The learning and transfer of science process skills in New Zealand secondary school distance education

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Abstract

This study investigates whether the science process skills of processing and interpreting scientific information, carrying out an investigation, communicating information and using information can be transferred across the strands of the *Science in the New Zealand Curriculum* (Ministry of Education, 1993b). The data were collected during the 1995 school year and was from a level 6 science course developed by the Correspondence School. Measurements of student performance were taken from moderated teacher-marked activities and were analysed using group means comparisons of each science process skill taught and pair-wise comparisons of students' performance. A representative population sample, chosen by using stratified random sampling, was surveyed on how they viewed the skills offered in the level 6 science course. The fulltime teachers who marked the level 6 science course in 1995, were also surveyed about the success of the course. The broad method used to conduct this research was illuminative evaluation. Results indicate, that while whole process skills such as carrying out an investigation may be transferable, other science process skills are more context bound and less likely to be transferred.

The Correspondence School

Wellington New Zealand

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1 Introduction

This thesis investigates the learning and transfer of science skills of investigation and the science process skills entailed, in a distance education setting. In this study the term 'science skills' embraces both routines of low cognitive content learnt by repeated rehearsal and those of high cognitive content such as communicating, classifying or predicting, while the term 'science process skills' is reserved for the coming together of the science skills to solve practical problems. Processes and methods are also linked. A method is understood by the researcher to be a collection of processes, while a process is a collection of skills that are used together. Processes are usually represented as a cycle or loop which in science learning and teaching goes through hypothesizing, experimenting, designing, evaluating, recording, interpreting and communicating but a skill is a capacity or a competence, the ability to successfully perform a task of some kind whether intellectual or manual. Watts (1991) prefers to classify science skills into specific and general skills. General skills are identified in clusters, for example, social skills, and degrees of skillfulness are recognized. These definitions hold true for both distance as well as face-to-face education.

The Correspondence School, Wellington, provides distance education for New Zealand citizens of compulsory school age, who are unable to attend conventional face-to-face schools in New Zealand. Some adults who wish to study at the post-primary level also study with the Correspondence School, as do some Home Schoolers who do not wish to attend conventional schools. Another group of students that use the Correspondence School courses are the secondary school students who are unable to study subjects at their own schools due to absence of teachers in that subject or because there are too few students to qualify for teacher time.

In 1995 the Correspondence School offered a skill-based, level 6 science course for the first time to cover the requirements of *Science in the New Zealand Curriculum* (Ministry of Education, 1993b) and the new School Certificate Science Prescription (1994). The course is intended for year 11 students who are preparing for the external School Certificate Science Examination. *Science in the New Zealand Curriculum* (Ministry of Education, 1993b) is one of the curriculum documents of *The New Zealand Curriculum Framework* (Ministry of Education 1993a) which presents the policy for

learning and assessment in all New Zealand schools, including the distance education situation of the Correspondence School. There was no national policy for distance education in 1995, the year of the present study, with the distinction between the two separate modes of face-to face and distance learning and teaching not evident in the curriculum and Ministry of Education documents. The documents gave guidance of what every student should be taught in each subject, but it was up to each school and teacher to choose the exact contexts, learning experiences and assessment tasks. This influenced what teachers included or did not include in their courses and could affect what children learn in different parts of the country. Due to individual circumstances, many students spend only a short time studying with the Correspondence School before returning to the classrooms of conventional schools. It is thought they may be disadvantaged by having to repeat work already completed, or by missing chunks of work previously done in their new school's programme.

This research highlights the issues encountered providing distance education courses to promote science skills and science process skills. It also has the potential to provide information on the learning and transfer of practical science skills in New Zealand post-primary distance education and indicate ways future development of other skill-based, distance education science courses could proceed or be revised. The research also gave the opportunity to see how the performance of different groups of students compared, while using a single science course for learning science process skills.

The reason for under taking this study was to find out if:

(a) skills and science process skills can be successfully taught by a distance education course so that transfer from one science context to another can occur
(b) a single distance education course, at a particular curriculum level, could accommodate several different groups of the student population.

The structure of the thesis

Following the introduction, the literature review (chapter 2) describes recent research in skill development and learning. The current view of science education presents science as a hierarchy of science skills and processes. It believes science skills can be taught, improved and then used in different

situations, however there are debates over whether such skill-learning is permanent and whether skill-learning should be isolated from the contexts in which the skills are used. This chapter continues with a review of the theories of teaching and learning science skills and the relationship between skill development and teaching practice. This is followed by a look at the factors that influence the learning and transfer of skills, especially student characteristics, teaching contexts, approach to learning tasks and assessment of skills and learning outcomes.

In chapter 3 the methodology chosen to investigate the research questions is described. The method used in this study come under illuminative evaluation umbrella and covers document analysis, student performance and perception of the level 6 Correspondence School science course. Teacher perceptions were also looked at as their opinions may have a flow on effect to the students, along with data gathered from student logsheets, the computerized Student Information System and questionnaires.

The next four chapters report on the data obtained from document analysis, student performance and the student and teacher perceptions of the level 6 Correspondence School science course. The data collected include grades recorded by teachers and what students and teachers think about the course and how they respond to the questionnaires.

In the discussion (chapter 8) the researcher attempts to pull all the threads of the research together to form an overview of how science skill learning and teaching at a distance affects student performance and progress through the school system and later in the work force.

In the last chapter (chapter nine) the findings of the study are brought together and recommendations are made for future skill based courses and research.