

Contents

About the Authors	8
Preface	10
Foreword	12
<i>Russell Tytler</i>	
Introduction	16
Summary of Key Findings of the Expert Reports	26
A Goals of Science Education Between the Ages of Three and Six and Their Assessment	30
1. Theoretical Assumptions	31
1.1 The Concept of Competence	32
1.2 Assumptions About the Acquisition of Science Competencies in Early Childhood	33
1.3 Assumptions About the Professional Competencies of Early Childhood Professionals	35
2. Goals at the Level of the Children	41
2.1 Motivation, Interest, and Self-Efficacy in Engaging With Natural Phenomena	41
2.2 Scientific Thinking and Process When Engaging With Natural Phenomena	43
2.3 Knowledge of Science	59
2.4 Basic Competencies	69
3. Goals at the Level of Early Childhood Professionals	75
3.1 Motivation, Interest, and Self-Efficacy in Engaging With Natural Phenomena	75
3.2 Scientific Thinking and Process When Engaging With Natural Phenomena	77
3.3 Knowledge of Science and Pedagogical Content Knowledge	80
3.4 Aspects of the Professional Attitude	87
4. Conclusion and Recommendations	92
4.1 Prioritisation of the Goals at the Level of the Children and the Early Childhood Professionals	92
4.2 Recommendations for Accompanying Research	98

B	Goals of Science Education at Primary School Age and Their Assessment	100
1.	Theoretical Assumptions	101
1.1	Concept of Competence	103
1.2	Scientific Literacy	103
1.3	Teachers' Professional Competence	105
2.	Goals at the Level of the Children	107
2.1	Motivation, Interest, and Self-Efficacy in Engaging With Natural Phenomena	107
2.2	Scientific Thinking and Understanding the Nature of Science	109
2.3	Knowledge of Science	124
2.4	Basic Competencies	131
3.	Goals at the Level of the Pedagogical Staff	137
3.1	Motivation, Interest, and Self-Efficacy in Engaging With Natural Phenomena	137
3.2	Epistemological Attitudes and Beliefs	140
3.3	Science Content Knowledge, Knowledge About Science, and Pedagogical Content Knowledge	143
3.4	General Aspects of Professional Role Perception and Self-Concept ..	159
4.	Conclusion and Recommendations	163
4.1	Prioritised Goals for Primary School Children	163
4.2	Prioritised Goals for Pedagogical Staff	166
4.3	Summary and Outlook	170
C	Process-Related Quality Criteria for Science Teaching: Ten Criteria for Effective Didactic Action at Pre-Primary and Primary Level	172
1.	Introduction	173
2.	The Goal of Science Teaching	175
3.	Learning-Theory and Didactic Premises	180
3.1	Constructivist Concept of Learning	180
3.2	Suitable Teaching-Learning Arrangements	182
4.	Scientific Reasoning at Primary School Age	185
5.	Quality Criteria	189
6.	Relevance and Hierarchy of the Individual Criteria	200
7.	Outlook	201

Conclusion and Outlook – How the “Haus der kleinen Forscher” Foundation Uses These Findings	202
1. Recommendations from the Expert Reports as a Basis for the Foundation’s Substantive Offerings	203
1.1 Inquisitiveness, Interest, and Enthusiasm for Collaborative Inquiry	205
1.2 Inquiry-Based and Questioning Approach, Problem-Solving Skills ...	207
1.3 Knowledge of Scientific, Technological, Computer Science, and Mathematical Relationships	211
1.4 Pedagogical Strategies for Action	215
1.5 Experience of Self-Efficacy and Self-Confidence as a Facilitator of Learning	217
1.6 Professional Role Perception and Self-Concept	218
2. Contribution of the Foundation to Professionalisation in Early Education in the Educational Domains of Science, Technology, Computer Science, and Mathematics	221
3. Further Development of Process Quality Through the Foundation’s Certification Procedure	223
4. Outlook: Measurement of the Outcomes of Science Education	226
References	228
Appendix I	264
Appendix II	265
Illustration Credits	266
“Haus der kleinen Forscher” Foundation	267