Preparing Engineering Graduate Students to Engage in Scholarly Communications

Prof. Dianna Morganti, Texas A&M University

Prof. Dianna Morganti is an Instructional Associate Professor at Texas A&M University teaching research-informed writing and publication practices to PhD students throughout the College of Engineering. She brings a focus on information literacy to the critical review of scholarly communication practices in the classroom.

Mrs. Angie Dunn, Texas A&M University

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Dianna E. B. Morganti

Angie Dunn

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Abstract

The typical engineering degree plan has several important gaps when reviewed against the research lifecycle. These gaps are often filled in by students learning ad hoc, by overworked faculty over numerous mentoring sessions, or often by the engineering research librarians in workshops and consultations. Purposeful incorporation of a curriculum that fills those gaps, though, can prepare students better for the norms of academia, for the process of research publication, and for critical review of scholarship.

Research librarians with both engineering and scholarly communication expertise are uniquely situated to fill in the gaps of the research lifecycle. Scholarly communication skills are vital for high-impact research writing – understanding and critically evaluating scientometrics, reviewing conferences and journals, evaluating and reviewing literature, navigating authorship, planning for data management, understanding various paper types, interpreting disciplinary norms, and more.

In 2022, the primary author designed and proposed the semester-long first-year graduate course "Research Lifecycle and Publication in Engineering" to the Multidisciplinary Engineering Department. The first course offering was in Spring of 2023, and the students (and their mentors) had overwhelmingly positive evaluations. Student comments showed that an introduction to scholarly communications at the early graduate research stage was also an introduction to the culture and norms of academia. Many of the students submitted their course papers to conferences or journals, practicing some of the scholarly skills learned in this first-year graduate course. The department made the "Research Lifecycle…" course mandatory for all Interdisciplinary Engineering PhD and Master of Science students, after its first semester.

This paper will present the course design for "Research Lifecycle and Publication in Engineering." It will encourage engineering research librarians, teaching faculty, and curriculum committees in engineering to collaborate to prepare their students to engage in the full research lifecycle.

Need for information literacy and scholarly communications education

Despite a wealth of resources at research institutions, there is still a gap between the need for research assistance for graduate students in engineering and the assistance that they actually use. According to a 2013 meta-synthesis, graduate students, especially those in engineering, tend to consult their faculty advisors first and most when beginning their information research [1]. People (rather than instructional resources) in general, have been shown to play a very large part in helping students begin their research. However, in a 2011 study that surveyed of 382 faculty mentors, many reported apathy or antipathy toward seeking out or attending training on the information literacy behaviors which would help them stay up to date on research methods and tools across the research lifecycle [2]. This likely contributes to the fact that many students (907 surveyed in the same 2011 study) report that their faculty mentors do not provide adequate support [2]. This leaves engineering graduate students often learning research skills ad hoc, even in very well-resourced institutions.

Librarians often receive specialized education in scholarly communications, teaching information literacy, and the assessment of research skills. Therefore, they are highly capable of teaching research skills across the full lifecycle. The Association of College and Research Libraries (ACRL) encouraged librarians to consider the confluence of information and scholarly

communication as a full research lifecycle, as it is more aligned with the social nature of information that contemporary students interact with [3]. While ACRL urged librarians and libraries to take a proactive role in evolving library services and research instruction, the implementation of that role is left to the readers. In fact, many of the ideas presented by the association are extracurricular in nature, which has been found to be ineffective for reaching engineering graduate students, according to meta-synthesis [1]. While librarians are often specialized in the areas engineering graduate students lack and seek personal mentorship in, they are often stuck in providing that support by ineffective means.

The typical engineering curriculum does not have courses on research methods, few have courses on research integrity or publication ethics, proposing research, writing, peer reviewing, or how your worldview influences your research [4, 5]. Published engineering literature, in fact, often leaves many of these important aspects of research as assumed [5].

Current state of librarian partnerships

Several research studies have attempted to transform or transfer traditional library resources into engineering landscapes, embedding librarians into existing engineering buildings, learning management systems, and labs [6]. Even in embedded contexts, though, the engagement between students and librarians often replicates the transactional service nature of literature search support and document delivery [6]. Librarians have also formed partnerships across campus that infuse services such as impact consultations, data management support, and more, across the research lifecycle throughout campus. These are vital ways that the library can support the institution and the faculty, but students and faculty alike are often unaware of the breadth of knowledge and assistance librarians can help with in the fuller research lifecycle [3].

Bringing library faculty into engineering departments as instructors and advisors to students on their research lifecycle and process can complement their research mentors' oversight of the methods. That is the context of the course presented in this paper.

Course Design

In the 2021-2022 academic year, the then-president of Texas A&M University announced that (among other changes) faculty status would be removed from the libraries [7]. The primary author (a faculty librarian at the time) interviewed with the Multidisciplinary Engineering department (MTDE) on campus. As a new department interested in breaking disciplinary silos in the interest of effective scholarship and teaching, MTDE was highly receptive to bringing a librarian on board as teaching faculty. In the initial discussions, the primary author proposed a course that would fill in the gaps of the research lifecycle that the regular engineering curriculum leaves behind. As a new department on campus that sought to bring the benefits of a diversity of disciplines into engineering, it was the right place and time for a new multidisciplinary course proposal. The department head expressed interest in a librarian-led course on scholarly communications for early engineering PhD students. The course became titled "The Research Lifecycle and Publication in Engineering" (RLE), a 3-credit hour course designed to help PhD students understand the nature of the full research lifecycle.

Libraries, as discussed, have long filled gaps in the curriculum through workshops, services, partnerships, instruction, and more. However, most engineering students are reluctant to seek research help outside their departments, and many do not receive the help they need [1, 2]. This librarian-led course concept may be more effective in getting engineering graduate students the research help they need for high-quality work across the research lifecycle.

The initial course offering was forward-designed from the composition of high-use library services to engineering. The topics were drawn from the instructor's experience in consultation, teaching, and reference and brought together into a course curriculum tailored to engineering students that aligned chronologically with the research lifecycle. Because of this forward design, the course design process was not cumbersome, but the assessment of it became a bit more difficult. Course refinement over the timeline of the course has involved bringing some backward design back in to ensure the highest priority competencies are covered and assessed effectively.

The course learning outcomes for RLE walk students through the knowledge necessary to engage in scholarly communication at an information-literate level throughout the full research lifecycle. Both the specific outcomes and the levels targeted are tailored to what most of the students will need following the course. The topics of the course include choosing research topics, selecting outlets, evaluating journal/author/article metrics, concepts in research data management, research integrity, publishing ethics, searching and selecting literature, synthesizing literature findings, writing literature reviews, engaging in peer review, and planning a systematic literature review.

Levels of learning outcomes target the typical level of engagement expected for the graduate student to engage in following the course. For example, many of the graduate programs in engineering assign students to complete a scoping or systematized literature review as part of a qualifying exam, a preliminary exam, or as part of their dissertation or thesis. These are expected to be comprehensive, but strict adherence to a published method (such as the one by Borrego, Foster, and Froyd [8] used in the course) is not expected. The class, therefore, leads the students to the lower-level learning outcomes on systematic review methods but covers

synthesizing literature at a more advanced level. All students will likely be writing narrative literature reviews as introductions to research papers; therefore, the levels of those learning outcomes are highest. The outcomes are tailored to the expected experiences of the students following the course.

Through the first two semesters, the levels of the learning outcomes were refined to scaffold well and integrate into the broader interdisciplinary engineering Ph.D. degree and the engineering education program, which emphasizes social science methods. Students leaving the course have a deeper knowledge in the topics that are directly related to narrative literature reviews and a broader awareness of the important (but not universally implemented) topics such as systematic literature reviews and data management. A truncated course syllabus is attached in Appendix A. Upon completion of the course, students will be expected to:

- describe the trends of scholarship in engineering;
- demonstrate understanding of the research lifecycle in engineering publications;
- critically evaluate data management planning through case study review of an engineering project plan;
- compare scientometrics rankings of engineering publications and conferences to quality markers;
- contrast and evaluate the methods of evidence synthesis and original research;
- compare the implementation of evidence synthesis research methods and standards in engineering scholarship and disciplines;
- develop a draft paper publication;
    - prepare a research pitch or proposal (student choice);

- choose and defend an outlet for your paper and evaluate its quality/impact using scientometrics and quality markers; and
- review a peer paper, in adherence to predominate peer review standards in engineering.

While course learning outcomes were mindfully chosen for the typical needs of graduate students following the course, some unexpected learning goals were brought forth by students in the earliest sections.

Students' writing anxiety was an unexpected major hurdle of the course that has driven a great deal of adaptation over the first three semesters. The narrative literature review went from a brief three-part assignment to a full semester-long seven-part assignment. When setting class goals on the first day, many students expressed anxiety about writing, about planning writing projects, and about managing time well for paper writing. The narrative literature review assignment is now broken up into these seven sub-assignments to help those students plan and manage their writing: a topic proposal in the format of an abstract submission, a journal choice essay (analyzing journal quality and understanding paper types), a literature review matrix, a writing project update, an initial submission, peer review, and a revision and response to reviewers. A visual syllabus, shown in Appendix A, shows students that the paper is iteratively developed through these milestones, to help alleviate the stress of so many grades and assure students that they are walking together through the planning process. Student feedback has shown that students find this planning method valuable. The instructor hopes to partner with a graduate student in engineering education who is interested in focusing on research topics around writing anxiety in engineering to continue to improve and research the efficacy of interventions.

Most effectively addressing writing anxiety, in addition to the primary learning outcomes, will help achieve the ultimate outcome of effective engineering communicators.

Students enrolled in the course come from several departments in engineering, not just those in the MTDE. Most students are in a PhD program, though a few MS students have taken the course at the request of their mentors. In the formal post-course surveys as well as in reflection writing assignments, student feedback has adhered to a few general themes: wishing they'd taken the course earlier, seeing themselves growing as researchers or writers, appreciating the broader picture of research, and specifically appreciating the literature review matrix tool. Some of the students in the course were involved in their qualifying exams, often literature reviews, and they expressed that the class was instrumental in helping them feel prepared. Many advisors approached the instructor and the department head to give appreciation as well. Subsequently, the course was adopted as a required course for the PhD - Interdisciplinary Engineering in MTDE, and the next section will discuss that process.

Adoption as a required course: From a graduate advisor's perspective

As a graduate advisor, the second author is involved in every student's academic journey with Multidisciplinary Engineering (MTDE, the department housing this course), seeing a student from application to graduation. As an advisor gains experience in the doctoral process, many questions about the process and, more importantly, the timeline for those processes, continue to present themselves. It became obvious that first semester students were enrolling in research credit hours. The question that continued to be raised was "what research were the students accomplishing during that time?". Other questions began to arise, such as "As a new doctoral student, what part of the research process could they possibly be attempting?" Quickly,

it became clear that the new students did not know what the research process was, much less where it should be going.

Many funded doctoral students are thrust into an ongoing research project early on in their academic career without being informed on the entire process. They are placed in a very small section of the project and never know how it began or how it should end. This becomes a problem when they attempt to begin their own dissertation research and try to piece the process together, making many avoidable mistakes that cost time and money. Once familiar with the research lifecycle course now offered by MTDE, it was clear that this was a foundational course that could be the missing link for doctoral students.

While this could have remained a "recommended" course for new students, part of the department's mission is to "ensure graduates have strong technical skills appropriate for the engineering practice", "engage in cutting-edge research and develop opportunities for student participation", and, finally, "prepare industry and research leaders and engineers who exhibit a dedication to lifelong learning, professional and ethical behaviors, sensitivity to global and cultural awareness and impact, and service as agents of positive change" [9]. To accomplish that mission, the department must instill the very core of research skills and understanding. To ensure those objectives are met, the department defined several strategic objectives that include concepts of research direction and goals, definitions of key competencies, ensuring students are aware of certain knowledge and skill sets in engineering, building the student experience, and promoting research, scholarship, and innovation. Action items to accomplish the strategic goals include establishing and finalizing metrics for student research output, finalizing metrics of research products, identifying MTDE key competencies, and evaluating student success metrics. Requiring the foundational course in the research lifecycle is the first step in establishing and

finalizing research metrics, as well as building the student experience and departmental infrastructure. Requiring this course establishes some quality control for the PhD – Interdisciplinary Engineering students for MTDE and further establishes MTDE as a department of research excellence.

MTDE requires that all doctoral students complete a qualifying exam by the end of their second long semester (fall/spring). The department views the qualifying exam as a way to determine if students are able to read, interpret, and then apply current research to their own engineering focus. Most students have not had enough research education and struggle with interpretation and application of research to use it for their own academic purpose. This is the reason the department recommends students take the lifecycle course within the first (ideally) or second semester of their enrollment. It provides the foundational knowledge doctoral students need to be successful in their qualifying exam and to begin their dissertation exploration.

In the end, the departmental goal is to graduate students who are competent researchers. If students are thrown into the deep end and expected to swim, it is doing them, and the department, a disservice. MTDE must be able to stand behind the degree and be confident everything was done to build a foundation that establishes a solid framework for future researchers in interdisciplinary engineering. An education in the research lifecycle guides new doctoral students in departmental and research expectations, as well as roadmap of what their academic journey should look like. In response to the departmental goals and the anecdotal evidence of the need for additional education on research methods, MTDE has formally adopted this course as a requirement for all research-based degrees, including the Master of Science and the PhD.

Replicability at other institutions

The course design for RLE is replicable. The circumstances at the author's institution that led to a librarian teaching in engineering are unique [7], but the course takes the most in-demand library services and topics for its disciplinary context to establish a customized curriculum. Librarians interested in such course proposals should look for researchers, departments, and programs that promote interdisciplinarity in research. They will be the most receptive to the value of a course on research and scholarly communications. Interdisciplinary programs are newer and more flexible in adaptations to their program requirements. Other programs that exhibit such flexibility may also be good candidates. While the authors' institution is unique in having an entire department devoted to multidisciplinary engineering, there are multidisciplinary and interdisciplinary engineering and STEM programs growing in numbers throughout higher education [10]. Those interested in implementing a course of this nature should focus learning outcome development on those aspects of the research lifecycle which are not otherwise covered in those programs' curriculum. The course is attractive to faculty and administrators as a way to help improve the learning and mentorship of their students [1].

Future work on the class

The biggest unexpected hurdle in the course is writing anxiety, which prevents some students from feeling confident to engage fully in the class. The instructor has a collaborator in engineering education, and they are working on a study together to help understand and intervene on this topic.

Another aim of the interdisciplinary PhD program that is not yet infused is a truly collaborative assignment. Due to the interdisciplinary nature of the program, the students in the class have very diverse engineering backgrounds. This is one of only a few classes where they

have the opportunity to partner across disciplines within a graduate course. Designing a new assignment or redesigning an existing assignment to allow for more collaboration is another major goal of the course.

Despite a wealth of campus resources to help students succeed in school, there remains a gap in engineering curriculum that can allow our graduate students to dive into research practice without knowing about the full research lifecycle. A partnership between programs and research librarians with scholarly communication expertise can help fill in this gap. The course presented here is one way to help make sure that students get faculty mentorship and education about the research lifecycle early in their graduate research journey.

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Appendix A: Syllabus for ITDE 710: Research Lifecycle and Publication in Engineering

Course Information

Course Number: ITDE 710
Course Title: Research Lifecycle and Publication in Engineering
Section No: TBD
Time: TBD
Location: Online - synchronous
Credit Hours: 3 (3-0)

Course Description

Development and trends in publishing and scholarly communication for disciplinary and interdisciplinary engineering; effective reading and writing of research; research methods such as evidence synthesis in engineering; the research lifecycle, publication trends, conference and journal impact and selection; protocol for evidence synthesis; preparation of a draft manuscript for journal submission.

Course Prerequisites

Graduate classification

Special Course Designation

None

Non-Traditionally Delivered Course

The in-person and synchronously delivered online versions of the course are intended to be the same, except as noted below.

- Online students will attend live synchronous lectures during the schedule class times, which will be delivered on a virtual meeting platform such as Zoom, while students of in-person classes will attend in person in a classroom.
- Online students will engage in in-class discussions via virtual breakout rooms, while in-person students will do so in the classroom environment. Both courses will turn in discussion assignments in Canvas, which will form the basis of many of the in-class discussions.

Course Learning Outcomes

This course prepares engineering students to understand and engage with the scholarship of engineering, to read and write effectively in engineering contexts, to collaborate effectively in

writing relationships, to evaluate opportunities for publishing and presentation, to understand the various kinds of research writing and methods, and to prepare a paper and a systematic or scoping review protocol. Course materials will help students understand the concepts and use resources to expand their abilities to conduct research and writing in engineering. Students completing this course should be able to:

- Describe the trends of scholarship in engineering
- Demonstrate understanding of the research lifecycle in engineering publications
- Critically evaluate data management planning through case study review of an engineering project plan
- Compare scientometrics rankings of engineering publications and conferences to quality markers
- Contrast and evaluate the methods of evidence synthesis and original research
- Compare the implementation of evidence synthesis research methods and standards in engineering scholarship and disciplines
- Develop a draft paper publication
    - Prepare a research pitch or proposal (student choice)
    - Choose and defend an outlet for your paper and evaluate its quality/impact using scientometrics and quality markers
    - Review a peer paper, in adherence to predominate peer review standards in engineering

Textbook and/or Resource Materials

- Course materials will be posted inside modules within the campus learning management system

Grading Policy

A: 90% +, B: 80 - 89% C: 70-79%, D 60-69%, F <60%

Assessment Item	Percentage of Course Grade
Participation in class discussions - 8 discussion posts, 7 highest taken as grades	10
Attendance	5
Data Management Plan Critique	10
Lit Review: Research topic pitch	5
Lit Review: Publishing outlet or	5

presentation opportunity identification and evaluation	
Lit Review: Matrix	5
Lit Review: Peer review	10
Lit Review: Paper	15
Protocol	15
Protocol Peer Review	5
MidTerm + Final Exam	15
Total	**100**

Grades & Assignments and Late Work Policy

Below you will find descriptions for each assignment. Even more detail will be provided in class. Each assignment also lists some information about lateness in the assignment. Work submitted by a student as makeup work for an excused absence is not considered late work and is exempted from the late work policies listed below (see Student Rule 7). For this reason - and for your sanity! - please chat with me ahead of time or as soon as you realize you're falling behind on assignments. I'm here to help!

All assignments are graded transparently by rubric. Rubrics are available for every assignment - use them to evaluate your own work before turning it in. If you disagree with the score given by the grader, please email me as soon as possible with an explanation of your disagreement. I'll re-evaluate and discuss the results with you in a meeting. I want you to stay on track in the course and meet your learning goals!

1. Participation in class discussions
    a. 8 weeks of the semester we will have assigned discussion posts that provide application of the concepts of the research lifecycle learned in class. The discussion posts have you identify scholarship in your area of engineering and either identify, compare, or critique elements of the research lifecycle learned in class within the paper.

    b. There will be both detailed questions to answer as well as a posted rubric showing exactly how credit is given for these discussions. As long as you answer the questions and follow the rubric, this will be an easy portion of your grade.

   c. The lowest-scored discussion post will not be included in your final grade. We all have off weeks, and I hope this alleviates some stress. Just be sure you catch up with me if you miss a week or don't get full credit so that you remain on track for the course!

   d. Due to the timely nature of the discussion format and the leniency of dropping the lowest-scored discussion, I won't give credit for late posts. Chat with me if you have excused or unexcused reasons for lateness - the purpose is to keep you on track, not to be overly penalizing.

2. Attendance
   a. For each 2 unexcused absences from the synchronous class time, a point will be taken from the attendance grade. Be sure you log into Zoom with your name, or a name the instructor is aware you'll be using. Zoom attendance reports, which leverage the Zoom participant name will be used to ensure full attendance in class.
   b. This is an analysis-heavy class, and the live discussion times are vital for your learning progress.

3. Data Management Plan Critique
   a. I will assign everyone to groups and give each group a Research Data Management Plan (DMP) to evaluate, discuss, and critique.
   b. You will critique the plan against the FAIR data principles we learn in class.
   c. I encourage groups to have discussions about the DMP and come to some of the same conclusions. Science is collaborative! Individuals will submit their own critique, though, so each individual should put their critique in their own words.
   d. I will accept this up to a week late without penalty. After that, students who are late for reasons not excused by Student Rule 7 will lose 5% of the points per day.

   (Note - Assignments 4-8 are all the same piece of work, iteratively developed)

4. Lit Review: Research topic pitch
   a. After learning about pitches and proposals, students may choose to submit their topic for their paper in either a pitch format or a proposal format. The paper you are proposing should be an engineering literature review, unless pre-approved by the professor (for example, if you are working on a paper in your lab and want this work to contribute to that, we can talk about strategies).

   b. This may be submitted either in writing (250-350 words) or in the form of a short 5-7 minute recorded video, depending on your preference and chosen style of pitch or proposal. You must cite at least 2 academic works (journal articles or conference papers in an engineering field) related to your topic.

   c. If I have feedback on your initial topic, I will suggest related topics. Consider this a discussion, not a mandate. You won't be graded on whether or not you agree with me, but on the adherence to the rubric.
   d. Timeliness is important. After a week, you will have both half-credit for the assignment and less time to develop your paper, so please chat with me early if you're falling behind on this.

5. Lit Review: Publishing outlet or presentation opportunity identification and evaluation
   a. Identifying a target engineering journal or conference for your paper is the next step in the draft paper assignment. You will present your outlet, give a summary of it (history, publisher information) and discuss its impact score(s) and your reason for choosing this outlet.
   b. Give its author guidelines, and discuss the impacts to your paper (i.e. headings they require, etc.). When guidelines are not available, students must look at similar papers published in this outlet to give their expected headings and guidelines.
   c. This assignment should be submitted as a discussion. Students are encouraged to read each other's outlets, share ideas, and may switch their chosen outlet after reading others' choices if they like.
   d. Timeliness is important. After a week, you will have both half-credit for the assignment and less time to develop your paper, so please chat with me early if you're falling behind on this.

6. Lit Review: Matrix
   a. Students will learn a technique of evidence synthesis known as the Literature Review Matrix.
   b. Students will use the search strategies learned in class to identify at least 5 sources that they will use for the literature review portion of their paper. It is noted that students will also have background and foundational literature they will discuss in the intro that will not show up in the Matrix.
   c. Students will use the research question skills learned in class to identify metadata they will collect from the studied papers and compare across the matrix.
   d. Finally, students will write a reflection on the process that includes their search strategies, experiences, and next steps.
   e. Timeliness is important. After a week, you will have both half-credit for the assignment and less time to develop your paper, so please chat with me early if you're falling behind on this.

7. Lit Review: Paper
   a. Students must follow author guidelines of the journal/conference chosen in Publishing Outlet assignment, or ones given in class if their choice lacked detail.

   b. The grades from this assignment come from exhibiting the skills of engaging in the research lifecycle (full draft submission, revision and response, synthesis/problematizing/gap-finding, establishing significance, building upon literature, and more) and the specific writing skills taught in class (formation of an argument, citation, academic writing conventions, and more). A clear rubric is posted in Canvas.
   c. The due date on the draft submission is less flexible because another member of your class must have your assignment in order to do their peer review. Beginning at due time, 5 percent will be reduced each day the item is late. Chat with me early if you're falling behind on this. The draft submission is otherwise complete/incomplete, with a rubric outlining what serves as the definition of 'complete'.
   d. Students will learn a specific revision and resubmission process that they will enact to respond to their peer review before submitting the final paper.
   e. The due date for the final revised submission is flexible up to the end of the final class date. Students who require an extension past that due time for reasons not covered by Student Rule 7 will have 25% of the points for the assignment removed. Come to me early if you're falling behind!

8. Lit Review: Peer Review
   a. Students' peer reviews will be conducted and graded according to a specific method of peer review taught in the class. This method prioritizes formative feedback, attention to power dynamics of peer review, higher-order feedback, and actionability of feedback.
   b. The due date on the peer review is less flexible because another member of your class must have your review in order to revise their paper. Beginning at due time, percent will be reduced each day the item is late. Chat with me early if you're falling behind on this.

9. Construct a protocol for a systematic review in engineering
   a. Systematic and scoping reviews are gaining in popularity in the engineering literature. Many of our engineering graduate programs incorporate systematic or scoping reviews (types of evidence synthesis) in their graduate degrees - sometimes as qualifying exams, preliminary exams, dissertation chapters, capstone projects, or within a course. The construction of a protocol is a key first step in an evidence synthesis project that is often skipped in these assignments for the sake of time. When students learn the purpose of protocols and practice making one, they will understand the process of evidence synthesis much more fully and be prepared for the evidence synthesis assignments in further graduate courses, when applicable. Evidence synthesis methodologies are gaining traction in all areas of engineering publication.
   b. Students will create a systematic review protocol based on expanding their Lit Review to a full systematic review.

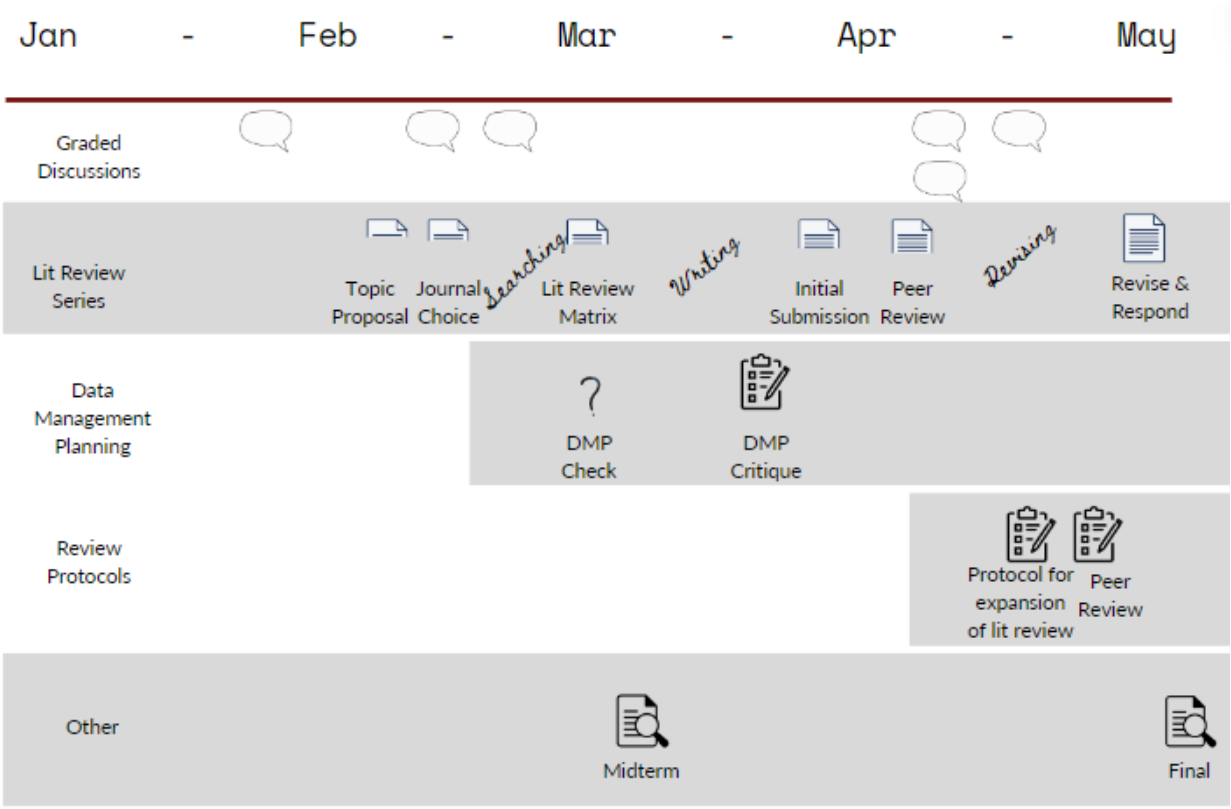
   c. Protocols will follow a set of guidelines given in class, and will be assessed on the skills taught in the class (search strategies, research question formation, understanding of scholarship sources, purpose of systematic reviews, and more).
   d. This due date is on the protocol is less flexible because another member of your class must have your assignment in order to do their peer review. Beginning at due time, 5 percent will be reduced each day the item is late. Chat with me early if you're falling behind on this.

10. Peer reviewing the systematic or scoping review protocol
    a. Peer review will be conducted in a single-anonymous process and the reviews will be assessed based on actionability of the formative feedback given and adherence to rubric posted.
    b. The due date for the peer review of a protocol is flexible up to the end of the final class date. Students who require an extension past that due time for reasons not covered by Student Rule 7 will have 25% of the points for the assignment removed. Come to me early if you're falling behind!

11. Mid-term and Final exams will involve analyzing a case study research article using the skills and concepts learned in the semester up to that point. Grades will be given based on a rubric of the learning outcomes. Any outcomes that achieve a higher grade in the Final than in the Mid-Term will replace Mid-Term grades so that progression of learning is emphasized.

Course schedule

I've created a rough course schedule so you can begin populating your calendar and analyzing your workload ahead of time. We'll discuss both the schedule as well as good practices in managing your writing focus time during the first class. Assignments may be pushed later to accommodate any changes in our schedules, but they will not be pushed earlier from this first course schedule.



Week	Learning Outcome	Assignments due by start of class this day
W1	Welcome	
W1	Describe the trends of scholarship in Engineering	Intros
W2	Describe the trends of scholarship in Engineering Demonstrate understanding of the peer-review process	
W2	Understand the path of research lifecycle	D1: Identify a journal paper by a mentor/professor - answer questions from rubric
W3	Understand the path of research lifecycle	

W3	Demonstrate understanding of research data management & research ethics Understand the path of research lifecycle	
W4	Demonstrate understanding of research data management	Lit Review: Research topic pitch
W4	Demonstrate understanding of research data management	D2 Publishing Outlets: Look up 3 faculty in your major/department. Do they publish more in journals or conferences? Follow rubric for discussion.
W5	Describe the trends of scholarship in Engineering (patents/commercialization as scholarship)	Lit Review: Publishing Outlet
W5	Describe the trends of scholarship in Engineering (pitches and proposals - choose your own path)	
W6	Assess the impact and merit of publishing outlets and presentation opportunities	D3: Impact and Metrics: Look at the citation metrics of the article, the author, and the journal from Discussion 1. Answer questions in rubric.
W6	Assess the impact and merit of publishing outlets and presentation opportunities Describe the trends of scholarship in Engineering	
W7	Review for midterm exam: group article case study review	Lit Review: Matrix
W7	Assess the impact and merit	

	of publishing outlets and presentation opportunities, Prepare for Discussion 6.	
W8	MidTerm Exam	MidTerm
W8	Discussing the parts of a research paper	
W9	Discussing conference presentations and opportunities and parts of a research poster	D4: Data Management Planning Knowledge Check
W9	Assess the impact and merit of publishing outlets and presentation opportunities Describe the trends of scholarship in Engineering	
W10	Explain the methods of evidence synthesis and original research	D5: Choose any form of scholarship discussed so far and expand on it. Critique a sample given based on your learning.
W10	Demonstrate understanding of evidence synthesis research methods Compare various evidence synthesis methodologies	Lit Review: Paper Submission
W11	Demonstrate understanding of the peer-review process	D6: Using a given open peer review article, and the methods of review discussed in class, discuss and analyze the peer reviewer's comments and the author's responses.
W11	Demonstrate understanding of the peer-review process	Lit Review: Peer Review Due

W12	Demonstrate understanding of evidence synthesis research methods Compare various evidence synthesis methods	D7: Find a Systematic Review in your discipline: Answer questions from rubric
W12	Research methods overview	
W13	Integrating outcomes	Protocol Due
W13	Tools introduction: demonstration of PRISMA and Covidence	D8: Grants, Patents, Commercialization: Answer questions about the form of scholarship you chose.
W14	Tools introduction: demonstration of LaTeX	Lit Review: Final submission & Response to reviewers
W14	Semester review of content, discussion-guided	
W15	What to expect in the final exam	Protocol Peer Review Due
	Final Exam	