IEEE PCS Professional Engineering Communication Series
Ryan K. Boettger, Series Editor

SO, YOU HAVE TO

A GUIDED WORKBOOK

WRITE

FOR ENGINEERS

A LITERATURE REVIEW

CATHERINE BERDANIER | JOSHUA LENART

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Table of Contents

List of Tables

List of Illustrations

	IEEE Press 445 Hoes Lane Piscataway, NJ 08854	
	IEEE Press Editorial Board Ekram Hossain, *Editor in Chief*	
Jón Atli Benediktsson	David Alan Grier	Elya B. Joffe
Xiaoou Li	Peter Lian	Andreas Molisch
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So, You Have to Write a Literature Review

A Guided Workbook for Engineers

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A Note from the Series Editor

Stop me if you have read this before: the skills acquired by students in STEM majors often conflicts with industry's expectations of skills.

Industry wants employees who not only have technical expertise but also the ability to clearly communicate that expertise. Meanwhile, academics are adjusting their programs to reflect their institution's initiatives to recruit and retain students and simultaneously expand their degree plans with math and science courses that meet external accreditation requirements. Though STEM program directors and professionals share a mutual goal – to produce and to hire the best technical talent – their paths toward achieving that goal often appear disparate.

Within this broader issue are conversations on the need for and placement of soft skills in STEM curricula. A 2018 survey found that STEM industry leaders identified communication skills as the most important in their fields. In fact, half of the highest ranked skills were considered soft skills: communication, work ethic, problem solving, team work, and analytical skills [1]. This does not mean that technical skills are not important to industry practitioners, but there seems to be a perception that soft skills (as well as managerial skills) play an increasingly important role in industry. This perception is further complicated by the findings that STEM majors do not always find value in improving their soft skills [2].

In engineering fields, writing is typically taught as a general elective requirement for undergrads, while relatively little (if any) required curricular time is focused on discipline-specific writing at the graduate level [3]. In

addition to a lack of writing instruction in STEM degree plans, we need to acknowledge the writing exposure our students received before they even entered a college classroom. Students in North American and European elementary and secondary schools are typically exposed to writing that only reflects the "'approved cannon' of literature common to most English classrooms" [4, p. 97]. This writing is characterized as expository and encourages developing writers to describe, reflect, and explain ideas in the forms of essays, reflective pieces, and short stories. These are not necessarily incorrect ways to teach writing, but they do condition developing writers to communicate in ways that may not reflect the situations they will encounter in the workplace.

It is not surprising then that the literature review, which requires writers to establish credibility not through their own personal insights and opinions but with a persuasive presentation of scholarly research, remains an unfamiliar and elusive text type to many STEM students. Before the actual writing can even begin, writers have to identify and sift through a seemingly unmanageable amount of information. Then they synthesize, paraphrase, and generalize that information to build credibility and establish ownership of their own ideas. Anyone tasked with writing a literature review has undoubtedly found it an arduous process, but I assume you already know this. It is why you chose this book. Maybe you are a Masters student about to start your thesis, or perhaps you are an advisor who needs a comprehensive guide for your students. Whatever your reason, you have no better coaches than Catherine G.P. Berdanier and Joshua B. Lenart.

I met Catherine and Joshua at their presentation at the 2017 IEEE International Professional Communication Conference [3]. I typically attend conference panels on curriculum development and assessment, but I rarely leave

those panels feeling particularly informed or inspired. Just as there is a stigma attached to the value in acquiring soft skills, there is a perception that pedagogical research is lightweight and inconsequential. Unfortunately, the related research in technical and scientific communication does little to combat this perception: the recommendations from these studies are often informed by self-report, lacking generalizability outside a single instructional setting. My own advisor equated these scholarly endeavors with having a cup of coffee with a colleague – the experience is often enjoyable and instantly gratifying, but the resulting recommendations are not sustainable and only as useful as chatting about an experience over a cup of coffee [5].

But rather than just describing their own experiences, Catherine and Joshua presented an instrument that engineering students could use to self-evaluate the structure and style of their own literature reviews. Their framework was inspired by moves-steps analysis, and their discipline-specific, non-reductionist, easy-to-follow coding scheme was refined from testing across multiple instructional sites and student populations. The scholarship that Catherine and Joshua conduct acknowledges engineering students' limited instruction in academic and technical writing and then builds from those realities to improve their communication competences.

This book offers a sampling of the rich data that Catherine and Joshua have collected throughout their careers. They scaffold learning appropriately with authentic examples and student-tested activities. They deliver content that is easy for students to digest but substantial enough for advisors who require a comprehensive text on the subject.

I remain committed to bringing you quality, accessible content with this series. In particular, the support from both the Wiley Press and IEEE teams make this

commitment a privilege. I would also like to acknowledge the contributions of Austin Goodwin whose work has helped me rebrand this series and freshen the perceptions of professional communication. As always, I have amazing support from the Department of Technical Communication at the University of North Texas and my chair Kim Sydow Campbell. Finally, to my son Liam West – we have not met yet, but I am already in love.

Ryan K. Boettger, PhD

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About the Authors

Dr. Catherine Berdanier is an Assistant Professor of Mechanical Engineering in the Department of Mechanical Engineering at Pennsylvania State University at University Park. She holds an MS in Aeronautical Engineering and a PhD in Engineering Education from Purdue University. Her research focuses mainly on graduate-level engineering education with emphasis on engineering writing and communication, attrition, and persistence. Her research has been funded through multiple NSF awards. She is the Director of the Engineering Cognitive Research Laboratory (E-CRL), where she and her graduate students investigate questions concerning the human side of engineering through a variety of quantitative, qualitative, experimental, and analytical methods.

Dr. Joshua Lenart is an Associate Instructor with the Communication, Leadership, Ethics, and Research (CLEAR) Program at the University of Utah where he also received his PhD in Writing and Rhetoric Studies and now teaches technical communication for the College of Engineering. His teaching expertise includes administrative and organizational writing, grant writing, teambuilding, and strategic communications. His research expertise focuses on natural resource management policy as it relates to landscape-scale impacts on wildlife habitat, hydrologic systems, community resilience, adaptation planning, and long-term land-use conservation. For the past five years, he has led various transdisciplinary research projects examining land, water, and wildlife resource management conflicts vis-à-vis policy, stakeholder input, feasibility and environmental impact assessment, and collective impact engagement.

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This book is dedicated to her family: Reid, Jacob, and the forthcoming baby (who did not contribute at all, really, but kept her company during final edits!)

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His wife Tanner and his daughter Cora – whose love, patience, and grace mean everything.

About the Book

Is a literature review looming in your future? Are you procrastinating on writing a lsiterature review at this very moment? If so, this is the book for you. Writing often causes trepidation and procrastination for engineering students – issues that compound while writing a literature review, a type of academic writing most engineers are never formally taught. Consider this workbook as a “couch-to-5k” program for engineering writers rather than runners: if you complete the activities in this book from beginning to end, you will have a literature review draft ready for revision and content editing by your research advisor.

So, You Have to Write a Literature Review presents a dynamic and practical method in which engineering students – typically late-career undergraduates or graduate students – can learn to write literature reviews, and translate genre-based writing instruction into easy-to-follow, bite-sized activities and content. Written in a refreshingly conversational style while acknowledging that writing is quite difficult, Catherine Berdanier and Joshua Lenart leverage their unique disciplinary backgrounds with decades of experience teaching academic engineering writing in this user-friendly workbook.

How to Use This Book

(Hint: These pages are important. You probably want to read them.)

We predict that because you are holding this book, reading these words, there is a strong probability that you are an upper-level undergraduate student or a graduate student who is fast-approaching a deadline for a senior project, thesis, or dissertation. There is also a chance that you fall into the rare type of engineer who enjoys writing, but more likely you may not like to write, or read all that much, either. There is also a high likelihood that you are a bit panicked about writing a literature review, and an even higher chance that you typically find yourself procrastinating on writing. We get it. We were both there in the not-so-distant past and now we work with students every semester who are in the exact same position that you find yourself in now. We have seen our students advance to fabulous careers, win prestigious awards, and travel to interesting places. We have also watched these same students stressed, frustrated, and occasionally in tears while working through the writing process.

We are here to help.

When we set out to write this book, we wanted to create a hands-on, easy-to-use workbook that facilitated the writing of a literature review in lieu of one of our classes, such that if students worked through the book, completing the materials from beginning to end, they would have a decent working draft to submit to their advisor.

Learning to write, as with any activity, takes time. Your timeline might vary, so we propose several timelines for completing this book and its activities: a 32-week plan, a

16-week plan, an 8-week plan, and (and only as a last resort) a 1- and 2-week *Help!* plan for those of you who accidentally procrastinated a little too vigorously.

Think of this workbook as you would your lab book. This is not a book to sit down and skim through once over a weekend and then launch into writing your literature review. Rather, we want you to write in it and dog-ear important pages. After years of helping engineering students improve their writing, we have found that when students respond to activities or write notes with a pen or pencil, they more easily focus their attention on smaller bits of the writing process rather than being overwhelmed. The activities in this book are designed to arrive to you *just at the time when you need them*, helping you focus your mind and time between composing tasks (i.e. thinking new thoughts and translating them into words) and revising/editing tasks (i.e. delivering those new thoughts in a clear, concise, and grammatically correct format). In writing subsequent literature reviews, you will not need to redo the learning activities or the deep discussions again as you will have developed more confidence and competence in writing.

As such, we have devised four plans for beginning and (more importantly) *completing* your literature review that is based on your timeline. You can also interpolate between plans to arrive at a plan that meets your personal goals. The 16-week and 8-week plans are the most popular and reasonable plans for students to undertake. We provide distributed timelines for book completion to help you with accountability and time management – just like in a class.

I.1 The 32-Week Plan

This plan is devised only for doctoral students writing a dissertation, who may be working thorough literature

review over a long period of time. If you are reserving a significant amount of time to thoroughly review the literature for a PhD proposal or for the dissertation itself, this plan is for you (Table I.1). However, skip to a shorter plan if (i) you do not have 32 weeks, (ii) you need to keep momentum to finish a project, or (iii) the literature review you are writing is not intended to be comprehensive (covering all salient literature associated with your project). For this plan, you will spend a significant amount of time on Chapters 3–7. Once you establish a pattern for how you review a particular piece of literature, you will apply that same method to all subsequent articles or books you read.

Table I.1 Sample 32-week plan for completing this book.

Week(s)	Chapters	Week(s)	Chapters
1	1	17–20	7
2	2	21–22	8
3–5	3	23–24	9
6–8	4	25–28	10
9–11	5	*29–30*	*Advisor review*
12–16	6	31–32	11

I.2 The 16-Week Plan

This plan is the most common for students who are writing a longer literature review, such as for a thesis or dissertation. A shorter literature review, like one required for a journal or conference paper, may be more suitable for the *8-week plan*. Here is a typical schedule for a 16-week plan, but adapt it for your circumstances (Table I.2).

Table I.2 Sample 16-week plan for completing this book.

Week(s)	Chapters	Week(s)	Chapters
1	1 and 2	9 and 10	7
2 and 3	3	11 and 12	8
4 and 5	4	13 and 14	9
6 and 7	5	15 and 16	10
8	6	*After advisor review*	*11*

I.3 The 8-Week Plan

This is the fast track plan. This plan is for you if you are (i) highly motivated to complete your project in a timely manner, (ii) approaching a draft submission deadline, (iii) already in the midst of reviewing literature and have been keeping a running account of the works you have already reviewed, or (iv) completing a professional paper or project that does not have to be as long as a traditional thesis or dissertation.

If you are on a quarterly academic calendar and would like to spend one quarter writing a literature review, you can work from the 8-week plan and expand it slightly to meet your timeframe (Table I.3). You will breeze through some chapters (1 and 2) quickly. Other chapters (3–7), will take more time, but do not neglect the time that revision and honing takes (9 and 10). Here is a recommend schedule.