

An Analysis of Textbooks for Web Engineering

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Abstract. Educating students and computer science professionals in Web Engineering skills is an increasingly important topic. However, due to the infancy of Web Engineering as a discipline, it is a challenge to provide appropriate learning materials. In this paper we analyze textbooks dealing with Web Engineering. We introduce a scheme for comparison and provide a qualitative assessment of 11 textbooks issued over the last 13 years.

Keywords: textbooks, learning material, comparison.

1 Introduction

Web Engineering (WE) is both a subject of research as well as a set of skills that computer science professionals increasingly need to understand. But even though there is a plethora of resources available (text books, individual chapters, and also online resources – google.com for instance lists 352.000 entries on the term “Web Engineering”, yahoo.com even offers 5,670.000 hits¹), it is difficult to find appropriate course material. We believe there are several reasons for that: firstly, Web Engineering as a discipline is not yet as mature as e.g. software engineering; secondly, given the speed of change and hype in Web technologies, it is difficult to provide up-to-date learning materials (as *books*); thirdly, as is true for software engineering, the subject is complex and can only be taught in a constructivist way [1]. Finally, Web Engineering is clearly interdisciplinary and encompasses technologies, applications, business models, and process models as well as themes like Semantic Web and other domains [2]. Therefore, the following market analysis of existing textbooks on Web Engineering attempts to give an overview of the type of books that are available and discusses their appropriateness as teaching resource for courses on Web Engineering.

Given the broadness of the term “Web Engineering” we need to provide a definition for focusing our work. We refer to the following definition [3]: “(1) Web Engineering is the application of systematic and quantifiable approaches (concepts,

¹ Both searches were performed with the term “Web Engineering” on April 20, 2010.

methods, techniques, tools) to cost-effective requirements analysis, design, implementation, testing, operation, and maintenance of high-quality Web applications. (2) Web Engineering is also the scientific discipline concerned with the study of these approaches.” This definition follows very much a software engineering perspective; as an emerging discipline Web Engineering is still very dynamic and upcoming topics such as Web Science or GeoWeb need to be included in this definition. We have structured this paper as follows. The following Section 2 addresses related work; Section three outlines the research method; Section 4 then provides the analysis of our work. And finally, Section 5 presents conclusions.

2 Related Work

Mendes et al. [4] provide a systematic review of Web Engineering research by analyzing 173 research papers. In particular they focus on the research contribution and methodological soundness of research papers and conclude that only a minority of papers are methodologically sound.

Navarro [2] provides a comprehensive view of research literature available to the Web Engineering community. He analyses 700 papers in various journals from a “Software Engineering Body of Knowledge” perspective. His conclusions are that Web Engineering is still an emerging discipline, which is heterogeneous with a non-empty intersection with software engineering.

Hadjerrouit [1] addresses the issue of teaching Web Engineering from a pedagogical point of view. He argues that there are three types of skills to be taught (using a constructivist approach):

- *Prerequisite* skills, e.g., object-oriented development and programming with UML and an object-oriented language such as Java; database development with JDBC and relational databases; Web programming with Javascript, etc.; knowledge of structured documents, in particular, XHMTL, HTML5, etc.
- *Specific* skills: this is where we believe textbooks should have their main focus; in particular, they should focus on process models, requirements engineering, design, deployment and testing;
- *Generic* skills: Project management and planning; design based on re-use principles; reading and writing skills; dialogue and communication with stakeholders

In summarizing, even though there are some extensive analyses available, they all focus on research papers. Therefore, to the best of our knowledge there is no work on comparing textbooks for Web Engineering.

3 Research Method

For our analysis, we started by collecting and comparing 11 existing textbooks on Web Engineering, which are listed with their full bibliography in Section 3.

apparently it does not occur often enough in titles of chapters and/or sections. The “non-focus” on technologies on the other hand makes sense in that the books selected are targeted on the process and engineering aspects.

In the following, we briefly characterize the books we have chosen:

- (1) *Powell, T., Jones, D., Cutts, D.: Web Site Engineering – Beyond Web Page Design, Prentice Hall 1998, 324 pages.* This book – written from a practitioner’s view – is the earliest of books on WE we analyzed. Starting from the fact that static Web pages have evolved into Web applications the ten book chapters discuss Web specific issues according to the software development life cycle, ranging from problem definition and requirement analysis to Web site promotion and maintenance. The book ends with business related concerns.
- (2) *Lowe, D., Hall, W.: Hypermedia and the Web: An Engineering Approach. Wiley, 1999, 626 pages:* This book comprising twelve chapters is (also) an early book on WE. It is motivated by the fact that at the time of writing – 1999 – many Web applications were available but that it also had become clear that these applications do not take advantage of the sound engineering principles that were of benefit to the software industry. The book therefore focuses on the (hypermedia) development process of Web applications. Furthermore, about a third of the book is dedicated to current and future research activities.
- (3) *Murugesan, S., Deshpande, Y.: Web Engineering – Managing Diversity and Complexity of Web Application Development, Springer 2001, 355 pages.* This edited volume argues for and provides the scope of the discipline “Web Engineering”, which only recently emerged at the time of its publication. The introductory part is a discussion on WE tasks, contributing disciplines and WE’s delimitation of computer science, information systems, and software engineering. The remaining five parts address WE issues (ranging from process/methodology to maintenance/reuse) each with an overview followed by two to seven adequately selected research contributions most of them originating from contributions to WE related conferences.
- (4) *Dumke, R., Lothar, M., Wille, C., Zbrog, F.: Web Engineering, Pearson 2003, 473 pages.* This book – written in German – comprises three parts (foundations, Web system development, domain specific aspects) and clearly focuses on the development of systems from a software engineering point of view. It is the only book with explicit properties of textbooks such as review questions at the end of each chapter, etc.
- (5) *Suh, W.: Web Engineering: Principles and Techniques. IGI Global, 2005, 364 pages.* This is an edited book with six sections, ranging from concepts and a reference model, Web application development, metrics and quality issues, maintenance to Web intelligence. Overall fifteen chapters, written very much from a research perspective.
- (6) *Mendes, E., Mosley, N.: Web Engineering, Springer 2006, 438 pages.* After an introduction to Web Engineering this edited volume comprises 10 chapters covering important WE issues, which can be grouped into three WE related perspectives: project management including Web effort estimation, Web quality

issues and Web modelling approaches. Another two chapters are dedicated to a non WE specific introduction to statistical techniques and empirical methods. Each chapter is self-contained by providing a thorough presentation of the subject, mostly followed by some (research) approach of the authors and illustrated by a case study.

- (7) *Kappel, G., Pröll, B., Reich, S., Retschitzegger, W.: Web Engineering – The Discipline of Systematic Development of Web Applications, Wiley 2006, 366 pages.* This edited book is based on the German book “Web Engineering – Systematische Entwicklung von Web-Anwendungen” by the same co-editors, published in 2004 by dpunkt. The book starts with a classification of Web applications and its determining characteristics, serving as a basic frame for the forthcoming chapters, which are arranged in three parts – approach (project management and process), product development and quality aspects. A chapter on the Semantic Web provides an outlook to future developments.
- (8) *Rossi, G., Pastor, O., Schwabe, D., Olsina, L.: Web Engineering: Modelling and Implementing Web Applications, Springer 2007, 464 pages.* This book is an edited volume with fifteen chapters and three parts, focusing on Web applications development, Web design methods and qualitative aspects of Web Engineering. Besides the – typical – introductory chapter it also has a chapter named “Conclusions” that links the various subparts together.
- (9) *Pressmann, R. S., Lowe, D.: Web Engineering: A Practitioner's Approach, McGraw Hill Higher Education, 2008, 458 pages.* This is a recent book comprising seventeen chapters that are grouped around a general model of WebApps’ process activities (communication, planning, modeling, construction and deployment). The book almost has a non-focus on technologies (the authors argue they are too many and too diverse to be covered in the book as well). There is a coherent example throughout the book.
- (10) *Mishra, J.: Web Engineering and Its Applications, Narosa Pub House, 2008, 232 pages.* This is a collection of research papers, attempting to combine the aspects of modeling and implementation. There are some rather technical papers (Internet backbone infrastructure, search crawlers, etc.) which at some point seem very specific (albeit relevant). The chapters also vary quite a bit in length and style.
- (11) *Casteleyn, S., Daniel, F., Dolog, P., Matera, M.: Engineering Web Applications, Springer 2009, 349 pages.* This textbook prepends a chapter on technologies, follows the typical development process with an extension on adaptation in its core part and ends with a contribution to semantic Web and Web 2.0 issues. The authors assembled a variety of Web relevant methods, techniques and tools from the software engineering and from the Web modeling & design perspective.

The following Table 1 summarizes our analysis results wrt. the dimension “type of book”. We distinguish between “course book”, “edited volume” (i.e., books with different authors for the individual chapters), “introductory text” (whereby we mean whether concepts, techniques and methods are explained in more detail with practical examples) and “Web resource” (i.e., whether additional information is available on

the Web). As can be seen from the table, only a few books are course books and most of them are edited volumes (which may be an indication of the diverse and multi-disciplinary nature of WE, see also the conclusions).

Table 1. Types of Web Engineering textbooks.

Type of Book				
Authors	Course Book	Edited Volume	Introductory Text	Web Resource
Powell et al. 1998	x	✓	✓	x
Lowe et al. 1999	✓	x	✓	x
Murugesan et al. 2001	x	✓	✓	x
Dumke et al. 2003	✓	x	✓	x
Suh 2005	x	✓	partly	✓
Mendes et al. 2006	x	✓	partly	x
Kappel et al. 2006	x	✓	✓	partly
Rossi et al. 2007	x	✓	x	x
Pressmann et al. 2008	x	x	✓	✓
Mishra 2008	x	✓	x	x
Casteleyn et al. 2009	✓	x	✓	x

Table 2 provides an overview of the didactical setup we have analyzed. We have analyzed whether learning targets have been identified, examples are given, a glossary is provided, summaries are provided, and finally, whether additional literature to deepen learning is discussed. Again, as can be seen from the table, only one book offers specific learning targets and only few offer examples.

Table 2. Didactical set-up of Web Engineering textbooks.

Didactical Set-up					
Authors	Learning Targets	Examples	Glossary	Summaries	Add. Literature
Powell et al. 1998	x	x	x	✓	x
Lowe et al. 1999	x	x	x	✓	✓
Murugesan et al. 2001	x	x	x	paper conclusions	x
Dumke et al. 2003	✓	✓	list of abbreviations	x	✓
Suh 2005	x	x	x	x	✓
Mendes et al. 2006	x	case studies	x	paper conclusions	x
Kappel et al. 2006	x	x	✓	partly	partly
Rossi et al. 2007	x	x	x	common example	partly
Pressmann et al. 2008	x	✓	x	✓	✓
Mishra 2008	x	x	x	x	x
Casteleyn et al. 2009	x	partly	list of abbreviations	✓	✓

Table 3 provides details on general criteria of the textbooks. We distinguish between visual appearance (how is the text presented, quality of figures, usage of accentuations, b/w vs. color, etc.), structure and outline (overall structuredness, self-containedness of chapters for cross-reading, index, etc.), comprehensibility (lively and clear language, explanation of technical terms), appropriateness (for students, practitioners, researchers, etc.). The analysis is done in a qualitative way.

As can be seen from the Table, especially the edited books – often comprising of chapters of individual research papers – vary greatly in style and appearance (and are thus not ideal as textbooks). Also, even though most of the covers argue that the contents would be suitable for practitioners, some of the books really focus on researchers.

Table 3. General Criteria of textbooks on Web Engineering.

General Criteria				
Authors	Visual Appearance	Structure and Outline	Comprehensibility	Appropriateness
Powell et al. 1998	simple graphics and screenshots	follows software development life cycle, plus business concerns	easy to read	practitioners
Lowe et al. 1999	b/w, excellent graphics, good layout	focuses on hypermedia development and processes; 1/3 on research activities	even though the book has a research touch it is good to read, wording is well done; the coherence of the overall parts and individual chapters is given; also, although it is multi-authored there is a consistent quality	researchers and practitioners
Murugesan et al. 2001	"standard" research paper style of appearance; good to read, adequate layout	except for the introductory part and the structuring in WE relevant parts each including an introduction, similar to a conference proceeding	highly readable introduction into WE followed by high quality research papers	researchers
Dumke et al. 2003	high readability, figures in consistent style, using UML, highlighting of important text	very much from a systems and software engineering point of view, 16 chapters divided into three parts (foundations, system development (core), domain specific development)	same structural approach throughout all chapters, written by the same set of authors, good use of examples	students, practitioners, researchers
Suh 2005	"Standard" research paper style of appearance; good to read, good layout; individual notations in figures	six parts with varying numbers of chapters, therefore partly imbalanced and somewhat serendipitous	overall good; however, as an edited volume it very much depends on the individual authors' contributions	researchers
Mendes et al. 2006	"standard" research paper style of appearance; good to read (dependent on chapter), adequate layout	coherence of the chapters is not reflected; mixture of WE related parts and non WE related chapters; each chapter in itself follows the same thorough structure	overall good; depending on the individual authors' contributions; chapter differ in writing style dependent on the chapter's target audience	target audience differs: some chapter target on researchers, others also on practitioners/students
Kappel 2006	good graphics and layout	2 chapters on project management/process, main part (7 chapters) on product development according to the development process, 3 chapters on quality aspects; future: semantic web	dependent on chapter	students, practitioners, researchers
Rossi et al. 2007	"Standard" research paper style of appearance; good to read, good layout; individual notations in figures	main part (9 of 15 chapters) on Web Design Models; a introductory chapter and a conclusions chapter provide the necessary links	overall good; however, as an edited volume it very much depends on the individual authors' contributions	researchers
Pressmann et al. 2008	b/w, excellent graphics, good use of UML, excellent printing quality	outlines a Web Engineering process and then has dedicated chapters for the various activities aligned to the process; has almost a non-focus on technologies	clear language, one example scenario that is used throughout the book, question & answer type of style for communication	practitioners, also researchers
Mishra 2008	mixed style, multiple authors, research papers	20 chapters with varying subjects, length and style	mixed, depending on author	researchers
Casteleyn et al. 2009	good graphics and layout	preceding chapter on technologies, 6 chapters following the development process, outlook chapter	good to read, in parts mixture of sw-perspective and Web modeling perspective	students, practitioners, researchers

Finally, in Table 4 we provide the results of our analysis according to themes covered.

As a basis for our analysis, we follow the classification of Pressman Software Engineering Resources⁴, which we extend by themes such as new issues arising from Web Science (including legal aspects or SNA) and therefore come up with the following criteria:

⁴ <http://www.rspa.com/spi/#webe>, last visited on April 20, 2010.

- *Web Engineering Process*: characteristics of the Web, general WE information, WE process, Web authoring guides, Web metrics
- *Formulation and Planning*: project planning and formulation for Web applications
- *Analysis Modeling for Web Applications*: analysis concepts for the Web, analysis methods
- *Design Modeling for Web Applications*: general topics, design principles, design methods (e.g., OOHDM), content design, architectural design, interface design, usability design, navigation design, Web design style guides, technology issues
- *Testing of Web Applications*: general testing resources, testing/qa articles and papers, navigation and configuration testing, usability testing, security and performance testing, testing tools
- *Web Science extensions (i.e. issues going beyond common WE tasks)*: legal and privacy issues, business aspects, social network analysis, Web governance, models of Web structure and Web growth etc. [16]
- *Specific Features and Future Developments*: Semantic Web, GeoWeb, etc.

Table 4. Themes and contents of textbooks on Web Engineering.

Web Engineering Themes Covered							
Authors	Web Engineering Process	Formulation and Planning	Analysis Modelling of Web Applications	Design Modelling for Web Applications	Testing of Web Applications	Web Science extensions	Specific Features and Future Development
Powell et al. 1998	✓	✓	✓	✓	✓	x	business concerns
Lowe et al. 1999	✓	✓	✓	✓	x	x	x
Murugesan e al. 2001	partly	x	✓	✓	✓	x	x
Dumke et al. 2003	✓	✓	✓	✓	✓	x	x
Suh 2005	✓	x	✓	✓	✓	partly	general outlook
Mendes et al. 2006	partly	partly	✓	✓	✓	x	cost estimation
Kappel et al. 2006	✓	✓	✓	✓	✓	x	Semantic Web
Rossi et al. 2007	✓	✓	✓	✓	partly	x	general outlook
Pressmann et al. 2008	✓	✓	✓	✓	✓	partly	general outlook
Mishra 2008	✓	x	x	✓	✓	x	general outlook
Casteleyn et al. 2009	✓	✓	✓	✓	✓	x	adaptation Semantic Web, Web 2.0/3.0

As can be seen from the table most books cover the Web engineering process and all activities of the Web application development cycle. However, in more detail, the presentations of these phases vary significantly with respect to the *timeliness of its content*, (e.g. the discipline's evolution implies the risk of outdated content), the *extent* (i.e. most books focus on one or a few specific methods instead of providing a comprehensive overview and evaluation), and the *viewpoint* they approach the issue from (i.e. SW engineer perspective vs. Web modeling & design perspective). Future developments are included by more recent books as add-on, while Web Science extensions, e.g. legal or business issues are rarely discussed.

5 Summary and Conclusions

In this contribution we have provided an analysis of 11 books on Web Engineering. We have structured our work in different dimensions (type of book, didactical set-up, overall readability and themes covered) and we have given some details on the results for each of the books.

In concluding, we want to stress the following:

- From a didactical point of view we agree with Hadjerrouit [1] in that the subject of Web Engineering can only be taught if a) sufficient basic knowledge is available and b) there are accompanying lectures (practical course work) that allow students to actually understand the topics by working themselves (this is referred to as constructivist approach).
- Secondly, the discipline is emerging rapidly and it seems to become even broader. Web Science and/or Geoweb are but two aspects of emerging topics. We believe that these themes can only be covered by additional – more specific – textbooks.
- Thirdly, most books are written by academics. While this is typical – and not per se a bad thing – it means that many books/and or chapters have a bias towards conceptual and/or theoretic work. Moreover, the fact that most textbooks are edited volumes implies that it is hard for a single authors' team to present all facets of WE as a discipline.

Finally, as a result from our analysis we can state that we are still lacking a textbook that is tailored to teaching Web engineering. Even if the discipline gains in maturity there is still a variety of methods, techniques and tools stemming from different Web related communities, which are not yet thoroughly evaluated against each other and far from being established or standardized.

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