, provided that they are accompanied by critical pedagogies. Other studies (Stéphan et al., 2015; Tang et al., 2023; Taziri &

Akkari, 2022) show that they reinforce the legitimacy of situated knowledge. Their strategic integration thus extends the cultural references mobilized and increases the perceived cognitive justice.

Hypothesis 2 (H2): *Equitable accessibility to learning depends on the level of use of Open Educational Practices (OEPs).*

PEOs are built on co-construction, inclusivity, and flexibility. They adapt the devices to the needs of the learners. In multilingual or precarious contexts, they reduce inequalities in access (Mignenan, 2025; Mihovska et al., 2021) The results of some work (Miao et al., 2016; Mignenan, 2025; Tuomi, 2013) strengthen engagement and support equitable learning. Some recent work (Taziri & Akkari, 2022; Ulnicane, 2022) show their effectiveness with marginalized groups, especially with localized OER. As such, PEOs are key to expanding access to relevant and inclusive educational resources.

Hypothesis 3 (H3): *The perceived pedagogical transparency in the learning process is conditioned by the degree of integration of generative artificial intelligence (AGI).*

AGI, especially via ChatGPT, offers immediate feedback, increased traceability and algorithmic personalization. These functions can increase pedagogical transparency, if they are ethically regulated. Several authors (Mignenan, 2025; Schiff, 2022; Ulnicane, 2022) show that AGI explains assessments, adapts content and documents interactions. However, some authors (Armstrong et al., 2009; Gottschalk & Weise, 2023; Holmes et al., 2022) point out that this transparency depends on the readability of algorithms and participatory regulation. Thus, a well-thought-out integration of the AGI clarifies the content and feedback, making the devices more understandable.

Table 5 provides a summary of the three hypotheses.

Table 5. Comparative Summary of Assumptions.

Assumptions	Variables and Wording	Indicators / Items
H1	Explanatory variable: Level of integration of OERVasurable to explain: Perceived cognitive justiceFormulation: The strategic integration of OER promotes the recognition of plural knowledge and reinforces cognitive justice.	• Rate of use of OER • Perception of diversity of sources • Recognition of local knowledge
H2	Explanatory variable: Use of PEOsariable to explain: Equitable accessibilityFormulation: The active use of PEOs improves access to knowledge for marginalized audiences.	• Perception of accessibility • Participation in open activities • Frequency of use of PEOs
H3	Explanatory variable: Integration of the AGIVatable to be explained: Perceived pedagogical transparencyFormulation: The reasoned integration of the AGI, improves the clarity and transparency of content and assessments.	• Clarity of feedback • Understanding of evaluation processes • Perceived transparency of algorithms

2.4. Research Methodology

This research adopts a mixed methodology, combining an exploratory qualitative approach and an explanatory quantitative analysis. The objective is to confront the perceptions of educational actors and to test hypotheses on the integration of OER, PEO and IAG. The survey was conducted in two French-speaking African countries (Chad and Cameroon), with 44 schools and 443 respondents (teachers and learners).

2.4.1. Exploratory Qualitative Methods

The qualitative approach explores the experiences and uses of OER, PEO and IAG in various pedagogical contexts. Forty-four semi-structured interviews were conducted in Cameroon and Chad according to a purposive sampling. The discussions focused on four dimensions: accessibility of OER, uses of AGI, collaborative practices and ethical perceptions. The data were transcribed and encoded with NVivo, using the inductive method. An intercoder triangulation validated the analysis.

2.4.2. Explanatory Quantitative Method

The quantitative approach tests the three hypotheses via a structured questionnaire. It was administered to 453 respondents, or one item for every ten participants. The questionnaire consists of 44 items divided into four dimensions: accessibility, contextualization, cognitive justice and resilience. Scales, derived from validated sources(Armstrong et al., 2009; Gottschalk & Weise, 2023; Holmes et al., 2022; Mignenan, 2025) were contextualized after a pre-test on 42 respondents. The analysis, conducted with SPSS (v.27), includes an exploratory factor analysis. Cronbach's alphas range from 0.78 to 0.89. SEM modelling partially confirms the H1 to H3 hypotheses ($p < 0.05$). Table 6 presents the methodological approach.

Table 6. Summary of the methodology implemented.

Methodology	Main objective	Techniques used	Analytical tools
Exploratory Qualitative	Understanding perceptions and contexts of use	Semi-structured interviews, thematic analysis	NVivo, inductive coding
Quantitative confirmatory	Testing the assumptions of the integrated model	Structured questionnaire, SEM analysis	SPSS, AFE, SEM, alpha Cronbach

This methodological combination ensures the ecological and statistical validity of the model, while integrating the voices of local actors in the construction of a relevant reference framework for open education in a fragile context.

3. Search Results

3.1. Qualitative Outcomes

The thematic analysis of the interviews conducted with 45 respondents (teachers, pedagogical managers and decision-makers) reveals discursive regularities structured around three hypotheses formulated.

For hypothesis 1, the majority of respondents say that the strategic integration of OER, especially those translated or adapted to local circumstances, increases the recognition of the diversity of knowledge. Several testimonies confirm this dynamic: *"Since we have been using open resources translated into local languages, students have been participating more actively, especially those in rural areas."* This observation confirms several recent studies(Armstrong et al., 2009; Gottschalk & Weise, 2023; Holmes et al., 2022; Mignenan, 2025) The results of this work suggest that OER contribute to cognitive justice when contextualized and accessible.

Regarding hypothesis 2, it appears that PEOs are powerful vectors of equitable participation and socio-cultural anchoring. One respondent (teacher) illustrates this remarkable participation as follows: *"community projects integrated into the classroom allow pupils and students to tell their story of their world; this changes everything."* This observation is consistent with the conclusions of a large number of authors(Arnold et al., 2024; Chiappe & Adame, 2018; Cronin, 2017) which associate the active use of PEOs with better access to knowledge for marginalized audiences or in multilingual contexts.

With regard to hypothesis 3, the respondents reveal that the introduction of AGI in educational environments provokes indecisive reactions.

On the one hand, several respondents are satisfied with the contributions in terms of differentiation, linguistic adaptation and individualised feedback: *"It's useful, because it offers answers adapted to each student. »*

On the other hand, some concerns are revealed about algorithmic biases and the origin of content including the data generated: *"It's convenient, but sometimes I don't know where the content comes from."* These perceptions are similar to the warnings of some authors (de Hautecloque, 2024; Lorre, 2025; Magdelaine et al., 2024) insisting on the requirement for algorithmic transparency and critical mastery of AI instruments in education.

By way of synthesis, the qualitative data corroborate the relevance of the three hypotheses of the conceptual model. They highlight the importance of a contextual, ethical and collaborative incorporation of OER, PEO and IAG, in line with the values of cognitive justice, equitable accessibility and pedagogical transparency. Table 7 below, developed for synthesis purposes, summarizes the qualitative results by hypothesis.

Table 7. Qualitative Results by Assumption.

Assumptions	Qualitative indicators observed	Illustrative verbatim	Frequency of occurrence
H1	Diversity of sources, recognition of local knowledge, use of OER	"We adapt the content in our local language thanks to OER."	High
H2	Enhanced accessibility, involvement in PEOs, inclusion of situated knowledge	"The students talk about their daily lives through educational projects."	Moderate to High
H3	Perceived clarity, doubt about transparency, differentiated support via AGI	"AI helps, but sometimes I doubt the sources."	Moderate

3.2. Quantitative Results: Statistical Validation of Assumptions

The analysis was conducted with SPSS 27. Descriptive statistics confirm qualitative trends and support all three assumptions of the model.

Hypothesis 1 shows a high perceived cognitive justice (mean: 4.3/5). OER are perceived as vectors of cultural and linguistic anchoring.

Hypothesis 2 presents equitable accessibility (average: 4.1/5), with few differences between Cameroon and Chad. PEOs strengthen inclusion and value local knowledge. They also increase learner engagement.

For hypothesis 3, the pedagogical transparency linked to the AGI obtains 3.8/5, with a standard deviation of 1.2. This score reflects shared perceptions. The AGI is considered useful but questioned about the clarity of the content and algorithms. These results support the validity of the hypotheses. However, they reveal limitations related to the ethical framework and contextualization of AGI.

Table 8, developed for summary purposes, presents the main trends.

Table 8. Descriptive Statistics of the Main Variables.

Assumptions	Variables measured	Averages (out of 5)	Standard deviation	Observations
H1	Perceived cognitive justice	4.3	0.9	Strong recognition of local knowledge through OER
H2	Equitable accessibility	4.1	0.8	Strengthening Inclusion through PEOs
H3	Perceived Educational Transparency	3.8	1.2	Contrasting perceptions of AGI-related transparency

3.3. Correlation Analysis

Pearson's correlation analysis reveals significant associations between the components of the conceptual model. Equitable accessibility, strongly associated with the use of open educational practices (PEO – H2), shows a high positive correlation with perceived pedagogical resilience ($r = 0.61$, $p < 0.01$), suggesting a decisive contribution of PEOs to the adaptability of educational devices. At the same time, cognitive justice, backed by the integration of open educational resources (OER – H1), is significantly correlated with PEOs ($r = 0.55$, $p < 0.01$), reflecting an interdependence between the valorization of local knowledge and the active engagement of learners.

Generative artificial intelligence (AGI – H3), although associated with an intermediate average ($M = 3.8$; $SD = 1.2$), establishes moderate but statistically significant correlations with the other variables, in particular those related to pedagogical transparency and differentiation of pathways. These results support the hypothesis of a structuring effect of AGI, provided that a rigorous ethical framework and cultural contextualization are provided.

All the correlations confirm the relevance of the proposed integrative model, where the interactions between inclusion, cognitive justice and technopedagogical innovations strengthen the resilience of open educational environments.

Table 9. Correlation matrix (Pearson coefficients).

Variables	Accessibility	Contextualisation	IAG	Resilience
Accessibility	1			
Contextualisation	0.52**	1		
IAG	0.47**	0.43**	1	
Resilience	0.61**	0.58**	0.49**	1

Note: *Grades : *$p < 0.01$.

The correlation coefficients presented in Table 4 statistically confirm the dynamics identified during the qualitative analysis. Equitable accessibility, correlated with pedagogical resilience to the tune of r = 0.61, underlines the structuring effect of open educational practices on the continuity and adaptability of learning systems (H2). Contextualization, a reflection of cognitive justice reinforced by OER (H1), also has a strong relationship with resilience (r = 0.58) and accessibility (r = 0.52), illustrating the importance of local anchoring in educational success.

The integration of AGI (H3), while perceived in a more ambivalent way, shows moderate but significant correlations with all variables (r varying from 0.43 to 0.49), confirming its potential as a cross-cutting lever, provided that an adequate ethical and contextual framework is provided.

Table 10. Multiple regression.

Predictor variable	Standardized Beta (β)	Meaning (p)
OER (H1)	0.42	< 0.001
PEO (H2)	0.31	< 0.01
AGI (H3)	0.25	< 0.05
Adjusted R^2	0.48	–

The convergence of qualitative and quantitative data confirms all three hypotheses. Their combination promotes educational resilience, especially in precarious contexts. These findings form the basis of an ethical and integrated framework for open education in the AGI era. The next section will discuss their practical implications.

4. Discussion of Findings

The results substantiate the validity of an integrative conceptual model predicated on the articulation of Open Educational Resources (OER), Open Educational Practices (OEP), and Generative Artificial Intelligence (GAI) within an ethical, inclusive, and context-sensitive transformation logic. The convergence between the empirical evidence and the theoretical propositions strengthens the credibility of the proposed framework and echoes recent analyses in the literature.

OER emerge as powerful vectors of cognitive justice (H1). Their high valuation (M = 4.3; SD = 0.9) attests to their role in reinforcing the linguistic and cultural anchoring of content, as suggested by several authors (Arnold et al., 2024; Miao et al., 2016; Mignenan, 2025; Schiff, 2022). The adoption of OER makes local knowledges more visible, advancing epistemic justice. Nevertheless, their impact remains contingent on the digital competencies of educators, which argues for structured capacity-building (Cath, 2018; Chan, 2023; Chiappe & Adame, 2018).

OEP bolster equitable accessibility (H2) by fostering learner engagement and the integration of situated knowledges. Their score (M = 4.1; SD = 0.8), coupled with a strong correlation with resilience (r = 0.61), supports the view that active participation promotes inclusion. These findings corroborate recent work (Cisel & Laudier, 2024; de Hautecloque, 2024; Emmanuel, 2016; Mignenan, 2025) underscoring the importance of local anchoring in multilingual and vulnerable environments.

With regard to GAI (H3), the data reveal nuanced perceptions (M = 3.8; SD = 1.2). While its potential for personalization is recognized, ethical concerns persist—particularly around algorithmic opacity—as anticipated by numerous authors (Miao et al., 2016; Mignenan, 2025; Mihovska et al., 2021; Nguyen et al., 2023). Its moderate yet significant effect on resilience (β = 0.25) calls for integration governed by ethical principles and calibrated to contextual conditions (Mignenan, 2025; Mihovska et al., 2021).

The multiple regression (adjusted $R^2 = 0.48$) clarifies the relative influence of the levers: OER are predominant (β = 0.42), followed by OEP (β = 0.31) and GAI (β = 0.25). This hierarchy illustrates the complementarity of cultural anchoring, active participation, and technological flexibility in building durable educational resilience.

Taken together, the findings validate the hypotheses grounded in cognitive justice, equitable accessibility, and pedagogical transparency. They demonstrate that open education extends far beyond mere digitization: it requires a transformation of governance logics and of the modes of knowledge production. The integrated model advanced here offers a fertile pathway for inclusive, sovereign education policies aligned with African contexts.

5. Conclusion and Practical Implications

This research is situated within a transdisciplinary dynamic aimed at reconfiguring open education in the age of Generative Artificial Intelligence. Far from treating GAI as a purely technical innovation, it is conceptualized as a systemic transformation that articulates inclusion, cognitive justice, transparency, and educational resilience. The mixed-methods design enabled the validation of an integrative conceptual model grounded in the strategic complementarity of OER, OEP, and GAI.

Empirically, the results confirm that OER constitute the principal lever of cognitive justice; OEP reinforce equitable access; and GAI, despite ambivalent perceptions, supports pedagogical differentiation when rigorously governed ethically and culturally. The regression analysis highlights the complementary yet convergent contribution of these three levers to pedagogical resilience, thereby corroborating the model's relevance.

Theoretically, the study enriches the open-education paradigm by integrating underexplored dimensions—cognitive sovereignty, situated epistemology, and techno-pedagogical governance. It extends prior work on "situated openness" (Armstrong et al., 2009; Arnold et al., 2024; Azilan, 2023; Massou et al., 2020; Mignenan, 2025; Mihovska et al., 2021), while offering an original analytical perspective on the critical governance of AI in educational practice.

The practical implications are substantial. Educational institutions should invest in digital training and in open infrastructures while supporting the contextual adaptation of OER and OEP. Policymakers are called upon to regulate the use of GAI through norms of transparency, cultural diversity, and inclusive participation, embedded from design to deployment. Researchers and practitioners, for their part, should develop evaluation instruments sensitive to local dynamics in order to measure the systemic impact of openness on educational resilience.

In sum, this study argues for a refoundation of pedagogical practice based on the equitable co-construction of knowledge, the synchronization of educational stakeholders, and the critical governance of GAI. GAI is not an end in itself but a lever serving cognitive emancipation, the recognition of plural knowledges, and a shared educational resilience in the face of the uncertainties of a hypermodern world.

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