Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.
AN INVESTIGATION INTO THE EFFECTS OF DATABASE USE ON THE ORGANISATION OF STUDENT KNOWLEDGE.

by

BILL ANDERSON

A THESIS
PRESENTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS OF THE DEGREE OF
MASTER OF PHILOSOPHY
IN
EDUCATION

EDUCATION DEPARTMENT
MASSEY UNIVERSITY

PALMERSTON NORTH, NEW ZEALAND

AUGUST, 1989
ABSTRACT

A knowledge based view of expertise points to the importance of well structured domain specific knowledge in developing expertise in a particular field. This study reports on the way in which a computer based data management system appears to influence student organisation of declarative knowledge of a domain towards more expert-like cognitive structures.

A class of Intermediate School students was divided into two groups. Groups had equal access to computers in terms of time, but one group used a word processor during the class program while students in the other group used a database to assist them in their classwork. For both groups, classroom practice stressed the importance of working in an environment that emphasised use of metacognitive strategies. It was hypothesised that the database group would show significant improvement in terms of the number of chunks, and the depth, of cognitive structure inferred, relative to the word processing group, as a result of their increased ability to discover relationships and trends in the data through datafile manipulation.

Cognitive structures were inferred using two techniques. The main technique (Ordered Tree Technique) inferred cognitive structures from each student's ordering of a set of concepts relating to the class unit of work. Analysis of pre- and post-unit structures inferred from this technique indicates that the database group did in fact develop significantly more expert-like cognitive structures than the word processing group. A second technique (Concept Structuring Analysis Technique), used only post-unit, provides converging evidence that supports this finding.
Results are discussed in terms of the type of restructuring that has occurred, the context in which the results arose, and the validity of depth and chunking as variables relevant to education. It is suggested that further research could focus on explicit knowledge representation by students as a way of helping those students develop their expertise in particular knowledge domains.
ACKNOWLEDGEMENTS

There are several people, and groups, whom I wish to acknowledge for their part in the construction of this thesis. First, and foremost, thanks to Annette for her invaluable support and encouragement from beginning to the very end. To the people in the Thursday morning group, thanks for continually reminding me how important our children are, ensuring I kept a focus on people, not machines. My fellow graduates have provided a breadth of discussion and diversity of opinion that may not be evident in the research reported here, but has certainly influenced my approach to educational computing research and the way I shall conduct it in future.

I've had assistance, that has saved me enormous amounts of time, from Ken Mercer. Ken's wizardry with computers made the task of data entry, data checking and data analysis extremely efficient. His enthusiastic approach to all the problems we met seemed to make finding solutions to them a relatively easy and painless process.

My supervisor, Dr. Ken Ryba, has helped in two ways. He had a way of making me feel good about my work, especially during those times when I felt I wasn't getting anywhere. While this encouragement bolstered my morale, his positive and careful commentary on the many drafts he read has contributed to my conceptual understanding of the area I'd chosen to work in. Many thanks Ken.

Special thanks, of course, to the people who allowed me to become part of their class community for nearly six months - Bobbie Oatway and the students in Room 2. We all seemed to work well together and ended the six months still friends. Their farewell comments would indicate that I gave them as much as they gave me. I hope this is the case.
# TABLE OF CONTENTS

Abstract.................................................................................................................. iii

Acknowledgements.................................................................................................. iv

List of Tables........................................................................................................... vii

1 Introduction and Review .................................................................................... 1
   Computers and the Learning Process ................................................................. 1
   Research on Metacognitive Skills in Educational Computing ......................... 4
   The Importance of Domain Specific Knowledge ............................................... 6
   Knowledge Organisation ..................................................................................... 9
   Databases and Knowledge Organisation ............................................................ 11
   Social Interaction in the Classroom Computer Environment ......................... 14
   Methodological Issues.......................................................................................... 16
   Preferred techniques for Inferring Cognitive Structures .................................. 20
   Implications for Research Methodology ............................................................ 26
   Teacher Assessment and Cognitive Structures .................................................. 26
   Summary ............................................................................................................. 27
   Intent of the Present Study .................................................................................. 29

2 Method ................................................................................................................. 31
   Overview ............................................................................................................. 31
   Participants ......................................................................................................... 31
   Permission .......................................................................................................... 32
   Matching of Groups ........................................................................................... 32
   Teacher-Researcher collaboration ...................................................................... 33
   Classwork Units and Techniques for Inferring Cognitive Structure .................. 34
   Evaluation Instruments and Procedures ............................................................. 35
   Description of Evaluation Tasks ........................................................................ 38
Teaching and Learning Context ............................................. 41
Follow-up ...................................................................... 51
Statistical analysis ............................................................. 51
Statistical significance ........................................................ 52

3 Results ............................................................................ 53
Matching of Groups ......................................................... 53
Ordered Tree Technique (OTT). ............................................. 53
Teacher Tests .................................................................. 64
Other Analysis ................................................................ 68
Concept Structuring Analysis Technique (ConSAT) .......... 69

4 Discussion ........................................................................ 74
Initial Concerns ............................................................... 74
Context of the Study ........................................................ 80
Depth and Chunking as Dependent Variables ..................... 83
Type of Structure Inferred .................................................. 87
Investigating Process ........................................................ 88

5 Conclusion ....................................................................... 91

References ............................................................................ 98

Appendices ........................................................................... 108
Appendix One. Permission .................................................. 108
Appendix Two. Tasks Used to Match Groups ......................... 110
Appendix Three. Evaluation Tasks ........................................ 113
Appendix Four. Example of Student Task Requirements ....... 121
Appendix Five. Database Environment Checklist ................. 122
Appendix Six. Examples of Datafile Records ......................... 124
Appendix Seven. Examples of Questionsheets Used by Students ... 126
Appendix Eight. Coding Worksheets ........................................ 130
Appendix Nine. Student Raw Score Data .................................. 133
Appendix Ten. Examples of Inferred Cognitive Structures .......... 135
# LIST OF TABLES

1. Means and Standard Deviations on Matching Tasks, by Group ........ 55
2. Means and Standard Deviations for No-Treatment Control Group .... 55
3. Means and Standard Deviations for Number of Chunks, OTT .......... 57
4. ANOVA Summary Data for Number of Chunks - OTT (space) ......... 57
5. Means and Standard Deviations for Number of Chunks, OTT .......... 58
6. ANOVA Summary Data for Number of Chunks - OTT (rocks) ....... 58
7. Change in Number of Chunks - OTT (space) ............................ 60
8. Change in Number of Chunks - OTT (rocks) ............................ 60
9. Means and Standard Deviations for Tree Depth, OTT (space) ...... 62
10. ANOVA Summary Data for Tree Depth - OTT (space) ............... 62
11. Means and Standard Deviations for Tree Depth, OTT (rocks) ...... 63
12. ANOVA Summary Data for Tree Depth - OTT (rocks) ............... 63
13. Means and Standard Deviations for Teacher Test (space) .......... 65
14. ANOVA Summary Data for Teacher Test (space) ..................... 65
15. Correlations - OTT Depth and Number of Chunks with Test Scores .. 66
17. Correlations - OTT Depth and Number of Chunks with Test Scores .. 67
18. Correlations - Depth with PRO ........................................... 68
19. Means and Standard Deviations for ConSAT Depth .................. 71
20. Means and Standard Deviations for ConSAT Number of Chunks .... 71
21. Correlations - ConSAT Depth and Number of Chunks with Test Scores ........................................... 72