

# CONTENTS

Preface .....	iii
Acknowledgements .....	iv
Contributors .....	vii
An Introduction to Cognitive Process Instruction Jack Lochhead .....	1
<b>Section I. Research Related to Cognitive Process Instruction</b>	
Introduction .....	7
<i>Methodology</i>	
Approaches to Clinical Research in Cognitive Process Instruction Herb Lin. ....	11
The Structural Paradigm in Protocol Analysis John A. Easley, Jr. ....	33
<i>Studies of Cognitive Processes</i>	
Proportional Reasoning and Control of Variables in Seven Countries Robert Karplus, Elizabeth Karplus, Marina Formisano, Albert-Christian Paulsen .....	47
Proportional Reasoning in the People's Republic of China A Pilot Study Robert Karplus .....	105
Information Processing Models and Science Instruction Jill H. Larkin .....	109
A Tale of Two Protocols Dorothea P. Simon and Herbert A. Simon .....	119
Mapping a Student's Causal Conceptions from a Problem-Solving Protocol John J. Clement .....	133
On Learning to Balance Perceptions by Conceptions: A Dialogue Between Two Science Students Jack Lochhead .....	147
<b>Section II. New Approaches to Teaching</b>	
Introduction .....	181
<i>Teaching General Thinking Skills</i>	
Problem-Solving Strategies and the Epistemology of Science Gene D'Amour .....	183

Students, Problems and “Courage Spans” Richard Wertime. . . . .	191
The Computer as a Personal Assistant for Learning Ira Goldstein and John Seely Brown . . . . .	201.
Some Thoughts on Reasoning Capacities Implicitly Expected of College Students Arnold B. Arons . . . . .	209
Toward Observing that Which is Not Directly Observable Robert L. Gray . . . . .	217

### *Teaching Science*

Engineering Student Problem Solving Lois B. Greenfield . . . . .	229
On Learnable Representations of Knowledge: A Meaning for the Computational Metaphor Andrea A. diSessa . . . . .	239
Teaching for Cognitive Development Robert P. Bauman, Thomas Wdowiak and Irene Loomis. . . . .	267
<i>Tribbles</i> , Truth and Teaching—an Approach to Instruction in the Scientific Method Ruth Von Blum. . . . .	275
A More Personal Approach to Teaching a Technical Course Robert E. Sparks. . . . .	283

### *Teaching Mathematics*

Mathematics and Learning: Roots of Epistemological Status James J. Kaput. . . . .	289
The Feeling of Knowing When One Has Solved a Problem Herb Koplowitz. . . . .	305
Teaching Analytical Reasoning in Mathematics Arthur Whimbey. . . . .	309
Can Heuristics be Taught? Alan H. Schoenfeld . . . . .	315