A Bibliometric Mapping of Medical Skills, Communication, Supervisor Support, and the Positioning of Self-Efficacy in Diagnostic Performance Research

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Abstract. This study aims to map the scientific literature addressing medical skills, communication skills, supervisor support, self-efficacy, and diagnostic performance in medical and health professions education using a bibliometric approach. A bibliometric analysis was conducted on publications indexed in Crossref between 2015 and 2025, including journal articles, conference proceedings, books, and book chapters. The analysis examined publication trends, citation patterns, author productivity, publication sources, keyword co-occurrence, collaboration networks, and citation age. The results show that communication skills represent the most prolific research theme, while diagnostic performance and self-efficacy have gained increasing attention in recent years. Medical skills remain a foundational domain, primarily disseminated through instructional and training-oriented publications. Supervisor support, although less frequently published, demonstrates strong citation impact, largely originating from interdisciplinary research. Keyword and network analyses reveal that self-efficacy occupies a central position, frequently co-occurring with medical skills, communication skills, supervisor support, and diagnostic performance. Rather than indicating causal or mediational relationships, these findings illustrate how the literature conceptually links technical, interpersonal, and psychosocial dimensions of clinical education. This study contributes by providing a comprehensive bibliometric mapping that clarifies the intellectual structure of research on diagnostic performance and identifies directions for future empirical investigation.

Keywords: medical skills; communication skills; supervisor support; self-efficacy; diagnostic performance; bibliometric analysis

1 Introduction

The diagnostic performance of medical students is one of the primary indicators of success in medical professional education, as it determines their ability to make accurate clinical decisions. This performance is influenced by a combination of medical skills, communication skills, and supervisor support, which are interrelated and affect students' clinical learning outcomes [1] Medical skills represent the foundation of medical education, as mastery of history taking, physical examination, and clinical reasoning enables students to identify patient problems more accurately ([2].

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Several studies have shown that clinical simulations not only improve technical skills but also non-technical competencies, such as teamwork and decision-making, which are crucial for diagnosis [2]. Furthermore, efforts to minimize diagnostic errors through structured learning have been proven to strengthen students' clinical reasoning [3]. Thus, while medical skills significantly contribute to diagnostic performance, other factors such as communication and supervisor support also play essential roles in the learning process.

Communication skills are equally important, as the quality of interaction between medical students and patients determines the accuracy of eliciting relevant information [1]. Research indicates that effective communication can enhance diagnostic accuracy by enabling students to listen to patients' complaints, interpret symptoms, and build therapeutic relationships [4] .Problem-based learning approaches further reinforce that students with strong communication skills tend to be more accurate in clinical diagnoses [1]. Interestingly, communication training through artistic approaches, such as art observation, has been proven to improve observational skills, which are crucial in clinical diagnosis (Mehta & Agius, 2023).Effective interaction not only impacts patient relationships but also teamwork within medical teams, thereby influencing the overall quality of healthcare services (Eklics et al., 2024). Therefore, communication skills should not be regarded as supplementary but as an integral component of medical students' diagnostic performance.

In addition to medical and communication skills, supervisor support plays a critical role in providing feedback, motivation, and a conducive learning environment for students [7]. High-quality supervisor support enables students to reflect on their clinical performance and improve identified weaknesses [8]. With direct supervision, students become more confident in applying their clinical skills, thereby enhancing diagnostic performance [9]Positive relationships with supervisors also foster independence, learning commitment, and confidence, which ultimately affect the quality of diagnoses made by students [10]. Thus, supervisors function not only as evaluators but also as key facilitators in the development of diagnostic competence.

Another mediating factor linking medical skills, communication, and supervisor support to diagnostic performance is self-efficacy, or students' confidence in their abilities. Self-efficacy has been identified as a key variable in connecting various learning factors to clinical performance outcomes [11] . In the context of medical education, students with high self-efficacy are more capable of utilizing their medical and communication skills to produce accurate diagnoses [12].Research has also shown that strong supervisor support increases students' self-efficacy, which in turn improves their diagnostic performance [13] . Moreover, motivation and pre-training experiences also influence self-efficacy, indicating that students with high learning motivation are more confident in clinical tasks [14].This confirms that self-efficacy is not only a mediator but also an essential element that must be strengthened in medical education.

The work environment and quality of mentorship are also significant determinants in shaping students' self-efficacy. Effective system support and conducive learning conditions have been proven to enhance healthcare providers' self-efficacy [15]. Conversely, workload stress and lack of knowledge can lower self-efficacy, affecting communication skills and patient management[16]. Adequate clinical exposure and direct

patient encounters have been shown to increase students' confidence in interacting with patients and making diagnostic decisions [17]Therefore, medical education strategies should incorporate practical experiences and psychological support to ensure the continuous development of students' self-efficacy alongside clinical and communication skills.

A bibliometric approach was applied in this study as it allows for a comprehensive analysis of the literature related to medical skills, communication skills, supervisor support, self-efficacy, and diagnostic performance. Bibliometrics was used to assess publication trends, author collaboration, and the impact of research in the field of medical education [18] . This analysis facilitates the mapping of central themes and influential authors in the domain of medical education, showing how inter-variable relationships have been explored in prior studies (Maggio et al., 2021).Through bibliometrics, researchers can also identify research gaps, such as the limited exploration of self-efficacy as a specific mediator in the relationship between clinical skills and diagnostic performance. This aligns with studies emphasizing the importance of mapping academic fields to set future research directions.(Albert et al., 2020;Yu et al., 2020).

Bibliometric evaluation also provides comparative insights across institutions, highlighting how the quality and quantity of publications in medical education vary and affect academic reputation [22]. It can also assess the effectiveness of learning methods, such as Problem-Based Learning (PBL), commonly used to improve clinical and diagnostic skills [23]. Nevertheless, bibliometrics should not be used in isolation but complemented with qualitative approaches for a more comprehensive interpretation [24] . Hence, the bibliometric analysis in this study offers a robust overview of the research landscape while supporting integrative understanding of factors influencing medical students' diagnostic performance.

Based on this rationale, the study is significant as it integrates medical skills, communication, supervisor support, and self-efficacy in relation to diagnostic performance, analyzed through bibliometrics. It addresses the need for broader, evidence-based literature mapping and provides practical contributions to curriculum development in medical education. The aim is to explore how scientific literature examines the relationship between medical skills, communication, supervisor support, and self-efficacy with diagnostic performance. Additionally, it seeks to identify publication trends, citation patterns, and key authors shaping scholarly discourse. The findings are expected to provide both theoretical and practical foundations to strengthen clinical learning strategies.

2 Research Questions

To achieve the study objective, the following research questions were formulated:

RQ1. What are the publication trends and growth patterns of research addressing medical skills, communication skills, supervisor support, self-efficacy, and diagnostic performance in medical and health professions education between 2015 and 2025?

RQ2. Who are the most influential authors, journals, and publication sources contributing to this research domain?

RQ3. How are medical skills, communication skills, supervisor support, and self-efficacy positioned and interconnected within the literature on diagnostic performance, as reflected in keyword co-occurrence and citation networks?

3 Material and Methods

3.1 Study Design

This study employed a bibliometric analysis to map the scientific literature addressing medical skills, communication skills, supervisor support, self-efficacy, and diagnostic performance in the context of medical and health professions education. Bibliometric methods were selected because they enable a systematic, quantitative examination of publication patterns, citation structures, thematic relationships, and intellectual networks within a research field, without testing causal or statistical relationships among variables.

The analysis focused on identifying publication trends, influential authors and sources, keyword co-occurrence patterns, collaboration networks, and citation age, thereby positioning self-efficacy within the broader literature linking technical, interpersonal, and supervisory dimensions of clinical education.

3.2 Data Source

The bibliographic data were retrieved from the Crossref database, selected due to its broad coverage of peer-reviewed journals, conference proceedings, and scholarly books in medical education, health sciences, psychology, and social sciences. Scopus is widely used in bibliometric research and provides standardized citation and metadata necessary for robust network and trend analyses.

3.3 Search Strategy

A systematic search was conducted in January 2025, covering publications from January 2015 to December 2025**.** The search strategy combined controlled keywords and free-text terms related to the study themes using Boolean operators. The following search string was applied to the Title, Abstract, and Keywords fields:

("medical skills" OR "clinical skills") AND ("communication skills" OR "clinical communication") AND ("supervisor support" OR "clinical supervision") AND ("self-efficacy") AND ("diagnostic performance" OR "diagnostic accuracy")

This strategy was designed to capture literature that explicitly discusses at least one of the core educational inputs (medical skills, communication skills, supervisor support) in relation to self-efficacy and diagnostic performance.

3.4 Inclusion and Exclusion Criteria

Inclusion Criteria. Publications were included if they:

1. Were published between 2015 and 2025**.**
2. Were indexed in Crossref
3. Addressed at least one of the five focal themes:medical skills, communication skills, supervisor support, self-efficacy, diagnostic performance.
4. Were published in English**.**
5. Appeared as journal articles, conference proceedings, books, or book chapters, reflecting the multidisciplinary and practice-oriented nature of medical education research.

Exclusion Criteria. Publications were excluded if they:

1. Were editorials, commentaries, letters, or non-scholarly documents.
2. Lacked abstracts or sufficient bibliographic metadata.
3. Were duplicates across document types.
4. Focused exclusively on non-educational contexts without relevance to health professions training.

Bibliometric Analysis Tools. Bibliometric analyses were conducted using:

- VOSviewer for network visualization, including keyword co-occurrence, co-authorship, and co-citation analyses.

Bibliometric Indicators and Analysis Procedures. The following indicators were analyzed:

1. Publication Trends
   Annual publication counts were calculated to identify growth patterns and
2. temporal shifts across the five thematic areas.
3. Citation Analysis
   Total citation counts and average citations per year were used to identify influential publications within each theme.
4. Author Analysis
   Author productivity was assessed based on the number of publications per author, highlighting core contributors to each research domain.
5. Source Analysis
   Journals and publication outlets were ranked according to publication volume to determine the primary dissemination channels of the literature.
6. Keyword Analysis
   Author keywords were analyzed using co-occurrence mapping to identify

dominant themes and conceptual linkages among medical skills, communication, supervision, self-efficacy, and diagnostic performance.

7. Network Analysis
   Co-authorship and co-citation networks were visualized to examine collaboration patterns and intellectual structures within and across domains.
8. Citation Age Analysis
   The average age of cited documents and citations per year were calculated to assess the maturity and developmental stage of each thematic area.

A full counting method was applied in network analyses to ensure consistency across indicators.

Methodological Boundaries. This bibliometric study does not test causal relationships or statistical mediation effects among variables. Instead, it maps how self-efficacy is positioned and connected within the literature linking medical skills, communication skills, supervisor support, and diagnostic performance. Interpretations are therefore limited to patterns of association, prominence, and thematic linkage as reflected in publication and citation data.

4 Publication Trends Analysis

The publication trend on communication skills shows a significant increase over the last decade. In 2017, there were 141 articles published, rising sharply to 175 in 2018. This surge indicates heightened academic attention on communication, particularly in the context of professional interactions. After peaking, the number of publications declined between 2019–2020, but then stabilized and increased again during 2022–2024. In 2024, there were 116 articles, though the number slightly decreased to 84 in 2025. These fluctuations suggest that while temporary declines occur, communication skills remain a consistently relevant research focus.

For diagnostic performance, the publication trend peaked early in the analysis period. In 2015, there were only 15 articles, but this number rose dramatically to 53 in 2016 and 60 in 2017. This rapid increase reflects growing interest in diagnostic performance, particularly with advancements in medical imaging and digital diagnostic systems. However, publications dropped to 23 in 2018, though subsequent years still showed continued research output with varying numbers. This indicates an initial surge followed by a consolidation phase, demonstrating the sustained importance of diagnostic performance in medical literature.

The topic of self-efficacy displayed a different trajectory. Publications rose sharply after 2017, continuing to grow through 2022–2023. The majority of studies focused on medical education and educational psychology, often linking self-efficacy with students' confidence, learning adaptability, and academic achievement. This trend suggests that self-efficacy has become a rapidly expanding research topic, recognized as a crucial psychological factor supporting clinical and academic performance.

For supervisor support, the publication trend has remained stable without sharp increases. Between 2015–2022, publications were evenly distributed each year, though the total was lower compared to communication skills. Despite fewer publications, stability and quality were consistent, with several articles appearing in high-impact journals. Initially, research on supervisor support was largely tied to organizational and management contexts, but recent studies have increasingly shifted toward clinical education and student supervision. This highlights its thematic flexibility and growing relevance in medical education.

The topic of medical skills showed stagnation in publication trends since 2015. Most publications were in the form of textbooks, training modules, or book chapters rather than journal articles. Although medical skills remain a fundamental element in medical education, the term itself appears less frequently in academic articles, possibly due to alternative terminology such as clinical skills or clinical competence. While stagnation limits current literature, it also represents an opportunity for new studies to enrich the field.

4.1 Citation Analysis

Citation analysis revealed the most influential works across the five themes.

- For diagnostic performance**,** the most cited article focused on prostate imaging reporting systems, with 249 citations. Another influential publication in neurology received 115 citations, while a clinical radiology article garnered 60. This underscores the dominance of diagnostic imaging validation studies in shaping the field.
- For self-efficacy, the most cited paper received 134 citations, examining self-efficacy in relation to self-esteem, dependency, and self-care. Other significant works received 100 and 95 citations, showing the cross-disciplinary relevance of self-efficacy across education and healthcare.
- In supervisor support, the highest citation count was 152, focusing on supervisor support and innovation. Additional key articles had 146 and 144 citations, mainly from management and organizational research, highlighting the concept's strong roots in non-medical disciplines.
- In communication skills, the most cited article (142 citations) examined digital communication and social media. Others with 79 and 61 citations addressed interpersonal communication and health communication, indicating the evolution from digital themes to professional healthcare contexts.
- For medical skills**,** the most cited article (251 citations) discussed socio-emotional skills as part of societal progress. Additional works received 161 and 129 citations, some specifically within medical education. These findings show that while medical skills are multidisciplinary, clinical training publications remain most relevant.

4.2 Author Analysis

- In diagnostic performance**,** the most productive author had 24 publications, primarily in radiology and diagnostic evaluation. Other authors contributed 10 publications,

while several others produced 3–4. This indicates the presence of a small core group of consistent contributors.

- In self-efficacy**,** the most productive author had 9 publications, followed by others with 7 and 4–6. This broader distribution suggests a multidisciplinary topic with wide collaborative involvement and no single dominant figure.
- In supervisor support**,** the leading author produced 15 publications, with others contributing 8, 7, and 6. The field appears concentrated among experts in counseling and human resource management, extending later into clinical supervision research.
- In communication skills**,** the dominant author had an exceptionally high output of 112 publications, far surpassing peers with 20–21. This reveals a strong central influence by a single figure who has authored multiple modules, books, and articles.
- In medical skills**,** the top author published 32 works, followed by others with 21 and 16. Research in this field is mainly driven by authors focused on clinical skills training modules.

4.3 Publication Source Analysis

For diagnostic performance, publication sources were dominated by radiology and diagnostic journals, many of which published dozens of articles. Other relevant outlets included journals in clinical microbiology and radiological research, highlighting the field's strong roots in health sciences.

For self-efficacy, most publications appeared in psychology instrument datasets, followed by educational psychology journals with significant contributions. Several international journals also published relevant studies, confirming the role of self-efficacy as a widely examined concept across multiple disciplines.

In supervisor support, the largest share of publications came from supervision-focused journals, numbering in the hundreds. Additional contributions came from management proceedings and psychology journals. This dominance shows that supervisor support remains primarily grounded in counseling and organizational contexts, though its application in clinical education is emerging.

For communication skills, publications were often in the form of modules and books, with fewer journal articles. Some medical education journals also served as important publication venues. This reflects the practical and instructional nature of communication skills, which often extend beyond academic articles.

In medical skills, main sources included journals of perceptual and motor skills, creativity, and medical education. Some interdisciplinary publications also appeared in law and social science outlets, showing the multidimensional nature of the topic.

4.4 Document Typology Analysis

- In diagnostic performance**,** journal articles dominated, followed by conference proceedings and technical reports. A smaller portion consisted of datasets. This indicates a balance between academic research and technical studies.

- In self-efficacy**,** journal articles and proceedings were the most common, alongside several datasets and books. This aligns with the frequent use of self-efficacy scales and research instruments.
- In supervisor support**,** journal articles strongly dominated, followed by reports and proceedings, with a few datasets. This shows its firm academic foundation.
- In communication skills**,** most publications were in the form of modules and books, with journal articles being fewer. This reflects its practical and instructional emphasis.
- In medical skills**,** most works were reports and textbooks, with journal articles being relatively scarce. This suggests medical skills are often developed through teaching materials rather than journal-based research.

4.5 Keyword Analysis

- For diagnostic performance, dominant keywords included *diagnostic*, *performance*, *review*, *meta*, *systematic*, *test*, *detection*, and *clinical*, indicating a focus on evaluating diagnostic methods and meta-analyses.
- For self-efficacy**,** common keywords were *self*, *efficacy*, *students*, *academic*, *learning*, and *scale*, emphasizing its relationship with student learning and education.
- For supervisor support**,** frequent terms were *supervisor*, *support*, *perceived*, *employee*, *organizational*, *performance*, *satisfaction*, and *engagement*, reflecting its traditional focus in organizational psychology.
- For communication skills**,** dominant keywords included *communication*, *skills*, *interpersonal*, *training*, *language*, *students*, and *professional*, confirming its role in interpersonal learning and professional education.
- For medical skills**,** frequent terms were *skills*, *medical*, *students*, *clinical*, *training*, *teaching*, *assessment*, and *knowledge*, linking the theme directly to clinical education and competency evaluation.

4.6 Network Analysis

Network analysis revealed diverse collaboration patterns:

- In diagnostic performance, central figures acted as hubs of collaboration within radiology.
- In self-efficacy, collaboration was more distributed, involving multiple authors from varied institutions, reflecting the topic's multidisciplinary nature.
- In supervisor support**,** strong clusters emerged in counseling and management research.
- In communication skills**,** the network was dominated by one highly prolific author, showing centralization of influence.
- In medical skills**,** collaboration networks revolved around experts in medical education and clinical training.

Co-citation analysis revealed that diagnostic performance was strongly linked to radiology journals, self-efficacy to educational psychology, supervisor support to management and psychology, communication skills to communication manuals and practical modules, and medical skills to medical education and perceptual skill journals.

Bibliographic coupling highlighted shared references: diagnostic performance with meta-analysis studies, self-efficacy with measurement scales, supervisor support with leadership literature, communication skills with training modules, and medical skills with OSCE and clinical training references.

4.7 Citation Age Analysis

The analysis of citation age revealed varying levels of maturity across the five themes:

- For diagnostic performance, the average publication age was 4.2 years, with an average of 0.72 citations per year**,** indicating that the field is relatively young but contains highly influential articles.
- For self-efficacy, the average publication age was 4.1 years, with an average of 0.65 citations per year**,** suggesting that this area is also relatively new and rapidly developing.
- For supervisor support, the average publication age was 4.3 years**,** but with the highest citation rate at 1.83 per year**,** reflecting a mature yet still highly relevant field.
- For communication skills, the average publication age was 5 years**,** with a relatively low average of 0.16 citations per year**,** showing that the field is well established, often represented in practical modules rather than citation-heavy journal articles.
- For medical skills**,** the average publication age was 10 years**,** with 0.67 citations per year, suggesting that while the field is mature, it has experienced stagnation in terms of new developments.

5 Result

5.1 Publication Trends (2015–2025)

The annual publication trends indicate differential growth patterns across the five thematic domains examined. Communication skills consistently represented the largest volume of publications throughout the study period, reflecting sustained scholarly attention to interpersonal competencies in professional and clinical education. After a marked increase between 2017 and 2018, publication output experienced fluctuations but remained stable in subsequent years.

Research on diagnostic performance demonstrated an early surge between 2015 and 2017, followed by a period of consolidation. This pattern suggests that initial methodological and technological developments—particularly in diagnostic evaluation—were followed by more specialized and incremental contributions. In contrast, self-efficacy showed a steady increase after 2017, indicating growing recognition of psychological constructs in health professions education.

Publications addressing supervisor support remained relatively stable across the decade, albeit at lower absolute volumes. Despite fewer publications, this theme maintained visibility in high-impact journals. Meanwhile, medical skills exhibited limited growth in journal articles, with a substantial proportion of outputs appearing as books, reports, and instructional modules, suggesting a mature but less frequently journal-published domain.

5.2 Source Analysis

An analysis of publication sources reveals that the literature is primarily disseminated through journals focused on medical education and health professions training. As shown in Table 1, BMC Medical Education, Medical Education, and Advances in Health Sciences Education emerged as leading outlets, underscoring the central role of education-oriented journals in shaping discourse on diagnostic performance, skills development, and self-efficacy.

Table 1. Text here

No	Journal	Number of Publications
1	BMC Medical Education	17
2	Medical Education	9
3	Advances in Health Sciences Education	1

Table 1 presents the top journals contributing to the literature on medical skills, communication, supervisor support, self-efficacy, and diagnostic performance between 2015 and 2025. The distribution highlights the dominance of medical education and health professions journals as primary dissemination outlets.

Multidisciplinary journals such as Plos One and Scientific Reports also contributed substantially, reflecting the cross-disciplinary nature of research on diagnostic reasoning and educational outcomes. The presence of clinical and nursing journals further highlights the applicability of these themes beyond undergraduate medical education.

5.3 Author Productivity and Collaboration Patterns

Author analysis demonstrates an uneven distribution of productivity across themes. A small number of authors accounted for a disproportionately large share of publications, particularly within communication skills and diagnostic performance research (Table 2). This concentration suggests the presence of dominant contributors who have shaped the field through sustained publication output.

Table 2. Text here

No	Author	Number of Publications	Collaboration Links
1	Kelly, Alex	112	5
2	Thompson, Neil	35	0
3	Chakraborty, Dev P.	24	0

No	Author	Number of Publications	Collaboration Links
4	Johnson, Stuart	21	41
5	Scott, Jon	21	41
6	Finch, Emily	21	21
7	Fafinski, Stefan	21	21
8	Overton, Tina	20	40
9	Bottomley, Jane	17	34
10	Pryjmachuk, Steven	17	34
11	Benbassat, Jochanan	16	0
12	Stuart, Johnson	15	15
13	Jon, Scott	15	15
14	Borders, L. DiAnne	15	10
15	Doty, Leilani	14	0

Table 2 shows the most productive authors across the five thematic domains. Author productivity is unevenly distributed, with several dominant contributors in communication and diagnostic performance research, reflecting topic-specific concentration patterns.

In contrast, self-efficacy research displayed a more distributed authorship pattern, with contributions spanning educational psychology, nursing, and medical education. Supervisor support publications were largely driven by authors originating from organizational psychology and management research, with more recent extensions into clinical supervision contexts.

The co-authorship network (Figure 2) illustrates clustered collaboration patterns, particularly within diagnostic performance research, while self-efficacy-related studies showed broader and more interdisciplinary collaboration structures.

5.4 Citation Analysis

Citation analysis identified several highly influential publications that anchor the intellectual structure of the field. As presented in Table 3, the most cited documents predominantly addressed diagnostic performance**,** self-efficacy**,** and supervisor support**,** indicating strong scholarly engagement with these themes.

Table 3. Text here

No	Title	Authors	Year	Total Citations	Research Theme
1	Diagnostic Performance of Prostate Imaging Reporting and Data System	Sungmin Woo et al.	2017	249	Diagnostic Performance
2	When Does Supervisor Support Encourage Innovative Behavior?	Tingting Chen et al.	2015	152	Supervisor Support
3	Supervisor Role Overload and Frustration	Gabi Eissa & Scott W. Lester	2016	146	Supervisor Support
4	Employee Voice, Supervisor Support, and Engagement	Tingting Chen et al.	2016	138	Supervisor Support

No	Title	Authors	Year	Total Citations	Research Theme
5	Self-esteem, Dependency, Self-efficacy and Self-control	—	2014	121	Self-Efficacy
6	Ethical Leadership and Team-Level Creativity	—	2015	118	Supervisor Support
7	Diagnostic and Prognostic Performance of Neuroimaging	Koen Poesen et al.	2019	115	Diagnostic Performance
8	Effectiveness of Supervisor Support in Less Hierarchical Contexts	Peerayuth Charoensukmongkol et al.	2020	113	Supervisor Support
9	Assessing Post-Traumatic Stress Disorder	—	2020	110	Supervisor Support
10	Health and Well-being at Work: The Role of Supervisor Support	Oliver Hämmig	2017	109	Supervisor Support

Table 3 lists the most cited publications shaping the intellectual structure of the field, dominated by studies on diagnostic performance, self-efficacy, and supervision.

Notably, several highly cited works related to supervisor support and communication originated outside medical education, particularly in management and organizational research. This pattern highlights the interdisciplinary borrowing that characterizes the literature and underscores the importance of cautious interpretation when applying findings to medical education contexts.

5.5 Keyword Co-Occurrence and Thematic Structure

Keyword co-occurrence analysis revealed distinct but interconnected thematic clusters (Figure 1). Medical skills and diagnostic performance formed a closely related cluster, reflecting their foundational role in clinical education. Communication skills appeared as a prominent cluster connected to both diagnostic and educational keywords, emphasizing its relevance across multiple learning contexts.

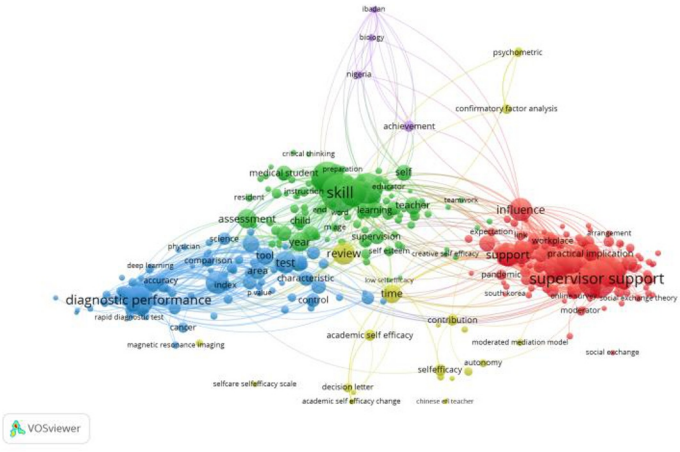

Fig. 1. Text here

Figure 1 illustrates the keyword co-occurrence network generated using VOSviewer. Self-efficacy appears as a central node connecting clusters related to medical skills, communication skills, supervisor support, and diagnostic performance. The network reflects thematic proximity rather than causal relationships.

Importantly, self-efficacy emerged as a central node connecting clusters related to skills, communication, and supervision. Rather than indicating mediation in a statistical sense, this central positioning reflects frequent co-occurrence and conceptual linkage within the literature. Supervisor support formed a smaller but well-defined cluster, closely associated with self-efficacy and professional development keywords.

5.6 Citation Age Analysis

Citation age analysis suggests varying levels of maturity across themes. Medical skills displayed the highest average citation age, indicating a well-established but relatively static literature base. Communication skills also showed moderate maturity, with many foundational works continuing to be cited over time.

Conversely, self-efficacy and diagnostic performance exhibited younger citation profiles, reflecting ongoing conceptual development and methodological innovation. Supervisor support demonstrated a combination of maturity and sustained citation impact, consistent with its long-standing theoretical foundations and continued relevance.

6 Discussion

This bibliometric analysis provides a structured overview of how the literature has addressed medical skills, communication skills, supervisor support, self-efficacy, and diagnostic performance within medical and health professions education over the past decade. Rather than testing causal or mediational relationships, the findings illuminate patterns of scholarly attention, thematic proximity, and intellectual linkages among these domains.

6.1 Positioning of Medical Skills in the Literature

The results indicate that medical skills remain a foundational theme in the literature, most frequently discussed in relation to diagnostic performance. Although journal-based publications on medical skills have shown limited growth, citation patterns suggest that core works in this area continue to inform contemporary research. This stability reflects the established nature of clinical skills training in medical education, where foundational competencies are often consolidated into textbooks, curricula, and instructional modules rather than journal articles.

From a bibliometric perspective, the close clustering of medical skills and diagnostic performance keywords highlights their conceptual proximity within the literature. This pattern suggests that research consistently frames diagnostic accuracy and performance as grounded in technical competence, while leaving room for complementary psychosocial and educational constructs.

6.2 Communication Skills as a Central Educational Theme

Communication skills emerged as the most prolific research area across the analyzed literature. The high volume of publications, particularly in instructional and practice-oriented formats, underscores the perceived importance of communication in clinical and professional education. Bibliometric patterns show that communication skills are frequently linked with diagnostic performance and educational outcomes, reflecting their role in patient interaction, information gathering, and clinical reasoning processes.

However, the dominance of communication-focused publications also reveals a concentration of authorship and a strong presence of non-journal outputs, such as modules and manuals. These characteristics suggest that while communication skills are widely acknowledged as essential, the evidence base often emphasizes pedagogical dissemination rather than empirical testing of outcomes. Consequently, the bibliometric prominence of communication skills should be interpreted as an indicator of thematic importance rather than demonstrable effect.

6.3 Supervisor Support and Interdisciplinary Influences

Supervisor support demonstrated a stable publication pattern with comparatively fewer outputs, yet maintained high citation impact. Notably, a substantial proportion of influential publications in this domain originate from organizational psychology, management, and counseling literature, rather than medical education per se. This interdisciplinary borrowing highlights both the conceptual robustness of supervisor support and the potential for domain noise when applying findings to clinical education contexts.

Within the bibliometric networks, supervisor support frequently co-occurred with self-efficacy and professional development keywords, indicating its conceptual alignment with learner confidence and motivation. These patterns suggest that the literature commonly frames supervisory relationships as mechanisms for fostering supportive learning environments, even though empirical validation in medical education settings remains limited.

6.4 Self-Efficacy as a Connecting Theme

One of the most salient findings of this bibliometric analysis is the central positioning of self-efficacy within the keyword co-occurrence and citation networks. Self-efficacy consistently appeared at the intersection of medical skills, communication skills, supervisor support, and diagnostic performance, indicating its role as a conceptual bridge across technical, interpersonal, and psychosocial domains.

Importantly, this centrality reflects frequent thematic linkage rather than statistical mediation. The literature often discusses self-efficacy as a construct that connects educational inputs with performance-related outcomes, particularly in health professions education and educational psychology. The prominence of self-efficacy in recent publications and its relatively young citation age further suggest that it is an evolving focus of scholarly inquiry.

6.5 Implications for Medical Education Research

Taken together, the bibliometric findings indicate that contemporary research increasingly adopts a holistic view of diagnostic performance, integrating technical competencies, communication, supervision, and learner psychology. This integration is reflected not in causal claims, but in the way themes are clustered, cited, and discussed across disciplines.

For medical education research, these patterns highlight the need for methodologically diverse approaches. While bibliometric mapping clarifies how concepts are positioned and interconnected, future studies should empirically test the relationships suggested by the literature. Longitudinal designs, mixed-methods approaches, and structural equation modeling could provide stronger evidence regarding how self-efficacy interacts with skills training and supervisory practices in clinical education.

6.6 Methodological Considerations

The findings also underscore important methodological considerations. The presence of domain noise—particularly in supervisor support and communication research—suggests that caution is warranted when generalizing bibliometric linkages to medical education populations. Moreover, the reliance on publication and citation data limits interpretation to scholarly patterns rather than educational effectiveness.

Nevertheless, bibliometric analysis remains valuable for identifying research gaps, mapping intellectual structures, and informing hypothesis generation. By clarifying how self-efficacy is positioned within the literature, this study provides a foundation for more targeted empirical investigations.

6.7 Contribution to the Literature

This study contributes to the field by offering a comprehensive bibliometric mapping of research linking medical skills, communication skills, supervisor support, self-efficacy, and diagnostic performance. Unlike prior bibliometric studies that focus on single domains, this analysis integrates multiple educational dimensions and highlights self-efficacy as a central, connecting construct in the scholarly landscape.

By reframing claims away from causality and mediation, the study aligns methodological rigor with interpretive restraint, strengthening its relevance for medical education scholars and curriculum developers.

6.8 Limitations

This study has several limitations that must be acknowledged:

- First, most publications on medical skills, communication skills, and supervisor support came from non-journal literature such as modules, textbooks, or reports, which limits the scope of empirical generalization.

- Second, much of the literature on supervisor support originates from management and organizational contexts, requiring careful adaptation when applied to medical education.
- Third, the bibliometric analysis provides a quantitative overview of publications and citations but does not fully capture the qualitative depth of each study.

7 Conclusion

This bibliometric study provides a comprehensive overview of how the literature has addressed medical skills, communication skills, supervisor support, self-efficacy, and diagnostic performance within medical and health professions education over the past decade. The findings demonstrate that diagnostic performance is consistently discussed in relation to both technical competencies and broader educational and psychosocial constructs.

Medical skills remain the foundational element of clinical education, although much of the related literature is disseminated through instructional formats rather than journal articles. Communication skills constitute the most extensively published theme, highlighting their perceived importance in clinical interaction and professional training. Supervisor support, while less prominent in publication volume, shows substantial citation impact, reflecting its strong theoretical grounding across disciplines.

Across all themes, self-efficacy emerges as a central and highly connected construct within the scholarly landscape. Its positioning reflects frequent conceptual linkage with skills development, communication, and supervision rather than empirical evidence of mediation. These bibliometric patterns underscore the growing recognition of psychological dimensions in clinical education research.

By clarifying the intellectual structure and thematic connections within the literature, this study contributes a robust foundation for future research. Empirical studies employing longitudinal designs, mixed methods, or structural equation modeling are recommended to test the relationships suggested by the bibliometric findings and to further advance evidence-based approaches in medical education.

8 Recommendations for Future Research

Future studies should deepen empirical exploration of the relationships among medical skills, communication skills, supervisor support, and diagnostic performance, with self-efficacy as a mediator. Longitudinal designs could track how these variables develop across students' professional training. Comparative studies across national and international institutions would also provide insights into contextual differences.

Further research should also test educational interventions aimed at enhancing self-efficacy, such as clinical simulations, case-based learning, and structured supervisor feedback. Other variables like intrinsic motivation and peer support should also be explored to determine their interactions with diagnostic performance.

By expanding into these areas, future studies can develop practical models that directly inform curriculum design and clinical education strategies.

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