UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

A COMPARISON OF THE EFFECTIVENESS OF SCIENCE EDUCATION IN KOREA AND SOUTH AFRICA: A MULTILEVEL ANALYSIS OF TIMSS 2003 DATA

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Submitted in partial fulfillment of the requirements for the degree of

PhD: Curriculum & Instruction Design & Development

In the Faculty of Education
University of Pretoria
PRETORIA

September 2010

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Summary

Science education becomes more important for future national development globally in high-technology-based society. In reaction to the trend, the International Association for the Evaluation of Educational Achievement (IEA) has conducted achievement tests in science along with mathematics, called TIMSS every four years. In TIMSS 2003, while Korea was a higher-performing country, South Africa was ranked in the lower-performing countries. Korea features homogenous demography, centralized curriculum, and competitive educational zeal while South Africa is characterized by multicultural demography with various languages, and previously segregated schools based on races. The current research, which is a secondary analysis of TIMSS 2003 data, aimed at explaining the differences and similarities by identifying factors most likely to influence science achievement in the two countries.

A conceptual research framework was built on the comprehensive literature review which involved mainly school effectiveness research and factors related to science achievement. The conceptual framework consists of multi-levels, viz., student, classroom, school, and context, and three key concepts, namely time on task, opportunity to learn, and quality.

Two research questions were formulated to reach the goal of the research and the first question is: To what extent does TIMSS 2003 reflect factors related to effective science education? Data from the student, teacher and school questionnaires were included in conjunction with the achievement data and analysed by means of factor, reliability and correlation analyses. The factors found to influence science achievement in three levels are as follows: at the student level, books at home, attitudes towards science, time on task; at the classroom level, time scheduled for science and teacher interaction; at the school level, school size, community size, and student background.

The second research question is: To what extent do the factors derived from the analysis explain the differences in the achievement of Korean and South African students? To answer this question, the current research used multilevel modelling

techniques to deconstruct the total variance in achievement into within- and between-classroom/school level. The strongest predictor is attitudes towards science in both countries at the student level. Student background in Korea and safety in school in South Africa is the strongest predictor of science achievement at the classroom/school level. Furthermore, educational resources such as books at home and educational level of father are significant in Korea while language, teacher qualification, physical resources, and educational leadership are significant in South Africa. For Korea, 93% of total variance in science achievement occurred at the student level while only 7% was attributable to the classroom/school level. For South Africa, 41% of the total variance was assigned at the student level and 59% at the class/school level.

From this comparative study, it was recommended that development of student-centred teaching practices to address negative attitudes to science in Korea be considered as opposed to basic issues such as improving teachers' subject knowledge, developing language skills, and fostering a culture of learning to improve science performance in South Africa.

Key words: ***science education, school effectiveness, South Africa, Korea, factor analysis, reliability analysis, correlation analysis, multilevel analysis, TIMSS***

Acknowledgements

I would like to give thanks to God for setting up all the situations around me and being with me during this long journey. Whenever I was stuck, he got me out and encouraged me to keep going.

I would like to give special thanks to my supervisors, Dr. Estelle Gaigher and Dr. Vanessa Scherman. I cannot think of this work without them. Actually, I believe God sent them for me. They sometimes were kind guides, other times harsh trainers, and always excellent promoters.

I wish to express my sincere gratitude to all those who crossed my path during my research.

Cilla Nel, she taught me how to write academically and edited my work.

Professor William Fraser, he provided support and guidance throughout the time I spent at the University of Pretoria.

Professor Sarah Howie and many the staff at the CEA, they helped me in the beginning, in the middle, and in the end of my work in various ways.

The staff in Administration building, they were willing to help an international student like me concentrate on research without being disturbed by other matters.

My colleagues, they took over many of my duties for me while I completed my research.

My families, they were patient about spending family time without me and encouraged and supported me.

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List of Acronyms

AIC – Akaike Information Criterion

ANC – African National Congress

C 2005 – Curriculum 2005

DBE– Department of Basic Education

DET – Department of Education and Training

DoE – Department of Education

FET – Further Education Training

FIMS – First International Mathematics Study

FISS – First International Science Study

FML – Full Maximum Likelihood

FRD – Foundation for Research Development

GDP – Gross Domestic Product

GET – General Education and Training

HE – Higher Education

HSRC – Human Sciences Research Council

IAEP – International Assessment of Educational Progress

ICT – Information-Communication Technology

IEA – International Association for the Evaluation of Educational Achievement

IGLS – Iterative Generalized Least Square

IIEP – International Institute for Educational Planning

IRT – Item Response Theory

ISC – International Study Centre

IT – Information and Technology

KICE – Korea Institute of Curriculum and Evaluation

KMO – Kaiser-Meyer-Olkin

MAR – Missing At Random

MCAR – Missing Completely At Random

MEHRD – Ministry of Education and Human Resources Development

MIP – Mathematics Improvement Program

ML – Maximum Likelihood

MLA – Monitoring Learning Achievement

MNAR – Missing Not At Random

MOS – Measure Of the Size

NAEP – Nation Assessment of Education Progress

NCS – National Curriculum Statement

NELS – National Education Longitudinal Study

NRC – National Research Coordinator

NSAECE – National Scholastic Achievement Examination for the College Entrance

OBE – Outcomes-Based Education

OECD – Organization for Economic Cooperation and Development

OTL – Opportunity to Learn

PIRLS – Progress in International Reading Literacy Study

PISA – Programme for International Student Assessment

PLS – Partial Least Squares

PPS – Probability-Proportional-to-Size

QCM – Quality Control Monitor

RML – Restricted Maximum Likelihood

RNCS – Revised National Curriculum Statement

SACMEQ – Southern and Eastern Africa Consortium for Monitoring Educational Quality

SD – Standard Deviation

SE – Standard Error

SER – School Effectiveness Research

SES – Socio-Economic Status

SIMS – Second International Mathematics Study

SISS – Second International Science Study

SPSS – Statistical Package for the Social Sciences

STS – Society, Technology and Science

TCMA – Test-Curriculum Matching Analysis

TER – Teacher Effectiveness Research

TIMSS – Trend in International Mathematics and Science Study

UNESCO – United Nations Educational, Scientific, and Cultural Organization

UNICEF – United Nations Children's Fund

VIF – Variance Inflation Factor