

Contents

Introduction	xi
 1. The political context	 1
1.1 Introduction	1
1.2 What part does history of mathematics currently occupy in national curricula?	2
1.2.1 Argentina	2
1.2.2 Austria	3
1.2.3 Brazil	3
1.2.4 China	4
1.2.5 Denmark	5
1.2.6 France	7
1.2.7 Greece	8
1.2.8 Israel	9
1.2.9 Italy.....	9
1.2.10 Japan.....	10
1.2.11 Netherlands.....	11
1.2.12 New Zealand.....	12
1.2.13 Norway	14
1.2.14 Poland	15
1.2.15 United Kingdom	16
1.2.16 United States of America	18
1.3 History of mathematics in curricula and schoolbooks: a case study of Poland	19
1.3.1 History of mathematics in mathematics curricula.....	20
1.3.2 History of mathematics in mathematics school-books	21
1.3.3 Final remarks	28
1.4 Policy and politics in the advocacy of a historical component	29
1.4.1 Political authorities (at all levels).....	31
1.4.2 Teacher associations	31
1.4.3 Professional mathematics associations	32
1.4.4 Tertiary teachers	32
1.4.5 Parents	33
1.4.6 Textbook authors	33
1.5 Quotations on the use of history of mathematics in mathematics teaching and learning	33

2. Philosophical, multicultural and interdisciplinary issues	39
2.1 Introduction	39
2.2 Philosophical issues.....	40
2.2.1 Historical investigation, evidence and interpretation	40
2.2.2 Philosophy of mathematics, old and new.....	42
2.2.3 The ends of the spectrum	44
2.3 Multicultural issues	46
2.3.1 Introduction	46
2.3.2 Multiculturalism inside the history of mathematics	47
2.3.3 Mathematics as a human enterprise	50
2.4 Interdisciplinary issues.....	52
2.4.1 Introduction	52
2.4.2 History of mathematics and the study of history.....	53
2.4.3 History of mathematics linking topics within mathematics	53
2.4.4 History of mathematics linking mathematics with other disciplines.....	55
2.5 Conclusion	61
3. Integrating history: research perspectives	63
3.1 Introduction	63
3.2 The historical dimension: from teacher to learner	66
3.3 The indirect genetic approach to calculus	71
3.4 Stochastics teaching and cognitive development.....	74
3.5 Ancient problems for the development of strategic thinking.....	78
3.6 Difficulties with series in history and in the classroom	82
3.7 On potentialities, limits and risks.....	86
3.8 Suggestions for future research	90
4. History of Mathematics for Trainee Teachers	91
4.1 Earlier views on history in teacher education	91
4.2 International overview	93
4.3 Examples of current practice.....	110
4.3.1 Current practice in initial teacher training	110
4.3.2 Current practice in in-service training.....	131
4.4 Issues of Concern	140

5. Historical formation and student understanding of mathematics.....	143
5.1 Introduction	143
5.2 The role of historical analysis in predicting and interpreting students' difficulties in mathematics	149
5.3 The relevance of historical studies in designing and analysing classroom activities.....	154
5.3.1 Bringing historical texts into the classroom: the 'voices and echoes' games.....	155
5.3.2 Indirect use of historical and epistemological studies in the design of activities for students.....	156
5.3.3 The example of linear algebra.....	157
5.3.4 The example of calculus	159
5.3.5 Research on the methodology of history-based design of activities for students	160
5.4 Epistemological assumptions framing interpretations of students understanding of mathematics	162
5.4.1 The 'epistemological obstacles' perspective.....	162
5.4.2 A socio-cultural perspective	163
5.4.3 The 'voices and echoes' perspective.....	165
5.5 Conclusions: guidelines and suggestions for future research	168
6. History in support of diverse educational requirements — opportunities for change.....	171
6.1 Introduction	171
6.2 Educational, cultural, social and economic diversity in primary, secondary and tertiary settings.....	172
6.2.1 Primary education and the use of mathematics history in the classroom	172
6.2.2 Under-served (limited resources) students.....	174
6.2.3 Alternative educational pathways: adult learners returning to mathematics education, vocational education and training	179
6.2.4 Minority school populations	184
6.2.5 Students having educational challenges.....	187
6.2.6 Mathematically gifted and talented students.....	188
6.3 Opportunities for change	195
6.3.1 Teacher education	195
6.4 Conclusion	199
7. Integrating history of mathematics in the classroom:an analytic survey.....	201
7.1 Introduction	201
7.2 Why should history of mathematics be integrated in mathematics education?	202

7.3	How may history of mathematics be integrated in mathematics education?	208
7.3.1	Direct historical information	208
7.3.2	A teaching approach inspired by history	208
7.3.3	Mathematical awareness	211
7.4	Ideas and examples for classroom implementation	213
7.4.1	Historical Snippets	214
7.4.2	Student research projects based on history texts	215
7.4.3	Primary Sources	216
7.4.4	Worksheets	216
7.4.5	Historical packages	217
7.4.6	Taking advantage of errors, alternative conceptions, change of perspective, revision of implicit assumptions, intuitive arguments etc.	219
7.4.7	Historical problems	224
7.4.8	Mechanical instruments	227
7.4.9	Experiential mathematical activities	228
7.4.10	Plays	229
7.4.11	Films and other visual means	230
7.4.12	Outdoor experiences	231
7.4.13	The WWW	232

8. Historical support for particular subjects

8.1	Introduction	241
8.2	Teaching projects inspired by history	243
8.2.1	Examples from algebra and analysis	243
8.2.2	A heuristic introduction to analysis implicitly inspired by its historical development	245
8.2.3	How may history help the teaching of probabilistic concepts?	248
8.2.4	Trigonometry in the historical order	252
8.3	Cultural aspects of mathematics in a historical perspective	253
8.3.1	Number systems and their representations	253
8.3.2	The Pythagorean theorem in different cultures	258
8.3.3	Measuring distances: Heron vs. Liu Hui	262
8.4	Detailed treatment of particular examples	264
8.4.1	Introducing complex numbers: an experiment	264
8.4.2	Intertwining a mathematical topic with other (non-) mathematical topics	265
8.4.3	Surveyors' problems	273
8.4.4	Theory of proportion and the geometry of areas	276
8.4.5	Deductive vs intuitive thinking: an example from the calculus	279
8.4.6	Tracing the root of the abstract concept of a set	281
8.4.7	Discrete mathematics: an example	282
8.4.8	The relation between geometry and physics: an example	283

8.5 Improving mathematical awareness through the history of mathematics..... 286

8.5.1 History of mathematics education.....286

8.5.2 Teaching secondary mathematics in a historical perspective288

8.5.3 Adults' mathematics educational histories.....289

9. The use of original sources in the mathematics classroom 291

9.1 Introduction291

9.2 Motivations, aims and uses292

9.2.1 The specific value and quality of primary sources292

9.2.2 Understanding the evolution of ideas.....294

9.2.3 Experiencing the relativity of truth and the human dimension of mathematical activity.....295

9.2.4 Relations between mathematics and philosophy.....296

9.2.5 Simplicity, motivation and didactics.....297

9.2.6 Perspectives on mathematics education297

9.2.7 Local Mathematics.....298

9.3 Sources, hermeneutics and language298

9.4 Integrating original sources in pre-service teacher education299

9.4.1 Example 1: Egyptian measures of angles.....299

9.4.2 Example 2: complex numbers in geometry and algebra303

9.5 Integrating Original Sources in the Classroom.....307

9.5.1 Example 1: Greek surveying: the tunnel of Samos307

9.5.2 Example 2: An 18th century treatise on conic sections.....310

9.6 Didactical strategies for integrating sources313

9.6.1 The triad: text - context - reader.....313

9.6.2 Classroom strategies313

9.7 Evaluation, research questions and issues of concern316

10. Non-standard media and other resources329

10.1 Introduction329

10.1.1 Why other media?329

10.1.2 And which media?330

10.1.3 Affect and effect331

10.1.4 Media and cognitive aspects of learning333

10.1.5 Media and assessment.....334

10.2 Learning through history and non-standard media335

10.2.1 Mathematical Dramatisation.....335

10.2.2 Ancient instruments in the modern classroom343

History in Mathematics Education

The ICMI Study

Fauvel, J.; van Maanen, J.A. (Eds.)

2002, XVIII, 437 p. 38 illus., Softcover

ISBN: 978-1-4020-0942-6