PREFACE

Studying Engineering has been updated and expanded. Dated material has been updated and a wealth of relevant Internet sites has been added. Substantial new graphics have been added as well to improve readability. A new Prologue has been included to give students a clearer perspective on what this book has to offer and – more importantly – what steps they can take to get the most from it. New sections have been added on subjects such as fixed vs. growth mindset, reverse engineering, sustainability, life-long learning, study abroad, entrepreneurship, and teamwork and leadership.

The Prologue, "What This Book Has to Offer and How to Get It," discusses the potential of this book to make a difference in students' lives, and provides guidance on how to realize that potential.

Chapter 1 lays the foundation for the book by introducing and overviewing the process of achieving success in engineering study. Key elements of the success process – goal identification, goal clarification, and behavioral and attitudinal change – are presented. Three models that will help students understand what is meant by a quality education and how to go about getting that education are also introduced. The chapter closes with the important topic of "Structuring Your Life Situation."

Chapter 2 addresses the subject of professional development. A primary purpose of the chapter is to motivate students through an increased understanding of the engineering profession and an awareness of the rewards and opportunities that will come to them if they are successful in their engineering studies. The University of Maryland's "Gamera" human-powered helicopter project is used to bring the engineering design process to life. The National Academy of Engineering's Grand Challenges for Engineering is used to show some of the many exciting problems engineers will need to tackle in the future.

Chapter 3 provides an overview of the *teaching/learning* process. Various types of Learning modes – cognitive, psychomotor, and affective – are described. Preferred learning styles and teaching styles are also discussed. Students are given general guidelines to strengthen their learning process and a summary of the most common mistakes

students make is presented, along with ways to avoid these mistakes.

Chapter 4 provides guidance on how to get the most out of the teaching process. The chapter emphasizes the importance of getting off to a good start and discusses strategies for taking full advantage of lectures – including listening skills, note-taking skills, and questioning skills. Approaches for making effective use of professors are described in detail.

Chapter 5 guides students in designing their learning process. Two important skills for learning – reading for comprehension and analytical problem solving – are covered. Approaches for organizing the learning process, such as time management skills, are also discussed. Study skills relevant to math/science/engineering coursework are emphasized. Finally, ways to make effective use of peers through collaborative learning and group study are also described.

Chapter 6 focuses on the important subject of personal growth and development. A *Student Success Model* is presented to help students understand the process of making behavioral and attitudinal changes essential to success in engineering study. Important personal development topics – understanding self, appreciating differences, personal assessment, communication skills, and health and wellness – are included as well. Finally, a section has been added on the important topic of leadership and teamwork.

Chapter 7 addresses five extracurricular activities that can greatly enhance the quality of a student's education: (1) student organizations, (2) engineering projects, (3) pre-professional employment, (4) study abroad, and (5) service to the university.

Chapter 8 provides an orientation to the engineering education system: faculty, curriculum, students, facilities, administration, and institutional commitment. Academic regulations, student ethics, and opportunities for graduate education in engineering are also covered in this chapter. We close with a discussion of engineering as a means of preparation for further education in business, law, and medicine.

Appendices are devoted to five important topics: 1) Design Project; 2) Definitions of Engineering; 3) Greatest Engineering Achievements of

the 20th Century; 4) Engineers among the World's 200 Wealthiest Individuals; and 5) Description of Engineering Disciplines.

The target audience for the book is first-year engineering students; therefore, it is ideally suited for use in an *Introduction to Engineering* course that has a "student development/student success" objective. Much of what is in the book has direct application to the community college experience, and the topics that are specific to the four-year university experience can provide community college students with a preview of what they will encounter when they transfer to a four-year institution.

High school students considering engineering as their college major will find the book useful as well. Engineering faculty can turn to it as a resource for ideas they can convey to students in formal and informal advising sessions or in the classroom. Deans of engineering have indicated that the book contains material that is helpful in preparing talks they give to high school students and first-year engineering students.

This book was the outgrowth of more than 30 years of teaching *Introduction to Engineering* courses. Much of the material was developed through brainstorming exercises with students. My greatest thanks go to the many students who contributed to the evolution of the ideas in this book. Thanks also go to the many engineering professors who have used the book since the *First Edition* was published in 1995. Those who provided valuable feedback used to improve this edition include: Dom Dal Bello, Rich Bankhead, Zahir Khan, David Gray, Jack Hopper, Sami Maalouf, Bill Latto, Nick Arnold, Zanj Avery, Ali Kujoory, Julie Zhao, Artin Davidian, Jawa Mariappan, Jeff Froyd, Anthony Donaldson, Janet Meyer, Dave Kaeli, Thalia Anagnos, Herb Schroeder, Bev Louie, Marty Wood, and Kevin McLaughlin.

Many people contributed directly or indirectly to the creation of the book – both its original and its revised form. Much credit goes to my partner Martin Roden for encouraging me to self-publish the book and for his constant help and support. Great thanks to Dave McNutt for putting his extraordinary artistic talent into creating the cover design. My appreciation also to my graphic artist Kerry Lampkin who did the many line drawings that have been included to improve the visual presentation

of the book. I also want to express my appreciation to Linda Dundas, President of Legal Books Distributing, and to her outstanding staff – Ted Rogers and Mike O'Mahony – for handling the distribution of the book so capably and with so much care and concern.

Finally, I would like to particularly acknowledge my wife Kathy Landis, who wrote the excellent section on Communication Skills in Chapter 6 and who did major editing on this edition of the book. Her gifts as a writer and editor have made the book much easier to read and understand.

Raymond B. Landis
February, 2013

PROLOGUE

What This Book Has to Offer and How to Get It

It isn't what the book costs. It's what it will cost you if you don't read it.

— Jim Rohn

About two years ago, I was speaking to an *Introduction to Engineering* class at a local university that was using my book. At one point, I asked the students whether they had any questions for me, and one student raised his hand. He asked, "Does the material at the beginning of Chapter 5 on 'Reading for Comprehension' apply to the reading of your book?"

"Yes. Of course!" I replied.

The student then asked,

"So why did I have to wait until I got to Chapter 5 to learn about it?"

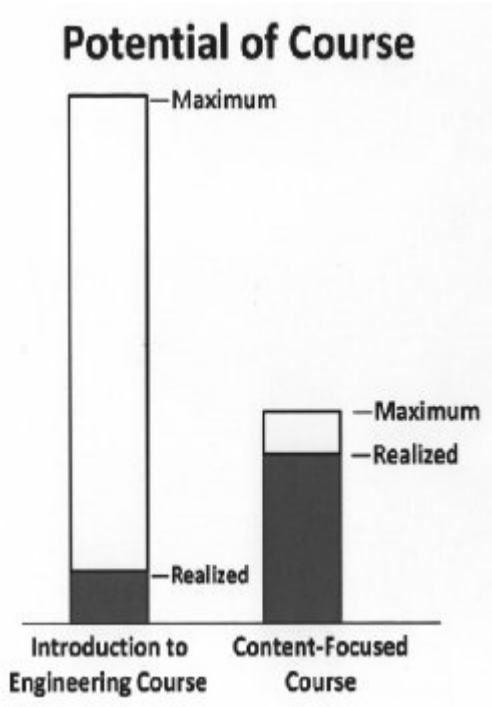
I thought this was such a well-taken point that I decided to write this "Prologue" to achieve two objectives:

- **Convince you of the potential of this book (and a course**

that uses it) to make a difference in your life
- **Give you guidance on how to realize that potential**

POTENTIAL FOR MAKING A DIFFERENCE

You may be reading this book on your own or as a course requirement. Regardless of the context, it promises to make a significant difference in your life, as both an engineering student and an engineering professional.



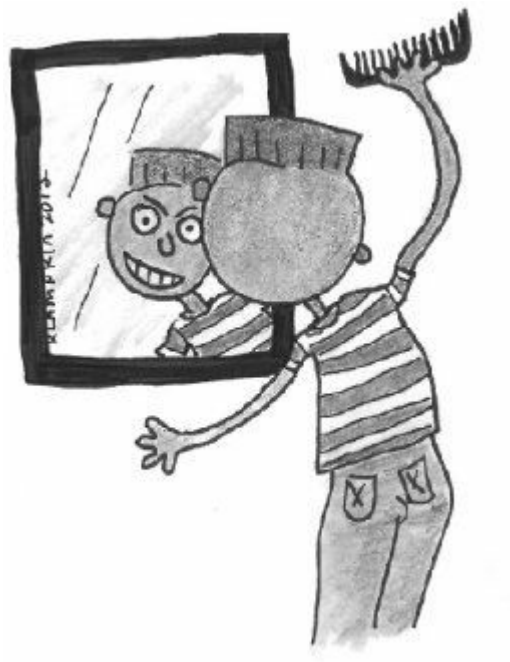
Most likely, you have never read a book like this or taken a course like this, and you probably won't again. Most of the courses you take will be about content and the application of that content to solving problems. *Studying Engineering* and a course that uses it are about **you**.

I contend that the maximum potential of this book and a course that uses it to make a difference in your life is far greater than that of any single content-based course you will take. The graph to the right illustrates this contention.

As the graph shows, in most content-based courses you will realize

something close to the maximum available potential. If you get an *"A"* grade you probably got 90 percent or more of what was there for you. If you get a *"B"* grade, you probably got 80-90 percent of what was there. And so on.

Unless you are proactive, in spite of the best efforts of your course instructor, you are likely to realize far less than the maximum potential available from this book and much less even than you will get from a single content-based course. ***Getting that maximum potential is to a great extent up to you***. And the payoff will be enormous. Not only will you develop academic skills that will enhance your success in engineering study, those skills will correlate closely with the skills you will need to be a successful engineering professional.

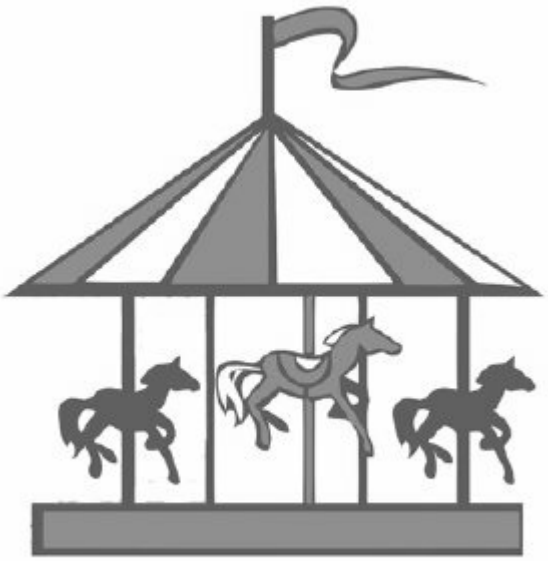


I often compare *Studying Engineering* to a mirror. When you get up in the morning, you clean, groom, and dress yourself. And perhaps the last thing you do before going out and confronting the world is to glance into a mirror. Why? It's because you have standards about your appearance, and you are checking to see that these standards are met.

Studying Engineering is like a mirror you look into to access other kinds of personal standards – those beneath your surface appearance. It

helps you stand back and reflect and work on characteristics of your deepest self: What kind of person are you? What values do you hold? Do you know what you want out of life, and are you on track to get it? Are you getting the most out of your education? What is your learning process, and how well is it working for you? Based on the insights you derive from the book, you will be prompted to make changes to move closer to the standards you set for yourself.

I hope that you have already committed to a personal goal of receiving your Bachelor of Science degree in engineering. You may not have thought about this explicitly, but achieving a challenging goal like getting your degree in engineering cries out to most students to change.



Change what?

- ***The way you think about things (your attitudes, values, mindsets, world views)***
- ***The way you go about doing things (your actions, behaviors)***

Indeed, this book and a course that uses it have no value except that they bring about significant changes in you – changes you are aware of

and can articulate.

Another way to look at this book is to imagine you are on a merry-go-round and trying to grab a brass ring as you go around. You reach for it, but you miss it. Since the carousel goes around and around, you have more than one chance to grab that ring. This book (and accompanying course) may only "go around once." It may be your one chance to grab the brass ring of growth and development. Don't miss it!

There is some possibility that you are not ready for what this book offers you. How could that be? How could you pass up the opportunity to become a more effective learner and a more successful student? Here's how. You may not pay attention to much of anything, so why would you pay attention to what this book (or class) teaches you? You may not believe that you can change. Or you may not want to change, assuming the way you approached your studies in high school will work in university-level engineering study. Or you may not know what or how to change.

If you aren't open to what this book has to offer, I hope you will keep it in mind should you run into academic difficulty down the line. Rather than give up, thinking you can't be an engineer or you can't get a college education, come back to the principles in this book. They work! I don't believe you can put what's in this book into practice and fail. I truly don't think it's possible.

HOW TO REALIZE THE MAXIMUM POTENTIAL FROM THIS BOOK

If you want to get the most out of the book, I suggest you adopt the following approach [1].

Read a portion of *Studying Engineering* (sentence, paragraph, section, or chapter); then close the book and develop answers to the following four questions:

1. What are the key ideas contained in what you read? (i.e., prepare a summary of what you read either in written form or by saying it out loud).
2. What does the passage you read mean to you? Does it make sense? Does it fit with your way of thinking? Does it fit with your past academic experiences? Are you persuaded of its efficacy? Are you likely to make changes based on it?
3. What questions would you like to ask the author or your instructor?
4. What can or will you change (in either your attitudes or your behaviors) as a result of what you read?

You may need to go back and reread sections to make sure you've gotten everything that's there.

The exercise on the next page will give you an opportunity to try out this approach to learning from this book. Stop and complete this exercise before continuing on.

If you apply the four-step methodology described above to reading *Studying Engineering*, I guarantee that you will come very close to realizing the maximum potential.

EXERCISE

I often receive testimonials from students who have taken a course using *Studying Engineering*. An example of such a testimonial is the last section of this Prologue. Read this testimonial (Pages 5-7) with three purposes in mind:

1) To hear from another first-year engineering student.

2) To answer the question: "Could you write such an articulate and insightful statement about your learning process?" If you can, do so. If you can't, set a personal goal to reach the point where you could. This book can help immensely with that.

3) To apply the four suggested steps for reading this text:

   a) Describe what you read.

   b) Describe what you read means to you.

   c) Formulate several questions you would like to ask this student.

   d) Commit to one or more changes you are willing to make in your learning process as a result of reading this testimonial.

ADDITIONAL WAYS TO GET THE MOST FROM THIS BOOK

There are three additional resources that can aid you in getting the most out of this book:

1) The reflections throughout each chapter

2) The problems at the end of each chapter

3) Term Design Project – "Design Your Process of Becoming a 'World-Class' First-Year Engineering Student" (See Appendix A)

If you are taking a course that uses this book, your instructor may assign you the task of developing written responses to some or all of the reflections, to complete some of the end-of-chapter problems, and to do the "Design Your Process" term project. If you are not required to do

this work or you are reading the book on your own, I encourage you to do as many of these tasks as possible.

The Reflections. Reflections are interspersed throughout each chapter. The idea is that you read a section and then stop to engage in a guided reflection about what you just read. Thinking about the reflections is good, but writing a response to them is even better.

You will find forms you can use to complete written responses to each reflection in the text at www.discovery-press.com/reflections.htm. Hopefully your instructor will require you to complete them and submit them electronically. But if he or she doesn't, you would still benefit from doing them.

The End-of-Chapter Problems. There is a set of problems at the end of each of the eight chapters of this book. The total number of problems in the entire text is 203. Some of these problems are short and will only take a few minutes, while others will require significant time (e.g., read a biography of a famous engineer and write a critique of the book). I hope you will complete as many of these problems as possible. Doing so will provide a significant learning experience.

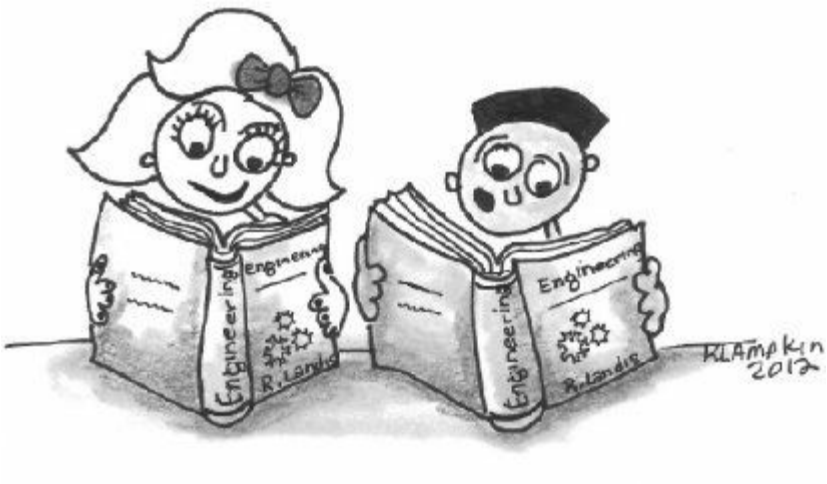
If you are taking a course using this book, I expect your instructor will assign you to do a representative number of the problems. If he or she doesn't or you are reading this book on your own, I hope you will step up to the plate and do as many of the problems as possible. Several years ago, a professor told me as an extra credit assignment he had a student do all the problems in the book. I'm sure that student learned a great deal from that exercise, including why not to need to seek an extra credit assignment to pass a course.

Design Project – "Design Your Process." In Appendix A (Page 277), you will find an innovative project – "Design Your Process for Becoming a World-Class First-Year Engineering Student." This project could be assigned by your *Introduction to Engineering* course instructor or, if not, you could do it on your own. Through the project you will have the opportunity to compare where you are to where you would need to be to be a "world-class" first-year engineering student and to develop a plan for getting there. Areas covered include strengthening your commitment, utilizing important resources, building relationships, becoming effective at managing time and tasks, adopting appropriate behaviors and attitudes, getting involved in co-curricular activities, and growing through self-assessment.

I wish you the very best in engaging *Studying Engineering*. I always enjoy hearing from students by email (rlandis@calstatela.edu) and make every effort to respond to student comments and questions.

STUDENT TESTIMONIAL (by Nathan Tyson, Messiah College)

There are many strategies that help one achieve academic success. Many of these strategies I have been applying for much of my life, while there are some I have more recently employed, and still others I have yet to put into action. *Intro to Engineering* has made me aware of many flaws in my study practices and has helped me practice a great deal of metacognition. *(Note: Metacognition is discussed on Pages 95-96 in Chapter 3. - RBL)*



Of the many success strategies: getting enough sleep, studying in a non-distractive place, making to-do lists, and asking for help have been weapons in my arsenal for much of my school career.

For all my life, I have been very good about getting enough sleep. If I don't get the proper amount of sleep, I have great difficulty concentrating on my schoolwork and thinking clearly, especially in areas like math and science.

During high school, I spent a lot more time studying than most people. Many of my high school friends would brag about not studying for a single test. I, on the other hand, cannot say the same. In fact, I don't know if I can recall a test that I didn't study for in some way during my high school career.

I learned early on about the importance of studying in a non-distractive place. My mind tends to wander quite easily and is quickly distracted by the most trivial of matters. I cannot study in a room where music is playing, a television is on, or people are talking. In order to study to my full potential, I have found that I need a completely noise-free environment like the library. When I need to study in my room, I have found that earplugs can help immensely by cutting out the distracting background noise.

I have stayed organized by writing to-do lists since my middle school years; however, due to the much heavier college workloads, I have found that simple lists are not adequate enough when it comes to

managing my time. In the last few months, my time has become more valuable than ever before; every minute must be spent wisely if I want to succeed in engineering study.

This course has taught me the importance of my time and keeping a schedule, reminding me that time lost can never be retrieved. In mid-October of this year, I started scheduling my week as Dr. Gray [my professor] taught us. Not only have I scheduled every class, but have also scheduled time to complete homework, eat, and sleep. Nearly every hour of every day is planned in order to minimize time wasted and maximize productivity. Since I started using my weekly schedule, I have found that my time seems to have increased exponentially. I feel less overwhelmed by large amounts of work because I know, if I follow my schedule, I *will* get it done.

My schedule has also helped me prepare for tests better than ever before. Back in high school, I would usually save my studying for the night before a test. College, however, is a very different story. I have found that I must start studying *at least* a week before a major test. When I started this, towards the end of September, I was blown away by how much easier and less stressful it was. I can study just an hour a night for a week before a test, and by the time test day rolls around, I have over seven hours of studying and a full night's sleep under my belt. This is much less stressful than staying up all night cramming for a test until I am so stressed out and so tired that I can no longer focus.

Another academic success strategy I have learned from this course is group study. I was always a loner when it came to my studies. Throughout high school, I would do all my work and all my studying by myself. During my first two weeks of college, however, I felt like everyone I talked to was encouraging me to study in groups. I heard it so many times from Dr. Gray, from the *Studying Engineering* book, and from older engineering majors, that I knew I had to try it.

My friends and I now study together on a regular basis. We often work together on calculus assignments, working out problems alone first and then bouncing ideas off each other if we are having difficulty. When one of us understands a difficult problem, he teaches the rest of the group, walking us through it until we all understand. Three of us reviewed together for the first *Intro to Engineering* test and found it quite beneficial. In fact, I believe everyone from our study group got an *"A"* or high *"B"* on the exam. It's amazing what can happen when people get together and teach each other.

Some of my proudest academic moments this semester came as a result of metacognition. Acing every test with little effort is nice, but

there is something special about working hard in a tough class and improving. One of my favorite stories of the semester is about my recent improvement in calculus. Earlier in the course, I would do all the homework and pay attention in class, but was always disappointed by my test scores. When I got a 76 percent on the second test, I knew something had to change. The problem was not that I could not do the math, but that I could not do it fast enough. In every test, I would take my time on problems, checking and rechecking my answers, not moving on until I had found the answer. By the time the test was over, I would be left with several incomplete problems and a poor grade. As I began to work on my test taking and study methods, my grade jumped from a 76 to an 88 on the third test. On the fourth and final test of the semester, after much hard work, I received not only my long-awaited *"A,"* but a 100 percent!

REFERENCE

1. Adapted by Anthony Donaldson, Dean of Engineering, California Baptist University from *Teaching Around the 4MAT Cycle: Designing Instruction for Diverse Learners with Diverse Learning Styles,* by Bernice McCarthy and Dennis McCarthy, Corwin Press, Thousand Oaks, CA, 2005.