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A Rapid Evidence Assessment on the Impact of Curriculum Mapping as an Educational Design Tool in Medical Education

Dr. Natasha Quandour
natasha.quandour@gmail.com
ORCID ID: 0009-0003-5506-1767

Abstract
This paper presents a rapid evidence assessment examining the impact of curriculum mapping in medical education, based on an analysis of forty studies synthesized using Elicit, an AI-powered tool. The review addresses two primary research questions: the effect of curriculum mapping on student learning outcomes and its impact on institutional efficiency. The findings reveal a significant divergence, with a notable absence of robust, quantitative evidence for a direct, measurable impact on student learning, while a majority of studies documented substantial improvements in administrative efficiency. This assessment suggests that while curriculum mapping is a highly effective tool for institutional management, its pedagogical benefits to students are less frequently substantiated in the existing literature. The methodology's reliance on a single AI tool for data synthesis is a key limitation of this work.
Keywords: Curriculum Mapping, Medical Education, Institutional Efficiency, Student Outcomes, Competency-based Education, Systematic Review, Rapid Evidence Assessment.

1. Introduction
Curriculum mapping has emerged as a critical tool in modern medical education, driven by the need for enhanced transparency, quality assurance, and alignment with national competency frameworks. The process aims to provide a clear, structured view of a curriculum, linking learning objectives to course content and assessment methods. While its administrative benefits are widely assumed, the extent to which it directly and measurably improves student learning remains a topic of scholarly inquiry. This review presents findings from an initial systematic literature analysis to provide a structured overview of the current evidence, focusing on the distinct impacts of curriculum mapping on institutional processes and student outcomes.

2. Research Questions
This rapid evidence assessment was guided by the following two research questions:
1. Do curriculum mapping tools lead to measurable improvement in student learning outcomes, such as higher grades or better retention?
2. What is the impact of technology-enabled curriculum mapping on the efficiency of institutional processes, particularly accreditation and program reviews?

3. Study Characteristics
The review included articles and conference publications that focused on curriculum mapping in a medical education context. The studies were required to address one or both of the two key research questions outlined above.

To be included, studies had to meet specific criteria, including:
- **Title Keywords:** The title had to include "curriculum mapping" or "mapping."
- **Medical Education:** The study had to be conducted within a medical education setting, such as medical schools, residency programs, or other healthcare professional education.
- **Curriculum Mapping Focus:** The study had to focus on curriculum mapping as a primary topic, examining its processes, tools, or implementation.

- **Publication Type:** The publication type was restricted to articles or conference publications.
- **Primary Research:** The study had to present primary research, systematic reviews, or meta-analyses, rather than commentaries or opinion pieces.
- **Relevant Outcomes:** The study had to report outcomes related to either student learning (e.g., grades, retention) or institutional process efficiency (e.g., accreditation, administrative efficiency).
- **Implementation Focus:** The study needed to describe, evaluate, or analyze the implementation or use of curriculum mapping in practice.
- **Sufficient Detail:** The study had to provide sufficient methodological detail or data to meaningfully contribute to the review.

4. Methodology

A rapid evidence assessment was conducted to synthesize findings from a pre-identified corpus of literature, guided by PRISMA's guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Haddaway et al., 2022)) to ensure rigor and transparency.

Search and Screening

The search was performed across the PubMed and Scopus academic databases, yielding a total of 286 sources. After 19 records were removed before screening, the researcher manually screened the remaining sources and selected 109 based on two exclusion criteria: the presence of keywords like 'curriculum mapping' or 'mapping' in the title and the accessibility of the full paper.

These 109 sources were then uploaded to the AI-powered synthesis platform, Elicit, for automated screening and data extraction (*AI-Enabled Systematic Reviews*, n.d.). The Elicit AI tool screened these sources and identified a final corpus of 40 studies for inclusion in the review, after excluding 50 records. The selection process is detailed in the PRISMA flow diagram (Figure 1).

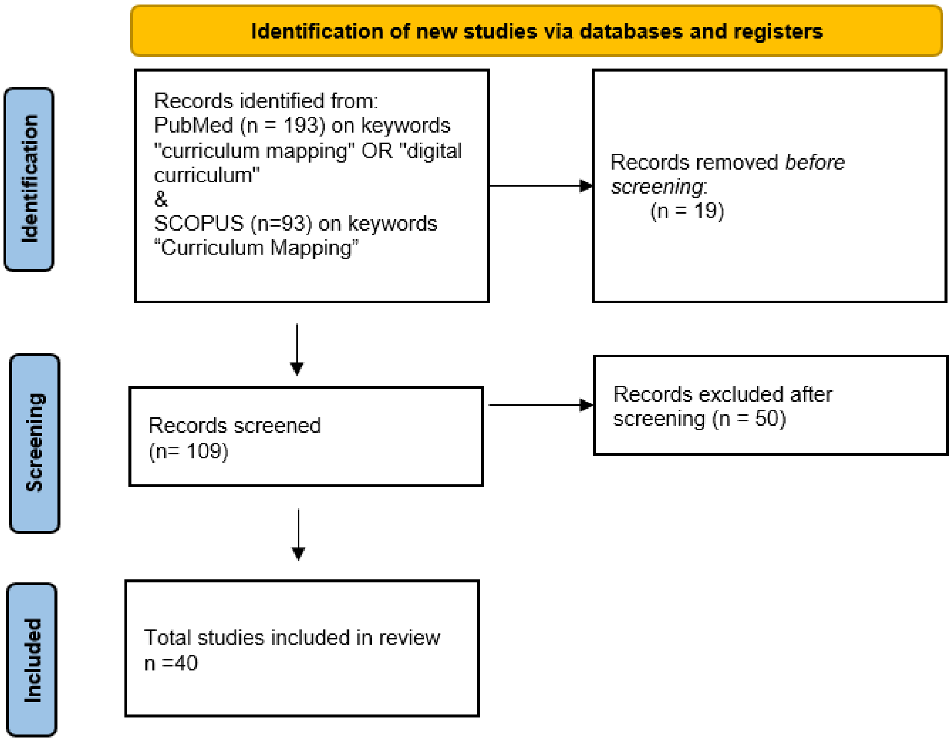

Figure 1: Selection of Publications for the Review

Data Extraction
The AI platform ‘Elicit’ was used to automatically extract data from the papers. The model was provided with a detailed set of instructions for each data column, covering study context, mapping system, student outcomes, institutional impacts, and other relevant factors. Due to the technical limitations of the Elicit AI model, the report was synthesized from the 40 sources for inclusion in the findings presented here.

5. Findings
The systematic review of forty studies revealed a clear and significant divergence in the documented effects of curriculum mapping. The findings are presented here as a straightforward report of the data, without extensive interpretation.

5.1. Student Learning Outcomes
Out of the forty studies on curriculum mapping in medicine that were examined, only thirteen attempted to quantify student learning outcomes. Of these, a mere two studies reported statistically significant improvements in grade performance and multiple-choice question scores(Balzer et al., 2016; Sterz et al., 2019). One study noted enhanced resident satisfaction (Bapat et al., 2018), while another documented heightened student perceptions of domain coverage (Abdolalipour et al., 2023). The remaining studies either provided qualitative feedback (e.g., improved competency achievement or skill development; (Alsayed & Omer, 2022; Gmeiner et al., 2017) or did not assess student outcomes.

5.2. Institutional Efficiency
In contrast, thirty-nine studies documented process impacts in areas such as accreditation, quality assurance, and coordination. Technology-enabled systems (for example, MERlin (Fritze et al., 2019), Looop (Balzer et al., 2016), EDUportfolio (Kononowicz et al., 2020), and a ChatGPT-based tool (Babin et al., 2024)) facilitated clearer data visualization, streamlined reporting, and reduced administrative workload. Quantitative improvements included 14 of 38 faculties adopting a new system (Komenda et al., 2015), 2,400 hours attributed to mapping activities, 5,000 users generating 380,000 visits per year, and a 50% reduction in faculty workload with 88.1% agreement between automated and human mapping (Jaroslav Majernik et al., 2022). These findings indicate that while measurable improvements in student outcomes were seldom reported, technology-enabled curriculum mapping is associated with enhanced efficiency in institutional processes.

6. Discussion
The clear dichotomy between the documented institutional and student-level impacts of curriculum mapping highlights a significant gap in the literature and practice. The findings suggest that while curriculum mapping is an exceptionally effective tool for administrative and institutional management, its direct pedagogical benefits for students are less frequently substantiated. This section delves deeper into the potential reasons for this disparity and discusses the broader implications for practice and future research.

6.1. The Dichotomy: Why the Disparity?
There are several plausible explanations for the observed divergence:

- **Difficulty of Measurement:** Quantifying student learning outcomes is inherently more challenging than documenting administrative efficiency. Metrics such as grades and test scores may not fully capture the nuanced benefits of a well-aligned curriculum. In contrast, institutional metrics like reduced faculty hours or successful accreditation are more concrete and easily verifiable.
- **Motivation for Implementation:** The primary motivation for implementing curriculum mapping tools in medical education may be administrative, not pedagogical. Institutions often adopt these systems to meet accreditation requirements, ensuring alignment with national standards and facilitating quality assurance processes. Student learning, while a stated goal, may be a secondary

benefit rather than the primary driver. The tools themselves are designed to be faculty- or administrator-facing, serving as a repository of information for quality control rather than an interactive guide for student learning.

- **Static vs. Dynamic Nature:** The current discussion points to a key limitation: many of the mapping methodologies reviewed create a "static view" of a program's structure. The existence of a mapped competency in a course does not guarantee that it is effectively taught or retained. This suggests a possible disconnect between the formal curriculum (what is mapped) and the lived or "actual" curriculum experienced by students.

6.2. Implications for Practice and Future Research

Based on these findings, a two-pronged approach for practice and future research is proposed.

Implications for Practice: Based on these findings, it is proposed that medical education institutions take a two-pronged approach to curriculum mapping to maximize both institutional and pedagogical benefits. First, institutions could move beyond using curriculum mapping as a static, administrative exercise. Instead of simply creating a document for accreditation, they could evolve their systems into a dynamic, pedagogical framework. This means:

- **Making the map a student-facing tool:** Empower students to use the curriculum map to visualize their learning pathways, identify connections between courses, and take a more active role in their education.
- **Integrating the map into daily practice:** Faculty could be trained to use the map as a real-time guide for teaching and assessment, ensuring that what is taught in the classroom is a true reflection of the mapped curriculum.

Second, institutions could leverage the documented institutional efficiency benefits to free up resources for pedagogical innovation. The time saved on accreditation and administrative tasks can be redirected towards developing and implementing a more dynamic curriculum. This reframing of curriculum mapping from a compliance-driven activity to a tool for continuous pedagogical improvement is a critical next step for the field.

Implications for Future Research: The absence of robust quantitative evidence calls for a more rigorous and diverse research agenda. Future studies could move beyond descriptive case studies and employ more rigorous methodologies. The following are recommended:

- **Quasi-experimental designs:** Studies that compare student outcomes in programs with and without a dynamic, student-facing curriculum map.
- **Longitudinal studies:** Research that tracks the long-term impact of curriculum mapping on student learning and retention.
- **Mixed-methods approaches:** Studies that combine quantitative data on student performance with qualitative data on student and faculty perceptions to provide a more holistic understanding of the impact.

7. Limitations

This review, while systematic in its approach, is subject to several key limitations that affect the interpretation of its findings.

- **Reliance on an AI tool:** The most significant limitation of this assessment is the reliance on a single, proprietary AI-powered tool (Elicit) for both screening and data extraction. Unlike a traditional systematic review with multiple independent researchers, this approach introduces a risk of selection and reporting bias as the AI's interpretation and synthesis of the data cannot be fully verified. The non-transparent, "black box" nature of the AI's algorithms means its internal reasoning for study selection and data emphasis cannot be assessed, which may lead to systematic bias or failure to capture the full nuance of the source material.

- **Qualitative Nature of Studies:** A significant limitation is the heterogeneity and qualitative nature of most studies analyzed. The majority were descriptive case studies, which restrict the ability to perform a meta-analysis or to draw causal conclusions about the effect of curriculum mapping on student learning.
- **Sample Size:** The final analysis was based on a selection of 40 studies from a larger pool of 90 screened sources due to the AI tool's processing limitations. While a preliminary review of the larger set confirmed the trends, the conclusions are based on a more limited sample than initially identified.

8. Conclusion

The findings of this rapid evidence assessment literature review confirm that while curriculum mapping is an exceptionally effective tool for improving institutional efficiency, its direct link to measurable improvements in student learning outcomes is not well-established. This disparity suggests a need for future research to employ more rigorous methodologies to assess student performance and for the development of curriculum mapping tools that are more directly integrated into the student learning experience.

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