

**THE EFFECT OF A STRUCTURED PROBLEM SOLVING STRATEGY
ON PERFORMANCE AND CONCEPTUAL UNDERSTANDING IN
PHYSICS:
A STUDY IN DISADVANTAGED SOUTH AFRICAN SCHOOLS**

by

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Submitted in partial fulfillment of the requirements for the degree
PhD (Science Education)
in the Faculty of Natural & Agricultural Science
University of Pretoria
Pretoria

December 2004

SUMMARY

Title: The effect of a structured problem solving strategy on performance and conceptual understanding in physics: A study in disadvantaged South African schools

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This study extended existing research on structured problem solving into disadvantaged South African classrooms. Sixteen disadvantaged urban South African high schools participated in a quasi-experimental study to investigate the effect of a structured problem solving strategy in physics on performance and conceptual understanding. The schools were disadvantaged with regard to standards set by the apartheid education system as well as by instruction in English, the second language of the students and most of the teachers. The problem solving strategy incorporated the use of different representations, group work, verbal arguments, written explanations, planning and interpretation of solutions. The strategy was implemented by a cascading model, where the researcher interacted with the teachers, while the teachers interacted with students. The treatment was non-disruptive of the normal school routine. The problem solving strategy was applied throughout the year while learning new content; there were no extra classes or additional work for learners. Normal classroom tests and examinations were utilized as sources of quantitative data.

The treatment group outperformed the control group by 8 % in the midyear examination; this increased average score was statistically significant at the .001 level, indicating enhanced problem solving skills. Evidence of enhanced conceptual understanding was found by analyzing solutions presented in the midyear examination, videotaped problem solving and responses to questionnaires. Two new techniques were developed to assess conceptual understanding. Firstly, “solutions maps” were constructed for specific examination problems. These maps were visual

representations of concepts, formulae, assumptions, substitutions and numerical answers presented by students. The popularity of various routes on the maps was compared for the two groups as a measure of differences in conceptual understanding. Secondly, a “conceptual index” was defined to quantify the extent to which a group of students used a conceptual approach in their solutions, as opposed to an algebraic approach. Learners and teachers regarded the structured problem solving strategy as a viable practice, they believed the students’ problem-solving skills were improved and they commented on the value of the strategy as a facilitator of understanding the language and concepts of physics. Teachers also believed that their own problem solving skills improved.

Greeno’s model for scientific problem solving and reasoning was incorporated to explain the effect of structured problem solving on performance and conceptual understanding. Two complementary theories were offered to explain the results of the study. It was proposed that implementing the strategy fostered (1) the co-development of conceptual understanding and problem solving skills, and (2) the development of a conceptual approach to problem solving.

Implementation of structured problem solving is a small intervention aimed at developing new habits of problem solving. In the South African context, it can make a significant contribution towards the enhancement of learning and teaching physics in disadvantaged schools.

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to all those who had been involved in this project.

- The teachers and learners who participated in this project.
- The Gauteng Department of Education, for permission to conduct the research in public schools.
- My promoter, Professor John Rogan, for expert guidance and encouragement.
- Professor Max Braun, my co-promoter for support and suggestions.
- The National Research Foundation, in collaboration with the National Science Foundation for a grant to continue my research for a period of three months in the USA.
- Professor Peter Hewson, who acted as my mentor at the University of Wisconsin-Madison. Thank you for valuable discussions and critical evaluation of my work.
- The Faculty of Education at the University of Pretoria, for granting three months study leave.
- The research group at the Center for Science Education at the University of Pretoria (later the Joint Center for Mathematics, Science and Technology Education), for stimulating discussions.
- The Science Education research group at the University of Wisconsin-Madison for stimulating discussions.
- Professor Gilbert Onwu and my colleagues in the Department of Science, Mathematics and Technology Education at the University of Pretoria for encouragement and support during the past year.
- Mrs Suzette Booyens of the Gauteng Department of Education, for introducing me to informal teacher support initiatives.
- My husband and family for encouragement, patience and support.

Dedicated to Horace

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