

APPLICATIONS OF COGNITIVE PSYCHOLOGY: Problem Solving, Education, and Computing

Technische Hochschule Darmstadt
Fachbereich 3
Institut für Psychologie
Steubenplatz 12, 6100 Darmstadt

Edited by

DALE E. BERGER

KATHY PEZDEK

The Claremont Graduate School

WILLIAM P. BANKS

*Pomona College and The Claremont
Graduate School*

Inv.-Nr. 9/08589



LAWRENCE ERLBAUM ASSOCIATES, PUBLISHERS
1987 Hillsdale, New Jersey London

Contents

Preface xi

PART I: A RANGE OF EDUCATIONAL APPLICATIONS

- 1. Television Comprehension as an Example of Applied Research in Cognitive Psychology** **3**
Kathy Pezdek
 - Introduction 3
 - Cognitive Psychology Research 4
 - Applied Research in Cognitive Psychology 6
 - An Example of Applied Research: Comprehension and Memory for Information Presented on Television 8
 - Conclusions 13
 - References 14

- 2. Electronic Technologies, Education, and Cognitive Development** **17**
Patricia M. Greenfield
 - Every Medium Has its Own Informational “Biases” 18
 - A Medium’s Informational “Bias” has Implications for Education 20
 - A Medium’s Informational “Bias” has Implications for Cognitive Development 20
 - Conclusions: The Case for Multimedia Education 30
 - References 31

3. Learning Programming Languages: Research and Applications	33
<i>Richard E. Mayer, Piraye Bayman, and Jennifer L. Dyck</i>	
Introduction	33
Users Possess Many Misconceptions—Diagnose and Remediate Users' Ineffective Mental Models	34
Programming Requires Going Beyond What is Taught—Use Concrete Models to Foster Transfer	36
All Learners are not Created Equal—Assess and Pretrain for Prerequisite Cognitive Skills	40
Programming Can Enhance Cognitive Skills—Use Computers as a Way of Teaching Students About Their Thinking Processes	42
Conclusion	43
References	44
4. An Investigation of Groups Working at the Computer	47
<i>David Trowbridge</i>	
Introduction	47
Research Methods	48
Review of Findings From the Pilot Study	49
Design of the Formal Study	50
Results	51
Summary	56
Conclusion	56
References	57
5. Applying Cognitive-Developmental Theory to the Acquisition of Literacy	59
<i>George Marsh</i>	
A Failure of Learning Theory	59
Which Cognitive Theory to Apply to the Acquisition of Literacy?	61
A Model of Reading Development	64
Relationship Between Cognitive Development and Reading Development	69
References	70

PART II: THE TEACHING OF THINKING AND PROBLEM SOLVING

- 6. Analogies as a Critical Thinking Skill** 75
Diane F. Halpern
 Empirical Studies of Critical Thinking
 Courses 77
 Use of Analogies 79
 Conclusions 84
 References 85
- 7. Developing Reasoning Skills in College Students** 87
Susan G. Nummedal
 Method 92
 Results 93
 Discussion 95
 References 96
- 8. Teaching Productive Problem-Solving Attitudes** 99
Kenneth Pfeiffer, Gregory Feinberg, and Steven Gelber
 Why Don't Educators Teach Problem Solving Directly? 100
 Problem Solving as a Skill to be Learned 101
 Useful Techniques for Teaching Skills 102
 Productive Problem-Solving Attitudes 104
 Summary 106
 References 107
- 9. Learnable Aspects of Problem Solving: Some Examples** 109
Richard E. Mayer
 Introduction 109
 Translation Training 112
 Schema Training 114
 Strategy Training 116
 Algorithm Automaticity 118
 Conclusion 120
 References 120

10. A Task Analysis of Algebra Word Problems	123
<i>Dale E. Berger and Jeffrey M. Wilde</i>	
Introduction	123
The Current Research	127
Conclusions	135
References	136

PART III: TRADEOFFS IN THE DESIGN OF HUMAN-COMPUTER INTERFACES

11. Design Principles for Human-Computer Interfaces	141
<i>Donald A. Norman</i>	
The UCSD User Centered System Design Project	144
Tradeoffs in Design	147
A Critique of the Tradeoff Analysis	155
Some Other Examples of Tradeoffs	156
Summary and Conclusions	160
References	161
12. Some Tools for Redesigning System-Operator Interfaces	163
<i>Arthur C. Graesser, Kathy L. Lang, and C. Scott Eloffson</i>	
Four Approaches to Investigating a System-Operator Interface	164
Background and Goals of Project: Investigating the Communication Control System	168
Methods of Data Collection	172
Data Analyses and Engineering Change Proposals	174
Final Comments	179
References	179
13. Developing Computer Tools to Support Performing and Learning Complex Cognitive Skills	183
<i>David McArthur</i>	
Introduction	183
Learning Through Practice	184
Learning Tools that Help Exercise Formative and Flawed Conceptions	189
Learning Tools that Help Detect and Fix Misconceptions	194
Motivation and Learning	198
Conclusions	199
References	200

- 14. An Evaluation Model of Chinese Graphemic Input Systems** **201**
Sheng-Ping Fang and Ovid J. L. Tzeng
- The Problem of Chinese Input Systems 202
Three Graphemic Input Methods for
Chinese Characters 204
A Tentative Model of Evaluation 215
References 216
- 15. WANDAH—A Computerized Writer's Aid** **219**
Morton P. Friedman
- Introduction 220
Theoretical Bases for WANDAH 220
The WANDAH System 221
Evaluating WANDAH 224
The Future of WANDAH 225
References 225
- Author Index** **227**
Subject Index **232**