Rethinking Systematic Review Assignment Design in Graduate Health Science Education from Librarians' Perspectives

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Abstract

Background: This article examines the problematic phenomenon of faculty assigning graduate health science students systematic reviews as semester-based assignments while expecting a health science librarian to be a willing support system for those students. Despite published conduct and reporting guidelines establishing that systematic reviews require a team, time, and methodological expertise, some faculty still turn to full systematic review assignments in the classroom. The authors propose applying cognitive load theory and chunking the systematic review process into manageable steps, allowing both faculty and students to better understand the required methodologies and to enhance educational outcomes.

Experience: The authors have often been invited to visit classes where faculty have required students to complete a full systematic review. These assignments often result in frustration among faculty, librarians, and students stemming from the faculty's limited experience with the methodology and students feeling overwhelmed by the process. While the authors' experiences with suggesting the adaptable assignments to faculty is limited at the time of this publication, it is the hope of the authors that by sharing these concepts with other health science librarians, the trend of adapting more appropriate review assignments will expand.

Discussion: Through applying cognitive load theory and chunking principles to simplify the systematic review process, the authors propose approaches to systematic review research methods that can improve the educational process, ameliorate faculty workload, and enhance student learning outcomes. As a result, students will be more prepared in future research endeavors. Challenges include faculty adoption and acceptance of different approaches to systematic review assignments, and a further burden on the librarians who support these types of assignments.

Takeaways: The authors aim to raise faculty awareness of proper systematic review methodologies by offering alternative assignments that enhance student learning outcomes and alleviate the librarian's teaching burden. Initial attempts to promote these adaptations have shown promise, with some faculty successfully revising their syllabi and capstone projects to align with the suggested modifications. Future research will include webinars for faculty on systematic review methodologies, followed by ongoing evaluations of how these modifications impact the health science curriculum.

Background

"I need you to visit my research methods class this fall. My students are going to be doing a systematic review and we need your help." What health science librarian has not received a similar invitation from faculty while feeling secretly resentful and frustrated at having to support a methodology that is not suited to the classroom?

Many health science programs encourage students to learn the skills they will need to perform research within their profession. To instill these research skills, many health science graduate program faculty assign systematic reviews as a semester-based individual or group project, and subsequently may invite a librarian to the classroom for support. Academic librarians, especially health science librarians, are increasingly viewed as research collaborators given

their skills in information organization, database structure, and searching[1-4]. It is generally well known among librarians, however, that systematic reviews require an in-depth knowledge of the complex standardized methodology in order to produce the quality of evidence necessary for the domains of medicine and health. The authors have observed a lack of faculty knowledge about the full systematic review methods process. Faculty inability to mentor students through a systematic review assignment impedes student learning outcomes and student success. By applying the educational principles of cognitive load theory (CLT) and chunking, which entails breaking down large tasks into smaller ones, the authors recommend several alternative methods to provide opportunities for faculty to implement learning about the standardized methodology required of systematic reviews. Enhanced knowledge could lead to positive outcomes for everyone involved: the faculty, the students, and the librarian.

Systematic reviews are often considered the highest quality of evidence due to their adherence to rigorous evolving published conduct and reporting standards[5]. Consequently, reviews that do not adhere to the strict methodology cannot be considered trustworthy[6-14]. A recent flourish of published systematic reviews has demonstrated a general lack of knowledge regarding the rigorous methodology and reporting standards throughout the healthcare and medical fields[8,9,11,15–19].This wave of inaccurately conducted and reported reviews has led to unreliable evidence, inaccurate estimates of treatment effectiveness, misleading conclusions, reduced applicability, and significant research waste[11]. Similarly, due to the recent evolution of graduate education programs in the health science fields, many faculty report a lack of knowledge and skills needed to advise in such projects[20–29]. This shortfall of experience is supported in other studies that have also found a limited community of researchers who thoroughly understand the methodology of systematic reviews, and a majority of faculty who lack training in this methodology[22,26–28,30,31]. In scholarship arguing for and against systematic reviews as graduate projects, most authors agree that the lack of faculty knowledge and experience with these reviews is a major barrier[26–28,31,32].

Scientific scholarship promotes skills of inquiry, analysis, critical thinking, and communication among healthcare professionals[21]. Promoting research skills in the classroom provides students with the opportunity to learn about methodologies, to develop database search strategies, to appraise research, to synthesize evidence, and to translate knowledge into practice[21,23,24,33,34]. While all of these skills can be gained by completing a systematic review, this type of literature review introduces challenges, due to the complexity of the standardized methodology, the possible lack of mentor knowledge or experience, time constraints, and the group nature of such projects[6,7,14,35,36]. The assignment of systematic reviews has led to controversies in the scholarship supporting and opposing such assignments in health science graduate programs due to the lack of experienced and knowledgeable faculty to act as supervisors[20,22,26–28,30-32,37]. This has also resulted in mixed feedback from students and faculty who describe the work as demanding in terms of the time and knowledge required[24]. Additionally, the final product of these review assignments rarely aligns with the standardized conduct and reporting standards. This significantly reduces the effectiveness of the overall exercise since the final review: 1) is most likely not publishable, and 2) has incorrectly influenced the students' understanding of how a systematic review is conducted[12,16,17,19].

The ability to comprehend and apply the complex methodology of a systematic review can be the primary hurdle for students assigned this type of project. The process of learning this

methodology according to the standardized methods presented by regarded organizations such as the Cochrane Collaboration or JBI, compounded by the pressures of graduate research assignments, can lead to cognitive overload for students and significantly impact learning outcomes[6,14,38]. The basic premise of cognitive load theory (CLT), "...is that human cognitive processing is heavily constrained by our limited working memory which can only process a limited number of information elements at a time.[39]" This theory postulates that when a learner is presented with an overload of new complex information, the working memory is unable to process the information and this leads to cognitive overload[38,40,41]. CLT proposes an instructional design method known as "chunking" to reduce the cognitive load associated with learning new information. Chunking reduces the complexity of an overall task, groups relevant information into an organized representation, allows time between learning episodes, and optimizes successful completion by advancing students through a simple to complex assignment process[38,40–44]. By chunking the aspects of learning the methodology process of a systematic review, the learner is able to merge prior knowledge into a cohesive unified framework and develop the expertise required to complete evidence-based research[45,46].

Chunking can be incorporated into the instructional design of teaching the systematic review process, which can help reduce the cognitive overload reported by students. By chunking the steps of a systematic review, the student will be able to build upon previously learned research skills and progress toward the more complex elements of a review with more confidence and likelihood of success. The chunked assignments presented in this article will introduce students and faculty to the skills and methodology required of a full systematic review in steps, which can and should replace a full systematic review assignment based on the authors' expertise with the methodology and their experience in a multitude of health science classrooms.

Experience

The authors of this paper are academic health science librarians who have provided research support to undergraduate, graduate, and practicing healthcare professionals. Librarian and information specialists, can specialize in various roles to support systematic reviews; inclusion of these specialists often leads to higher quality searching and reporting[1,2,4].

The authors have been invited to numerous graduate classes where "systematic reviews" have been assigned. Often, the librarians are then expected to teach some kind of in-class instructional session and create learning materials or an instructional narrative to support the students in completing a semester-based systematic review. However, as noted earlier, full systematic reviews are not suitable for graduate students due to the guideline requirements, and the timeline of a systematic review is also not feasible within a typical semester. Anecdotal experience of the authors and informal discussions with their librarian colleagues illustrate that these scenarios can often result in feelings of frustration for all parties. As a case in point, one of the authors was invited to a class where the students were required to complete a systematic review. The faculty requested that the PRISMA Checklist and the PRISMA Flow Diagram be demonstrated and explained as part of the library instruction session. However, when the librarian demonstrated the PRISMA Flow Diagram, which captures total search results, duplicates, included records, and excluded records as they are moved through the systematic review screening process, the students became extremely distraught. Upon delving deeper, the author realized that the students were not doing a

comprehensive literature review, and neither were they planning to document their searches. Rather, the students had been directed by the faculty to handpick articles they felt were relevant to their topic, making the application of the PRISMA Flow Diagram and the PRISMA Checklist impossible. The faculty member failed to realize this disconnect between their instruction and the assignment. The author left the classroom feeling distressed.

Due to multiple experiences like these, the authors wish to make recommendations that are better suited to the classroom, as well as to provide other academic health science librarians with examples to present when faced with similar circumstances. The assignments presented here were developed with the Cochrane Collaboration and JBI systematic review conduct guidelines, as well as the PRISMA reporting statement and its extensions, in mind[6,14,18]. Even though the authors do not recommend that students be assigned or attempt to complete a full systematic review within a semester, they still believe that it is possible to provide students with research experiences that will assist them to produce true systematic reviews in the future[6,14,35]. The authors have applied their experience and knowledge working with graduate health science students and faculty to address the hurdles often presented with systematic review assignments and subsequent librarian collaborations.

The listed assignments include a brief description, learning outcomes, and are presented in order of increasing complexity. The authors also recommend that these assignments be completed as a group. The systematic review process requires a team of experts, so by completing these assignments in a group setting, the students will learn how the team process reduces bias within the systematic review method[6,14]. The suggested assignments can be incorporated into a variety of pedagogical techniques as necessary and appropriate for the classroom environment. Faculty and health science librarians may adapt these chunked assignments in the same way that they may have adapted a full systematic review assignment for the classroom; that is, with a rubric and curriculum to support the student, tailored to the needs of the discipline. Because these assignments are more feasible than a full systematic review, the authors feel that faculty who adopt and adapt these practices may have more fruitful collaborations with librarians and better student academic outcomes. Most health science librarians who have supported evidence synthesis are familiar with the ideas around literature review typologies, topic and protocol development, systematic searching and screening, risk of bias/critical appraisal, data extraction, synthesis, and peer review of academic manuscripts, enabling them to support such assignments more actively.

Table A. Chunked Assignment Summaries

Assignment	**Summary**
Narrative Review	A **narrative review** allows students to learn the literature review process without the necessity of a comprehensive literature search, critical appraisal, data extraction, a team, or time.
Systematic Review Protocol	A **systematic or scoping review protocol** contains many of the same reporting elements as the final review but can be performed as an independent exercise within a shorter amount of time.

Systematic Search and Search Methods	Conducting and reporting a documented and reproducible **literature search** helps students understand the foundation of a systematic literature review.
Risk of Bias/Critical Appraisal	**Critically appraising or determining the risk of bias** of a set of relevant research requires that students become familiar with the standardized instruments, research design, and advanced critical thinking skills.
Data Extraction	Having students **extract data from relevant published studies** requires them to adhere to pre-defined criteria and manage research data in a transparent way.
Qualitative Synthesis	**Qualitatively describing how the data answers the research question** allows students to determine the strengths and weaknesses of the data, identifies evidence gaps, and compare the findings with existing scholarship.
Peer Review	**Peer review** is a process all scholars will experience in their career, whether it is in the form of receiving or providing this feedback. Conducting a peer review of another student's work allows students to learn to provide gracious yet constructive feedback. The peer review can be completed with any of the alternative assignments suggested.
Systematized Review	While a **systematized review** does not meet the strict criteria for conducting and reporting a systematic review, it can work as an introduction to the process and be performed by an individual or group within a shorter time frame.

While pairing assignments together is not necessary, suggested pairings have been provided dependent on the scope and goals of the research methods course.

Narrative Review Assignment

A narrative literature review is an integrated analysis of the existing literature used to summarize a body of scholarship, draw conclusions about a topic, identify research gaps, justify the need for the research question, and develop a broad overview of a topic. By understanding the current state of the literature, one can show how new research fits into the larger corpus of literature. The purpose of a narrative literature review is to explain the background of the research on a topic; identify major themes, concepts, and scholars; and highlight critical gaps, points of disagreement, or flawed approaches. This type of literature review can also suggest new areas of research. A narrative literature review is often the opening section of many published articles and is a necessary pedagogical step to introduce the purpose of a systematic review. The complexity of the narrative literature review assignment can be modified depending on the course objectives, and steps in the process can be further chunked to meet timelines throughout the semester.

Students can use a topic of their choice or a current assignment to complete a narrative literature review, which can be graded according to a rubric. A collaborating librarian can assist with topic development, resource selection, searching, and records management.

Learning objectives for the Narrative Review Assignment include:

- Students will develop a research question.
- Students will search for literature to answer the research question.
- Students will distinguish appropriate databases for their topic of inquiry.
- Students will format and construct a literature review.
- Students will synthesize themes.
- Students will accurately cite sources.

Systematic Review Protocol Assignment

One of the initial steps for completing a systematic review is to develop and register a protocol. The purpose of a protocol is to provide a detailed plan for the review project, reduce the risk of bias within the review, and establish providence of the research question to be evaluated[47]. Students can learn how to plan the steps and the workflow of a systematic review by following the PRISMA-Protocol reporting guideline[47].

Students may use a previously developed topic, or a topic related to a class assignment to complete the protocol assignment. The PRISMA-Protocol checklist provides instructors with a grading rubric for the assignment[47]. A collaborating librarian can discuss different review types, help students plan and potentially execute their literature search, and support student knowledge on protocol development.

Learning objectives for the Systematic Review Protocol Assignment include:

- Students will develop a research question.
- Students will summarize the steps and methodology of the research process of a systematic review.
- Students will recognize and identify the resources available to develop a protocol according to established guidelines.

Systematic Search and Search Methods Assignment

Developing an appropriately sensitive and specific search strategy to ensure that the results are comprehensive for a systematic review is a complex task which often involves days of work for health science librarians. This process involves learning how to determine which search terms and databases are applicable to the research topic, identifying the appropriate controlled vocabulary within the chosen databases, and translating the search strategy from one database to another to ensure a systematic search[6,14]. In addition to the development and

translation of the search strategy, a systematic review requires that the search strategy be documented in enough detail to be reproducible[48]. Documentation of the search strategy is done according to the PRISMA-Search (PRISMA-S) extension standards and recorded in a PRISMA Flow Diagram[13,48]. Developing a systematic and comprehensive search strategy is a major factor that distinguishes a systematic review from other types of reviews, and arguably an important foundation of the review[49].

Students will conduct a comprehensive literature search in three to five bibliographic literature databases and report the search with the elements of PRISMA-S extension[48]. It is recommended to invite a health science librarian or information specialist to be embedded in the class to advise on searching comprehensively in academic databases for scholarly, peer-reviewed literature and documenting the search[2,4]. A collaborating librarian can assist students with selecting the best databases to search and provide tips for creating documented, reproducible searches.

Learning objectives for the Systematic Search and Search Methods Assignment:

- Students will develop a research question.
- Students will demonstrate learned search skills through the successful retrieval of evidence.
- Students will identify optimal databases for evidence-based practice in health science.
- Students will understand how to document a reproducible search strategy.

This assignment is best paired with the Peer-Review Assignment.

Risk of Bias Assessment/Critical Appraisal Assignment

Critical appraisal "is the process of carefully and systematically examining research to judge its trustworthiness, and its value and relevance in a particular context. It is an essential skill for evidence-based practice because it allows healthcare professionals to find and use research evidence reliably and efficiently.[50]" Critical appraisal of the evidence to be synthesized is a vital step in the methodology of a systematic review because it can highlight the risk of bias in results, which can affect the quality of the evidence incorporated[6,14]. The process involves becoming familiar with standardized instruments and critical appraisal checklists, such as those from JBI and the Critical Appraisal Skills Programme (CASP), learning the whys and hows of bias assessment and critical appraisal, and using critical thinking to determine the validity, reliability, and relevance of a study in relation to the research question[12,50,51].

Start by providing the students with a set of key studies that can be appraised with the use of checklists or other tools. Collaborating librarians can then assist with determining the value and quality of publications through recognized information literacy techniques.

Learning objectives for the Risk of Bias Assessment/Critical Appraisal Assignment:

- Students will use critical thinking and appraisal skills.
- Students will appraise critically through the use of the standardized checklists.

- Students will identify markers of validity, reliability, transparency, and relevance of research methods.
- Students will distinguish methodological quality within a scientific study.

Data Extraction Assignment

Data extraction is the first step in the synthesis process of a systematic review. This step requires that the review team adhere strictly to the inclusion and exclusion criteria identified by the review authors and extract data according to those elements. For this assignment, the students may work independently and then come together as a team to discuss their findings. Additional information regarding the data extraction process can be found in Chapter 5 of the *Cochrane Handbook for Systematic Reviews*[6].

Start by giving students a collection of predetermined key studies on a chosen topic. Provide adaptable templates that students will use to extract data elements of the studies such as population, participant demographics, intervention, methodology, and more. Collaborating librarians can provide classroom instruction in records management.

Learning objectives for the Data Extraction Assignment:

- Students will design a data extraction process for a systematic review.
- Students will describe the process of extracting specific criteria.
- Students will differentiate between data collection, data management, and process documentation.

This assignment is best paired with the Qualitative Synthesis Assignment.

Qualitative Synthesis Assignment

Qualitative synthesis of the data extracted is a required aspect of a systematic review. This process is completed regardless of whether or not a quantitative meta-analysis is also done. The qualitative synthesis is a narrative thematic analysis of the themes found within the data and usually includes a summarization of the general characteristics that were identified along with any relationships, patterns, heterogeneity, and degrees of consistency that were observed. This narrative will also describe how the data answers the research question, determine the strengths and weaknesses of the data, identify evidence gaps, and compare the findings with known scholarship. Additional information regarding the qualitative evidence synthesis process can be found in Chapter 21 of the *Cochrane Handbook for Systematic Reviews*[6].

Students will select five to ten key research articles based on their research question. They will then provide a detailed summary of these articles using an adaptable template or form for identifying themes and categories. Collaborating librarians can assist students with planning and executing a literature search and finding other qualitative syntheses as model publications.

Learning objectives for the Qualitative Synthesis Assignment:

- Students will develop a research question.
- Students will differentiate between analyzing and synthesizing qualitative data.
- Students will apply critical thinking skills.
- Students will develop advanced writing skills.
- Students will describe the qualitative synthesis process of a systematic review.

This assignment is best paired with the Data Extraction Assignment.

Peer-Review Assignment

Peer review is a process all scholars will experience in their career, whether it is in the form of receiving or providing this feedback. Many of the previously mentioned assignments would be appropriate for a peer review assignment. The Systematic Review Protocol Assignment and the Systematic Search and Search Methods Assignment could be reviewed using the PRISMA-Protocol and the PRISMA-Search checklists[14,47,48]. An initial literature review can also be a source of a peer review assignment. For this assignment, students would benefit from faculty-developed examples of constructive review feedback along with an explanation of how the peer-review process works, and why it is important in health science scholarship.

After the students have completed either the Narrative Review, Systematic Review Protocol, or the Systematic Review and Search Methods assignments noted above, they can pair up, exchange assignments, and conduct a peer review statement based on best practices and readings around the peer review process. Alternatively, faculty or the librarian(s) can provide students with published research articles from the health science literature and have them conduct a "post-publication" peer review. Grade according to a rubric. While librarians do not often play a role in the peer review process, they may be able to create learning materials around scholarly communication and publication ethics[3].

Learning objectives for the Peer Review Assignment:

- Students will interpret necessary requirements of existing reporting standards through peer review.
- Students will examine how peer review supports the scholarly process.
- Students will identify how to optimally document the systematic review process.

This assignment is best paired with the Narrative Review, Protocol, or the Search Methods Assignments.

Systematized Review Assignment

The systematized review is an introductory review process for students[52]. While a systematized review does not meet the strict criteria for conducting and reporting a systematic review, it can work as an introduction to the process. This type of review can also be

completed by a single researcher or student whereas a systematic review requires a team of experts. As described by Grant and Booth in 2009, it is an "attempt to include elements of systematic review process while stopping short of systematic review… [and]… typically conducted as a postgraduate student assignment.[52]"

Have individuals or groups of students conduct a thorough, reproducible literature review with key elements, such as the protocol, bias assessment, and formalized data extraction, excluded. Once again, collaborating librarians can assist through teaching review typology education, topic development, comprehensive searching, records management, and more.

Learning objectives for a Systematized Review Assignment:

- Students will understand the methodology needed for a systematic review.
- Students will develop an appropriate research question.
- Students will determine appropriate inclusion and exclusion criteria.
- Students will determine which databases and resources are suitable for their research question.
- Students will develop a systematic search strategy.
- Students will document a transparent and reproducible search strategy.
- Students will critically appraise scholarly evidence.
- Students will synthesize evidence.
- Students will report the bulk of a systematic review according to the PRISMA guidelines.

Discussion

This paper presents a solution grounded in cognitive load theory and chunking to address the critical need for structured and supportive methods in teaching systematic review methodology. The previously identified deficiencies in faculty knowledge and mentorship, and the resulting cognitive overload among students, necessitates innovative solutions.

By applying principles of CLT and chunking, the authors propose modified instructional methods to alleviate cognitive burden and enhance student learning outcomes. The division of the systematic review process into manageable chunks not only facilitates skill acquisition by students, but also empowers them to navigate the complexities of evidence synthesis with confidence. Each step of the review process can be parsed into its own separate assignment, which provides the students with an opportunity to learn the details of that step and how it relates to the systematic review process as a whole. The presented assignments, developed in alignment with established systematic review standards and guidelines, offer a structured pathway for faculty and students alike, fostering the development of competent and proficient researchers.

Ultimately, by advocating for structured learning experiences, the authors seek to bridge the gap between theoretical knowledge and practical application in systematic review education.

By adopting chunked systematic review assignments and collaborating with librarians who have systematic review expertise, graduate health science programs can better equip students with the necessary skills to produce high-quality evidence, thus advancing evidence-based practice and future decision-making.

Takeaways

While the authors of this paper are limited in their ability to assign these exercises, they aspire to promote faculty awareness of standardized, best practice systematic review methodology while providing them with alternative assignments that are pedagogically sound. Adopting this approach can potentially result in enhanced research skill development for faculty and students while reducing the burden on librarians who have been asked to teach in ways that are inconsistent with accepted and standardized methods. Although the authors' experiences with the suggestions in this manuscript and the application of these modified assignments has been limited at this point, the few attempts to promote these adaptations to health science faculty have shown promise. Examples of such promise include witnessing faculty adapt syllabi with individual assignments mimicking the above examples and the revision of previously assigned systematic and scoping reviews for capstone projects.

As health science librarians are fully aware, how each individual faculty is approached regarding modifications to their assignments is dependent on the relationship between the faculty member and the librarian. It is the experience of the authors that librarians who wish to make these suggestions should focus on the faculty they already have strong relationships with first, since they are more likely to be receptive. Additionally, librarians might consider offering regular faculty-focused workshops on review typologies and evidence synthesis methodologies. When faculty are made aware of the standardized methods regarding these review types and the constraints they present as student assignments, they may be more likely to adapt their approach.

Future research is planned to quantifiably evaluate faculty-focused webinars which will provide attendees with instruction regarding the proper methodology of a systematic review, and an introduction to the modified assignments described in this manuscript. This research will be followed by an annual evaluation of the modifications noted in the health science curriculum supported by the authors.

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