

# Contents

## Part I The Landscape

<b>1 What Is Real About the Real World?</b>	3
1.1 Four Epistemological Views of Reality	3
1.2 Narrative’s Account of Reality Constitution	5
1.2.1 Paradigmatic Mode of Thought	5
1.2.2 Narrative Mode of Thought	6
1.3 Activity-Theoretic Account of Reality Constitution	6
1.4 Narrative View of Culture	7
1.5 Activity-Theoretic View of Culture	10
1.6 The World View	12
1.7 School as a Moderator of Student Worldview	13
1.8 My Narrative About the “Real World”	14
References	16
<b>2 School, Society, and Culture</b>	19
2.1 Perspectives on Formal Schooling	19
2.1.1 Formal Schooling from the Critical Perspective	20
2.1.2 Formal Schooling from an Emancipatory Perspective	20
2.1.3 Formal Schooling from the Social Mobility Perspective	21
2.1.4 Formal Schooling from the Socialization Perspective	22
2.1.5 Formal Schooling from the Deschooling Perspective	22
2.1.6 Formal Schooling from the Personalized Perspective	23
2.1.7 Formal Schooling from the Cultural Reproduction Perspective	25
2.2 Use Value of Schooling	26
2.3 Pedagogic Modes of Acculturation	27
2.4 My Narrative About School, Culture, and Society	28
References	31

<b>3 Mathematical Literacy: Does It Exist?</b> .....	33
3.1 Perspectives on Literacy.....	33
3.1.1 Autonomous Model of Literacy.....	34
3.1.2 Ideological Model of Literacy.....	34
3.1.3 Critical Literacy.....	35
3.1.4 Literacy as a Cultural Capital.....	36
3.2 Mathematical Literacy: Does It Exist?.....	37
3.3 Perspectives on Mathematical Literacy.....	38
3.3.1 Autonomous Mathematical Literacy.....	38
3.3.2 Ideological Mathematical Literacies.....	39
3.3.3 Critical Mathematical Literacy.....	40
3.3.4 Mathematical Literacy as a Cultural Capital.....	41
3.4 Mathematical Literacy in the UNESCO's Evolving Notion of Literacy .....	42
3.5 My Narrative About Mathematical Literacy .....	43
References .....	45

## **Part II The Perspectives**

<b>4 Activity Theory as a Foundation of Real-World Problem Solving in School Mathematics</b> .....	49
4.1 Introduction.....	49
4.2 Development of Activity Theory .....	50
4.3 Perspectives on Activity Theory .....	52
4.3.1 Activity as a Psychological Process.....	52
4.3.2 Activity as a Transformation Process.....	53
4.3.3 Activity as a Cultural Historical Process.....	53
4.3.4 Activity as a Systematic-Structural Process.....	53
4.4 Problem Solving from the Perspective of Activity Theory.....	54
4.4.1 Real-World Problem Solving as an Individual Activity.....	54
4.4.2 Real-World Problem Solving as a Collective Activity.....	55
4.4.3 School Mathematics Problem Solving as an Individual Activity .....	55
4.5 Contrasting Problem Solving in School Mathematics and Real World.....	57
4.6 Overview on Problem-Solving Research That Used Activity Theory Framework.....	58
4.6.1 Social-Cultural Context.....	59
4.6.2 Workplace Context.....	60
4.6.3 STEM Context.....	61
4.7 Interfacing School Mathematics and Real-World Problem Solving.....	62
4.7.1 Alternative Conceptualizations of Interfacing Interacting Activity Systems .....	63

4.8	Crossing the Boundary Between School Mathematics and Real-World Problem Solving .....	65
4.8.1	Boundary Crossing Construct .....	65
4.8.2	Boundary Crossing in Educational Contexts .....	65
4.8.3	Boundary Objects.....	66
4.8.4	Boundary Crossing Between School Mathematics and Real-World Problem Solving .....	67
4.9	Boundary Objects Between School Mathematics and Real-World Problem Solving .....	69
4.9.1	Modeling .....	69
4.9.2	Narrative Discourse.....	70
4.9.3	Critical Conception of Mathematics .....	71
4.9.4	Ethnomathematics .....	72
4.9.5	Mathematical Practices in the Workplace .....	72
4.9.6	Mathematical Practices in STEM.....	73
4.10	My Narrative: How I Was Drawn to Activity Theory.....	74
	References .....	76
<b>5</b>	<b>Real-World Problem Solving from the Perspective of Modeling.....</b>	<b>79</b>
5.1	Perspectives on Modeling .....	79
5.2	Modeling as a Mathematical Practice .....	80
5.3	Modeling as an Epistemic Practice .....	81
5.4	Modeling as a Sociocultural Practice.....	81
5.5	Contrasting Modeling Practices in Real-World Problem Solving and in School Mathematics Problem Solving.....	82
5.5.1	Role of the Community of Practice.....	85
5.5.2	Agency of the Human Subject .....	85
5.5.3	The Visibility of Mathematics.....	85
5.6	Modeling as an Interface Between Problem Solving in School Mathematics and in the Real World.....	86
5.6.1	Recontextualizing Word Problems as Modeling Activities .....	86
5.6.2	Interpreting Outputs of Black-Boxed Modeling .....	87
5.6.3	Emergent Modeling.....	87
5.6.4	Model-Eliciting Activities.....	88
5.7	My Story with Modeling.....	89
	References .....	91
<b>6</b>	<b>Real-World Problem Solving from the Perspective of the Narrative Mode of Thought.....</b>	<b>93</b>
6.1	Bruner's Narrative Mode of Thought.....	93
6.2	The Human-Making Experience as a Narrative .....	94
6.3	Mathematics-Making as a Narrative .....	94
6.3.1	Example of a Mathematics-Making Narrative: An Epistemological Drama .....	95
6.3.2	Example of a Mathematics-Making as a Life Experience .....	96

6.4	Problem Solving as a Narrative.....	97
6.4.1	An Example of Problem Solving an Epistemological Narrative: Polya's "How to Solve It" .....	98
6.4.2	Example of Problem Solving as a Life Narrative.....	99
6.4.3	Example of Problem Solving as a Paradigmatic Thought .....	100
6.5	Narrative as an Interface Between Problem Solving in School Mathematics and in the Real World .....	101
6.5.1	Polya's Expanded Framework of Problem Solving .....	101
6.5.2	Journal Writing About Real-World Problem Solving .....	103
6.5.3	Modeling Narratives.....	104
6.5.4	Historical Narratives About Mathematics-Making .....	104
6.6	My Narrative About Narrative .....	104
	References .....	106
<b>7</b>	<b>Real-World Problem Solving From the Perspective of Critical Mathematics Education .....</b>	<b>109</b>
7.1	Paulo Freire's Emancipatory Education.....	109
7.2	Critical Mathematics Education.....	110
7.3	Critical Mathematics Education in Practice: Possibilities and Challenges .....	112
7.4	Problem Solving as a Critical Mathematics Education Practice.....	115
7.5	Critical Mathematics Education as an Interface Between Problem Solving in School Mathematics and in the Real World.....	116
7.5.1	Critical Mathematics Education Project.....	116
7.5.2	Critical Reflection on Mathematical Practices .....	117
7.6	My Reflection on Critical Mathematics Education.....	118
	References .....	120
<b>8</b>	<b>Real-World Problem Solving from the Perspective of Ethnomathematics .....</b>	<b>121</b>
8.1	Foundational Issues in Ethnomathematics .....	121
8.2	Relation of Ethnomathematics to Mathematics Education .....	123
8.3	Relation of Ethnomathematics to Critical Mathematics Education.....	126
8.4	Ethnomathematical Practices and Mathematics Education.....	127
8.5	Ethnomathematical Practices and Problem Solving .....	128
8.6	Ethnomathematics as an Interface Between Problem Solving in School Mathematics and in the Real World .....	129
8.6.1	Problematisation of Ethnomathematical Practices.....	130
8.6.2	Exploration of Historical Culturally Specific Problems.....	130
8.6.3	Student Ethnomathematical Research Project .....	131
8.7	My Narrative About Ethnomathematics .....	131
	References .....	133

## Part III The Contexts

<b>9 Workplace as a Context for Real-World Problem Solving.....</b>	<b>137</b>
9.1 Contrasting Practices in the School and the Workplace.....	137
9.2 Contrasting Problem Solving in the School and in the Workplace.....	140
9.3 Interfacing School and Workplace .....	141
9.3.1 Boundary Crossing.....	141
9.3.2 Subjectification.....	142
9.4 The Workplace Context as an Interface Between Problem Solving in School Mathematics and in the Real World .....	142
9.4.1 Workplace Routines as School Problems.....	143
9.4.2 Case Study Investigation .....	145
9.4.3 Joint School–Workplace Focus Group .....	146
9.4.4 Technical Training Workshop .....	146
9.5 My Narrative About Workplace Mathematics .....	147
References .....	148
<b>10 STEM Education as a Context for Real-World Problem Solving .....</b>	<b>151</b>
10.1 Overview of Perspectives on STEM Education .....	152
10.1.1 STEM Education as Literacy .....	152
10.1.2 STEM Education as Pedagogy .....	152
10.1.3 STEM Education as Curriculum.....	154
10.2 Integrative Objects Among STEM Disciplines.....	156
10.2.1 Problem Solving .....	156
10.2.2 Design .....	157
10.2.3 Real-World Oriented Goals .....	158
10.3 Interfacing School-Mathematics Problem Solving and STEM Disciplines to Cross .....	158
10.3.1 Model-Eliciting Activities (MEA).....	159
10.3.2 STEM Project-Based Learning (PBL).....	159
10.3.3 Mathematics Studio .....	159
10.4 My Narrative About STEM.....	161
References .....	163

## Part IV The Framework

<b>11 Learning Real-World Problem Solving in School Mathematics: A Multiple-Perspective Framework .....</b>	<b>167</b>
11.1 Zone A: Individual Learning Activity.....	169
11.2 Zone A: Individual Learning of Problem Solving in School Mathematics.....	171
11.3 Zone B: Collective Learning Problem Solving Activity in School Mathematics.....	171

11.4	A Proposed Multiple-Perspective Framework for Learning Real-World Problem Solving in School Mathematics (Zone C).....	172
11.4.1	Premises Underlying the Multiple-Perspective Framework.....	172
11.4.2	Boundary Objects in the Multiple-Perspective Frame Work .....	174
11.4.3	Learning Mechanisms at the Boundary .....	175
11.5	Features of the Multiple-Perspective Framework for Learning Real-World Problem Solving in School Mathematics .....	175
11.6	My Narrative About Learning from Writing This Book.....	177
	References .....	179
<b>12</b>	<b>Teaching Real-World Problem Solving in School Mathematics: A Multiple-Perspective Framework .....</b>	<b>181</b>
12.1	Paradigm Shifts in the Conception of Teaching.....	181
12.2	The Conception of Teaching from an Activity-Theoretical Perspective .....	183
12.3	A Multiple-Perspective Framework for Teaching Real-World Problem Solving in School Mathematics .....	185
12.4	Features of the Multiple-Perspective Framework for Teaching Real-World Problem Solving in School Mathematics .....	186
12.5	Instructional Objectives of Teaching Real-World Problem Solving in School Mathematics.....	188
12.6	Vertical Sequencing Instruction in Real-World Problem Solving in School Mathematics.....	189
12.7	Horizontal Sequencing of Problem Tasks in Teaching Real-World Problem Solving in School Mathematics .....	190
12.8	Epilogue .....	193
	References .....	195
	<b>Index.....</b>	<b>197</b>

Learning and Teaching Real World Problem Solving in  
School Mathematics

A Multiple-Perspective Framework for Crossing the  
Boundary

Jurdak, M.

2016, XX, 199 p. 24 illus., 4 illus. in color., Hardcover

ISBN: 978-3-319-08203-5