

Contents

Foreword by Zoltán P. Dienes	13
Preface	15
Acknowledgements	17

Part I PEDAGOGICAL BACKGROUND

1. New Mathematics Programs	19
1.1. The uneasy alliance between mathematicians, teachers and psychologists	20
1.2. The mathematical picture	22
1.3. The psychological picture	25
1.4. Points to look for in mathematics curricula	26
1.5. An attempt to classify modern mathematics programs	28
1.5.1. Set-oriented approach	29
1.5.2. Arithmetic-oriented approach	29
1.5.3. Geometry-oriented approach	29
1.5.4. Science-oriented approach	30
1.5.5. Symbol-game-oriented approach	30
1.5.6. Multiple-embodiment approach	31
1.6. Traditional versus modern approaches	31
1.6.1. The Budapest Study	31
1.6.2. The Sherbrooke Study	32
1.6.3. The New York Study	33
1.6.4. The Porto Alegre Study	33
2. The OPI Mathematics Project (Budapest, Hungary)	35
2.1. Some characteristics of present teaching of mathematics in Hungary	35
2.2. Origin and evolution	35
2.2.1. Initiation of the project	36
2.2.2. Further development	37
2.3. Principles and objectives	38
2.3.1. A break with the usual fragmentary approach, and a view of mathematics as a whole (selection of curriculum)	38

2.3.2.	Nothing to impose, either on teachers or on children	40
2.3.3.	The process of abstraction viewed as the interiorization of concrete experiences	40
2.3.4.	Independence training	41
2.3.5.	The importance of individual differences	41
2.3.6.	Internal as opposed to external motivation	42
2.3.7.	The taxonomy of the OPI Mathematics Project in the cognitive field	44
2.4.	Curriculum	45
2.5.	Teaching aids (facts and desires)	47
2.6.	A geometry class in an OPI Mathematics Project school	50
3.	Dialogue at Sherbrooke (Quebec, Canada)	53
4.	A visitor at Sherbrooke	70
4.1.	Introduction	70
4.2.	A first look	71
4.3.	The children's personal relations	73
4.4.	Other subjects are also there	75
4.5.	Numbers too have survived	76
4.6.	Dr. Dienes in the classroom	77
4.7.	The preparation of the teacher	78
4.8.	A closer look	79
4.8.1.	A situation of free play	79
4.8.2.	A game of familiarization	81
4.8.3.	Starting some classification	81
4.8.4.	Trying some geometry	82
4.8.5.	Operators	84
4.8.6.	Order	85
4.8.7.	Difference and similarity	86
4.8.8.	The logic tracks	87
4.8.9.	Little vector spaces	88
4.9.	Final appraisal and speculations	90
5.	The New York Project	92
5.1.	A historical sketch of the Fleming School	92
5.2.	The philosophy of the Fleming School	93
5.3.	Bilingualism	95
5.4.	Teacher selection and preparation	97
5.5.	Assessment of progress	97
5.6.	Initial contact with the Dienes method	98
5.7.	Adoption of the Dienes method	98
5.8.	An attempt at evaluation	102
5.9.	The situation in 1974	103
5.10.	Some misgivings	103
6.	The Porto Alegre Project	105

Part II
EVALUATION

7. Evaluation in mathematics	112
7.1. The nature of evaluation. The origin and latest developments in educational evaluation	112
7.2. Evaluation models	113
7.2.1. Definition and classification	116
7.2.2. Judgements versus decisions	117
7.2.3. Summative and formative evaluations	117
7.2.4. Informal evaluation	117
7.2.5. Formal evaluation	118
7.3. Common elements in modern evaluation	119
7.4. The necessity for improved evaluation methods	120
7.4.1. The need for innovation in teaching methods and objectives	120
7.4.2. The need for feedback through evaluation	120
8. Difficulties in educational evaluations	122
8.1. Finding behavioural objectives	124
8.1.1. Aims	126
8.1.2. Objectives	128
8.2. Criteria and methods to be considered in an evaluation program	130
8.2.1. Overabundance in evaluation dimensions and methods	132
8.2.2. Shortage of relevant measurements	132
9. Theoretical model of evaluation for the mathematics programs	135
9.1. Objectives	135
9.2. Personality concept	142
9.3. Hypotheses	143
9.4. Statistical design	144
9.4.1. Population of interest	144
9.4.2. Selection of groups	145
9.4.3. Variables of interest	145
9.4.4. The problem of measurement	147
9.4.5. Sampling	148
9.4.6. Statistics	148
9.4.7. Generalization	149
10. The structure of the four evaluation studies	151
10.1. The Budapest Study	151
10.1.1. Purpose of the study	151
10.1.2. Organization	152
10.2. The Sherbrooke Study	154
10.2.1. Purpose of the study	154
10.2.2. Organization	155
10.3. The New York Study	157
10.3.1. Purpose of the study	157
10.3.2. Organization	158

10.4. The Porto Alegre Study	158
10.4.1. Purpose of the study	158
10.4.2. Organization	159

Part III
METHODS AND RESULTS

11. Traditional mathematics	162
11.0. Theoretical Background	162
11.1. The Budapest Study	163
11.1.1. Method	163
11.1.2. Treatment of data	164
11.1.3. Expectation	164
11.1.4. Results	164
11.2. The Sherbrooke Study	167
11.2.1. Method	167
11.2.2. Treatment of data	167
11.2.3. Expectation	168
11.2.4. Results	168
11.3. The New York Study	169
11.3.1. Method	169
11.3.2. Treatment of data	170
11.3.3. Results	170
12. Knowledge of modern mathematics	171
12.1. The Budapest Study	171
12.1.1. Method	171
12.1.2. Treatment of data	171
12.1.3. Expectation	171
12.1.4. Results	172
12.2. The Sherbrooke Study	173
12.2.1. Method	173
12.2.2. Results	174
12.3. The New York Study	176
12.3.1. Method	176
12.3.2. Treatment of data	177
12.3.3. Results	177
12.4. The Porto Alegre Study	178
13. Fatigue	179
13.1. Treatment of data	179
13.2. Theoretical background and methods	180
13.2.1. Reaction time for visual stimulus	180
13.2.2. Reaction time for acoustic stimulus	181
13.2.3. Heart rate	181
13.2.4. Visual field	182
13.2.5. Finger tremor	182

13.3. Results	184
13.3.1. Reaction time for visual stimulus	184
13.3.2. Reaction time for acoustic stimulus	185
13.3.3. Heart rate	186
13.3.4. Visual field	186
13.3.5. Finger tremor	186
 14. Attention	187
14.1. Theoretical background	187
14.2. Method	188
14.3. Treatment of data	189
14.4. Expectation	189
14.5. Results	189
14.5.1. Discussion of results	190
 15. Learning ability	191
15.1. Theoretical background	191
15.1.1. The origin of the idea	191
15.1.2. Studies with simple learning tasks in the USA	192
15.1.3. Studies using complex learning tasks in the USA	193
15.1.4. Studies using complex learning tasks in the FRG	194
15.1.5. Intelligence and learning ability	196
15.1.6. Personality variables and learning ability	197
15.1.7. Our own studies with programmed learning material in Hungary	197
15.2. The Budapest Study	202
15.2.1. Method	202
15.2.2. Treatment of data	206
15.2.3. Expectation	206
15.2.4. Results	206
15.3. The Sherbrooke Study	206
15.3.1. Scoring	206
15.3.2. Treatment of data	211
15.3.3. Results	211
15.4. The New York Study	212
15.4.1. Method	212
15.4.2. Treatment of data	212
15.4.3. A question of interest	213
15.4.4. Results	213
15.5. The Porto Alegre Study	213
15.5.1. Method	213
15.5.2. Treatment of data	214
15.5.3. Results	214
 16. Creativity	215
16.1. Theoretical background	215
16.1.1. Creativity and intelligence	217
16.1.2. Personality correlation of creativity	218
16.1.3. Fostering creativity at school	218
16.2. The Budapest Study	220

16.2.1. Method	220
16.2.2. Treatment of data	221
16.2.3. Expectation	221
16.2.4. Results	221
16.3. The Sherbrooke Study	225
16.3.1. Method	225
16.3.2. Treatment of data	228
16.3.3. Results	228
17. Perseveration	249
17.1. Theoretical background	249
17.2. The Budapest Study	250
17.2.1. Method	250
17.2.2. Treatment of data	251
17.2.3. Expectation	251
17.2.4. Results	251
17.3. The Sherbrooke Study	252
17.3.1. Method	252
17.3.2. Treatment of data	253
17.3.3. Results	253
18. Sociometric structure	254
18.1. Theoretical background	254
18.2. Method	254
18.3. Treatment of data	255
18.4. Expectation	255
18.5. Results	256
19. Attitude	257
19.1. Theoretical background	257
19.2. Method	258
19.3. The Budapest Study	262
19.3.1. Method	262
19.3.2. Treatment of data	263
19.3.3. Expectation	263
19.3.4. Results	263
19.4. The Sherbrooke Study	265
19.4.1. Method	265
19.4.2. Treatment of data	268
19.4.3. Expectation	272
19.4.4. Results	272
19.5. The New York Study	276
19.5.1. Method	277
19.5.2. Treatment of data	278
19.5.3. Results	278
19.6. The Porto Alegre Study	285
19.6.1. Method	285
19.6.2. Treatment of data	285
19.6.3. Expectation	285
19.6.4. Results	286

20.	Anxiety	294
20.1.	Theoretical background	294
20.2.	The Budapest Study	297
20.2.1.	Method	297
20.2.2.	Treatment of data	298
20.2.3.	Expectation	298
20.2.4.	Results	298
20.3.	The Sherbrooke Study	298
20.3.1.	Method	298
20.3.2.	Treatment of data and results	300
21.	Achievement motivation	302
21.1.	Theoretical background	302
21.1.1.	Two components of achievement-related motivation: to achieve success (M_s) and to avoid failure (M_{at})	302
21.1.2.	Intrinsic motivation	305
21.2.	Method	307
21.3.	Treatment of data	308
21.4.	Expectation	308
21.5.	Results	308
22.	Effects on personality	311
22.1.	Theoretical background	311
22.2.	Method	313
22.3.	Expectation	313
22.4.	Results	313
23.	Attitude toward problems	318
23.1.	Theoretical background	319
23.1.1.	Problem-solving ability	319
23.1.2.	Attitude toward problems	320
23.2.	Method	322
23.2.1.	The test development process	322
23.2.2.	Description of the test	322
23.2.3.	Instruction to subjects	325
23.2.4.	Scoring	325
23.2.5.	Statistical data	327
23.3.	The Sherbrooke Study	335
23.3.1.	Method	335
23.3.2.	Treatment of data	335
23.3.3.	Expectation	335
23.3.4.	Results	335
23.4.	The New York Study	336
23.4.1.	Method	337
23.4.2.	Treatment of data	337
23.4.3.	Results	337
23.5.	The Porto Alegre Study	338
23.5.1.	Method	338
23.5.2.	Treatment of data	338
23.5.3.	Results	338

24.	Summary	339
25.	Epilogue	343
Appendix 1 Comparison of Fourteen Group Structure Tests		345
1.	Introduction	345
1.1.	Preliminaries	345
1.2.	Purpose of this study	345
1.3.	The group structures involved	346
1.4.	The embodiments	347
1.5.	The design of the tests	347
2.	The trial	348
2.1.	Experimental design	348
2.2.	The sample	349
2.3.	Experimental procedure	350
2.4.	Scoring	350
2.5.	Reduction of the sample	350
3.	Results and consequences	351
3.1.	General discussion	351
3.2.	Correlations between the Raven and the Group Structure Tests	352
3.3.	Relative difficulty of Group Structure Tests	353
3.4.	Transfer between different Group Structurestests	356
3.5.	Conclusions	357
Appendix 2 Tests of Traditional Material in the Budapest Study		365
Appendix 3 Tests of Experimental (OPI) Material in the Budapest Study		372
Appendix 4 Modern Mathematics Tests in the Sherbrooke Study		
Directions for Administration		382
Appendix 5 Secret Writing Test		384
Appendix 6 Sherbrooke Problem Facing Questionnaire		408
Bibliography		415