

LEXICAL AND AI-POWERED SEARCH FOR SCIENTIFIC DATABASE MINING

Pedro Almeida Moyano^{1,2}; Zainab Salam Sheikh³; Fatima Binte Athar³; Larissa Gouveia¹; Luciana Aparecida Campos¹; Ovidiu Constantin Baltatu^{1,3}

¹ Center of Innovation, Technology, and Education (CITE), Anhembí Morumbi University, Ânima Institute, São José dos Campos, Brazil.

(pedro.moyano@animaeducacao.com.br)

² Inspirali Research Organization (IRO), Inspirali, Ânima Educação, São Paulo, Brazil.

³ College of Medicine, Alfaisal University, Riyadh, Saudi Arabia. (obaltatu@alfaisal.edu)

Abstract:

Introduction: The exponential growth of scientific publications makes comprehensive literature retrieval increasingly challenging for systematic reviews. Traditional lexical searching relies on Boolean operators, controlled vocabulary (MeSH terms), and field-specific tags to retrieve documents through exact term matching. In contrast, AI-powered semantic search platforms employ natural language processing (NLP) and large language models (LLMs) to assess relevance based on conceptual alignment rather than keyword concordance. Whether these approaches are redundant or complementary remains unclear.

Objectives: To evaluate the comparative and complementary performance of lexical versus AI-powered semantic search methodologies for systematic review literature retrieval, using a review on aromatherapy effects in ICU patients as a case study.

Methodology: Three platforms representing distinct technological approaches were systematically searched: PubMed for lexical searching (MeSH-based indexing and Boolean logic), Elicit for AI-powered semantic searching (integrating Semantic Scholar, OpenAlex, and PubMed with machine learning relevance filtering), and Undermind for hybrid semantic searching (GPT-4-based relevance scoring with iterative citation network exploration). Cross-platform overlap and retrieval rates were quantified using DOI and title matching. Methodological limitations include potential indexing bias across databases and restriction to a single review topic as case study, which may limit generalizability to other research domains.

Results: Of 555 unique articles identified, only 12 (2.2%) appeared across all three platforms, while 463 (83.4%) were retrieved exclusively by a single platform. Retrieval rates for the 18 finally included studies revealed differential performance: Elicit identified 14 (77.8%), Undermind 12 (66.7%), and PubMed 9 (50.0%). Six articles (33.3%) were identified exclusively through AI-powered platforms, while none were retrieved exclusively by lexical search alone. Complete retrieval (100%) required combining all three platforms, representing a 22.2 percentage-point improvement over the best single platform. These findings carry practical implications across research domains: interdisciplinary fields with heterogeneous terminology may particularly benefit from multi-modal strategies, while highly standardized fields with well-established controlled vocabularies may experience smaller but still meaningful gains from AI-augmented searching.

Conclusions: Lexical and AI-powered semantic search methodologies provide complementary rather than redundant literature coverage. The minimal cross-platform overlap (2.2%) indicates that exclusive reliance on traditional searching may result in incomplete evidence synthesis. Multi-modal search strategies integrating both approaches should be adopted as standard practice for systematic reviews, particularly in specialized and interdisciplinary research domains.

Keywords: Artificial intelligence; Natural language processing Evidence synthesis; Systematic review; database mining