Contents

1	Introduction	. 1
	1 General Picture	2
	1.1 Technology Enhanced Learning	2
	1.2 TEL and CS Technical Artifacts	1
	1.3 Educational Software	4
	1.4 Computer-Based Pedagogical Settings (CBPSs)	4
	1.5 Non-definitional Character of Software	
	1.6 Summary	8
	2 Examples	
	2.1 Examples of Computer-Based Pedagogical	
	Settings (CBPSs)	8
	2.2 Examples of Educational Software	
	3 Design of Educational Software: Different Realities	15
	3.1 Designing and Implementing New Software	15
	3.2 Articulating and/or Customizing Software Components	16
	3.3 Education and CS Interplays	17
	4 Addressing Educational Software Design	18
	4.1 Considering Software Properties	18
	4.2 Making Explicit Matters of Concern and Perspectives	19
	4.3 Importance of Explicitness	22
	4.4 Difficulty and Limits of Explicitness	23
	5 Content and Structure of the Book	25
	5.1 Objective	25
	5.2 Content Synthesis	26
	5.3 Rationale for the Organization	26
	5.4 General Comments	28
2	A General Conceptualization for Educational Software	31
	1 Reference Educational Notions	
	1.1 Pedagogical Setting	32

digitalisiert durch DEUTSCHE NATIONAL BIBLIOTHEK

x Contents

1.2 Teaching Setting	33
1.3 Activity	35
1.4 Pedagogical Objective	37
	39
	40
	40
	41
	45
	45
	47
3 Important Dimensions and Issues Put to the Fore	48
	48
	52
	55
5.5 Synthesis of the introduced Dissociations	00
Understanding Differences in Perspectives	57
	57
	58
-	59
	60
	61
	62
	64
	65
	65
3.2 Software Usage and Socio-technical Dimensions	0.5
	67
	69
	70
	71
	/ 1
	72
	74
	76
5 1 Mone disciplinary W. 1	76
	77
	78
	79
6 Conclusions	79
Review of Prototypical Evamples	83
1 Gel MS the Generic Learning Management System	83
1 General Deathing Management System	
2 Phys-edit, the Physics Modeling Editor	86
	1.4 Pedagogical Objective 1.5 Pedagogical Setting Design 2 Educational Software Notions 2.1 Computer-Based Pedagogical Setting (CBPS) 2.2 Educational Software 2.3 Pedagogical-Setting Support Software 2.4 Software Pedagogical Rationale (SPR) 2.5 The Technology Enhanced Learning Field (TEL) 3 Important Dimensions and Issues Put to the Fore 3.1 Disentangling Pedagogical Objectives 3.2 Analyzing the SPR/CBPS Relationships 3.3 Synthesis of the Introduced Dissociations Understanding Differences in Perspectives 1 Notions and Definitions 1.1 Examples 1.2 Discussion 2 Nature of the Setting Analysis: An Example 2.1 A General and a Domain-Specific Analysis 2.2 Differences and Implications 2.3 Conclusions 3 Acknowledgement of Influential Factors: Examples 3.1 Impact of Software 3.2 Software Usage and Socio-technical Dimensions of the Field 3.3 Diagnosing Learners' Activity 4 Acknowledgement of Activity-Related Uncertainties 4.1 Uncertainties Related to the Effectively Considered Task 4.2 Uncertainties Related to the Effective Use of Technology 4.3 Acknowledgement and Possible Implications for Design 4.4 Conclusions 5 Disciplinary Dimensions 5.1 Mono-disciplinary Work 5.2 Clarifying the X-Disciplinary Dimensions of Projects 5.3 Conclusions Review of Prototypical Examples 1 GeLMS, the Generic Learning Management System

Contents xi

	4 <i>Colab-edit</i> , the Collaborative Editor Environment	88
	5 Bio-sim, the Inquiry Setting Environment	90
	6 JavIT, the Java Programming Intelligent Tutoring System	91
	7 Scen-play, the Generic Scenario Player	93
	8 Colab-solver, the Collaborative Problem-Solving Environment	94
	9 Geo-world, the Mathematics Graphical Microworld	95
	10 Discussion	96
5	CS Perspectives and TEL	. 99
	1 Roles of Computer Science in TEL	100
	1.1 Creating Novel Possibilities for Supporting	
	Human Activities	100
	1.2 Elaborating Powerful Abstractions	101
	1.3 Implementing Specified Models and Processes	
	on Computers	103
	2 Engagement of Computer Scientists	103
	2.1 TEL as a Place for Clever CS Applications	104
	2.2 TEL as a Field Where Some CS Problems Arise	107
	2.3 TEL as a Proper Field	108
	3 Conclusions	109
6	Educational Software Engineering	111
	1 Engineering and Research	111
	2 Educational Software Engineering as a Scientific Field	112
	2.1 Educational Software as Complex Artificial Objects	112
	2.2 Definition and Matters of Concern	113
	2.3 Transversal Efforts to Clarify Issues	114
	2.4 Specific Efforts to Build Engineering Methodologies	115
	2.5 Conducting Projects as Vectors for Knowledge	
	Development	117
	3 Reconsidering the CS-TEL Relationship	118
	3.1 Educational Software Engineering and Research	118
	3.2 Educational Software Engineering and CS Research	119
	4 Conclusions	122
7	Characterizing the Design Context and the Software Artifact	123
	1 Introduction	124
	2 Characterizing the Design Context	126
	2.1 Research/Development Nature of the Work	126
	2.2 Theoretical Background	128
	2.3 Nature of the Targeted Outcome	130
	2.4 Rationale for Designing Software	132
	2.5 How Software Is Considered Within the CBPS	133
	2.6 Design Approach	135

xii Contents

	2.7 Actors Concerned	137
	2.8 Context and Historical Dimensions of the Project	138
	3 Characterizing the Software Artifact	139
	3.1 Level of Analysis of Software Properties	139
	3.2 Actions Considered at the Level of Software	139
	3.3 Reification of the Pedagogical Intention in Software	140
	3.4 Nature of the CS Treatments	141
	3.5 Level of Achievement	143
	4 Examples	143
	4.1 <i>GeLMS-4</i> , the Generic Learning Management System	144
	4.2 JavIT, the Java Programming Intelligent Tutoring	1 7 7
	System	146
	5 Conclusions	148
	5 Conclusions	1.0
8	Methodological Considerations	151
•	1 Clarifying Concerns	151
	2 Dealing with Complexity and Models	152
	2.1 Multiplicity of Models	152
	2.2 Foundations of Models	153
	2.3 Traceability of Models	154
	3 Making the SPR Explicit	155
	4 Considering Activity and Indirect Design	158
	5 Developing Knowledge	160
	5.1 Definition of Issues	160
	5.2 Definition of Results	162
	5.3 Evaluation of Results	163
9	Conclusions	165
	1 Educational Software Design and Evolution of Technologies	165
	2 Lack of Knowledge Capitalization	167
	3 Pushing Forward Educational Software Engineering	170
	3.1 Conditions for Capitalizing Knowledge	171
	3.2 Review of Possible Focuses	173
	3.3 Analysis of the Different Perspectives	176
	3.4 Conclusions	177
T.,	udov	170