Chapter 1
Introduction

Abstract In this book, you can find information about the major milestones in your PhD trajectory, and how to reach them. We also discuss the soft skills that support the research process. This book is mostly aimed at PhD students in sciences and engineering. In particular, the topics that are discussed in this book are: defining your research question, developing a literature review, preparing and executing experiments, time management, scientific writing, academic presentations, and preparing for a career after the PhD.

1.1   What Can You Find in this Book?

In this book, you can find information about the major milestones in your PhD trajectory, and how to reach them. We also discuss the soft skills that support the research process. This book is mostly aimed at PhD students in sciences and engineering. In particular, the topics that are discussed in this book are: defining your research question, developing a literature review, preparing and executing experiments, time management, scientific writing, academic presentations, and preparing for a career after the PhD.

You can find two parts in this book: the formal course text, which runs from Chap. 1 through 14, and a glossary with reference items, organized from A to Z. This glossary can serve as a reference for common terms related to the PhD trajectory, and you can look up terms for inspiration and advice after completion of the course. Most entries will also refer you to relevant chapters in the course text.

I have written this book as a course text for PhD students, to offer material that can support students throughout their PhD trajectory, and to turn the tide in the trend of PhD students dropping out of their programs because they are lacking the right tools or support. In the Netherlands, for example, about 15% of all PhD candidates graduate within 4 years, and 70% after 8 years [1]. In the United States, the completion rate after 10 years is 57% [2]. There are many reasons why students drop out of their PhD programs. To reduce the rates at which students drop out, a better guidance of the students is essential. This book, and associated proposed course or series of workshops, aims at giving PhD candidates the right tools to carry out their research. During your PhD trajectory, you have to learn how to do research, a skill

nobody has taught you in the past. Traditionally, your PhD promotor[1] will teach you the ropes of doing research and take you on as his/her apprentice during your PhD trajectory. But supervisors are busy people, often supervising a large number of students. To help students learn the transferable research skills they need, universities are offering more and more courses and workshops. This book, and its associated course or series of workshops, offers a structured way for introducing research skills to PhD students. Consider this book as an invitation to explore techniques and to use what works for you. Please don't take this book as a cookbook that will exactly tell you how to get your PhD. During your PhD trajectory, you will grow from student into independent scholar, a path that is nonlinear, deeply personal, and at times very messy and confronting. For this reason, this book focuses on planning and self-reflection – steps that are different for every person on the PhD trajectory. Consider this book as your toolbox: you can use it to learn skills, and then apply these skills on an as-needed basis.

What you will learn in this book is how to achieve the goals of your PhD trajectory (i.e. fulfilling the requirements for graduation) within a reasonable amount of time. You'll learn how to identify your goals (the major milestones of the PhD trajectory), plan for them, and carry them out successfully. We'll be discussing planning, time management skills, and the ability to manage one's self and energy frequently throughout this book.

You won't find the following topics in this book: a more technical discussion on qualitative versus quantitative methods, statistical analysis of data, and programming languages. For these topics, you can refer to textbooks that address these specific elements and skills that you may or may not need during your PhD.

1.2 Who Can Benefit from this Book?

This book can be useful for:

– M.Sc. students considering a PhD in STEM fields[2]
– PhD students in STEM fields
– The supervisors of PhD students in STEM fields
– Professors and/or coaches preparing to teach a course on research for PhD students

You don't need any prior knowledge on research skills to read this book. A course on research skills can stand alone within a doctoral studies program. The chapters are written so that they are suitable as a course text in a course taught over a single

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[1] Also called: supervisor or advisor. In this book, mostly European terms are used. Where relevant, a footnote with the term used in North America is given. Further information is also available in the glossary of Part II.

[2] This book focuses on the perspective of STEM fields, but many of the general ideas are valid for a wide range of fields

academic period, taught throughout workshops, or for self-study if your university does not offer courses to support learning about research skills.

The second part of the book is a reference manual that you can use throughout your PhD trajectory. You can pick up this material at any point during your PhD trajectory and explore the concepts from the second part as you need them. From the glossary, you can revisit elements of the first part. The references to the relevant chapters are provided with the glossary items.

This book is in particular written for PhD candidates in STEM fields. The general concepts are valid for all fields. Since most books about the PhD trajectory are written from the perspective of the social sciences, you can find that this book is addressing some particular topics for the STEM fields: working in a laboratory, gender and diversity issues, and we focus additional attention on the soft skills PhD students in STEM fields may not have learned in their previous studies.

1.3   Using this Textbook for a Class or Series of Workshops

This textbook can be used for the development of a course that follows the regular academic year (i.e. a course with a length of a semester, trimester, or quarter, depending on the system of your institution), or it can be used to develop a series of workshops. If you teach this course in a regular academic period, you can work systematically through the first 14 chapters of the book. The glossary can serve as a reference for the students upon completion of the course. You can also take Chaps. 7, 8 and 9, which deal with communication skills, towards the beginning of the period in which you teach this material, but preferably after covering Chaps. 2 and 3.

If possible, a series of workshops during the PhD trajectory is to be preferred to work through this material. Form groups of maximum 12 PhD students that have started their trajectory at the same time, so that they can grow together through this series of workshops. Include plenty of time for discussions and reflection. If possible, combine a longer workshop with an overnight stay away from campus for the introduction of the series of workshops, so that the students can get to know each other better. In between the different workshops, at regular time intervals, and after the formal part of this series of workshops, it is recommended to organize intervision[3] meetings every 2 or 3 months in which the group of students can meet and discuss problems they are currently facing among their peers. In Table 1.1, you can find a proposed outline for the organization of this series of workshops. You can see the planning for the intervision meetings for the first 2 years. After this, it is recommended to keep organizing these meetings every 2 or 3 months. The dates for the continuing intervision meetings are not outlined in Table 1.1, as the length of the total PhD trajectory depends on the institution, and typically takes between 3 and 5 years.

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[3] Intervision meetings are meetings among peers, as opposed to supervision meetings which take place between supervisor and student. The goal of intervision meetings is to discuss difficulties and solutions, and use these meetings as a tool for learning from your peers.

Table 1.1 Proposed timeline for a series of workshops based on this course text

Nr.	Topic	Duration	Chapters	When?
1	Toolbox for a successful start to the PhD	2 days, overnight stay	1, 2, 3, 7, 8, 9	Start of PhD
2	Literature review	1 afternoon	4	Two weeks after nr. 1
3	Research question	1 afternoon	5	3 months into the PhD
4	Experiments	1 afternoon	6	6 months into the PhD
5	First conference	2 sessions of 1 afternoon	10	8 months into the PhD
6	First intervision, with instructor as facilitator	2 hours		10 months into the PhD
7	Second intervision	2 hours		At the end of the first year
8	First journal paper	2 sessions of 1 afternoon	11	15 months into the PhD
9	Third intervision	2 hours		18 months into the PhD
10	Fourth intervision	2 hours		20 months into the PhD
11	Fifth intervision	2 hours		22 months into the PhD
12	Dissertation	4 sessions of 1 afternoon	12	At the end of the second year
13	Finding a job	3 sessions of 1 afternoon	13	18–12 months before estimated graduation date

References

1. Belleman, B. (2015) Promovendi haken massaal af. http://delta.tudelft.nl/artikel/promovendi-haken-massaal-af/29784
2. Council of Graduate Schools. (2010). Ph.D. *Completion and attrition: Analysis of baseline demographic data from the Ph.D. Completion Project*.