

ORIGINAL

Inclusive curriculum adaptations as a global strategy to guarantee the Sustainable Development Goals in Education

Adaptaciones curriculares inclusivas como estrategia global para garantizar los Objetivos de Desarrollo Sostenible en Educación

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ABSTRACT

Introduction: educational inclusion and sustainability have historically developed as separate fields, but Sustainable Development Goal 4 (SDG 4) highlights the need to integrate them to ensure equitable, quality education oriented toward global citizenship. In this context, inclusive curricular adaptations (ICA) emerge as an essential strategy to articulate inclusion and sustainability.

Objective: to propose a theoretical-practical model that positions ICA as a global strategy for achieving SDG 4, based on mapping the state of the art, identifying research gaps, and systematizing substantive categories in recent literature.

Method: an integrative systematic review was conducted, complemented by bibliometric analysis and conceptual meta-analysis. The search was carried out in high-impact databases (Scopus, Web of Science, ERIC, SciELO, and Redalyc), considering publications in English and Spanish from the last ten years related to inclusive education, curriculum, and sustainability.

Results: the bibliometric analysis showed a sustained growth in scientific production since 2020, with higher concentration in 2024 and 2025, mainly in journals specialized in education and sustainability. The conceptual meta-analysis classified the findings into four dimensions: equity, as a basis for reducing gaps; accessibility, as a condition for full participation; functional diversity, as recognition of student heterogeneity; and sustainability, as an ethical and formative horizon.

Conclusions: ICA constitute a strategic pedagogical mechanism that integrates inclusion and sustainability. The proposed model provides innovative, replicable, and assessable guidelines that inform educational policies, strengthen teacher training, and contribute to the fulfillment of the 2030 Agenda.

Keywords: Inclusive Education; Curricular Adaptations; Sustainable Development; SDG 4; Educational Bibliometrics.

RESUMEN

Introducción: la inclusión educativa y la sostenibilidad se han desarrollado históricamente como campos separados, pero el Objetivo de Desarrollo Sostenible 4 (ODS 4) plantea la necesidad de integrarlos para garantizar una educación equitativa, de calidad y orientada a la ciudadanía global. En este contexto, las adaptaciones curriculares inclusivas (ACI) emergen como una estrategia esencial para articular inclusión y sostenibilidad.

Objetivo: proponer un modelo teórico-práctico que posicione a las ACI como estrategia global para el

cumplimiento del ODS 4, a partir del mapeo del estado del arte, la identificación de vacíos de investigación y la sistematización de categorías sustantivas en la literatura reciente.

Método: se aplicó una revisión sistemática integrativa, complementada con análisis bibliométrico y metaanálisis conceptual. La búsqueda se efectuó en bases de datos de alto impacto (Scopus, Web of Science, ERIC, SciELO y Redalyc), considerando publicaciones en inglés y español de los últimos diez años vinculadas con educación inclusiva, currículo y sostenibilidad.

Resultados: el análisis bibliométrico evidenció un crecimiento sostenido de la producción científica desde 2020, con mayor concentración en 2024 y 2025, principalmente en revistas especializadas de educación y sostenibilidad. El metaanálisis conceptual permitió clasificar los hallazgos en cuatro dimensiones: equidad, como base para reducir brechas; accesibilidad, como condición de participación plena; diversidad funcional, como reconocimiento de la heterogeneidad estudiantil; y sostenibilidad, como horizonte ético y formativo.

Conclusiones: las ACI constituyen un mecanismo pedagógico estratégico que articula inclusión y sostenibilidad. El modelo propuesto ofrece lineamientos innovadores, replicables y evaluables que orientan políticas educativas, fortalecen la formación docente y contribuyen al cumplimiento de la Agenda 2030.

Palabras clave: Educación Inclusiva; Adaptaciones Curriculares; Desarrollo Sostenible; ODS 4; Bibliometría Educativa.

INTRODUCTION

Inclusive education and sustainable development have become established over the last decade as two of the major axes of transformation of education systems worldwide. Sustainable Development Goal 4 (SDG 4) of the 2030 Agenda calls for universal access to equitable, inclusive, and quality education.⁽¹⁾ However, multiple international reports, such as those by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Children's Fund (UNICEF), show that deep gaps in access, participation, and academic achievement persist, especially among populations with disabilities, vulnerable groups, and rural and indigenous communities.⁽²⁾

At the same time, education for sustainable development (ESD) has promoted the incorporation of environmental, social, and ethical competencies into curricula, but in many contexts it has been treated as a separate agenda from educational inclusion. Recent studies^(3,4) warn that this dissociation limits the possibility of ensuring a comprehensive approach that responds to student diversity and, at the same time, prepares new generations to face global challenges.

Given the gaps and the need for integration, inclusive curriculum adaptations (ICAs) are emerging as the central pedagogical tool for addressing diversity in classrooms. These allow for flexibility in objectives, content, methodologies, and forms of assessment, with the aim of ensuring learning for students with different educational needs. The literature shows that, when applied systematically and consistently, ICAs strengthen equity and promote accessibility at all levels of education.^(5,6)

However, several challenges remain today, such as conceptual fragmentation, treating inclusion and sustainability as separate policies, the absence of integrated theoretical frameworks that articulate the dimensions of equity, accessibility, functional diversity, and sustainability, coupled with a lack of evidence-based practices, particularly in developing countries where education systems face resource and teacher training constraints.

In this vein, it is noted that the field of inclusive education has shown exponential growth in scientific publications over the last ten years, reflected in the expansion of academic networks, the increase in systematic reviews, and the emergence of integrative models.⁽⁴⁾ However, most studies remain anchored in national or regional contexts, which makes it difficult to generate a global vision to guide the formulation of replicable policies and practices.

Therefore, it is necessary to conduct studies such as this one, which combines a systematic review, bibliometric analysis, and conceptual meta-analysis in order to map the state of the art, identify gaps, and systematize substantive categories. This research responds to that need and seeks to propose a theoretical-practical model that positions inclusive curriculum adaptations as a global strategy for achieving the goals of SDG 4.

Consequently, the article is organized into five sections. The first section develops the theoretical framework, analyzing the conceptual foundations of inclusive education, curricular adaptations, and education for sustainable development. Next, the methodology is presented, which combines a systematic integrative review with bibliometric tools and a conceptual meta-analysis. The third section presents the results, divided into bibliometric analysis (trends, countries, co-authorship networks, and conceptual categories) and conceptual meta-analysis (equity, accessibility, functional diversity, and sustainability). The discussion contrasts the

findings with the literature and international policies. Finally, a theoretical-practical model is proposed that synthesizes global guidelines for psycho-pedagogical training and the implementation of inclusive curricular adaptations aimed at achieving equitable and quality education.

DEVELOPMENT

Inclusive education has become established, first, as a principle of social justice and, at the same time, as a public policy mandate that challenges school organization, curriculum, and assessment. In the last decade, this agenda has increasingly intersected with education for sustainable development (ESD) and SDG 4's goal of ensuring inclusive, equitable, and quality education, although the literature warns that both fields have often been treated as parallel lines rather than as an integrated project.⁽¹⁾ It is therefore crucial to articulate inclusion and sustainability in discourse as well as in curriculum and instructional design. In this regard, recent reviews recommend moving from thematic juxtaposition to common analytical frameworks and pedagogical practices that simultaneously remove barriers and develop competencies for sustainability.^(1,2) From an international policy perspective, there has also been a renewed commitment to SDG 4, emphasizing that equity is a prerequisite for meaningful learning and the acquisition of ESD competencies. This means addressing historical gaps in access, participation, and achievement with concrete systemic measures.⁽³⁾

However, although the normative consensus has expanded, academic discussion recognizes tensions that hinder the realization of an "inclusive curriculum." On the one hand, inclusive rhetoric may be stated without being translated into decisions on teaching time, professional training, and instructional support; on the other hand, the tension between universalist approaches such as Universal Design for Learning (UDL) and reasonable accommodation approaches focused on individual response is not always resolved.⁽⁶⁾ Far from being a dichotomy, evidence suggests that the combination of universal design and personalized adjustments enhances participation and learning, especially in higher education, where diversity of profiles is more acute and student autonomy demands differential support.^(5,7) Strictly speaking, the operationalization of inclusion lies in the curriculum's ability to offer multiple avenues of access and expression, without lowering expectations or fragmenting the classroom experience. Hence, inclusive curriculum adaptations (ICA), conceived as planned modifications of objectives, content, methodologies, resources, and assessment, constitute the key pedagogical device for removing barriers and sustaining heterogeneous trajectories.⁽⁶⁾

At this point, it is worth distinguishing between two complementary levels of ICA. On the one hand, access adaptations, which ensure physical, communicational, and digital conditions for participation—alternative formats, screen readers, interpreters, technological supports; on the other hand, content, process, and assessment adaptations, which make the learning path more flexible through differentiated sequencing, scaffolding, formative assessment, and alternative evidence of achievement.⁽⁶⁾ According to systematic reviews in higher education, these decisions are most effective when integrated with active teaching strategies, academic advising, and stable institutional support, which requires pedagogical governance and coordination between teaching, support services, and academic leadership.^(5,7) At the same time, recent overviews of inclusive policies and practices confirm that the effective implementation of ICIs requires multiscale coherence: classroom, institution, system, and quality criteria that allow for monitoring results and transferability.⁽⁸⁾ Hence, the contemporary debate positions ICAs not as bureaucratic appendages, but as an ecology of instructional decisions informed by evidence and sustained by institutional capacities.

Likewise, recent literature on instructional innovation and assistive technologies shows that inclusion is strengthened when adaptations are combined with interactive platforms, gamification, and personalized learning, especially if these tools are subordinated to clear curricular goals and fair and transparent assessment.^(9,10) Furthermore, when adaptations are contextualized, for example, by integrating local knowledge or addressing cultural specificities in early childhood education, their relevance and sustainability are increased, while socio-emotional and student agency components are reinforced.⁽¹¹⁾ Similarly, field studies that use qualitative instruments such as interviews, observation, and triangulation allow for the personalization of adjustments without sacrificing the comparability of results, contributing to the construction of learning paths that preserve academic rigor and full participation.⁽¹¹⁾ Taken together, these findings converge on one premise: advance planning (SUD) + reasonable accommodations (in context) = greater participation, achievement, and sense of belonging.

When placing this debate within the scope of SDG 4, it should be emphasized that equity is not an isolated goal, but rather a condition for the fair distribution of opportunities to develop Education for Sustainable Development (ESD) skills, such as critical thinking, complex problem solving, global citizenship, and the ethics of care.⁽¹²⁾ Therefore, without accessibility, there can be no talk of sustainable learning; and, symmetrically, without a focus on sustainability, inclusion runs the risk of becoming a series of technical adjustments that do not transform school culture.⁽³⁾ In response, integrative frameworks have been proposed that organize evidence and guide design: among them, structured approaches such as IPOF (Input-Process-Output-Feedback), which allow inputs, teaching processes, learning outcomes, and feedback cycles to be aligned with indicators

of equity, accessibility, functional diversity, and sustainability.⁽⁴⁾ The usefulness of these frameworks is not merely taxonomic: their value lies in connecting curricular decisions (content selection and sequencing), teaching options (active strategies, cooperative work, formative assessment), and organizational conditions (collaborative teaching time, specialized advising, professional development).

In light of recent output, bibliometrics also provides a map of trends and gaps. On the one hand, there has been sustained growth in publications and expansion of co-authorship networks in Europe and America; on the other hand, gaps remain in the evaluation of impact, the effects of ICAs on achievement, retention, well-being, and ESD competencies, and in the transferability of experiences to resource-constrained contexts.⁽⁸⁾ In fact, several analyses confirm the emergence of co-word clusters where terms such as inclusion, accessibility, and sustainability converge, suggesting an integrative agenda in the making.^(3,8) However, capitalizing on this convergence requires strengthening quasi-experimental and mixed designs, making explicit the interoperability between DUA, digital accessibility, personalization, and ESD, and building school governance models that align SDG goals with incentives, resources, and evaluation.⁽⁶⁾

In summary, the state of the art offers a clear point of support: inclusive curriculum adaptations are the operational mechanism for inclusion and sustainability to cease being juxtaposed slogans and become ways of organizing learning. If they are assumed as decision architecture, advance planning, reasonable supports, formative evaluation, and continuous improvement, ICAs make it possible to operationalize SDG 4, articulate equity and accessibility with sustainability competencies, and, finally, scale up evaluable practices at different levels and in different contexts.^(4,5,8,9,10,11,12) From this perspective, the challenge is no longer just what policies to enact, but how to govern the curriculum to sustain, measure, and improve the integration of inclusion and sustainability in a systematic way.

METHOD

This research was developed under an integrative systematic review design, complemented by a bibliometric analysis and a conceptual meta-analysis. This methodological combination allowed us to identify, synthesize, and analyze the scientific production related to inclusive curriculum adaptations and their articulation with the Sustainable Development Goals (SDGs) in education. The procedure was framed within the guidelines of the PRISMA 2020 protocol, which ensured transparency in the search, selection, and analysis phases of the studies considered.

The search strategy was applied to high-impact international databases such as Scopus, Web of Science (WoS), ERIC, SciELO, and Redalyc. These platforms were selected for their global coverage and for concentrating relevant publications in the fields of inclusive education, educational policies, and sustainability. The analysis period was limited to the years 2015 to 2025 in order to capture the most recent and up-to-date production, considering only documents in English and Spanish. The search terms were designed using Boolean operators, integrating both English and Spanish vocabulary. In the case of Scopus, for example, the following search equation was used:

(TITLE-ABS-KEY(("inclusive education" OR "inclusive curriculum" OR "curricular adaptation*" OR "reasonable accommodation" OR "universal design for learning" OR "UDL" OR "curricular adaptations" OR "inclusive education" OR "universal design for learning" OR "reasonable adjustments")) AND (TITLE-ABS-KEY("sustainable development" OR "education for sustainable development" OR "ESD" OR "SDG*" OR "SDGs" OR "SDG4" OR "sustainable education")) AND PUBYEAR > 2014 AND PUBYEAR < 2026 AND (LIMIT-TO(LANGUAGE, "English") OR LIMIT-TO(LANGUAGE, "Spanish"))).

In terms of inclusion criteria, empirical studies, systematic reviews, scoping reviews, and theoretical essays that explicitly addressed inclusive education and/or curriculum adaptations, linking them to the SDGs or education for sustainable development, were considered. In addition, they had to present experiences, regulatory frameworks, or pedagogical proposals and be published in indexed academic journals between 2015 and 2025. Conversely, non-academic documents, gray literature, conference abstracts, studies focused on clinical medical fields with no educational connection, duplicate publications between databases, and articles written in languages other than English and Spanish were excluded.

The selection process was structured in five phases: first, the identification of documents through systematic searches in the selected databases; second, the initial removal of duplicate records using the Zotero reference manager; third, a screening of titles and abstracts to determine the relevance of the studies; fourth, a full-text review of eligible articles; and finally, the inclusion of studies that met all the criteria. The methodological process will be summarized in a PRISMA diagram, which will detail the number of studies identified, excluded, and included at each stage.

To ensure efficient information management, the results of the Scopus and WoS searches were exported in BibTeX (.bib) format and integrated into Zotero, which allowed for the unification of records and management of duplicates. Subsequently, the files cleaned in Zotero were exported in CSV formats for processing in the Bibliometrix (R) tool, which was used to develop the bibliometric analysis (trends, productivity, co-authorship

networks, and co-words). At the same time, an extraction matrix was constructed in Excel, where key information from each study (authors, year, country, population, educational level, dimensions analyzed, and link to the SDGs) was systematized, which was essential input for the conceptual meta-analysis.

RESULTS

Results of the bibliometric analysis

The bibliometric analysis of the selected studies revealed a clear trend of growth in scientific production related to inclusive curriculum adaptations and their link to the Sustainable Development Goals. In particular, there was an upturn from 2020 onwards, reaching its highest concentration in 2024 and 2025 (figure 1). This evolution reflects the consolidation of the field and, in turn, the decisive influence of the 2030 Agenda in promoting research aimed at inclusion and sustainability. As international regulatory frameworks have emphasized the need to guarantee SDG 4, academic production around inclusive pedagogical practices and adaptive curriculum models has been strengthened.

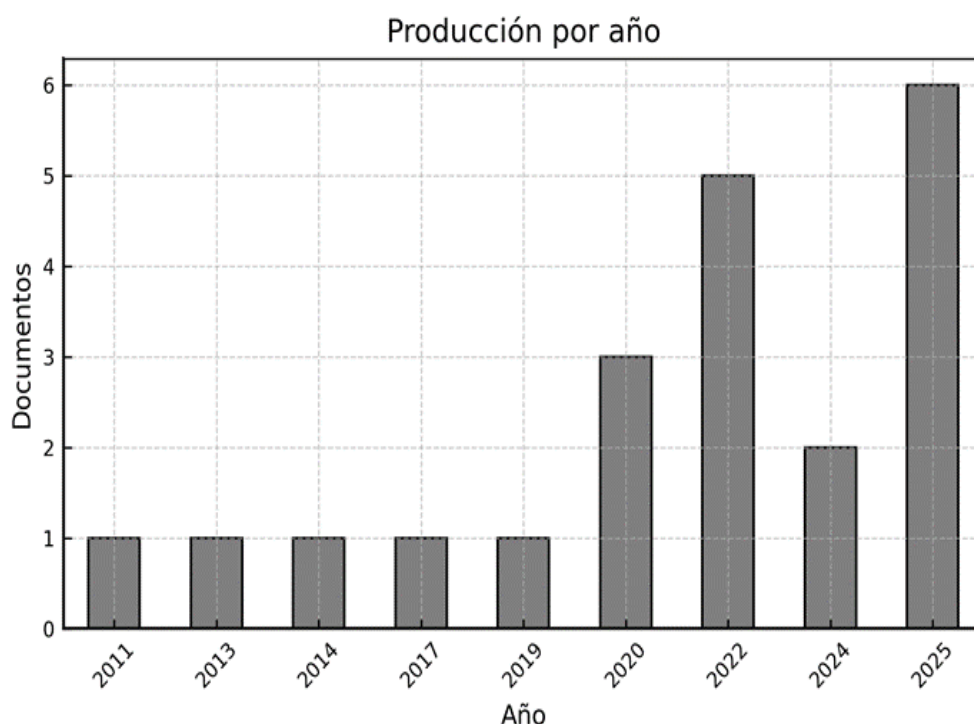


Figure 1. Output by year

Consequently, the distribution of output by journal showed a concentration in internationally renowned titles such as *Frontiers in Education* (Switzerland), *Sustainability* (Switzerland), and *Education Sciences* (Switzerland), which account for a significant proportion of the articles analyzed (table 1). This pattern confirms the cross-cutting nature of the topic, since despite the interest in publications specializing in inclusive education, they are also dedicated to sustainability and educational innovation. Likewise, the presence of European and North American journals such as the *British Journal of Sociology of Education* (United Kingdom), *Educational Technology Research and Development* (United States), and *Medical Teacher* (United Kingdom) broadens the scope of the debate to complementary fields such as the sociology of education, applied technology, and teacher training in professional contexts. The positioning of these journals in high-impact databases, such as Scopus and Web of Science, legitimizes the topic in the academic sphere and, in turn, guarantees its visibility in global research networks, fostering international collaboration and the circulation of comparative frameworks. In this sense, the journals are strategic hubs for consolidating the contemporary debate on inclusive curriculum adaptations and their articulation with the Sustainable Development Goals.

With regard to document types, empirical research articles and systematic reviews predominated, followed by conceptual studies and methodological proposals (figure 2). This distribution reveals an expanding field that is not limited to practical experiences but is moving toward the construction of theoretical syntheses and comparative frameworks. The emphasis on integrative reviews indicates a growing concern for consolidating available evidence and generating replicable models that can serve as references in different contexts.

Table 1. Journals, country, citation, and selected articles with titles in English and Spanish

Journal	No. of articles	Country	Selected articles	Citation
British Journal of Sociology of Education	2	United Kingdom	Critically considering the ‘inclusive curriculum’ in higher education.	(13)
Journal of Open Innovation: Technology, Market, and Complexity	2	Switzerland	Critical consideration of the ‘inclusive curriculum’ in higher education. Pedagogical innovation and curricular adaptation in enhancing digital literacy: A local wisdom approach for sustainable development in the Indonesian context.	(10)
PROSPECTS	2	Netherlands	Pedagogical innovation and curriculum adaptation in strengthening digital literacy: a local wisdom approach to sustainable development in the Indonesian context. Reaching SDG 4: Our shared responsibility and renewed commitment to action.	(12)
Sustainability	2	Switzerland	Reaching SDG 4: Our shared responsibility and renewed commitment to action A Human Rights-Based Approach in Implementing Sustainable Development Goal 4 (Quality Education) for Ethnic Minorities in Vietnam.	(4)
Addictive Behaviors	1	Oxford, United Kingdom	A human rights-based approach to implementing Sustainable Development Goal 4 (quality education) for ethnic minorities in Vietnam. Towards a Sustainable Future in Education: A Systematic Review and Framework for Inclusive Education. Towards a sustainable future in education: a systematic review and framework for inclusive education.	(14)
African Journal of Disability	1	South Africa	Beyond path diagrams: Enhancing applied structural equation modeling research through data visualization. Beyond path diagrams: Enhancing applied structural equation modeling research through data visualization	(6)
American Journal of Psychiatric Rehabilitation	1	United States	Adaptation of the curriculum for the inclusion of learners with special education needs in selected primary schools in the Fort Beaufort District. Adaptation of the curriculum for the inclusion of learners with special education needs in selected primary schools in the Fort Beaufort District	(9)
Science and Education	1	Latin America	Curriculum Adaptation for Children with Special Educational Needs: Best Practices in Inclusive Education. Curriculum adaptation for children with special educational needs: best practices in inclusive education.	(11)
Education Sciences	1	Switzerland	Proposal for curriculum adaptations for the educational inclusion of students with physical disabilities.	(5)
Educational Technology Research and Development	1	United States	A Systematic Review of Inclusive Education Strategies for Students of Determination in Higher Education Institutions: Current Challenges and Future Directions. A systematic review of inclusive education strategies for students of determination in higher education institutions: current challenges and future directions From digital literacy to digital competence: the teacher digital competency (TDC) framework From digital literacy to digital competence: the teacher digital competency (TDC) framework	(15)

European Journal of Education Studies	1	Romania	INCLUSIVE EDUCATION AND PEDAGOGY: A PRACTICE FOR ALL STUDENTS	(16)
Excellence in Higher Education	1	United States	Inclusive education and pedagogy: a practice for all students The Implementation of Inclusive Education for Students with Special Needs in Indonesia	(17)
Frontiers in Education	1	Switzerland	The implementation of inclusive education for students with special educational needs in Indonesia Education for Sustainable Development and Inclusive Education with Particular Consideration of Learners with Special Needs: A Scoping Literature Review	(3)
Nordic Journal of Studies in Educational Policy	1	United Kingdom	Education for sustainable development and inclusive education with particular consideration of learners with special needs: an exploratory literature review Promoting inclusion and equity in education: lessons from international experiences.	(18)
Review of Education	1	United Kingdom	Promoting inclusion and equity in education: lessons from international experiences Inclusive policies and practices in higher education: A systematic literature review.	(8)
Report, regional data on progress towards SDG4	1	Latin America	Inclusive policies and practices in higher education: A systematic literature review UNICEF & ECLAC. The Crossroads of Education in Latin America and the Caribbean: Regional Monitoring Report SDG4-Education 2030 (2022).	(2)
Regulatory framework	1	Rome, Italy	UNICEF & ECLAC. The Crossroads of Education in Latin America and the Caribbean: Regional Monitoring Report SDG4-Education 2030 (2022). Sustainable D. Sustainable Development Goals. Food and Agriculture Organization: Rome, Italy (1986).	(1)
Sustainable D. Sustainable Development Goals.				

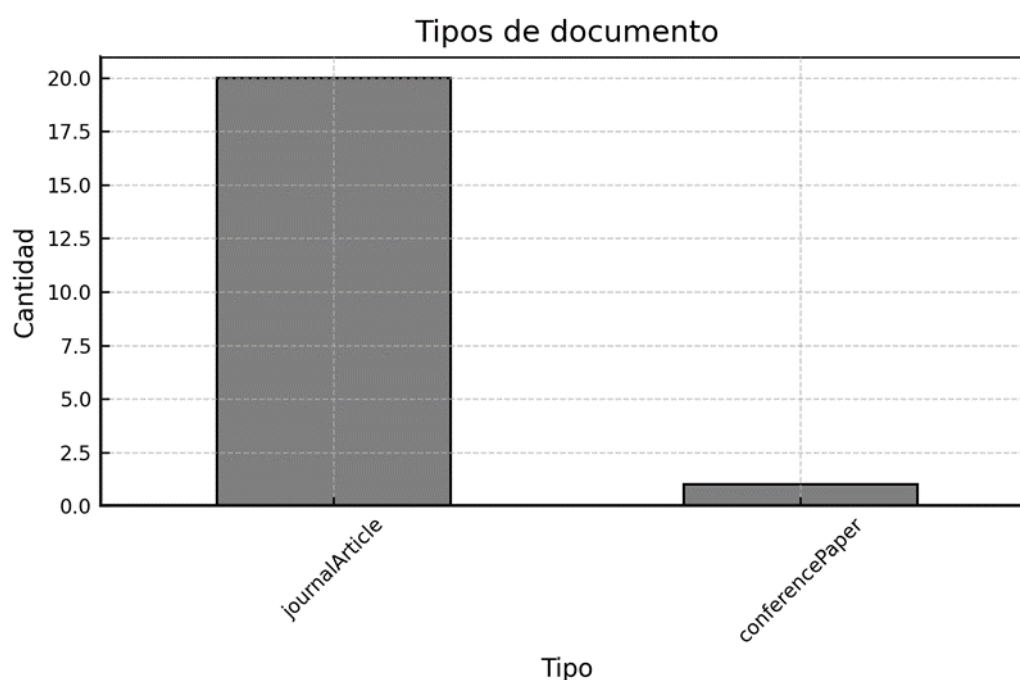


Figure 2. Types of document

Results of the conceptual meta-analysis

The conceptual meta-analysis allowed us to delve deeper into the findings identified and organize them into four essential dimensions: equity, accessibility, functional diversity, and sustainability. These categories are not conceived in isolation, but as an interdependent framework that explains how inclusive curriculum adaptations materialize in diverse contexts.

The first dimension corresponds to equity, which is confirmed as a cross-cutting theme in the literature analyzed. The evidence highlights that real inclusion is not achieved solely through access, but through policies and practices that reduce gaps related to gender, disability, ethnicity, and socioeconomic status. To this end, flexible learning pathways, differentiated support, and contextualized assessments are proposed to ensure complete educational trajectories with quality standards.

The second dimension is accessibility, approached from a dual perspective. On the one hand, Universal Design for Learning (UDL) promotes advance and flexible planning that reduces structural barriers from the outset. On the other hand, reasonable accommodations offer personalized responses to specific needs, ensuring conditions of equity in the classroom.

This accessibility is understood on three levels: physical, digital, and curricular, consolidating itself as an indispensable condition for full participation and academic achievement.

The third dimension, functional diversity, involves recognizing the heterogeneity of the student population as part of pedagogical normality. The studies reviewed show that active methodologies such as cooperative learning, together with the use of assistive technologies, interactive platforms, and gamification strategies, increase motivation and promote student self-determination. From this perspective, diversity is not an exception that requires compensatory measures, but rather a resource that stimulates pedagogical innovation.

The integrative synthesis of these dimensions, the bibliometric results, and the conceptual meta-analysis provided an understanding of the maturation of the field in recent years. The growing emphasis on equity and accessibility demonstrates that the scientific community recognizes that it is not enough to guarantee formal access; beyond that, concrete mechanisms are required to support heterogeneous educational trajectories. Similarly, the emergence of innovative experiences in functional diversity reveals the capacity of educational systems to transform their practices, provided they have teaching support, technological resources, and consistent regulatory frameworks. The incorporation of sustainability as a cross-cutting category also opens up an opportunity for curricular adaptations to be conceived not as isolated adjustments, but as part of a global educational project aimed at building fair and sustainable societies.

These results provide an overview and also offer input for the formulation of public policies and teacher training programs. The theoretical-practical model derived from this review proposes guidelines that can be adapted to different scales, from the classroom to national education systems, always with the aim of ensuring inclusive, quality education in line with the Sustainable Development Goals.

Theoretical-practical model of Inclusive Curriculum Adaptations (ICA) oriented towards SDG 4

Overall objective of the model: to guarantee inclusive, equitable, and quality education through the implementation of curriculum adaptations that integrate the principles of equity, accessibility, functional diversity, and sustainability, in line with the 2030 Agenda and SDG 4.

Stages of the model

1. *Diagnosis and advance planning*

- Identification of barriers to learning and participation.
- Application of Universal Design for Learning (UDL) as a preventive basis.
- Assessment of specific student needs and institutional contexts.

2. *Design and implementation of ACI*

- Access adaptations (infrastructure, technology, communication).
- Adaptations to content, methodology, and assessment.
- Incorporation of active strategies (cooperative learning, gamification, use of ICT).

3. *Continuous monitoring and evaluation*

- Adapted formative and summative assessments.
- Indicators of participation, academic achievement, and well-being.
- Reasonable dynamic adjustments based on results.

4. *Scalability and support policies*

- Integration into institutional plans and national regulations.
- Continuing teacher training in inclusion and sustainability.

Creation of academic networks and international collaboration.

Substantive dimensions integrated into the model

Equity → reducing gaps in gender, disability, ethnicity, and socioeconomic status.

Accessibility → ensuring physical, digital, and curricular conditions for full participation.

Functional diversity → recognizing and valuing heterogeneity as a driver of pedagogical innovation.

Sustainability → orient learning toward global citizenship, ethics of care, and critical skills.

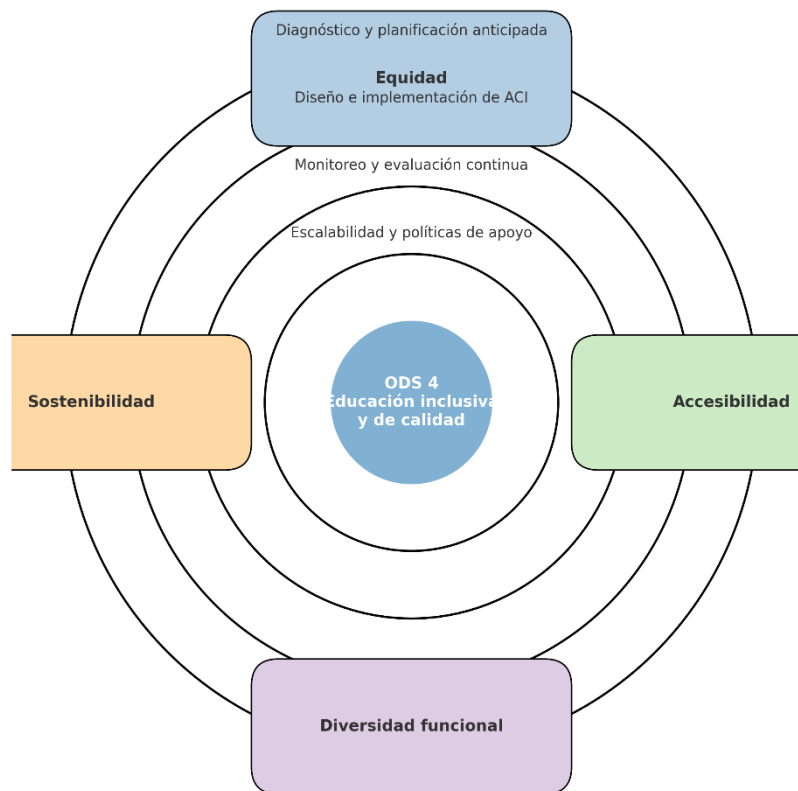


Figure 3. Theoretical-practical model of Inclusive Curriculum Adaptations (ICA) oriented towards SDG 4

The proposed model for Inclusive Curriculum Adaptations (ICA) oriented towards SDG 4, offers a practical and sustainable route to ensuring inclusive, quality education. By integrating equity, accessibility, functional diversity, and sustainability, it establishes itself as a strategic tool for transforming education systems in line with the 2030 Agenda.

DISCUSSION

The results obtained confirm that inclusive curriculum adaptations (ICA) are a decisive operational axis for ensuring inclusive and quality education as set out in SDG 4. Bibliometrics showed sustained growth in academic production on inclusion and sustainability over the last decade, which is in line with the international consolidation of the Sustainable Development Goals as a reference framework for educational policies.⁽¹⁾ This finding demonstrates that scientific research is progressively adapting to global demands for social justice, equity, and sustainability.

Firstly, bibliometric findings corroborate the findings of ⁽³⁾, who identify that inclusive education and education for sustainability have evolved as separate fields and have only recently begun to converge. The growth in publications after 2020 reflects the transition towards an integrative paradigm, where inclusion is conceived as a condition for equitable access to learning and sustainability as the educational horizon of global education. In this sense, the discussion is in line with what is proposed by ⁽¹²⁾ which points out that the fulfillment of SDG 4 requires a renewed commitment to equity as the basis of the right to education.

Secondly, the conceptual results obtained reinforce the literature that distinguishes between accessibility and equity as complementary dimensions. On the one hand, accessibility, understood from the DUA and reasonable adjustments, is essential to ensure student participation and retention.⁽⁶⁾ On the other hand, equity ensures that these opportunities are distributed fairly, recognizing diversity and reducing structural gaps.^(11,12) The evidence coincides with the findings of ^(5,7), who emphasize that inclusive curricula require not only

pedagogical strategies but also institutional policies that ensure consistency between objectives, resources, and evaluation.

However, there are still gaps in the research that limit the consolidation of evidence. Most of the studies reviewed focus on descriptive analyses or conceptual proposals, while there are still few longitudinal and quasi-experimental designs that allow for accurate assessment of the impact of inclusive curriculum adaptations on indicators such as academic achievement, student retention, social-emotional well-being, and the acquisition of sustainability-related skills. This lack of solid empirical evidence points to the need to promote comparative research and systematic evaluations that strengthen the transferability and scalability of inclusive practices to contexts with different levels of resources.

Third, the discussion shows that functional diversity should no longer be conceived as an exception but rather as part of pedagogical normality. Recent studies emphasize the value of active methodologies and assistive technologies, which is consistent with the findings reported by ^(9,10), where cooperative learning, gamification, and interactive platforms are presented as effective mechanisms for strengthening autonomy and motivation. At the same time, the proposal by ⁽¹¹⁾ shows that personalized and contextually situated adaptations are key to ensuring the cultural relevance and sustainability of inclusive practices.

The results reaffirm that sustainability cannot be conceived in isolation, but rather as a cross-cutting dimension of inclusive education. As proposed by ^(4,8), the convergence between inclusion and sustainability requires integrative frameworks, such as the IPOF, that connect inputs, processes, outcomes, and feedback. In this way, ICAs not only remove barriers to learning, but also promote critical skills for addressing global challenges. The incorporation of the SDGs as a curricular horizon, proposed since their initial formulation ⁽¹⁾, confirms that education must be at the center of strategies to achieve more just, equitable, and sustainable societies.

Likewise, by placing the results in the regional context, reports such as those by UNICEF and ECLAC (2022) ⁽²⁾ on the monitoring of SDG 4 in Latin America and the Caribbean warn that gaps in equity and accessibility remain significant, especially in relation to students with disabilities, rural and indigenous populations. In this context, the proposed model responds to global guidelines and also offers practical criteria for contextualizing curricular adaptations in settings where resources are limited and cultural diversity demands pedagogical relevance. This connection between the global and the local reinforces the model's usefulness as a flexible tool for the formulation of public policies and teacher training programs in the region.

In summary, the discussion shows that ICAs represent a pedagogical mechanism with a dual function: on the one hand, to guarantee equity and accessibility in the present; on the other, to develop skills for sustainability in the future. The articulation of these dimensions in a theoretical-practical model offers an innovative and replicable proposal that responds to local challenges and the international commitments of SDG 4.

CONCLUSION

The findings of this research allow us to conclude that inclusive curriculum adaptations represent an indispensable resource for operationalizing SDG 4 and ensuring inclusive, equitable, and quality education. The bibliometric analysis showed steady growth in scientific production in recent years, confirming that the topic has become an academic and political priority at the global level. This trend reflects a greater awareness of the need to articulate inclusion and sustainability as complementary dimensions of the same educational project.

Likewise, the conceptual meta-analysis showed that the four dimensions identified—equity, accessibility, functional diversity, and sustainability—form an interdependent framework that guides the design of inclusive curricula. Equity is confirmed as the basis for reducing educational and social gaps; accessibility emerges as a structural condition for full participation; functional diversity is recognized as a legitimate expression of student heterogeneity; and sustainability is projected as an educational horizon that gives global and ethical meaning to inclusive practices. Far from being isolated spheres, these dimensions are integrated into a theoretical-practical model that can guide policies, teacher training programs, and specific pedagogical practices.

In this context, curricular adaptations should not be considered as mere bureaucratic appendices, but as dynamic strategies for pedagogical governance that require advance planning, reasonable adjustments, and continuous evaluation and improvement processes. Their implementation demands solid institutional capacities, collaborative work time, and sufficient resources, as well as a sustained commitment to public policies.

This study demonstrates that the convergence between inclusive education and education for sustainable development is both desirable and necessary. Inclusion without sustainability runs the risk of being limited to the technical correction of immediate inequalities, and sustainability without inclusion becomes an unattainable ideal for a large part of the student population. Therefore, inclusive curriculum adaptations constitute the bridge to integrate both approaches, becoming a replicable and scalable mechanism that contributes to the construction of more equitable, resilient, and sustainable education systems.

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