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Epistemological gaps in medical education: a bibliometric and critical analysis of contemporary academic discourse

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Abstract

Contemporary medical education is shaped by imperatives of efficiency, measurability and standardisation, often to the detriment of epistemological reflection. This study investigates how epistemological themes—critical reflection, uncertainty, epistemic justice, reflective reasoning—are represented in recent academic discourse. A bibliometric analysis was carried out on a corpus of 2,830 PubMed-indexed articles (2015–2025), followed by a qualitative interpretation of keyword co-occurrence networks generated in VOSviewer at three thresholds (≥5, ≥20, ≥40 occurrences). The analysis revealed a discursive structure dominated by themes such as "curriculum", "clinical competence", "simulation", "assessment" and "students". In contrast, terms such as "epistemic uncertainty", "critical thinking", "reflective practice", "epistemic injustice", or "bias" were absent from the central networks or completely non-existent at high thresholds. Semantic clustering indicated a systemic orientation towards a performative, technological and algorithmic vision of medical training, to the detriment of the critical, narrative and humanistic dimensions of medical knowledge. Findings indicate the existence of systemic epistemological gaps, with implications for clinical reasoning, professional uncertainty management and the integration of patient experience as epistemic knowledge. The study suggests the need for a curricular reconfiguration that integrates epistemic reflection into medical training.

Keywords: medical education, epistemology, clinical reasoning, uncertainty, cognitive bias, critical reflection, epistemic injustice, VOSviewer, bibliometric analysis, medical curriculum, clinical competence, narrative medicine.

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Introduction

Medical education between science, epistemology and humanism

Modern medical education is more than just the accumulation of scientific knowledge or technical training: it is a complex, ongoing process that combines science, clinical practice and the profoundly human dimension of healthcare. Essentially, training a doctor involves not only imparting information, but also cultivating a critical, reflective and ethical understanding of the medical act, which lies at the intersection of science and humanity (Bleakley et al., 2011). In this formative equation, epistemology (the branch of philosophy that deals with the nature, sources and limits of knowledge) plays an essential, though often neglected, role. In the medical context, epistemology becomes a necessary framework for understanding how clinical knowledge is constructed, validated and applied. However, current medical education seems to be affected by significant epistemological gaps that compromise the comprehensive training of medical professionals. The problem is not only theoretical, but has direct implications for practice, the doctor-patient relationship and public health in general (Montgomery, 2006; Greenhalgh et al., 2014).

Research aim and contribution

The aim of this study is to examine how epistemological concepts are represented in contemporary academic discourse on medical education and to identify the structural gaps that shape current approaches to clinical training. By combining bibliometric mapping with qualitative interpretation, the paper contributes to the field by offering a systematic, evidence-based overview of epistemological absences in medical education literature and by outlining their implications for curriculum design, clinical reasoning and reflective professional formation.

Epistemological gaps in medical training: typologies and effects

One of the most significant limitations is biological reductionism, i.e. the tendency to interpret health and disease almost exclusively through a biological lens. This model, specific to modern biomedical-inspired medicine, often ignores the psychological, social, cultural or spiritual dimensions of illness, factors that are essential for a complete understanding of the patient's experience (Engel, 1977; Borell-Carrió et al., 2004). The result is a therapeutic relationship devoid of depth and an approach that treats the disease, but not necessarily the sick person. This perspective is exacerbated by the fragmentation of medical knowledge, induced by overspecialisation and excessive compartmentalisation of the university curriculum. Instead of an integrated view of the body and health, students end up with highly specialised knowledge, but with major difficulties in applying it in a holistic clinical context (Flexner, 1910; Frenk et al., 2010). Medicine thus becomes a sum of parts, lacking a unifying epistemological architecture. Another major problem is the neglect of epistemological reflection in the educational process. Future doctors are rarely encouraged to question the nature or validity of the

knowledge they receive. Courses such as philosophy of science, medical epistemology or applied ethics are often optional, if not completely absent. This lack of critical training leads to a dogmatic acceptance of information, which weakens intellectual autonomy and the ability to adapt to unforeseen clinical situations (Upshur et al., 2001; Michel, 2007). Last but not least, the epistemological limitation of evidence-based medicine (EBM) is also worth discussing. Although EBM has brought significant benefits in standardising and streamlining medical practice, in some cases it becomes a form of epistemic rigidity. A strictly applied hierarchy of evidence risks excluding clinical judgement, professional experience and patient values, which are essential elements in a truly individualised medical practice (Greenhalgh et al., 2014; Tonelli, 2006).

Epistemological and clinical consequences of these limitations

The consequences of these epistemological shortcomings are numerous and serious. They can lead to the training of professionals who lack intellectual autonomy, are incapable of critical reflection, and have a poor understanding of the existential dimension of illness. Furthermore, the lack of systemic thinking and training in managing uncertainty favours burnout, a rigid relationship with the patient and the dehumanisation of the medical act (Charon, 2006; Wear & Zarconi, 2008).

Possible directions for epistemological reform in medical education

To counteract these trends, a systematic integration of the humanities into the medical curriculum is necessary: courses in philosophy, ethics, medical anthropology, medical sociology or the history of medicine can play a key role in the formation of critical, empathetic and contextualised thinking (Bleakley, 2015; Hafferty & Franks, 1994). It is also essential to reconceptualise the student as an active epistemic subject. This involves encouraging personal reflection, promoting metacognitive thinking and stimulating critical analysis of the specialist literature. Instead of passive learning, there is a need for a pedagogy of questioning, debate and continuous reflection (Branch, 2010; Kumagai & Lypson, 2009). A transdisciplinary and systemic approach is required, one that transcends strictly biomedical boundaries. The interconnection between medicine and fields such as ecology, economics, and psychology can lead to a deeper understanding of health as a complex, emergent, and dynamic phenomenon (Nicolescu, 2002; Morin, 2008).

Medical education in the 21st century can no longer be reduced to mere technical and scientific training. It must train reflective professionals who are capable of navigating the complexity and uncertainty of clinical reality. Epistemological reforms do not imply abandoning scientific rigour, but rather complementing it with critical thinking, ethical awareness and sensitivity to the profoundly human dimension of illness. Without this transformation, medicine risks becoming an applied technology, emptied of its fundamental human and social meaning.

Between knowledge and uncertainty – an epistemological problem in medical education

Contemporary medical education is undergoing a continuous process of transformation, trying to keep pace with the accelerated pace of scientific progress, social changes and the increasing complexity of clinical practice. However, despite the refinement of the curriculum and the emphasis on evidence-based medicine (EBM), a set of profound epistemological gaps persist that affect how future doctors understand, construct and apply medical knowledge. These gaps are not merely pedagogical or curricular, but involve a series of fundamental questions: What does it mean to "know" in medicine? What sources of knowledge are valid? How is uncertainty managed? – questions that pertain to the epistemology of medical practice.

A first level of the problem is represented by the fragmentary nature of initial training, in which students acquire compartmentalised information (anatomy, physiology, pharmacology), but are rarely guided in integrating it into coherent clinical reasoning (Deschênes et al., 2025). This model of "chunked learning" produces superficial knowledge that is poorly anchored in context, making it difficult to transition from theory to clinical practice (Cate & Durning, 2017). In addition, the traditional emphasis on memorisation and factual reproduction limits the development of critical thinking and epistemic reflection, two essential skills in the formation of intellectual autonomy (Eastwood et al., 2017).

Medical education continues to reproduce an authoritarian model of knowledge transmission, in which teachers or senior doctors are considered infallible sources. This dependence on authority is a form of epistemic gap, as it reduces the student's ability to question sources of knowledge and construct independent medical judgement (Ackers et al., 2020). In this context, there is a notable absence of educational components that introduce concepts such as epistemic uncertainty, cognitive biases, decision-making in conditions of ambiguity, or the epistemology of evidence, which are essential topics in real medical practice but rarely explicit in the curriculum (Sadler, 2023).

Another source of epistemological tension is the disjunction between the ideal of evidence-based medicine and the concrete realities of clinical practice. Although EBM provides a rigorous framework for evaluating and applying scientific evidence, students often find that medical decisions are guided by routine, local traditions or institutional pressures, a reality that generates a conflict between "science" and "experience" (Greenhalgh et al., 2014). This disconnect highlights the lack of adequate training in navigating uncertainty and critically evaluating sources of knowledge in a clinical context (Gheihman et al., 2020).

Medical training often ignores the narrative, emotional, and contextual dimensions of suffering, reducing the patient to a sum of symptoms and biomarkers. Such a view excludes knowledge through personal experience and the patient's voice as legitimate epistemic sources, which can lead to epistemic inequity, a form of marginalisation of patients who do not fit standard patterns (Fricker, 2007; Kidd & Carel, 2017). This lack

of epistemic diversity is exacerbated by university curricula, which do not take into account cultural, socioeconomic, or ethnic variations in the expression and perception of disease (Tsai et al., 2016).

The structural gaps in the medical education system, such as the lack of active and reflective teaching methods (simulations, case-based learning, guided reflection), or inequalities in access to scientific language and resources, should also be mentioned. All of these contribute to the perpetuation of a system in which medical knowledge is transmitted but not questioned, in which one learns "what to think" but not "how to think" (Bleakley, 2015).

In this context, an epistemological approach to medical education is no longer optional, but essential for training reflective, critical and adaptable professionals. Only by recognising and addressing these epistemological gaps can we build a medical education that reflects the real complexity of medicine, but also the ethical responsibility of knowledge in the service of humanity.

Regional grounding

Although the bibliometric analysis is international in scope, the critical reflection underpinning the study is informed by the European, and in particular Central and Eastern European, context of medical training. This region remains marked by a historically biomedical educational paradigm, with slower institutional integration of medical humanities, reflective practice or epistemology. Understanding these regional dynamics helps situate the analysis and highlights the relevance of epistemological reform in societies where medical education has traditionally emphasised technical competence over reflective professional development.

Methodology

Research design: This study adopts an exploratory bibliometric methodology (Donthu et al., 2021), combined with a qualitative-interpretative analysis of keyword co-occurrence networks, in order to identify epistemological gaps in the academic literature on medical education. The method allows for the investigation not only of thematic frequency, but also of the conceptual structure of the scientific field.

Methodological objective: To map the contemporary academic discourse on medical education (with an emphasis on epistemology) (Eastwood et al., 2017), looking at which themes are dominant, which epistemological concepts are present or absent, and how the conceptual structure varies according to co-occurrence frequency.

Article search and selection strategy: The database used was PubMed (https://pubmed.ncbi.nlm.nih.gov), chosen for its relevance to biomedical medical and educational literature. Advanced query involved the following formula: ("epistemology" OR "epistemic cognition" OR "knowledge gaps" OR "clinical reasoning" OR "critical thinking" OR "reflective practice" OR "epistemic uncertainty" OR "epistemic injustice") AND ("medical education" OR "medical students" OR "medical curriculum" OR "clinical training"). The filters applied were: publication date (last 10 years - 2015–2025), article

type (review and research article), subject - studies on humans (Humans[MeSH]) and language (English).

Selection result: total number of articles included - 2,830 and export format, PubMed (.txt) for further processing in VOSviewer. The analysis tool was the VOSviewer programme, and the software used was VOSviewer v.1.6.20, developed by Van Eck & Waltman (Leiden University, Centre for Science and Technology Studies – CWTS) (van Eck & Waltman, 2010). In terms of the type of analysis, the co-occurrence of author keywords was analysed within a co-occurrence network. The parameters analysed in the research were the occurrence thresholds (5, 20, 40), the grouping algorithm was the VOS clustering technique, the network visualisation involved density view and cluster view, and finally, maps were created in image format (.jpg).

Data analysis: The quantitative (bibliometric) stage involved identifying thematic networks by frequency and intensity of links between terms and identifying central nodes (e.g., "medical students", "clinical competence") and marginal nodes (e.g., "epistemic injustice", "uncertainty"). The qualitative-interpretative stage involved classifying and interpreting clusters according to dominant themes, significant absences, and implicit or explicit epistemological links. Comparison between networks obtained at different thresholds was used to assess the conceptual robustness of epistemological themes.

Methodological challenges

Conducting a bibliometric study in a field where epistemological terminology is inconsistently used presents inherent difficulties. Many epistemic concepts relevant to clinical reasoning—such as uncertainty, judgement or reflective cognition—may be embedded in articles but omitted from author-selected keywords, leading to underrepresentation in co-occurrence networks. Additionally, VOSviewer's clustering algorithm tends to privilege high-frequency technical terms, which may obscure less conventional or humanistic concepts. These challenges required a qualitative interpretive stage to ensure that absences were analysed critically rather than taken at face value.

Methodological limitations: PubMed does not systematically index epistemological terms (e.g., "epistemic injustice"), which may lead to underrepresentation. The absence of certain terms does not mean that epistemological reflection does not exist, but rather that it may not be labelled as such. Keywords are chosen by authors, so they may reflect thematic preferences rather than the deep structure of the articles.

Ethics and transparency: No sensitive data or human subjects were used. Sources are public, accessible, and cited according to scientific standards. All procedures comply with the norms of responsible research and academic integrity.

Author positionality

The perspective adopted in this paper is shaped by the author's professional trajectory within Romanian medical education and healthcare. As a senior physician in

Anaesthesia and Intensive Care, with eight years of experience as Head of Department and Medical Director in a general private hospital, the author has been directly exposed to the clinical, organisational and epistemological challenges of contemporary medical practice. In parallel, seven years of teaching in higher education—predominantly in medical sociology and interdisciplinary courses involving medical, social work, pharmacy and nursing students—have provided insight into how different professional communities construct, interpret and apply medical knowledge. This dual experience informs the critical interpretation of epistemological gaps and the call for more reflective, humanistic and context-aware medical education.

Additional study limitations

The present analysis examines published research, not curricula or teaching practices themselves. Therefore, the findings reflect how medical education is represented in academic discourse rather than how it is concretely designed or implemented in specific national contexts. Moreover, using English-language publications introduces heterogeneity: studies may refer to educational systems with fundamentally different structures (e.g. postgraduate training in the US vs. undergraduate entry programmes in Europe). These constraints limit the extent to which conclusions can be generalised about actual curricular content and highlight the need for future qualitative and comparative research on medical curricula across countries.

Results

Semantic cluster analysis

The general semantic distribution was observed through the analysis of keyword co-occurrence, which generated three distinct thematic networks, depending on the frequency threshold used. This distribution can be seen in Table 1.

Table 1

General semantic distribution

Co-occurrence threshold	No. of terms included	Observations
≥5	779	Wide coverage, marginal themes visible
≥20	199	Well-defined dominant themes
≥40	91	Only the core of institutionalised discourse

The structure of the identified networks and clusters is fairly homogeneous; at all thresholds, the VOSviewer algorithm generated 4–5 major semantic clusters, as can be seen in Table 2.

Table 2

Structure of identified networks and clusters

Thematic cluster	Central terms	Dominance
Formal medical education	"students", "medical", "curriculum", "teaching", "feedback"	Very high
Clinical competence	"clinical competence", "simulation", "assessment"	High
Public health/behaviour	"health knowledge", "attitudes", "practice patterns"	Medium
Digital education/simulations	"virtual reality", "anatomy", "technology-enhanced learning"	Media
Social/contextual dimensions	"gender minorities", "interprofessional education"	Low

Semantic analysis showed that epistemological themes are poorly represented or completely absent from the discourse. Table 3 summarises some key findings.

Table 3

Presence and absence of epistemological terms

Epistemological concept	Presence in networks	Observations
"epistemology"	Marginal (threshold 5)	Absent at thresholds 20/40
"epistemic uncertainty"	Non-existent	Does not appear at threshold 5
"reflective practice"	Marginal (threshold 5)	Weak links, peripheral term
"epistemic injustice"	Non-existent	Totally absent in all networks
"critical thinking"	Appears rarely, in isolation	Not connected to central terms
"bias", "heuristics"	Non-existent	Although fundamental to clinical reasoning

The evolution of discourse according to the co-occurrence threshold was assessed by comparing networks at different thresholds and revealed a clear process of epistemic filtering. At threshold 5, we are allowed access to alternative, social, narrative concepts, but these remain semantically isolated. Moving to threshold 20, institutionalised themes (curriculum, competence, simulation) are emphasised, while epistemology disappears completely. At threshold 40, a hyper-standardised, technological and efficiency-based core is formed, with an educational discourse devoid of critical reflection.

Comparative analysis of VOSviewer maps

Map 1 (minimum co-occurrence threshold 5): Conceptual macro-landscape

General characteristics: this is the densest map (779 terms) and there is a huge semantic core around "humans", "medical students" and "internship and residency". The map (shown in Figure 1) is divided into 5-6 clusters, relatively well defined thematically.

Red cluster: Clinical practice and pathologies (e.g. "treatment outcome", "heart failure", "diabetes mellitus");

Green cluster: Medical education and professional training (e.g. "students", "feedback", "teaching");

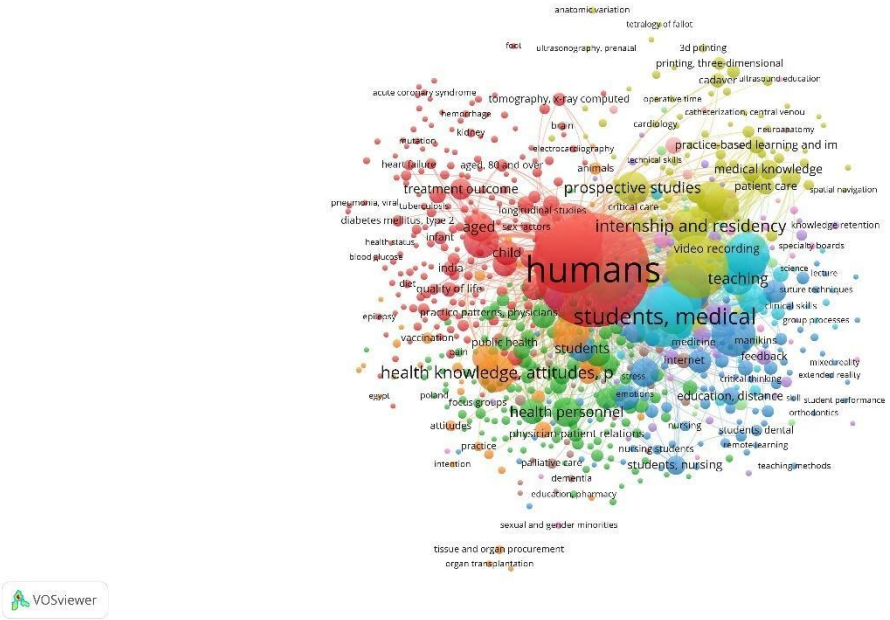
Blue cluster: Clinical techniques and skills (e.g. "clinical skills", "simulation", "virtual reality");

Yellow cluster: Technical/imaging aspects (e.g. "anatomy", "cadaver", "3D printing");

Orange cluster: Social and minority issues (e.g. "sexual and gender minorities", "palliative care").

Figure 1

Bibliometric image at a term co-occurrence threshold of 5



The epistemological interpretation focuses on the fact that biomedical topics ("disease", "treatment", "organs") dominate, reflecting an approach that is still biologically centred. Terms such as "critical thinking", "uncertainty", "epistemology" or "reflective practice" are absent or very peripheral, suggesting an underrepresentation of epistemic reflection in the corpus of articles.

Map 2 (threshold 20): Clearer thematization, more visible networks

General characteristics: 199 terms are included; background noise is reduced and the main relationships are highlighted. Four large clusters emerge (as can be seen in Figure 2).

Yellow cluster: Medical education and curriculum ("active education", "feedback", "teaching");

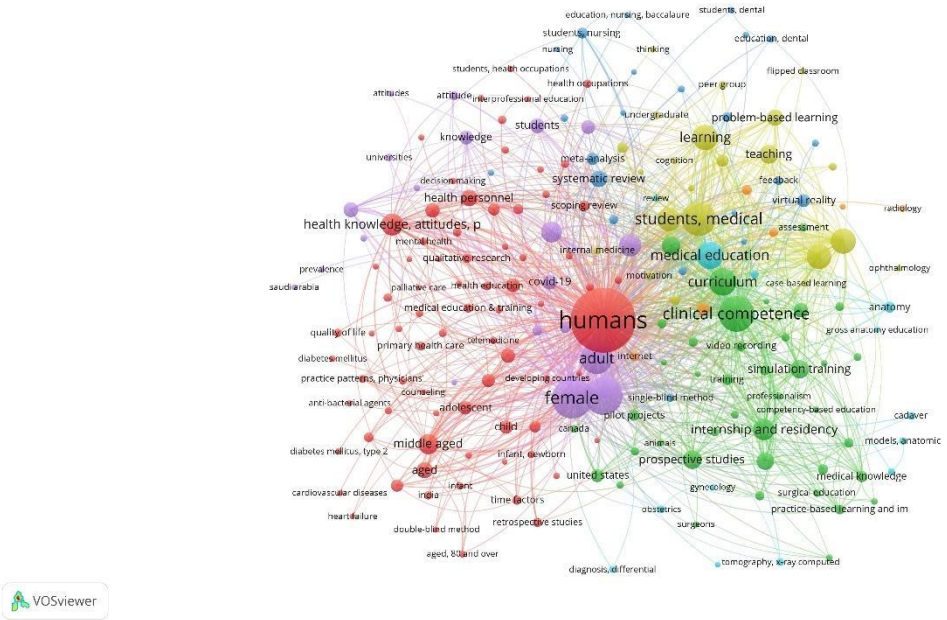
Green cluster: Applied clinical training ("internship", "residency", "competence");

Red cluster: Public health and attitudes ("health knowledge", "practice patterns", "mental health");

Blue cluster: Digital education and simulations ("virtual reality", "anatomy", "suture techniques").

Figure 2

Bibliometric image at a term co-occurrence threshold of 20



The main epistemological observations stem from the fact that terms such as "problem-based learning", "case-based learning", "feedback" and "simulation" are central and indicate an orientation towards applied methods, but not necessarily reflexive ones. Terms such as "bias", "epistemology", "epistemic uncertainty", "judgment", and "decision-making under uncertainty" are missing, suggesting that epistemological themes are systematically neglected in the central discourse.

Map 3 (threshold 40): The dominant core of the discourse

General characteristics: major terms are included and provide a very clear overview of the dominant themes. The clusters are more merged, but still persist (as can be seen in Figure 3).

Yellow cluster: includes terms such as "clinical competence", "curriculum", "education";

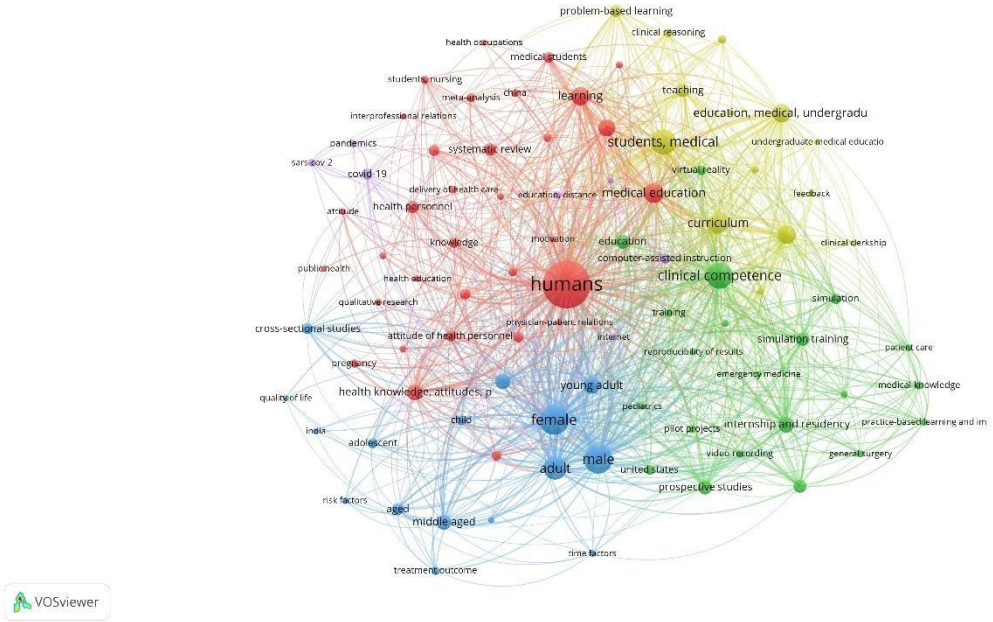
Red cluster: includes terms such as "health knowledge", "attitude", "health personnel";

Blue cluster: Demographics and social context; includes terms such as "female", "young adult", "adolescent";

Green cluster: Clinical practice; includes terms such as "internship and residency", "simulation training", "practice-based learning".

Figure 3

Bibliometric image at a term co-occurrence threshold of 40



The epistemological observations are based on the fact that the map reflects medical education focused on results and clinical performance, not on the construction of knowledge.

Critical terms are missing (e.g., "epistemic injustice", "reflective practice", "uncertainty"), confirming that epistemological gaps are not visibly addressed in the dominant literature. The red cluster suggests a connection between medical education and public health, but from a perspective that is more oriented towards behaviours and attitudes, not towards how knowledge is constructed, contested or transmitted.

The analysis of bibliometric maps shows us that epistemology is peripheral; key terms in the field of medical epistemology (e.g. "epistemic uncertainty", "epistemic injustice", "critical thinking" or "cognitive bias") do not appear as central nodes either at low thresholds or in dominant networks, suggesting a structured epistemological gap in the literature on medical education. The curriculum is focused on "competence" rather than "epistemic reflection". "Clinical competence", "simulation", "assessment" and

"curriculum" are very central, but they are not accompanied by terms that imply an analysis of how competence is constructed. Academic medical discourse is largely technological and standardised; modern methods (e.g. "VR", "simulation", "teaching methods") are strongly represented, but they support an applied pedagogy, not a reflective one.

Epistemological gaps identified based on network analysis and qualitative interpretations have been compiled in Table 4. The results suggest a dominance of the performative-instrumental paradigm in medical education. Epistemology, as a concern for the nature, validity, and limits of knowledge, remains peripheral, poorly connected, or completely absent in mainstream scientific discourse. This finding provides a solid foundation for the development of future curricular interventions and critical research.

Table 4

Identified epistemological gaps

Type of gap	Description
Epistemic	Lack of reflection on how knowledge is constructed and justified
Uncertainty	Underrepresentation of ambiguous and probabilistic decision-making contexts
Cognitive	Absence of biases and errors of judgement as objects of pedagogical study
Epistemic equity	Lack of concern for marginalised voices or diversity of patient experience
Narrative	Exclusion of narrative medicine and lived knowledge

Analysing each semantic cluster (group of terms) in the map is useful for understanding which themes dominate academic discourse in medical education and how they relate (or do not relate) to epistemological dimensions.

Red cluster: Illness and health behaviour

The central terms are "health knowledge", "attitudes", "practice", "health personnel", "quality of life", "diabetes mellitus", "practice patterns", "mental health" and "public health". This cluster is anchored in research on health behaviour, attitudes towards disease and chronic disease management. There is a link to medical education through the prism of health education, but no transition to epistemic reflection is made. The epistemological gaps can be summarised as follows: knowledge is treated as transferable information, not as a critical process of contextualised learning; there is no questioning of sources or the validity of information. This aspect is found in the literature that criticises the 'linear transfer' model of knowledge in public health (Greenhalgh & Sietsewieringa, 2011).

Green cluster: Clinical skills and professional training

The central terms are "clinical competence", "internship and residency", "simulation", "medical knowledge", "video recording", "assessment" and "patient care". This represents the most "technical" area of medical education. The emphasis is on skills training, assessment and clinical simulation, with a highly standardised framework.

Epistemological gaps are found in the lack of reflection on how skills are defined and measured; the validity of clinical assessment and decision-making uncertainty are absent as terms. The literature has identified these gaps in various areas of medical practice. In mental health, there is talk of assessment in the post-psychometric era, which will involve learning subjective and collective love (Hodges, 2013). What should every teacher know about clinical reasoning? This is already a question (Eva, 2005) that awaits answers and practical applications.

Yellow cluster: Teaching methods and curriculum

Key terms are "students", "medical", "curriculum", "feedback", "problem-based learning", "case-based learning", "teaching", "assessment" and "motivation". The cluster focuses on modern teaching methods and curriculum design. Despite the innovative vocabulary, knowledge is treated as content to be delivered efficiently. Epistemological gaps consist in promoting processes of "engagement" and "feedback" without a framework that cultivates critical, reflective clinical reasoning. Terms such as "epistemic cognition", "epistemic humility" or "uncertainty" do not appear. The literature has begun to examine the relationship between the contexts of medical learning and practice and epistemic cognition, because this relationship has the potential to improve medical education (Eastwood et al., 2017). The call for reform of medical education returns from time to time in the academic medical landscape (Mooly Cooke, 2010), as evidence of a rigidity in changing core principles; assessment must go beyond what students know and can do to address their ability to identify gaps and next steps for learning (Molly. Cooke, Irby, & O'Brien, 2011).

Blue cluster: Demographics and context

The central terms are "female", "male", "adult", "young adult", "pregnancy", "cross-sectional studies", and "developing countries". This is a statistical cluster, centred on the populations studied. It reflects a concern for inclusion and representativeness in studies, but is not related to the student's epistemological training. The epistemological gaps could be summarised in the fact that epistemic inequity (Fricker, 2007) is not addressed, nor is the lack of patient representation in professional training.

Purple cluster: Public health and interprofessional education

The central terms are "students", "nursing", "students", "health occupations", "interprofessional education", "telemedicine", "health education" and "systematic review". The emphasis is on collaborative, interprofessional education, but in terms of "efficiency" and "deliverability". Epistemic reflection on collaboration is almost absent. Although training programmes for health professionals have succeeded in providing graduates with the necessary skills, knowledge and standards of professionalism, the predominant emphasis on specialisation and training oriented exclusively towards one's own profession has contributed to the consolidation of a single-professional identity. This orientation has proven to be a significant obstacle to the development of a collaborative interprofessional practice that is truly person-centred (Khalili et al., 2013).

This cluster analysis leads to the observation that the dominant discourse in medical education is oriented towards efficiency, performance and technology, but does not systematically include reflection on how knowledge is constructed, limited or distorted. Key epistemological terms such as "epistemic uncertainty", "epistemic humility", "reflective reasoning" or "cognitive bias" are missing from the core. This absence confirms the existence of an epistemological gap in the dominant discourse, a topic with high potential for critical research and educational reform.

Discussions

Reconfirmation of a dominant performative-instrumental paradigm

The results of the bibliometric analysis unequivocally indicate that the dominant scientific literature in medical education is centred on a performative, technological and standardised paradigm, in which concepts such as "curriculum", "clinical competence", "simulation" and "assessment" occupy central positions in semantic networks. In contrast, epistemological reflection on how medical knowledge is constructed and validated is either marginalised or completely absent. This orientation reflects a way of conceiving medical education as a process of efficient information delivery and development of measurable skills, but not as a space for training critical thinking, intellectual autonomy and the ability to navigate clinical uncertainty (Mooly Cooke, 2010; Bleakley, 2015).

Systemic epistemological gaps – a deeply structured problem

The absence of terms such as "epistemic uncertainty", "reflective practice", "epistemic injustice" or "cognitive bias" from the centre of the analysed networks indicates not a simple accidental omission, but a systemic epistemological gap. Medical training does not systematically encourage reflection on the nature of medical knowledge, the limits of evidence and the uncertainty that accompanies medical practice (Eastwood et al., 2017). Paradoxically, although medicine is a practice deeply dependent on context, ambiguity and uncertainty, medical training remains beholden to a positivist episteme, in which truth is perceived as objective, stable and transmissible, rather than constructed, contextual and negotiable.

Consequences for the professional training of future doctors

This orientation can have a number of significant effects on the quality of medical training. The inability to manage clinical uncertainty can lead to professional anxiety and risk of burnout (Gheihman et al., 2020); at the same time, it can lead to a deficit in critical thinking and rational autonomy, with a tendency to follow algorithms without understanding clinical nuances. Lack of awareness of cognitive biases can increase the risk of medical error; excluding the patient as an epistemic subject affects the quality of the therapeutic relationship and equity in care.

Exclusion of narrative knowledge and humanistic medicine

The absence of concepts such as "narrative medicine" or "subjective experience" reflects a reductionist approach to disease in biology. The lived dimension of suffering, which involves valid but non-quantitative knowledge, is rarely addressed; without a narrative dimension, medicine risks becoming an applied technology rather than a humanistic profession (Charon, 2006).

Implications for curriculum reform

To correct these epistemological imbalances, interventions are needed at the curricular, institutional and epistemic levels: the introduction of epistemic reflection in medical training (seminars dedicated to medical epistemology, uncertainty and decision-making in conditions of ambiguity, the integration of critical, metacognitive thinking and "epistemic humility" in all stages of training), education focused on uncertainty and biases (training in recognising and managing cognitive biases, studying clinical errors as an epistemological source, not just as technical failures), the recovery of narrative medicine and patient experience (integration of patient stories into clinical training, capitalising on experiential knowledge in everyday practice) and promoting epistemic equity (revising the curriculum to reflect cultural, racial and gender diversity and critically learning how certain perspectives, such as those of marginalised patients, may be excluded from medical practice).

Clarifying the scope of the analysis

The study does not evaluate medical curricula or teaching practices directly, but analyses how they are conceptualised within the international academic literature. Consequently, the findings concern the epistemological orientation of scholarly discourse rather than the concrete design of educational programmes. Because the analysed publications originate from diverse educational systems, their curricular assumptions vary widely—from postgraduate medical training in North America to early-entry undergraduate models typical of Europe. This reinforces the argument that systematic, comparative, qualitative research on medical curricula is needed to understand how epistemological dimensions are actually enacted in practice.

Conclusions – A critical look at epistemic absences in medical education

This study set out to examine how epistemological concepts are represented in contemporary academic discourse on medical education. Through a large-scale bibliometric analysis of 2,830 PubMed-indexed articles and a qualitative interpretation of keyword co-occurrence networks, the findings reveal a significant imbalance in the structure of the field. The dominant discourse is centred on curriculum design, competence training, simulation, assessment and other performative-instrumental elements, while epistemological themes—epistemic uncertainty, reflective practice, cognitive bias, epistemic injustice, narrative knowledge—remain marginal or absent from the conceptual core.

These patterns indicate a systemic epistemological gap that extends beyond terminology: they reflect a mode of understanding medical education primarily as the delivery of measurable skills rather than the cultivation of reflective, context-aware, and critically engaged professionals. The low visibility of concepts related to uncertainty, judgement, and epistemic humility is particularly paradoxical given the centrality of such dimensions to real clinical practice. As a result, current educational discourse risks reinforcing an overly technical paradigm that obscures the humanistic, interpretive and relational dimensions of medicine.

The implications are substantive. A medical curriculum that does not explicitly train students to navigate uncertainty, recognise biases, integrate patient narratives, or question the limits and sources of medical knowledge may produce competent technicians but insufficiently reflective clinicians. This is especially relevant in educational systems—such as those in Central and Eastern Europe—where the historical prevalence of a strictly biomedical model has delayed the integration of medical humanities and epistemic reflection. In such contexts, addressing epistemological gaps becomes not only an academic imperative but a practical necessity.

At the same time, the study acknowledges its own methodological boundaries. Analysing published academic discourse is not equivalent to evaluating national curricula or concrete teaching practices, and English-language publications reflect a diversity of educational structures. These limitations reinforce the need for future comparative qualitative research on curricula and student experiences across different countries.

Overall, the paper contributes to the field by offering the first systematic bibliometric mapping of epistemological concepts in medical education and by demonstrating how their structured absence shapes contemporary understandings of clinical training. Strengthening medical education in the 21st century requires complementing scientific rigour with epistemic reflection, integrating uncertainty as a core learning domain, and re-humanising medical knowledge. Only through such a reconfiguration can medical education prepare professionals capable not only of applying evidence, but of understanding its limits, interpreting complexity, and engaging responsibly with the lived experience of patients.

In a medical future dominated by artificial intelligence, big data, and decision algorithms, it is precisely these epistemological qualities—humanistic, reflective, and critical—that will make the difference between a mere executor and a true professional of knowledge. And medical education has a duty to cultivate this difference.

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