



Transhumanism and Education as a Contested Space of Human Development: A Bibliometric and Critical Analysis

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Abstract - *The rapid diffusion of artificial intelligence, neurotechnologies, and immersive learning environments has repositioned transhumanism from speculative philosophy to an influential framework in educational research. Despite this growing interest, the intellectual structure and conceptual evolution of transhumanism in education remain insufficiently mapped. This study presents a comprehensive bibliometric and theoretically informed analysis of transhumanism-and-education research published between 2001 and 2026.*

Based on 141 Scopus-indexed documents, the study integrates keyword co-occurrence, co-authorship, citation, co-citation, and bibliographic coupling analyses using VOSviewer. These findings are interpreted through an integrative framework combining transhumanist philosophy, posthuman pedagogical ethics, and neuroeducational perspectives.

The results reveal a strong philosophical foundation centered on ethics and human enhancement, alongside a growing shift toward artificial intelligence, neuroeducation, and immersive learning. Bibliographic coupling further indicates emerging epistemic convergence around applied transhumanist education, where enhancement is framed as an ethically governed pedagogical design challenge. Overall, the study positions education as the primary mediating arena in which technological amplification is negotiated through human dignity, responsibility, and inclusive learning design.

Keywords: Transhumanism, Education, Posthumanism, Bibliometric Analysis, Learning Technologies.

1. INTRODUCTION

The accelerating convergence of human and technological systems has fundamentally reconfigured the conditions of learning, cognition, and human development. Within this landscape, transhumanism—the philosophical and technological vision of enhancing human capacities beyond biological limits—has emerged not only as a future-oriented aspiration but also as a contested developmental discourse within education [1][2]. Far from representing a neutral trajectory of progress, transhumanist imaginaries increasingly shape how learning, intelligence, and human potential are defined, governed, and distributed in contemporary societies [3][4][5].

Educational research has become a central arena in which these transformations are negotiated. Technologies such as artificial intelligence, neurotechnologies, immersive

environments, and data-driven learning systems are no longer peripheral instructional tools; they actively participate in redefining cognitive norms, learner agency, and developmental expectations [6][7]. As a result, education functions as a politically charged and ethically contested developmental space, where human enhancement is simultaneously legitimized, questioned, and unevenly experienced [8][9].

Within the literature, two dominant but weakly integrated strands can be identified. The first emphasizes the philosophical and ethical implications of transhumanism, raising concerns related to human dignity, autonomy, equity, and the moral boundaries of enhancement [10][11]. This line of inquiry interrogates whether enhancement-oriented educational futures risk reinforcing normative assumptions about the “ideal” human learner while marginalizing bodies, minds, and developmental trajectories that fall outside technologically privileged norms. The second strand foregrounds technological and pedagogical applications, focusing on artificial intelligence, neuroeducation, and embodied learning environments as drivers of instructional innovation and cognitive extension [12][13][14].

Despite the growing visibility of both strands, research on transhumanism in education remains fragmented and epistemically uneven. Existing studies are predominantly conceptual, speculative, or contextually localized, offering limited insight into how transhumanist ideas have evolved systematically across educational research and how ethical concerns are positioned relative to technological acceleration [15][16]. Moreover, insufficient attention has been paid to how global knowledge production on transhumanism and education reflects broader patterns of power, inclusion, and exclusion within human development discourse.

Addressing these gaps, the present study conducts a bibliometric and citation-based analysis of transhumanism-related educational research indexed in Scopus between 2001 and 2026. Rather than treating bibliometric mapping as a purely descriptive exercise, the study adopts a critical human development perspective, conceptualizing education as an unequal and ethically contested laboratory of transhumanist development. In this laboratory, enhancement is not merely designed or implemented but socially negotiated, normatively framed, and differentially accessible across educational contexts [17][4].



By integrating keyword co-occurrence, co-authorship, co-citation, and bibliographic coupling analyses, the study maps the intellectual, conceptual, and collaborative structures shaping transhumanism in education. These quantitative patterns are interpreted through an integrative framework that combines transhumanist aspirations, posthuman ethical critique, and concerns central to human development. In doing so, the article advances the argument that education operates not simply as a site of technological experimentation, but as a critical domain in which the future trajectories of human development are actively constructed—and contested.

Through this approach, the study contributes to human development scholarship by revealing how enhancement-oriented educational discourses intersect with ethical reflexivity, developmental norms, and global knowledge hierarchies. Rather than asking how far human enhancement can proceed, the article foregrounds a more fundamental question: whose development is being enhanced, under which conditions, and at what ethical cost.

2. LITERATURE REVIEW

The intersection of transhumanism and education has increasingly been recognized as a critical site for examining how technological enhancement reshapes learning, cognition, and human development. While early transhumanist discourse emerged primarily from philosophical debates on human limits, consciousness, and technological transcendence [1][18][19], educational scholarship has gradually reframed these concerns in relation to pedagogical purpose, learner agency, and developmental norms [20][15].

A growing body of literature conceptualizes transhumanism in education through two interrelated yet tension-laden dimensions: ethical–normative critique and cognitive–technological extension. The ethical dimension foregrounds concerns about human dignity, equity, and moral responsibility in technology-mediated learning environments [8][11][9]. Scholars within this strand question whether enhancement-oriented educational futures risk normalizing particular cognitive ideals while marginalizing learners whose bodies, minds, or socio-economic positions fall outside technologically privileged norms.

In contrast, the cognitive–technological dimension emphasizes neuroeducation, artificial intelligence, and embodied learning as drivers of instructional innovation and cognitive augmentation [6][12]. From this perspective, learning is understood as an extended process in which biological intelligence increasingly co-evolves with algorithmic systems, immersive environments, and neuroadaptive technologies [7][13]. While this strand highlights new pedagogical possibilities, it often under-theorizes the developmental and ethical consequences of redefining cognition through technological benchmarks.

Recent postdigital and posthumanist educational theories have sought to address this imbalance by challenging linear narratives of progress and technological determinism [10][16]. These perspectives reconceptualize learning as relational, embodied, and situated, emphasizing coexistence rather than optimization. However, despite their critical intent, posthumanist and postdigital studies remain unevenly integrated into broader transhumanist education research, often operating in parallel rather than dialogic relation.

Across these strands, the literature reveals a field characterized by conceptual richness but structural fragmentation. Much of the existing scholarship relies on theoretical reflection, qualitative discourse analysis, or localized case studies, offering limited insight into how transhumanist ideas are distributed, clustered, and prioritized across global educational research [21]. Consequently, questions of whose knowledge dominates, which ethical concerns gain visibility, and how developmental norms are reproduced through academic discourse remain insufficiently examined.

To address these limitations, a bibliometric and network-based approach provides a systematic means of mapping the intellectual, conceptual, and collaborative structures of transhumanism-related educational research [22]. Such an approach not only quantifies publication patterns but also reveals how ethical critique, technological innovation, and human development concerns intersect—or diverge—within the field. By situating bibliometric analysis within a critical human development perspective, this study seeks to move beyond descriptive mapping toward a reflexive understanding of how transhumanist educational discourse is produced, circulated, and normalized.

2.1 Research Questions

Building on the identified conceptual tensions and structural gaps in the literature, this study addresses the following research questions:

- How has scholarly production on transhumanism and education evolved over time in relation to human development concerns?
- Which conceptual clusters dominate transhumanism-related educational research, and how do they reflect ethical, technological, and developmental priorities?
- How are authorship, institutional, and country-level collaboration networks structured, and what do these structures suggest about epistemic power and knowledge distribution within the field?

By addressing these questions through bibliometric and network analysis, the study aims to illuminate not only research trends but also the normative and developmental assumptions embedded within transhumanist educational scholarship.

3. THEORETICAL FRAMEWORK



This study adopts a theoretically integrative framework to guide the interpretation of bibliometric patterns related to transhumanism and education. Rather than offering a comprehensive overview of transhumanist or posthumanist theory, this section delineates the analytical lenses through which the intellectual structure of the field is examined. The framework brings together transhumanist educational aspirations, posthuman ethical critique, and neurotechnological extensions of learning to support a critical reading of how enhancement-oriented educational discourse is constructed, legitimized, and contested.

3.1. Transhumanist Education as an Aspirational Paradigm

Transhumanism conceptualizes technology as a means of extending human capacities—cognitively, biologically, and socially—beyond historically defined limits [1][18]. Within education, this orientation has been translated into an aspirational paradigm in which learning is framed not merely as knowledge acquisition but as the augmentation of human potential. Educational technologies are thus positioned as evolutionary interfaces that mediate new forms of agency, creativity, and adaptive cognition [2].

However, transhumanist educational discourse also introduces normative assumptions about what constitutes desirable development, intelligence, and learning capacity. By emphasizing optimization, adaptability, and enhancement, this paradigm risks privileging technologically mediated forms of cognition while marginalizing alternative developmental trajectories [8]. In this study, transhumanism is therefore treated not as a neutral framework but as a value-laden orientation whose influence on educational research requires critical examination.

3.2. Posthuman Pedagogical Ethics and Normative Constraint

Posthumanist educational theory offers a critical counterpoint to enhancement-driven narratives by questioning who benefits from technological progress and how ethical responsibility is distributed within human-technology assemblages [10][15]. Rather than centering education on optimization and performance, posthuman pedagogy emphasizes relational ethics, embodiment, and coexistence among human and non-human actors.

From this perspective, learning is understood as participation in entangled systems of becoming, where ethical responsibility extends beyond the individual learner to include data infrastructures, algorithmic agents, and ecological contexts [4][14]. In the present study, posthuman ethics functions as a normative constraint, shaping the interpretation of bibliometric clusters associated with dignity, inclusivity, and care, and highlighting tensions between technological ambition and ethical accountability.

3.3. Neurotechnological and AI Extensions of Learning

Advances in artificial intelligence, brain-computer interfaces, and neurofeedback technologies have rendered

the transhumanist vision of cognitive extension increasingly tangible. Neuroeducational research conceptualizes learning as a distributed process spanning neural, digital, and social systems rather than a brain-bound activity [6][13].

While these technologies enable personalization, immersion, and adaptive feedback, they also raise concerns related to autonomy, privacy, and cognitive sovereignty [12]. Within this study, neurotechnological and AI-driven learning systems are interpreted as sites of tension where enhancement potential intersects with ethical and developmental risk. This lens informs the analysis of bibliometric patterns related to AI, embodiment, and cognition.

3.4. Integrative Framework for Bibliometric Interpretation

The three perspectives outlined above are integrated into a coherent interpretive framework that guides the bibliometric analysis. Transhumanist constructs informed the identification of enhancement-oriented keywords and thematic clusters; posthuman ethics shaped the critical reading of clusters related to dignity, equity, and pedagogical care; and neuroeducational perspectives supported the interpretation of cognitive and embodied learning networks.

By aligning philosophical inquiry with data-driven mapping, this framework enables a multi-layered understanding of how transhumanist educational discourse is structured, circulated, and normalized within academic knowledge production.

3.5. Education as the Ethical Laboratory of Transhumanism

Building on this integrative stance, the study proposes a conceptual model that positions education as the ethical laboratory of transhumanism—a mediating domain where technological enhancement is cognitively embodied and ethically negotiated. The model synthesizes three interdependent dimensions: technological enhancement (transhumanism), ethical reflexivity (posthumanism), and cognitive embodiment (neuroeducation).

These dimensions intersect in what is conceptualized as educational praxis as ethical experimentation, where learning becomes a reflective and normatively constrained process rather than a purely optimization-driven endeavor. The bibliometric findings presented in later sections empirically support this triadic structure, revealing convergent patterns across keyword co-occurrence, citation networks, and bibliographic coupling analyses.

Accordingly, the model functions both as an interpretive framework and as a meta-analytic synthesis of the evolving field of transhumanist education.

3.6. Significance and Originality of the Study

The significance of this study lies in its integrative and critical approach to mapping transhumanism in educational research. While transhumanism has been extensively discussed within philosophical and ethical debates, its



systematic examination within education as a field of human development has remained limited. By combining bibliometric techniques with a theoretically grounded interpretive framework, this study advances understanding of how enhancement-oriented imaginaries are embedded, prioritized, and contested within educational scholarship.

At a theoretical level, the study bridges transhumanist aspirations with posthuman ethical critique, positioning education as a mediating domain where technological potential, moral responsibility, and developmental norms intersect. This synthesis extends existing discussions by foregrounding education not merely as an application site of emerging technologies, but as a formative space in which visions of human development are actively negotiated.

At a methodological level, the study employs a multi-technique bibliometric design that integrates keyword co-occurrence, co-authorship and country networks, citation analysis, and bibliographic coupling. This triangulated approach enables a comprehensive examination of the field's conceptual, social, and intellectual structures, offering a replicable model for future meta-research in education and philosophy of technology.

In comparison with prior bibliometric studies that primarily emphasize publication counts or surface-level keyword trends [23], the present research adopts a broader temporal scope (2001–2026) and a theory-informed analytical strategy. By interpreting bibliometric patterns through the combined lenses of transhumanism, posthumanism, and neuroeducation, the study moves beyond descriptive mapping toward a critical understanding of how ethical concerns, cognitive extension, and technological design co-evolve within educational discourse.

Overall, the originality of this work lies in its transdisciplinary synthesis, connecting philosophy, educational technology, ethics, and cognitive science to illuminate not only what has been studied, but how educational research itself participates in shaping future trajectories of human development.

4. METHOD

4.1. Research Design

This study adopted a theory-informed bibliometric research design combining quantitative mapping with qualitative interpretation. Bibliometric analysis was employed to examine the conceptual, social, and intellectual structures of transhumanism-related educational research, while interpretive analysis was guided by the integrated theoretical framework outlined in Section 3. The purpose of this design was not only to identify publication patterns, but also to critically examine how enhancement-oriented educational discourse is constructed, circulated, and legitimized within academic knowledge production.

Following established guidelines for bibliometric research [21][22], the study applied a structured workflow integrating four analytical layers: (a) conceptual structure through keyword co-occurrence, (b) social structure through

co-authorship networks at author, institutional, and country levels, (c) intellectual structure through citation and co-citation analysis, and (d) emerging convergence through bibliographic coupling. These layers enabled a multi-dimensional examination of how ethical, technological, and developmental perspectives intersect within the field.

To enhance transparency and replicability, the data selection process followed a PRISMA-informed workflow adapted for bibliometric research [24][25]. Rather than applying PRISMA as a clinical reporting standard, its stepwise logic was used as a methodological guide to document data identification, screening, and inclusion decisions in a systematic and auditable manner.

4.2 Data Collection and Screening

4.2.1 Database and Search Strategy

Bibliographic data were retrieved from the Scopus database, selected for its broad interdisciplinary coverage across education, social sciences, philosophy, and technology-oriented journals. The search was conducted on May 10, 2025, using the following query:

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( TITLE-ABS-KEY ( transhumanism ) OR TITLE-ABS-KEY (
transhumanist ) OR TITLE-ABS-KEY ( transhuman ) AND
TITLE-ABS-KEY ( education ) OR TITLE-ABS-KEY ( learning
))
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The time frame of 2001–2026 was chosen to capture both early conceptual contributions and recent developments reflecting the increasing integration of artificial intelligence, neurotechnology, and posthuman perspectives in education.

4.2.2 Inclusion and Exclusion Criteria

Records were filtered based on the following (Table 1) criteria.

Table -1: Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Language	English	Non-English
Document Type	Journal Articles, Conference Papers	Books, Editorials, Reviews
Subject Area	Education, Social Sciences, Philosophy, Computer Science	Medicine, Biology, Engineering (non-pedagogical)
Focus	Educational application or ethical reflection of transhumanism/posthumanism	Purely speculative or non-educational discussions

Only English-language journal articles and conference papers addressing educational applications or ethical reflections related to transhumanism or posthumanism were included. Documents focusing exclusively on medical, biological, or engineering contexts without pedagogical relevance were excluded. Duplicate records were removed, and entries lacking bibliographic completeness or educational focus were omitted.

4.3 PRISMA-Informed Workflow



The PRISMA-informed workflow comprised four stages: identification, screening, eligibility, and inclusion. An initial set of 186 records was retrieved from Scopus. After removing duplicates ($n = 22$) and non-educational records ($n = 17$), 147 documents remained for abstract-level review. Following eligibility screening, six additional records were excluded due to scope misalignment, resulting in a final dataset of 141 documents included in the analysis. Figure 1 presents the corresponding flow diagram.

Figure 1. PRISMA-Informed Workflow for Bibliometric Data Selection



Note. The figure illustrates the identification, screening, eligibility, and inclusion stages of the bibliometric data selection process adapted from the PRISMA framework for meta-research purposes.

This process ensured methodological transparency and compliance with current bibliometric reporting standards.

4.4 Data Analysis

All bibliometric analyses were conducted using VOSviewer (version 1.6.20). Full counting was applied, and association strength normalization was used to ensure comparability across networks. Minimum thresholds were set at one document for authors and keywords, and two citations for citation-based analyses. Visualization parameters were configured consistently across analyses to support interpretive coherence.

Analyses conducted in Table 2.

Table -2: Analysis types

Analysis Type	Objective	Output
Keyword Co-occurrence	Identify conceptual clusters	Conceptual structure maps

Co-authorship (Author/Institution/Country)	Explore collaboration patterns	Social structure networks
Citation & Co-citation	Trace intellectual genealogy	Citation networks
Bibliographic Coupling	Detect emerging convergence	Cognitive structure map

Four types of analyses were conducted (Table 1): keyword co-occurrence analysis to identify conceptual clusters; co-authorship analysis to examine collaboration patterns; citation and co-citation analysis to trace intellectual structures; and bibliographic coupling to detect emerging research convergence.

4.5 Validity and Reliability

Several procedures were implemented to enhance validity and reliability. Author names and institutional affiliations were manually standardized to reduce fragmentation in network structures. Only verified Scopus-indexed records were included. Analytical parameters and clustering outcomes were independently cross-checked by two researchers, and visual interpretations were compared with established bibliometric studies to ensure methodological consistency [21][22].

4.6. Interpretation Framework

Quantitative findings were interpreted qualitatively through a theoretically grounded triangulation combining (a) transhumanist perspectives on enhancement and augmentation, (b) posthumanist ethics emphasizing relational responsibility and inclusivity, and (c) neuroeducational approaches framing learning as embodied and distributed cognition. This interpretive strategy ensured that bibliometric patterns were not treated as neutral indicators, but as reflections of underlying normative, ethical, and developmental orientations within educational research.

5. RESULTS AND DISCUSSION

The bibliometric and network analyses conducted using VOSviewer (version 1.6.20) reveal the evolving intellectual and collaborative landscape of research on transhumanism and education between 2001 and 2026. In alignment with the study's research questions, the findings are presented through a combination of descriptive statistics and network visualizations capturing conceptual, social, and citation-based structures.

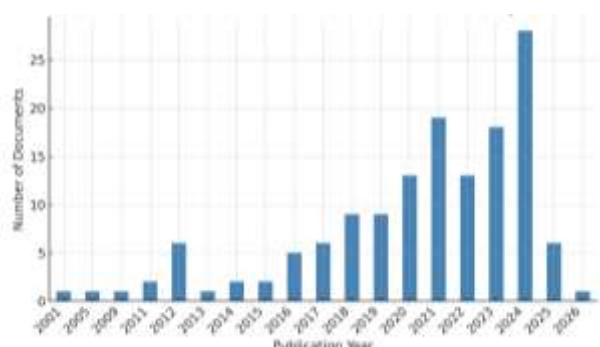
Interpretation of the results was guided by the integrative theoretical framework outlined in Section 3. Accordingly, each bibliometric pattern was examined not only in terms of frequency or connectivity, but also through its ethical, developmental, and pedagogical implications. This theory-informed approach situates quantitative trends within broader discussions of human development, technological enhancement, and posthuman responsibility.

5.1. Temporal Evolution of Research on Transhumanism and Education



Figure 2 illustrates the annual distribution of publications on transhumanism and education between 2001 and 2026. The trajectory reveals three distinct phases of development. The first phase (2001–2012) is characterized by slow and sporadic growth, reflecting an early period in which transhumanism was addressed primarily as a speculative or philosophical concern within educational discourse. During this stage, publications were limited in number and largely conceptual in orientation.

Figure 2. Publication Trends on Transhumanism and Education (2001–2026)



The second phase (2013–2019) marks a period of accelerated theoretical consolidation. This phase coincides with the increasing visibility of digital learning, early artificial intelligence applications, and ethical debates surrounding human–technology interaction in education. The gradual rise in publication output suggests that transhumanist ideas began to gain legitimacy as an analytical lens for examining learning, cognition, and educational futures.

The third phase (2020–2026) demonstrates a sharp and sustained increase in scholarly output, indicating a period of rapid expansion. This surge aligns closely with the global acceleration of AI-driven educational innovation, heightened attention to neuroeducation, and the normalization of immersive and data-intensive learning environments following the COVID-19 pandemic. As shown in Figure 2, publication volume peaks after 2020, reflecting a shift from speculative inquiry toward empirically grounded and application-oriented research.

Beyond quantitative growth, this temporal pattern signals an epistemic turning point. Post-2020 studies increasingly frame transhumanism not merely as a philosophical projection, but as an operational framework informing pedagogical design, ethical governance, and cognitive augmentation in education [20][7][12]. This transition suggests that educational research has begun to treat transhumanist inquiry as a legitimate domain of empirical investigation rather than a peripheral or speculative discourse.

From a human development perspective, the observed acceleration also raises critical questions regarding the

normalization of enhancement-oriented learning models. While the expansion reflects growing scholarly engagement, it simultaneously foregrounds ethical tensions related to equity, cognitive norms, and the differential accessibility of emerging technologies [14]. Thus, the temporal growth of the literature should be interpreted not only as an indicator of academic interest, but also as evidence of intensifying debates over how education mediates technological futures of human development.

Given the diversity of publication venues in transhumanism and education research, it is essential to examine how scholarly outputs are distributed across document types. This distribution not only indicates the maturity and disciplinary integration of the field but also highlights shifts in the preferred modes of dissemination—whether conceptual essays, empirical studies, or edited chapters. The distribution of publication types is summarized in Table 3.

Table -3: Distribution of Document Types in Transhumanism and Education Research (2001–2026)

Document Type	Count	Percentage (%)
Journal Article	102	72 %
Book Chapter	21	15 %
Conference Paper	11	8 %
Review Article	5	4 %
Editorial / Others	2	1 %
Total	141	100 %

Table 3 presents the distribution of document types in transhumanism and education research between 2001 and 2026. The dataset is dominated by peer-reviewed journal articles (72%), followed by book chapters (15%) and conference papers (8%), with review articles (4%) and editorials or other formats (1%) representing a relatively small proportion of the literature.

The predominance of journal articles suggests that research on transhumanism and education has moved beyond an exploratory or speculative phase toward a more institutionalized and methodologically stabilized scholarly discourse. In bibliometric life-cycle terms, such a distribution is typically associated with a maturation phase in which research outputs consolidate around established journals, refined analytical approaches, and increasingly specialized theoretical frameworks [22].

The growing share of book chapters, particularly after 2020, reflects the expansion of transhumanist educational discourse into edited volumes addressing artificial intelligence ethics, postdigital pedagogy, and neuroeducation [20][2]. These contributions often synthesize perspectives across philosophy, educational technology, and human development, indicating a transdisciplinary deepening of the field rather than mere diversification of publication outlets.

In contrast, the relatively modest proportion of conference papers suggests a shift away from preliminary idea exchange toward more formalized and peer-reviewed knowledge



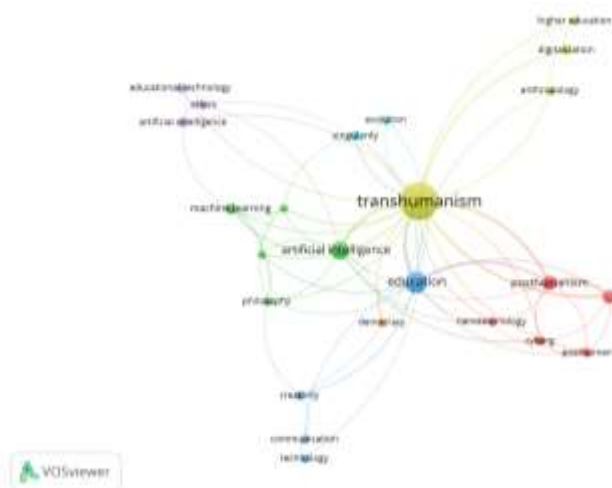
production. This pattern is consistent with research domains transitioning from conceptual debate to empirical grounding and theoretical consolidation. Similarly, the limited presence of review articles indicates that comprehensive synthesis efforts remain underdeveloped, pointing to future opportunities for systematic and meta-analytical research on topics such as AI-mediated cognition, neuroethical governance, and human-machine co-learning.

From a human development perspective, this distribution underscores the role of education as a primary site where transhumanist ideas are translated into structured pedagogical models, ethical frameworks, and design-oriented research agendas. As noted by Jandrić (2021), the current phase can be understood as one of postdigital normalization, in which transhumanist concepts increasingly move from speculative philosophy into applied and empirically oriented educational research.

5.2. Conceptual Structure: Keyword Co-occurrence Analysis

Figure 3 presents the keyword co-occurrence network generated through full counting, revealing the conceptual structure of transhumanism and education research. The visualization identifies three dominant and interrelated thematic clusters, reflecting how philosophical foundations, technological applications, and socio-ethical concerns converge within the field.

Figure 3. Keyword Co-occurrence Map of Transhumanism and Education (Full Counting, n = 141)



Cluster 1: Philosophical and Posthuman Foundations (Yellow-Red)

The first cluster is anchored by transhumanism as the central and most densely connected node, closely linked with posthumanism, ethics, posthuman, cyborg, nanotechnology, and singularity. This cluster reflects the philosophical core of the field, where debates on human enhancement, identity, and the boundaries between human and machine cognition are foregrounded. The strong coupling between transhumanism and posthumanism

indicates that educational research increasingly treats enhancement not as a purely technological aspiration [26], but as an ontological and ethical question embedded in learning processes.

Cluster 2: Artificial Intelligence and Educational Technology (Green-Purple)

The second cluster centers on artificial intelligence and machine learning, interconnected with educational technology, ethics, and philosophy. This configuration illustrates the operationalization of transhumanist ideas through AI-mediated learning environments. The co-occurrence of AI with ethics suggests a paradigmatic shift: technological innovation is no longer framed as value-neutral but as inherently pedagogical and moral. Rather than focusing solely on efficiency or personalization, this cluster reflects growing concern with responsible AI design, algorithmic agency, and human-machine collaboration in education [7][17].

Cluster 3: Pedagogical Mediation and Civic Orientation (Blue)

The third cluster is organized around education, communication, creativity, democracy, and technology. This cluster positions education as the mediating domain where philosophical and technological discourses are translated into pedagogical practice. The presence of civic concepts such as democracy alongside creativity and communication indicates that transhumanist education research increasingly frames enhancement within social responsibility, participatory learning, and democratic values. Education thus emerges as the arena in which enhancement is pedagogically negotiated rather than technologically imposed.

Taken together, the conceptual structure confirms that transhumanism functions as a connective epistemic hub, linking philosophical reflection, AI-driven educational design, and socio-civic pedagogical concerns. The increasing prominence of artificial intelligence alongside ethics signals a shift from speculative discourse toward ethically grounded, technology-mediated pedagogy. This mapping supports the interpretation that education has become the primary site where transhumanist ideas are rendered pedagogically meaningful and normatively constrained.

Temporal Evolution of Conceptual Focus

To further examine how this conceptual landscape has evolved, the temporal distribution of author keywords was analyzed across four time periods (Table 4). This analysis traces the gradual migration of the field from philosophical inquiry toward applied educational praxis.

Table -4: Temporal Evolution of Core Keywords in Transhumanism and Education (2001–2026)

Period	Dominant Keywords	Emerging/Transitional Terms
2001–2010	transhumanism, ethics, human enhancement,	bioethics, human nature



	philosophy of education	
2011–2015	posthumanism, technology, singularity, digital learning	democracy, cyberculture
2016–2020	artificial intelligence, neuroeducation, digital citizenship	embodiment, data ethics
2021–2026	ethical AI, immersive learning, cognitive enhancement	empathy, inclusion, human–AI interaction

Visualized using full counting in VOSviewer (v.1.6.20). Keywords grouped into four temporal intervals to indicate thematic shifts.

The early period (2001–2010) is dominated by ethical and philosophical reflection, largely influenced by foundational transhumanist debates on human nature and enhancement. Between 2011 and 2015, the emergence of posthumanism and cybercultural concepts reflects a sociotechnical turn in educational theory, coinciding with the rise of digital learning environments [3].

The period from 2016 to 2020 marks a decisive shift toward cognitive and technological embodiment, with artificial intelligence and neuroeducation becoming central concepts. Learning is increasingly conceptualized as a distributed process involving neural, digital, and social systems [7]. This phase corresponds to what Ferrando (2024) describes as a transhuman pedagogical threshold, where enhancement becomes integral to rethinking learning capacity.

Finally, the 2021–2026 period reflects a maturation into applied and ethically oriented transhumanism. The prominence of ethical AI, immersive learning, and human–AI interaction indicates that the field has moved beyond the question of whether enhancement should occur, toward how it can be designed responsibly, inclusively, and pedagogically [28]. This trend aligns with post-pandemic transformations in education, where AI literacy, embodiment, and ethical governance increasingly shape curricula and policy debates [17][12][27].

Overall, the temporal evolution of keywords confirms a clear conceptual migration from metaphysical speculation to ethical praxis. Transhumanism in education is no longer framed as a distant future scenario but as an operational framework guiding contemporary pedagogical design and human development.

5.3. Social Structure: Co-authorship Network (Authors, Institutions, and Countries)

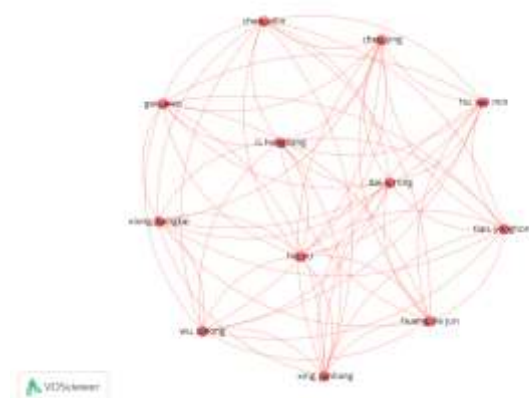
The social structure of transhumanism and education research was examined through co-authorship networks at the author, institutional, and country levels (Figures 4–7). Together, these analyses reveal a field characterized by conceptual diversity but limited collaborative density, reflecting its interdisciplinary and emergent nature.

5.3.1. Author-Level Collaboration

Figure 4 presents the co-authorship network among individual authors. The network exhibits a low-density and

fragmented topology, composed primarily of small, tightly connected micro-groups with limited cross-cluster interaction. Rather than indicating intellectual weakness, this dispersed structure suggests an emergent knowledge ecology, in which scholars approach transhumanism in education from distinct epistemic entry points—philosophical ethics, educational technology, and pedagogical design.

Figure 4. Co-authorship Map by Authors (Minimum 1 Document per Author)



The absence of a dominant, centralized author cluster implies that the field has not yet crystallized into a single theoretical school. While this fragmentation may slow the diffusion of shared methodologies, it simultaneously preserves pluralism and theoretical experimentation. From a developmental perspective, strategic cross-cluster collaboration could accelerate the translation of philosophical insights into pedagogical design without sacrificing epistemic diversity.

5.3.2. Institutional Collaboration Patterns

Figure 5 illustrates institutional co-authorship patterns. Similar to the author-level analysis, the institutional network reveals limited inter-institutional collaboration, with clusters largely reflecting disciplinary orientations. Philosophy and ethics-oriented institutions tend to collaborate internally, while education and technology-focused institutions form separate, loosely connected clusters.

Figure 5. Co-authorship Map by Institutions



This pattern suggests that institutional silos continue to mirror disciplinary boundaries, potentially constraining the maturation of applied transhumanist education. For the field to advance, greater institutional integration is needed—particularly through cross-faculty research hubs and joint laboratories that align ethical reflection with technological design and pedagogical implementation.

5.3.3. Country-Level Collaboration and Global Structure

Country-level co-authorship patterns (Figure 6) reveal a geographically asymmetric collaboration structure. High-capacity research hubs function as knowledge amplifiers, while emerging regions contribute contextual diversity with more limited connectivity. This center-periphery structure is characteristic of developing interdisciplinary fields, where conceptual leadership and resource concentration remain unevenly distributed.

Figure 6. Co-authorship Map by Countries

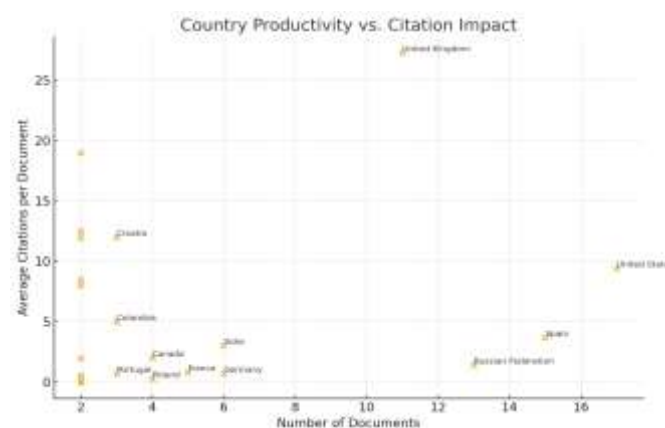


Despite this asymmetry, the presence of diverse national nodes indicates increasing globalization of the discourse. The distributed nature of collaboration aligns with posthuman and postdigital perspectives, in which knowledge production is understood as decentralized and relational rather than hierarchically controlled.

5.3.4. Country Productivity and Citation Impact

Figure 7 maps country-level productivity against average citation impact. The United States, Spain, and the United Kingdom emerge as the primary production centers, collectively accounting for over 40% of the total publication output. However, citation patterns reveal important qualitative distinctions.

Figure 7. Country productivity vs. citation impact in transhumanism-and-education (Scopus, 2001–2026)



The United Kingdom demonstrates the highest average citation impact (approximately 27 citations per paper), reflecting its conceptual influence in critical pedagogy, posthumanism, and ethical AI discourse [17]. The United States, while the most prolific contributor, displays a more applied orientation, balancing philosophical inquiry with empirical research on AI ethics, neuroeducation, and learning design [12]. Spain shows high productivity but comparatively lower average citation impact, suggesting broader dissemination across diverse outlets rather than concentration in high-citation journals.

Emerging contributors—including Poland, Turkey, Brazil, and Colombia—have expanded their presence notably after 2020, coinciding with increased international attention to AI ethics, digital transformation, and inclusive education. Several smaller research systems (e.g., Finland, Croatia, Chile) exhibit high citation-to-output ratios, indicating specialized yet influential niches in areas such as neuroethics, embodied learning, and human–AI interaction.

5.3.5. Interpretive Synthesis

Overall, the social structure analysis depicts transhumanism in education as a decentralized and evolving research ecosystem. Rather than forming a unified academic movement, the field operates through loosely connected networks that mirror posthuman principles of distributed agency and plural intelligence. While this structure supports epistemic diversity, it also highlights the need for more inclusive and integrative research infrastructures—such as open data practices, multilingual dissemination, and cross-national collaboration—to prevent enhancement debates from reproducing global and epistemic inequalities [4][2].

5.4. Intellectual Structure: Citation and Co-citation Analyses

To examine the intellectual foundations and knowledge dynamics of transhumanism and education research, citation-based analyses were conducted at the document, author, and co-citation levels using VOSviewer (v.1.6.20). Figures 8–11 collectively visualize how foundational philosophical contributions, mid-level theoretical syntheses,



relational ethics, and critique of technological determinism. A second lineage reflects transhumanist philosophy and enhancement ethics, drawing on foundational debates about human augmentation and future-oriented education. The third lineage groups authors associated with AI, learning sciences, and applied cognition, whose work focuses on implementation, design, and empirical evaluation.

Importantly, the visual structure shows limited bridging ties between philosophical/posthuman authors and AI-driven educational researchers. This structural gap suggests that, although shared ethical concerns exist, sustained integrative dialogue between critique and implementation remains underdeveloped. The co-citation patterns therefore highlight a key intellectual opportunity: the development of design-based ethical frameworks capable of translating philosophical insight into assessable pedagogical practice.

5.4.4. Intellectual Synthesis and Developmental Interpretation

Taken together, the citation and co-citation analyses depict transhumanism and education as a layered intellectual ecosystem. Foundational philosophical texts establish normative boundaries; mid-level theoretical syntheses adapt these ideas to educational contexts; and recent applied studies experiment with AI, embodiment, and immersive learning within those constraints.

Rather than converging on a single theoretical paradigm, the field exhibits what may be described as productive epistemic stratification. Philosophical critique, ethical mediation, and pedagogical experimentation operate at different but interdependent levels. This structure mirrors core posthuman assumptions about distributed intelligence and relational agency, suggesting that the intellectual organization of the field reflects its theoretical commitments.

From a human development perspective, this intellectual ecology positions education as the primary mediating space where technological possibility is filtered through ethical reasoning and pedagogical responsibility. The citation structure thus not only maps scholarly influence but also reveals how transhumanist ideas are progressively domesticated within educational research—moving from speculative futures toward ethically governed learning design.

5.5. Cognitive and Epistemic Convergence: Bibliographic Coupling Analysis

While co-citation analysis reveals how established literatures are retrospectively connected, bibliographic coupling offers a prospective lens, capturing how contemporary authors draw on shared reference bases to construct emerging research trajectories. In this sense, bibliographic coupling is particularly well suited to identifying epistemic convergence—the formation of new intellectual alignments that signal where the field is heading rather than where it has been.

Figure 11 presents the bibliographic coupling map of authors, visualizing how recent contributions cluster around overlapping bibliographic foundations. Unlike the more stratified structures observed in citation and co-citation networks, the coupling map reveals incipient convergence among authors working at the intersection of transhumanist philosophy, AI-supported pedagogy, and neuroethical learning design.

Figure 11. Bibliographic Coupling Map of Authors



The visualization indicates that authors such as Lipowicz, Markus, and Paloma exhibit strong coupling relationships, reflecting shared reference patterns that integrate philosophical discourse with empirical and design-oriented educational research. Their coupling does not merely reflect thematic similarity, but a common epistemic orientation: the translation of transhumanist ideas into operational frameworks for learning environments shaped by artificial intelligence, cognitive augmentation, and ethical governance.

Notably, the coupling links extend beyond purely philosophical sources, incorporating literature from learning sciences, educational technology, and neuroeducation. This pattern suggests the emergence of an interdisciplinary subfield of applied transhumanism in education, where enhancement is no longer treated as abstract speculation but as a design problem—one that must be addressed through pedagogical models, empirical validation, and ethical constraints.

From a cognitive perspective, bibliographic coupling thus evidences a migration from discursive theorization toward design-anchored and implementation-oriented research. Transhumanism becomes embedded in instructional models (e.g., AI tutors, immersive environments, neuroadaptive systems), while ethical considerations such as dignity, accessibility, and human agency are increasingly framed as design principles rather than external critiques. This convergence reflects a shift from asking whether enhancement should inform education to examining how it can be responsibly enacted within learning systems.

5.6. Synthesis of Findings

Across the conceptual, social, and intellectual analyses, three cross-cutting insights emerge.

First, the field demonstrates a progressive movement from philosophy to practice. Early speculative and normative debates on human enhancement have gradually evolved into applied research on AI-supported, immersive, and neuroadaptive learning environments.



Second, this transformation is accompanied by a clear ethical reorientation. The growing prominence of concepts such as ethics, dignity, inclusion, and responsibility indicates increasing recognition that technological amplification in education must be normatively guided rather than technologically driven.

Third, the network analyses reveal a pattern of distributed but converging collaboration. Although the field remains socially fragmented, bibliographic coupling points to emerging transdisciplinary alignments—particularly between European philosophical traditions and Anglo-American empirical and design-oriented research cultures.

Together, these findings suggest that transhumanism in education is no longer a loosely connected set of ideas, but an evolving research domain characterized by epistemic convergence around ethically governed educational design.

5.7. Integrative Discussion: Education as the Site of Transhuman Evolution

Interpreted through the study's theoretical framework, the findings position education as both the laboratory and the conscience of transhumanism. Education is the space where technological enhancement is tested, negotiated, and normatively framed. While transhumanism articulates aspirations to expand human cognitive and experiential capacities, educational research mediates these aspirations through pedagogical responsibility and ethical reflection.

The bibliometric patterns mirror this philosophical duality. On one hand, the field exhibits a forward-looking orientation toward AI, neurotechnologies, and immersive learning. On the other, it demonstrates sustained engagement with posthuman ethics, emphasizing relationality, accountability, and human dignity. Rather than resolving this tension, educational research sustains it—transforming pedagogy into an ethical architecture of technological evolution.

As AI and neurotechnologies increasingly mediate learning processes, educators assume a critical developmental role: safeguarding human agency while enabling meaningful cognitive augmentation. In this sense, transhumanist education can be understood as a liminal pedagogical zone—where human aspiration meets technological mediation, and where the future of human development is shaped not by technology alone, but by ethically informed educational design.

6. CONCLUSION AND IMPLICATIONS

6.1. Conclusion

This study offered a comprehensive bibliometric and citation-based mapping of research at the intersection of transhumanism and education between 2001 and 2026. By integrating keyword co-occurrence, co-authorship, citation, co-citation, and bibliographic coupling analyses, it systematically revealed the conceptual evolution, social organization, and intellectual foundations of the field.

The findings point to three interrelated developments. First, the field remains grounded in a strong philosophical

foundation, centered on ethics, human enhancement, and posthumanist critique. Second, it demonstrates a clear technological trajectory, marked by the increasing prominence of artificial intelligence, neuroeducation, and immersive learning environments. Third, these shifts are accompanied by a pedagogical reorientation toward inclusive, embodied, and ethically informed approaches to learning.

Taken together, these patterns confirm that education has become the primary mediating arena of transhumanist transformation—where aspirational visions of human enhancement are translated into pedagogical practice and constrained by ethical responsibility. Transhumanism, once largely speculative, is now embedded in the epistemic practices of contemporary education, shaping how learning is designed, experienced, and evaluated in the twenty-first century.

6.2. Implications

By grounding transhumanist philosophy in empirical educational research, this study bridges the normative gap between enhancement ideals and pedagogical implementation. In doing so, it aligns with postdigital perspectives that conceptualize education as a space of coexistence between human and machine cognition rather than technological substitution. The integration of bibliometric evidence with a transhumanist–posthumanist theoretical synthesis advances an applied transhumanist education perspective—one that unites cognitive augmentation, ethical literacy, and design-based inquiry.

6.2.1. Implications for Educational Practice and Policy

The findings suggest several implications for educational stakeholders:

Ethical integration in curricula. Educational programs should embed transhumanist and posthumanist ethics within technology-driven curricula, fostering critical awareness of enhancement, automation, data use, and algorithmic agency.

Teacher preparation and professional development. Educators require systematic preparation to work with AI-enhanced pedagogy, neuroadaptive systems, and immersive learning environments while maintaining inclusive and ethically grounded practices.

Institutional collaboration. The fragmented collaboration patterns observed across authors and institutions indicate the need for transdisciplinary partnerships linking education, philosophy, neuroscience, and engineering. Universities may function as experimental learning laboratories where innovation is balanced by ethical reflexivity.

Policy orientation. Educational technology policies should foreground human dignity, agency, and equitable access, ensuring that cognitive enhancement initiatives align with democratic and inclusive educational values.



6.2.2. Implications for Future Research

Future research should move toward empirical validation of the ethical and cognitive dimensions of transhumanist education. Longitudinal and cross-cultural studies may examine how concepts such as digital embodiment, neural feedback, and AI agency manifest across diverse educational systems. Mixed-method approaches integrating learning analytics with physiological measures (e.g., EEG, eye-tracking) could illuminate the affective–cognitive dynamics of augmented learning environments.

Further research directions include; investigating how ethical literacy and moral reasoning develop in AI-mediated and neuroadaptive classrooms, comparing regional and cultural trajectories of transhumanist education beyond Western academic contexts, tracing the longitudinal evolution of key transhumanist concepts through advanced bibliometric and learning analytics, examining the pedagogical implications of AI tutors, learning agents, and digital twins for human–machine interdependence, and developing education-specific AI ethics frameworks addressing data ownership, consent, and fairness.

6.3. Integrative Synthesis: Education as the Ethical Laboratory of Transhumanism

Synthesizing the study's findings through its theoretical framework positions education as both the laboratory and the conscience of transhumanism. While transhumanism articulates aspirations to expand human cognitive and experiential capacities, education provides the normative space in which such expansion is critically examined, tested, and ethically governed.

As artificial intelligence and neurotechnologies increasingly mediate learning, educators assume a central developmental role: enabling cognitive augmentation while safeguarding human agency and dignity. In this sense, transhumanist education represents a liminal pedagogical zone—where human aspiration encounters technological mediation, and where pedagogy becomes the ethical architecture guiding technological evolution.

6.4. Research–Practice Integration Matrix

To operationalize this synthesis, Table 5 presents a Research–Practice Integration Matrix linking the study's bibliometric evidence with pedagogical, institutional, and policy-oriented pathways.

Table 5. Research–Practice Integration Matrix

Dimension	Key Insight from Findings	Research Contribution	Practical Policy Implication /
Philosophical foundation	Ethics and enhancement converge in education	Positions education as the ethical laboratory of transhumanism	Guides curriculum reform grounded in ethical literacy
Epistemic evolution	Shift from speculation to empirical	Introduces a temporal–bibliometric model of field	Supports policy and funding priorities

	inquiry	development	
Cognitive learning	Neuroeducation and embodiment gain prominence	Links transhumanism with neurocognitive models	Informs AI- and neuro-based teacher training
Collaborative ecosystem	Distributed but expanding networks	Reveals global knowledge ecologies	Encourages transdisciplinary research clusters
Ethical reorientation	Dignity and inclusion become central	Frames applied transhumanist education	Supports equity-driven AI integration

The matrix demonstrates how philosophical aspirations of transhumanism can be translated into ethically grounded and cognitively embodied educational practice. Ultimately, the future of AI-mediated learning will depend not on the extent of technological enhancement, but on institutional and pedagogical capacity to balance innovation with moral responsibility.

Conflict of Interest Statement

The author declares that there are no conflicts of interest related to the conduct, authorship, or publication of this article.

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Ethics Approval and Informed Consent

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REFERENCES

- [1] Bostrom, N. (2005). In defense of posthuman dignity. *Bioethics*, 19(3), 202–214. <https://doi.org/10.1111/j.1467-8519.2005.00437.x>
- [2] Ferrando, F. (2019). *Philosophical posthumanism*. Bloomsbury Academic.
- [3] Bayne, S. (2015). Teacherbot: interventions in automated teaching. *Teaching in Higher Education*, 20(4), 455–467. <https://doi.org/10.1080/13562517.2015.1020783>
- [4] Jandrić, P. (2021). The postdigital challenge of critical educational research. In *The handbook of critical theoretical research methods in education* (pp. 31–48). Routledge.
- [5] Uğur, S. (2018). Transhumanizm ve öğrenmedeki değişim. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi*, 4(3), 58–74.
- [6] Cinel, C., Valeriani, D., & Poli, R. (2019). Neurotechnologies for human cognitive augmentation: current state of the art and future prospects. *Frontiers in*



human neuroscience, 13, 13.
<https://doi.org/10.3389/fnhum.2019.00013>

[7] Gómez Redondo, S., Rodríguez Higuera, C. J., Coca, J. R., & Olteanu, A. (2024). Transhumanism, society and education: An edusemiotic approach. *Studies in Philosophy and Education*, 43(2), 177-193. <https://doi.org/10.1007/s11217-024-09927-6>

[8] Bokedal, T., Reindal, S. M., Stølen, T., & Wivestad, S. M. (2025). Risking human dignity? Reflections on transhumanist understandings of education. *Journal of Philosophy of Education*, qhaf064. <https://doi.org/10.1093/jopedu/qhaf064>

[9] Llano, F. H. (2019). Transhumanism, vulnerability and human dignity. *Deusto Journal of Human Rights*, (4), 39-58.

[10] Braidotti, R. (2022). *Posthuman feminism*. Polity Press.

[11] Lipowicz, M. (2019). Overcoming transhumanism: Education or enhancement towards the overhuman?. *Journal of Philosophy of Education*, 53(1), 200-213.

[12] Gorsky, M., & Levin, I. (2025). Cognifying Education: Mapping AI's transformative role in emotional, creative, and collaborative learning. *arXiv preprint arXiv:2509.25266*. <https://doi.org/10.48550/arXiv.2509.25266>

[13] Liu, S., Su, L., He, Q., Qiu, M., & Liang, R. (2025). Comparative evaluation of ChatGPT and Gemini in brain-computer interfaces patient education: A multi-dimensional analysis of reliability, accuracy, comprehensibility, and readability. *International Journal of Medical Informatics*, 106164.

[14] Sisman-Ugur, S. (2026). Integrating AGI and Transhumanist Technologies in Education: An Integrative Framework of Cognitive Enhancement and Ethical Implications. In: Iklé, M., Kolonin, A., Bennett, M. (eds) *Artificial General Intelligence. AGI 2025. Lecture Notes in Computer Science*(vol 16058). Springer, Cham. https://doi.org/10.1007/978-3-032-00800-8_21

[15] Dhungana, S. (2023). The posthuman pedagogy: A learning centric educational dimension. *Bodhi: An Interdisciplinary Journal*, 254-270.

[16] Moylan, R., Code, J., & O'Brien, H. (2025). Teaching and AI in the postdigital age: Learning from teachers' perspectives. *Teaching and Teacher Education*, 153, 104851. <https://doi.org/10.1016/j.tate.2024.104851>

[17] Bayne, S., & Ross, J. (2024). *Speculative futures for higher education*. International Journal of Educational Technology in Higher Education, 21(1), 39.

[18] Kurzweil, R. (2005). The singularity is near. In *Ethics and emerging technologies* (pp. 393-406). London: Palgrave Macmillan UK.

[19] More, M., & Vita-More, N. (Eds.). (2013). *The transhumanist reader: Classical and contemporary essays on the science, technology, and philosophy of the human future*. John Wiley & Sons.

[20] Bayne, S., & Ross, J. (2013). Posthuman literacy in heterotopic space: A pedagogical proposal. In *Literacy in the digital university* (pp. 95-110). Routledge.

[21] Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact? *Scientometrics*, 105(3), 1809-1831. <https://doi.org/10.1007/s11192-015-1645-z>

[22] Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285-296. <https://doi.org/10.1016/j.jbusres.2021.04.070>

[23] Güneş, G., Güz, M. Z., Aktaş, O., Özer, E., & Kılcan, B. (2025). Transhümanizm Bağlamında Gerçekleştirilen Eğitim Makalelerinin Serüveni. *Journal of Interdisciplinary Education: Theory and Practice*, 7(2), 151-167. <https://doi.org/10.47157/jietp.1667349>

[24] Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>

[25] Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429-472. <https://doi.org/10.1177/1094428114562629>

[26] Ahmed, S. (2024). Beyond Human Teachers: Post-Humanist Perspectives on AI, Cultural Inequities, and Educational Transformation. *Journal of Posthumanism*, 4(3), 364-373.

[27] Uğur, S., & Kurubacak, G. (2019). Artificial intelligence to super artificial intelligence, cyber culture to transhumanist culture: Change of the age and human. In



Peer Reviewed Journal, ISSN 2581-7795

Handbook of Research on Learning in the Age of Transhumanism (pp. 1-16). IGI Global.

[28] Sisman-Ugur, S. (2025). Artificial Intelligence-Supported Meta-Learning Assistant. In *Integrating Artificial Intelligence in Education: Enhancing Teaching Practices for Future Learning* (pp. 153-176). IGI Global. <https://doi.org/10.4018/979-8-3693-3944-2.ch006>

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