To use or not to use: ERIC database for medical education research

Michael T. Lam, Helen R. Lam, Manfred Gschwandtner, and Philip Chan

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To use or not to use: ERIC database for medical education research

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ABSTRACT

Introduction: Bibliographic databases are essential research tools. In medicine, key databases are MEDLINE/PubMed, Embase, and Cochrane Central (MEC). In education, the Education Resource Information Center (ERIC) is a major database. Medical education, situated between medicine and education, has no dedicated database of its own. Many medical education researchers use MEC, some use ERIC and some do not.

Methods: We performed a descriptive analysis using search strategies to retrieve medical education references from MEC and ERIC. ERIC references which were duplicates with MEC references were removed. Unique ERIC references were tallied.

Results: Between 1977 and 2022, MEC has 359,354 unique references relevant to medical education. ERIC provided 3925 unique references for the same period, all of which would be missed by searching only MEC. The mean unique ERIC medical education references per year for all 46 years is 85 ($SD = \pm29$), or 119 ($SD = \pm15$) for the last 10 years from 2013 to 2022.

Conclusion: ERIC consistently offered a small yet significant number of unique references relevant to medical education for decades. We recommend the use of ERIC for medical education research when comprehensive literature searches are required, such as in systematic reviews, scoping reviews, evidence synthesis, or guideline development.

Introduction

We live in a time of research information overload. In the year 2022 alone, 1.3 million new references were added to the MEDLINE database, the most popular bibliographic database for medical research [1–3]. As the size of the academic peer-reviewed literature continues to increase exponentially, strategic and conscious selection of bibliographic databases to conduct library research becomes crucial for efficient academic endeavors.

Medical education as an interdisciplinary subject area is at the crossroads between medicine and education. For this study, we defined medical education as the undergraduate, postgraduate education of medical students and postgraduate trainees, as well as the continuing education of qualified medical doctors [4]. To contain the scale of the study, our scope did not include the education of other health care professionals, such as pharmacists, nurses, physician assistants, dentists, etc. Interprofessional education is included in our research if it involves the training of medical students or physicians. Medical education, training, or teaching involves both classroom-based learning and more unstructured learning in the workplace, to train students in the skills for a particular job, that of a junior doctor, on graduation. Unsurprisingly, this unique feature has led to a parallel exponential increase in scholarly activity and research into medical education. For example, there was only a single journal specialising in medical education in 1955 in the English-speaking world (*J of Med Edu*, predecessor to *Acad Med*), joined by a second in 1966 (*Br J Med*

Practice points

- Medical education as an interdisciplinary subject area has no dedicated bibliographic database for retrieval of peer-reviewed studies.
- Many medical education researchers use MEDLINE/ PubMed, Embase, Cochrane Central (MEC) for library research due to the discipline's close ties with clinical medicine, as the three databases are recommended by the Cochrane Collaboration for clinical medicine evidence synthesis.
- ERIC is a major bibliographic database for general education, but there has been no validating study or guideline on whether it should be used for medical education research.
- Our study proves that ERIC is a worthwhile tool for medical education library research, particularly when comprehensive literature searching is called for, as in the cases of systematic review, scoping reviews, evidence synthesis, and guideline development projects.
- Low cost (free version available) and relatively small number of search results makes ERIC an easy-to-use supplement to MEC.

Edu, predecessor to *Med Edu*) [5]. There are now a lot more journals dedicated to medical education research. A simple tally of our main set of search results from MEDLINE,

Table 1. Search strategy for quick sampling of medical education systematic reviews in MEDLINE for the year 2022.

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions <1946 to January 05, 2023> Search Strategy:
1 exp Education, Medical/(182449)
2 exp Students, Medical/(42123)
3 exp Schools, Medical/(27727)
4 exp Faculty, Medical/(14620)
5 ((medical or surgery or surgical) adj1 (education* or educator* or instruction or curricul* or course* or mentorship or mentoring or mentor* or preceptor*)).ti,ab,kf. (73620)
6 ((teach* or learn*) adj1 (medicine or medical or surg* or diagnos*)).ti,ab,kf. (8045)
7 or/1–6 (250242)
8 limit 7 to English language (218061)
9 limit 8 to (meta-analysis or 'systematic review') (1688)
10 limit 9 to yr = '2022' (232)

Embase, Cochrane Central (MEC), and ERIC databases revealed 45 active medical education focused journals in the year 2022, which does not include some newer journals on the open Internet which have yet to be accepted and indexed by MEC and ERIC (Supplementary Appendix I). By and large, these journals are indexed by bibliographic databases concerned with medicine. However, we were aware that medical education articles continue to be published in journals focused on higher education, which might fall outside of the coverage of these medical databases. This might create a defect in search coverage for literature reviews and evidence synthesis in medical education.

Medicine has an arsenal of bibliographic databases available for retrieval of peer-reviewed studies. The Cochrane Collaboration has recommended the searching of MEDLINE/PubMed, Embase, and the Cochrane Central Register of Controlled Trials (MEC) for comprehensive medical literature searching required for evidence synthesis [6]. Medical education as an academic discipline does not have its own purpose-built bibliographic database [7]. Because of its close tie to the field of medicine, our impression is that medical education researchers use the same medical bibliographic databases recommended by the Cochrane Collaboration intended for medical research [5], namely MEDLINE/Pubmed, Embase, and Cochrane (MEC). Another interesting development in recent years is that both MEDLINE/Pubmed and Embase have gradually moved away from human indexing and rely heavily on computerised assignments of subject headings in the subject indexing of new records [8–10]. We are curious to see if this affects the subject indexing of peer-reviewed publications on medical education, as the quality of subject indexing directly impacts the chance of successful retrieval by database users.

ERIC (abbreviation of *Education Resource Information Center*) is a major bibliographic database in the field of education research. It is a database owned and maintained by the Institute of Education Sciences, United States Department of Education. ERIC is available for free on the Internet *via* the United States Education Department, Institute of Education Sciences website [11]. Researchers who prefer a more sophisticated search engine can access ERIC *via* a premium paid platform, such as Ovid [12].

In terms of subject coverage, at the beginning ERIC focused on special education, as well as primary, secondary, and university education [13]. While ERIC did not start out as a resource for professional education, over time, it gradually started adding small amounts of references on medical education, first reaching double digit number of references per year in the year 1977 as shown in our study.

When medical education researchers conduct research that requires comprehensive searching of the peer-reviewed literature, such as in the cases of systematic reviews or scoping reviews, making informed decision about the choice of bibliographic databases is essential to the success of the projects. Historically, some medical education research studies have included ERIC besides MEC in their research that called for comprehensive literature searches [7]. But to our knowledge, there is no study which validates the effectiveness of ERIC for medical education research. Our research question was whether ERIC provides any significant number of unique references not already covered by MEC. We conducted this descriptive study to provide the research community with validation on the use of ERIC in medical education library research.

Methods

Preliminary confirmation

Before our main research, to quickly confirm our impression that MEDLINE, Embase and Cochrane Central (MEC) are still the most popular bibliographic databases in medical education research, we designed and ran a simple tally in Ovid MEDLINE to find all the systematic reviews on medical education for the year 2022 (Table 1). We then examined the abstracts of all the resulting references and noted down the names of bibliographic databases used in the studies.

Design: The main research

The main research involved a simple quantitative descriptive study in the realm of information science or library science. We used search strategies to identify and count computer records in ERIC and MEC with a certain characteristic (on topic of medical education). After duplicate removal, the number of unique records on medical education found in ERIC but not found in MEC for each year was recorded (Figure 1).

Despite similarities to a cross-sectional observational study used in human epidemiology, our quantitative study is essentially a simple 'counting exercise' where computer records with a certain characteristic (on medical education) in four populations (four bibliographic databases) were counted for each year of the 46 consecutive years [14–17].

For this study, we used the Ovid versions of MEDLINE, Embase, Cochrane Central, and ERIC. We searched all four databases since their inception.
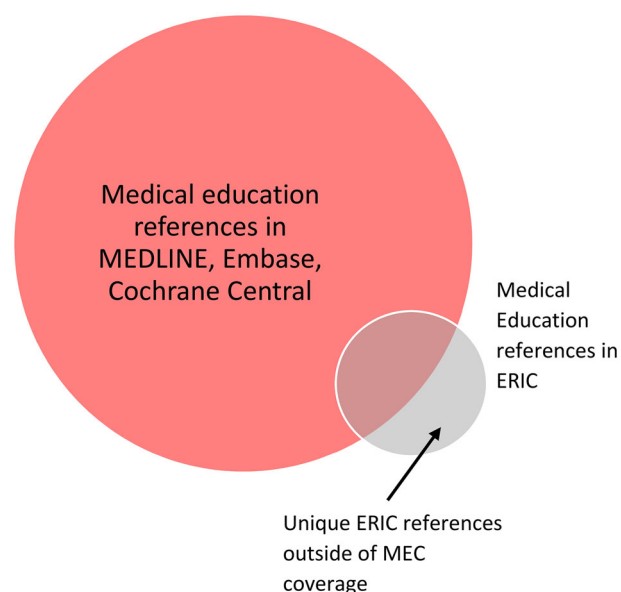
Medical education references in MEDLINE, Embase, Cochrane Central

Medical Education references in ERIC

Unique ERIC references outside of MEC coverage

Figure 1. Concept of research.

As with any comprehensive literature searching, we designed search strategies that included both controlled vocabularies (subject headings) and free text keywords (Table 2).

During the experimentation with different search terms, we noticed at an early stage that we needed to rely more on controlled vocabulary (also known as subject headings, MeSHs, Emtree terms) searches than free text keyword searches. We found that while free text keyword searches with phrases, such as 'medical schools,' 'medical education' would retrieve relevant references, searching with phrases, such as 'medical students' or 'medical trainee' would pull up too many irrelevant hits which are mostly clinical trials or clinical studies that involved medical students and trainees as research team members. In most cases, these clinical trial reports focus on the medical interventions or epidemiology being studied and have very little to do with medical education. Because of this issue, we decided to rely mainly on controlled vocabulary searches and be very selective when picking terms used in the free text keyword searches part of our strategies (Table 2). MEC was selected as the baseline database as this group has been recommended for medical research by the Cochrane Collaboration since 2002, and the three have been the most popular databases among authors of systematic reviews on medicine [3,6,18].

The search included two parts: part one was to search MEC as a group, and part two was to search only ERIC (Table 2).

Design: Data collection, processing and screening

We used the EndNote X9 reference management software to process all the references we obtained from the searches.

After the searches in MEC, we imported all MEC references, year by year, into EndNote to remove internal duplicates among the three databases. A separate EndNote file was created for each calendar year, from 1977 to 2022.

After importing references into EndNote, another round of screening was performed within EndNote to catch any irrelevant or off-topic hits retrieved by error. This step was necessary as no search strategy is perfect, and that there

would always be irrelevant hits regardless of how much effort has been put into the design of the search strategies. We used the internal keyword search function within EndNote X9 to highlight references that contain keywords related to dentistry, nursing, midwifery, and some other non-physician health professions. Keywords we used include: 'dentist,' 'dental,' 'veterin*,' 'pharmacy,' 'pharmacist,' 'nurse,' 'nursing,' 'physical therap*,' 'physiotherapy*,' 'midwi*' (midwife), 'optomet*,' 'physician assistant*,' 'physician's assistant*,' 'physician associate*,' 'diagnostic teaching.' We would then screen the references highlighted manually. Any references found focused solely on these professions and not relevant to medical education of medical students or physicians would be deleted. After all these steps, we ended up with sets of unique references from MEC relevant to medical education, for each calendar year. The number of references was recorded for each year.

We then followed the same steps to process references obtained from the search in ERIC. After the search in ERIC, we imported the results, year by year, into the same EndNote files that contained the MEC references for the year. Making use of the duplicate removal feature of EndNote as well as manual confirmation, duplicates with the existing MEC references were immediately detected, manually confirmed, and deleted, leaving behind only unique ERIC references not found in the MEC group of references.

Then the unique ERIC references went through the same EndNote internal keyword search process to have those focused on allied health education highlighted for manual confirmation. Any references not relevant to medical education were deleted. At the end, we tallied the number of on topic, unique ERIC references for each year (Figure 2).

Results

Preliminary confirmation

We surveyed systematic reviews on the topic of medical education as they appear in Ovid MEDLINE, in the year 2022 (Table 1). We found 232 references, and upon examination of the abstracts, there were 117 records which explicitly listed the choice of databases in the abstracts. Among these, 95% of the studies used MEDLINE/PubMed, 61% Embase, 39% Cochrane, and 23% used ERIC. We confirmed our impression that MEDLINE/PubMed, Embase, and Cochrane Central are the three most popular databases used by medical education researchers, and that majority of current systematic reviews in medical education *did not* use ERIC. Results from this quick tally, together with the recommendation by the Cochrane Collaboration for using MEC in evidence synthesis in the field of medicine, which was again confirmed as the actual practice of the research community [3,6], explained our decision in comparing the coverage of ERIC against that of MEC.

Unique references retrieved from MEC and ERIC relevant to medical education

Whilst our searches covered all the way back to the year 1946 for Medline and Embase, year 1966 for Cochrane

Table 2. Search strategies for main study: for MEDLINE, Embase, Cochrane Central, and ERIC.

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions <1946 to January 05, 2023>, Embase Classic + Embase <1947 to 2022 Week 52>, EBM Reviews—Cochrane Central Register of Controlled Trials < December 2022>:

1 exp Education, Medical/use ppezv (182449)
2 exp Students, Medical/use ppezv (42123)
3 exp Schools, Medical/use ppezv (27727)
4 exp Faculty, Medical/use ppezv (14620)
5 ((medical or surgery or surgical) adj (education* or educator* or instruction or curricul* or course* or mentorship or mentoring or mentor* or preceptor*)).ti,ab,kf. use ppezv (73620)
6 ((teach* or learn*) adj1 (medicine or medical or surg* or diagnos*)).ti,ab,kf. use ppezv (8045)
7 (or/1–6) use ppezv (250242)
8 limit 7 to english language (217343) [lines 1–8 strategy for MEDLINE]
9 medical education/use emcz (260717)
10 exp medical school/use emcz (73022)
11 exp residency education/use emcz (31864)
12 exp surgical training/use emcz (25507)
13 medical student/use emcz (88130)
14 ((medical or surgery or surgical) adj (education* or educator* or instruction or curricul* or course* or mentorship or mentoring or mentor* or preceptor*)).ti,ab,kw. use emcz (72592)
15 ((teach or learn) adj1 (medicine or medical or surg* or diagnos*)).ti,ab,kw. use emcz (1108)
16 (or/9–15) use emcz (400281)
17 limit 16 to English language (358721) [lines 9–17 strategy for Embase]
18 exp Education, Medical/use cctr (3578)
19 exp Students, Medical/use cctr (1261)
20 exp Schools, Medical/use cctr (79)
21 exp Faculty, Medical/use cctr (107)
22 ((medical or surgery or surgical) adj (education* or educator* or instruction or curricul* or course* or mentorship or mentoring or mentor* or preceptor*)).ti,ab,kf. use cctr (2161)
23 ((teach* or learn*) adj1 (medicine or medical or surg* or diagnos*)).ti,ab,kf. use cctr (475)
24 (or/18–23) use cctr (6138)
25 limit 24 to English language (6075) [lines 18–25 strategy for Cochrane Central]
26 8 or 17 or 25 (582139) [joint results from three databases]

Database: ERIC <1965 to February 2023> Search Strategy:
––
1 medical education/(10121)
2 exp graduate medical education/(1327)
3 exp medical school faculty/(943)
4 exp medical schools/(2985)
5 exp medical students/(4939)
6 ((medical or surgery or surgical) adj (education* or educator* or instruction or curricul* or course* or mentorship or mentoring or mentor* or preceptor*)).ti,ab,hw. (12192)
7 ((teach* or learn*) adj1 (medicine or medical or surg* or surgical or diagnos*)).ti,ab,hw. (2481)
8 or/1–7 (17193)
9 limit 8 to English language (13231)

Central, and year 1873 for ERIC, we decided to report only numbers since the year 1977, when the number of unique ERIC references on medical education became significant and reached double digit in one year for the first time.

We retrieved a total of 548,881 references relevant to medical education from MEC for the 46 years from 1977 to 2022. After duplicates removal and deletion of irrelevant or off-topic references focused on allied health education with second round of screening within EndNote, a total of 359,354 unique, relevant references were identified. The mean unique relevant medical education references found in MEC per year for the 46 years is 7812 ($SD = \pm6228$). The mean for the last ten years (year 2013 to 2022) increased to 17,398, with a significantly smaller variance ($SD = \pm2621$) (Supplementary Appendix II).

Our ERIC search retrieved a total of 12,954 references for the 46 years from 1977 to 2022. After removing duplicates with MEC and deletion of irrelevant or off-topic materials with second round of screening within EndNote, a total of 3925 unique, relevant ERIC references were identified. Upon careful examination of the ERIC search results, we discovered that the unique ERIC references consist of two subsets. The first subset, which includes most of the references, are the truly ERIC-only references (EORs). These references are absent in the MEC databases, meaning no

search strategies can lead to their discovery in MEC. The second subset is a small number of 'poorly indexed references' (PIRs). These ERIC references were also present in MEC but were hard to find in the latter group due to improper subject indexing by MEC (hence missed by our MEC search). The PIRs were properly indexed by ERIC with subject heading 'medical education/,' etc., and hence led to their retrieval by our ERIC search strategy without problem.

Out of the 3925 ERIC records not found in MEC search, 3641 (93%) were 'ERIC-Only References' (EORs), 284 (7%) were 'Poorly Indexed References' (PIRs). The mean EORs per year for the 46 years is 79 ($SD = \pm27$). The mean per year increased to 111 for the last decade (year 2013–2022), with a significantly smaller variance ($SD = \pm17$). The mean PIRs per year for the 46 years is 6 ($SD = \pm5$), with the last decade (year 2013–2022) at 8 per year ($SD = \pm6$), indicating a very small but consistent indexing issue in MEC for references on medical education (Supplementary Appendix II) (Figure 3).

Most of the ERIC-only References (EORs) are regular peer-reviewed journal articles published in *non-medical, general education* journals. These useful references have a high chance of being overlooked by medical education researchers as the general education journals they are
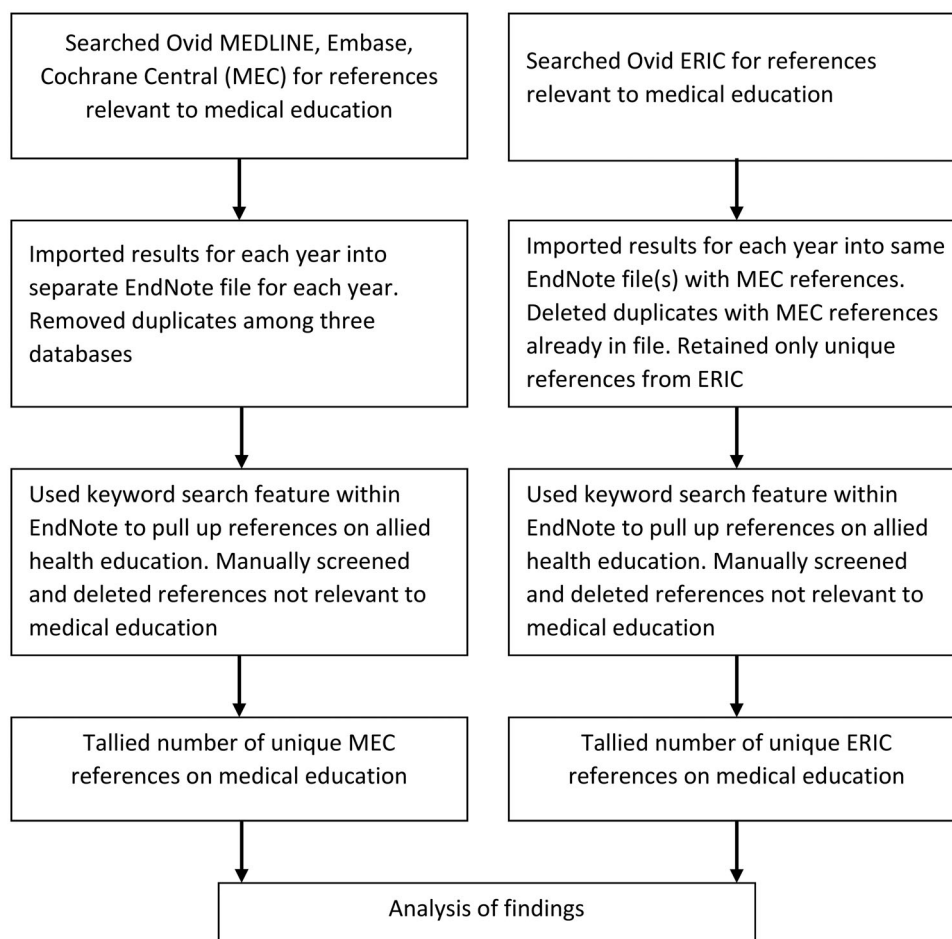
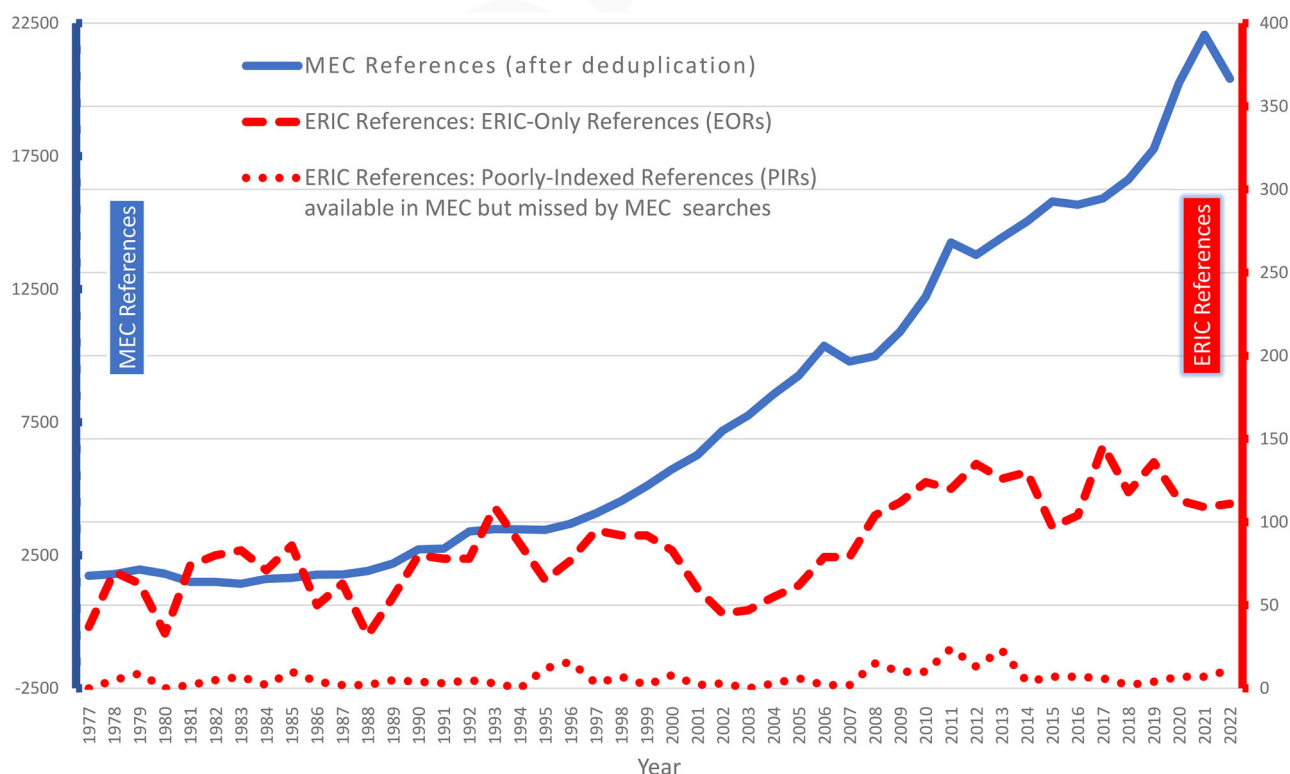**Figure 2.** Research process flow diagram.

Figure 3. Unique medical education references retrieved from MEC *vs.* ERIC.

published in are not covered by MEC. We have listed below a few examples of such *non-medical, general education* journals, their publishers, and the number of EORs they provided in the last few years (in bracket):

- *American Journal of Distance Education* (Taylor & Francis—3 EORs in 2019)
- *Assessment & Evaluation in Higher Education* (Taylor & Francis—4 EORs in 2020)

- *Cogent Education* (Taylor & Francis—3 EORs in 2021)
- *Education and Information Technologies* (Springer—4 EORs, year 2022)
- *International Journal of Education Management* (Emerald Publishing—3 EORs, year 2019)
- *International Journal of Higher Education* (Sciedu Press—4 EORs, year 2020)

Medical education papers published in these general education journals are therefore invisible to many researchers as a result of their absence in MEC.

Contrary to EORs, the Poorly-Indexed References (PIRs) were actually present in MEC but missed by our search strategy due to inadequate controlled vocabulary indexing (i.e. subject indexing) by MEC. MEC failed to recognize the implied subject matter of these references. MEC failed to tag these references with the controlled vocabularies 'Education, Medical/,' 'Students, Medical/' (in MEDLINE and Cochrane) or 'medical education/,' 'medical student/' (in Embase). There have been complaints about the inadequacy of controlled vocabulary (i.e. MeSH, Emtree) assignments in both MEDLINE and Embase, from health sciences scholars of different fields [19–22]. To our knowledge, both MEDLINE and Embase have both gradually moved away from utilizing human indexers to assign controlled vocabularies, but rather rely on computerised indexing [8–10]. We are not sure about the effect of this development on the quality of subject indexing in general, but our study results show that some medical education papers which did not explicitly use phrases, such as 'medical education,' 'medical students,' 'medical schools,' etc., in the titles, were not indexed correctly in MEC. Problems arise when a paper's relevance to medical education is subtle or implied. The ERIC database, contrary to MEC, at the writing of this paper, still uses human indexers in assigning controlled vocabularies [23]. We have selected below a sample from our ERIC search result to show how computerised (MEDLINE and Embase) *vs.* human (ERIC) indexing practice might affect the outcome. It is a highly cited 2019 paper by Dauphinee et al. is a paper which exists in but is inadequately indexed by MEDLINE and Embase and hence missed by our MEC search:

- Dauphinee, D.W., Boulet, J.R., Norcini, J.J. (2019) Consideration that will determine if competency-based assessment is a sustainable innovation. *Advances in Health Sciences Education: Theory and Practice* 24(2), 413–421.

It is a paper about the application of competency-based assessment in health care education including medical education. It was indexed correctly by ERIC with ERIC controlled vocabularies 'medical education/' and 'medical students/.' MEDLINE, on the contrary, has only indexed the paper with MeSH terms 'clinical competence/,' 'competency-based education/,' 'health occupations/ed [education],' but missed out on broader MeSH terms 'Education, Medical/, 'Students, Medical/.' Embase had the same issue by indexing this reference with Emtree terms 'clinical assessment/,' 'undergraduate assessment/,' 'postgraduate medical assessment/' but did not use broader Emtree terms 'medical school/,' 'medical education/,'

'residency education/,' etc. Since this paper is not a randomized controlled trial, it is outside the scope of Cochrane Central and hence not covered by the database. The overall result is that medical education researchers using only MEC have a significant chance of missing this reference if they rely on controlled vocabularies that represent broader subjects 'medical education' or 'medical student.' The same researchers who also use ERIC would have a good chance of capturing this unique paper thanks to more insightful subject indexing by ERIC.

Discussion

Due to the presence of EORs and PIRs, we argue that while it is true that MEC provides more than a hundred times more references on medical education in any given year than ERIC, ERIC can still be a valuable, easily accessible supplement after searches in MEC, especially when comprehensive coverage is necessary, such as in the case of systematic reviews, scoping reviews or any evidence synthesis projects. There are a few merits to using ERIC: free version available on the Internet, small number of references making for easier searching and faster screening, consistent availability of content on medical education year after year, and at times more complete subject indexing.

Another special feature of ERIC is that authors may propose their work for inclusion by ERIC, if it is not already indexed by the database [24]. This unique opportunity is not available in MEC, as inclusion of individual articles in MEC is dictated by the respective editorial policies and is mostly non-negotiable for individual works. The medical education community may potentially use this 'open for proposal' feature of ERIC to make known their significant published or unpublished work which they believe to be useful to the medical education community.

Another attraction of using ERIC is low cost. The free version of ERIC is an attractive option to researchers with limited access to expensive subscribed resources. Together with the free version of MEDLINE in PubMed, and the free version of Cochrane Central on the Cochrane Library website, researchers can conduct evidence syntheses in the field of medical education without any paid databases. The only missing database from this group is Embase, which is a costly, for-profit database that has recently been downgraded as an optional database by the Cochrane Collaboration for the purpose of systematic reviews on medical topics [6].

Our recommendation is for any researcher conducting evidence syntheses, systematic reviews, meta-analyses, scoping reviews, or preparing medical education practice guidelines to add ERIC as a supplement to searches in MEDLINE, Embase, and Cochrane Central. Due to a lower yield, we think ERIC is optional and not necessary for other research types that do not require comprehensive literature searches.

Strengths and limitations

Our study is the first study validating ERIC as a bibliographic database for medical education secondary research.

The search strategies we used are reasonably comprehensive and they covered common controlled vocabularies (MeSHs, Emtree terms, ERIC subject terms) and free text keywords likely used by researchers or librarians when conducting research in medical education. We believe the descriptive data we reported and the recommendation we made based on our research is practical to the medical education research community.

There are some limitations to our study. The first is that our search strategies in MEC and ERIC are not perfect, as no search strategies are. Search strategies are always compromises between recall (sensitivity) and precision (specificity), and researchers need to customize strategies for the project on hand according to many practical considerations, such as whether comprehensive coverage is essential for the project on hand, how much manpower is available for references screening, etc. It is possible that our search strategies might have missed a small number of references, but any imperfection in our search strategies does not alter the fact that we were successful in confirming there are indeed a constant stream of unique medical education references in ERIC that are absent in MEC. Another limitation of our study is that whilst we did confirm the practical usage of ERIC in medical education research, the value of some other generic scientific databases, such as Scopus or Web of Science, remains unknown and is outside the scope of our study.

Conclusion

ERIC as a bibliographic database in the field of education consistently provides a small but significant number of unique references relevant to the subject of medical education not found by searches in MEDLINE, Embase and Cochrane Central. With a version of ERIC freely available on the Internet, we recommend its use in any medical education research projects where comprehensive searching of the peer-reviewed literature is required, as a supplement to searches done in MEDLINE, Embase, and Cochrane Central.

Ethical approval

This is a descriptive analysis based on examination of the records of four bibliographic databases, no human subjects, human records, or animal subjects are involved, and hence no ethical approval is required.

Author contributions

This is an original work from the four authors, who all made substantial contributions to the conception, design, and/or the acquisition, analysis, and interpretation of data. All authors took part in the drafting, revision, and final approval of the manuscript. All four authors agreed to be accountable for the content of the manuscript.

Disclosure statement

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