THE PRAXIS OF INITIAL SECONDARY SCIENCE TEACHER EDUCATION IN SEYCHELLES AND NEW ZEALAND: A COMPARISON BETWEEN THE NATIONAL INSTITUTE OF EDUCATION AND THE UNIVERSITY OF CANTERBURY COLLEGE OF EDUCATION

By

Rosianna P.C. Jules

A dissertation submitted to the University of Canterbury in New Zealand in partial fulfilment of the requirements of the degree of Master in Science Education.

January 2009

TABLE OF CONTENTS

CHAPTER ONE INTRODUCTION 1

1.1 Background 1

1.1.1 Rationale for choosing this study 2

1.1.2 Broad aims of the research 4

1.2 Setting the context: Teacher education in Seychelles and New Zealand 5

1.2.1 Teacher Education in Seychelles 5

1.2.1.1 Initial teacher education at the National Institute of Education 6

1.2.2 Teacher Education in New Zealand 8

1.2.2.1 Teacher Education at the University of Canterbury College Of Education 9

1.3 Usage of terms 9

CHAPTER 2: REVIEW OF LITERATURE 11

2.1 Introduction 11

2.2 Teaching and teacher education: acknowledging complexities 12

2.3 The characteristics of a coherent and effective programme 12

2.4 Initial secondary science teacher education curriculum: what pre-service secondary science teachers need to know 15

2.4.1 Subject matter content knowledge/science knowledge (SMK) 17

2.4.1.1 Content Knowledge 18

2.4.1.2 Substantive structures/knowledge 19

2.4.1.3 Syntactic structures/knowledge 19

2.4.1.4 Beliefs and attitudes about the subject matter 20

2.4.2 General Pedagogical Knowledge (PGK) 21

2.4.3 Pedagogical Content Knowledge (PCK) 22

2.4.3.1 Curricular knowledge 23

2.4.3.2 Knowledge of the science learners 24

2.4.3.3 Knowledge of science instructional strategies 24

2.4.4 Knowledge of education contexts 25

2.5 Pedagogy of teacher education: how to teach and assess pre-service teachers 27

2.5.1 Addressing the problems of learning to teach 27
2. 5.2 Pedagogy of teacher education 28
2.5.2.1 Emerging pedagogies in teacher education 29
2.6 Conclusion 33

CHAPTER 3: METHODOLOGY 34
3.1 Introduction 34
3.2 Rationale for using the qualitative research approach 34
3.3 Research design 35
3.3.1 Data gathering tools 36
3.3.1.1 Document analysis 36
3.3.1.2 Interview 37
3.3.1.1 Participant observation 41
3.3.2 My role as the researcher: insider status 43
3.4 Credibility (Rigours and trustworthiness) 44
3.4.1 Addressing the issue of credibility 44
3.5 Ethics in qualitative research 45
3.5.1 Addressing ethical issues 45
3.5.1.1 Informed and voluntary consent 46
3.5.1.2 Respect for rights of privacy and confidentiality 46
3.5.1.3 Limit to deception 47
3.6 Data analysis in qualitative research 47
3.4.1 The data analysis process 48

CHAPTER 4: RESEARCH FINDINGS 49
4.1 Introduction 49
Part 1: Initial secondary teacher education programmes for the aspiring secondary science teachers at NIE and UCCE 49
Section 4A: The context of the ISTE programmes at NIE and UCCE 49
4A.1 The qualification offered to prospective secondary science teachers at NIE and UCCE
4A.1 The qualification offered by NIE and UCCE
4A.2 Academic entry requirement
4A.3 The duration of the DSTE and the GradDipTchLn(Secondary) programmes

Section 4B: The components and structure of the ISTE programmes at NIE and at UCCE

4B1 The components of ISTE programmes at NIE and UCCE

4B2 Weightings assigned to the different components of the programmes

4B3 The structure of ISTE programme at NIE and UCCE

Part 2: Insights from inside the initial secondary science teacher education classes

Section 4C: The integration of theory and practice in the ISSTE classes at NIE and UCCE

4C1 Knowledge base of the science education course(s): what are student teachers taught?

4C1.1 The knowledge base of the science education course(s) at NIE and at UCCE

4C1.2 Other significant findings

4C2 Pedagogical approaches in ISSTE classes: how are student teachers taught?

4C2.1 Similarities and differences

4C2.2 Student teacher's concerns about their teacher educators' pedagogical practice

4C3 Approaches to assessment/assignment in the ISSTE classes: how are student teachers assessed

4C3.1 Types of assessment/assignment tasks

4C3.2. Assessment processes: individual and group assessments/assignments

4C3.2.1 Individual assessment/assignment: the benefits

4C3.2.2 Group assessment/assignment

4C4 Approaches to teaching practice in the ISSTE classes: when do student teachers practice what they have learnt?

4C4.1 Frequency and duration of teaching practice at NIE and UCCE

4C4.2 Teaching practice requirement

4C4.3 Practicum supervision: the role of the teacher educator

Section 4D: Decision making about the contents of the science education course(s)

4D1.1 Who decides on the contents of the science education course(s)?

4D1.2 Factors influencing the decision-makers

4D1.2.1 Factors common to the decision makers in both institutions

4D1.2.1 Context-specific factors

Summary of findings

CHAPTER 5: DISCUSSION AND CONCLUSION

5.1 Introduction

5.2 The Discussion

5.3 Limitations of the study

5.4 Further research potential

5.5 The Recommendations to the teacher education institutions

5.5.1 Recommendations to NIE

5.5.2 Recommendations to UCCE

5.6 Concluding statement

List of Figures

Figure 1.1: Structure of the education system of Seychelles

Figure 1.2: The New Zealand education system

Figure 2.1: "Clustering of the seven principles into components of programs and program change" (Korthagen et al., 2006, p. 1037, Fig. 2) 14

Figure 2.2: The knowledge base of science teachers (derived from Coble and Koballa, 1996; Darling-Hammond & Baratz-Snowden, 2005; Grossman, 1990; Shulman, 1986/2004c) 17

Figure 4B.1: A comparison of the weightings given to the components of the ISTE programme at NIE and at UCCE

List of Tables

Table 1.1: Teacher education courses (programmes) offered by NIE

Table 1.2: Initial teacher education programmes offered by UCCE

Table 3.1: Documents analysed from UCCE and NIE

Table 3.2: The interview participants and their assigned pseudonyms

Table 3.3: Participant observation schedule

Table 4A.1: The qualification, entry requirement and duration of ISTE programme at NIE and UCCE

Table 4B.1: The pairs of analogous components of the two ISTE programmes

Table 4B.2: Weightings allocated to each component of the DSTE programme

Table 4B.3: Weightings assigned to each component of the GradDipTchLn(Secondary) Programme (Adapted from the

University of Canterbury (2008)

Table 4C.1: The variety of assessment tasks that prospective secondary science teachers perform in their science education course at UCCE

Table 4C.2: The variety and frequency of the assessment tasks that prospective secondary science teachers perform in their 22 secondary science education courses at NIE

Table 4C.3: The schedule and general purpose of the different teaching practice blocks at NIE

Table 4C.4: The schedule and general purposes of the different teaching practice blocks at UCCE

Table 4C.5: The main differences between practicum supervision of the secondary science student teachers at NIE and UCCE

Appendixes

APPENDIX A Ethical Approval Letter from the College of Education Ethical Clearance Committee

APPENDIX B Letters and Consent Forms sent to participants

Letter 1A Request for Permission to Research the Pre-Service Secondary Science Teacher Education at the College Of Education

Letter 1B Request for Permission to Research the Pre-Service Secondary Science Teacher Education at the National Institute of Education

Letter 2A Letter to Pre-Service Secondary Science Teacher Educators from the College Of Education in New Zealand

Letter 2B Letter to Pre-Service Secondary Science Teacher Educators from the National Institute of Education in Seychelles

Letter 3A Letter to Pre-Service Secondary Science Student Teachers from the College of Education in New Zealand

Letter 3B Letter to Pre-Service Secondary Science Student Teachers from the National Institute of Education in Seychelles

Letter 4 Letter to Teacher Educators concerning classroom observation

Consent 1A Consent Form (for the Dean of UCCE and the Director of NIE)

Consent 1B Consent Form (for the participants – teacher educators and student teachers)

APPENDIX C Details about the components of the initial secondary teacher education (ISTE) programme at NIE and at UCCE.

APPENDIX D ISTE Programme Structure at NIE and UCCE

APPENDIX E Knowledge base offered at NIE and at UCCE

ACKNOWLEDGEMENTS

I wish to express my heartfelt gratitude to all those who have, in a way or another, contributed towards this product.

First and foremost, I would like to thank and dedicate this dissertation to my husband, Alain, daughter, Raksha, and son, Alvin, for their patience, support and understanding throughout this process.

My greatest debt is to my supervisors, Associate Professor Lindsey Conner and Dr Missy Morton for their continuous advice, guidance, understanding, enthusiasm, encouragement and friendly dispositions. I am forever grateful.

I acknowledge with thanks the teacher educators and student teachers at the National Institute of Education and at the University of Canterbury College of Education who participated in the interviews.

My sincere thanks also go to the science teacher educators at the University of Canterbury College of Education who welcomed me into their class for the participant observation.

My gratitude also goes to Ms Marie-Noel Finesse, for acting as my liaison at NIE and for obtaining and forwarding electronic copies of several documents.

My vote of thanks also goes to my relatives back in Seychelles, especially my sister, Lorena Sultan; their words of encouragement from time to time were very much appreciated.

To my husband who tirelessly assisted with the transcribing of the interviews, I am forever grateful.

Last but not least, I would like to thank NZAID for the financial assistance..

List of acronyms most frequently used in the report

BEd/GradDipTchLn(Secondary)	Bachelor of Education and Graduate Diploma in Teaching and Learning (Secondary) specialising in PE
DSTE	Diploma in Secondary Teacher Education
DSTE(Science)	Diploma in Secondary Teacher Education (Science)
EDST	Educational Studies
GradDipTchLn(Secondary)	Graduate Diploma in Teaching and Learning (Secondary)
ICT	Information and Communication Technology
ISTE	Initial Secondary Teacher Education
ISSTE	Initial Secondary Science Teacher Education
NIE	National Institute of Education
NOS	Nature of Science
NZTC	New Zealand Teachers Council
PCK	Pedagogical content knowledge
GPK	General pedagogical knowledge
SMK	Subject matter knowledge
UC	University of Canterbury
UCCE	University of Canterbury College of Education

Chapter One: Introduction

1.1 Background

Quality education remains the top priority of the Ministry of Education in Seychelles (as well as most if not all other countries around the world) while teachers remain "the most important elements in an effective education system" affirmed President James Michel in his Teachers' Day Message 2005 (*Seychelles Nation*). The long-lasting importance of teachers in a society is advocated by many. Shulman for instance, eloquently proclaimed that:

> We will sooner de-school society than de-teacher it . . . . No microcomputer will replace them [teachers], no television system will clone and distribute them, no scripted lesson will direct and control them, no voucher system will pass them (as cited in Wilson, 2004, p. 3)

Inevitably, the onus is placed on teacher education providers to ensure that this on-going pursuit for education quality permeates every aspect of the teachers' professional practice. Hence, teacher education has the obligation to provide student teachers with the most relevant and most effective programme that will empower them to not only develop into competent teachers in the face of the uncertainties and complexities of teaching, but also to develop into reflective practitioners whose search for perfection of practice which will eventually contribute towards maintaining and improving education quality. However, a number of publications reveal that teacher education is not as coherent as we might expect: teacher education programmes have long been criticised for failing to connect theory with practice (Darling-Hammond & Baratz-Snowden (2005); Korthagen, Loughran & Lunenberg, 2005; Korthagen, Loughran, & Russell, 2006; Shanker 1996). More than a decade ago, Shanker (1996) reproached teacher education for "presenting knowledge in a piecemeal and disconnected manner." He claimed that "theory is unrelated to practice; content knowledge is disconnected from teaching methods; instructional practices are unrelated to learning and development" (p. 221). Unfortunately, Korthagen et al. (2006) remark that despite the various

Comment [RD1]: Great Introduction!

attempts, teacher education has still not adequately addressed or solved the problem of "how to connect theory and practice in such a way that teachers would be able to handle the problems of everyday teaching through theory-guided action" (1021). But the quest to address this perennial problem continues.

1.1.1 Rationale for choosing this study

My personal experience was a lived experience of Shanker's admonishment. The science component of my two-year initial secondary teacher education course (programme), at the School of Education and Community Studies (SECS) in Seychelles, focussed on science content knowledge (academic science). Teaching methodology or general pedagogical knowledge was learned during Educational Studies (Professional Studies at UCCE) units (courses). What was missing from the science units was the subject-specific (in my case science) pedagogical knowledge or 'pedagogical content knowledge' (Shulman, 1986/2004c). Expectedly, as a newly qualified teacher, the application of general pedagogical knowledge led to immense creativity, trial and error, and reflection to ensure that students learn and understand various science concepts prescribed by the science curriculum. Unfortunately, it was not until I was transferred to the National Institute of Education in Seychelles in 2002, where I had to teach on that same course I followed almost a decade ago, that I questioned the contents of the science component of that two -year course. I pointed out that there was a need to provide the aspiring science teachers with some methodology specific for science teaching, such as how to teach the different types of practical work. (Bekalo & Welford 1999). Looking back, it was, as Bekalo and Welford (1999) put it:

> Somehow ironic that in teacher-training institutions, where one might expect a focus on pedagogy and pedagogical methods, one encounters instead a devotion to academic study with little attention given to pedagogical study. (p. 1306).

After some discussions and considerations it was agreed that the review of the 18 science units (courses) was imminent. Our review which started in 2002 coincided with the review of Secondary Course (programme) Structure in 2004 which led to an additional four units to the course. I then assumed the responsibility of team leader for the review of NIE’s secondary science curriculum. With the urgency to review the science units to cater for the prospective secondary science teachers (the 2003-2004 and the consecutive 2004-2005 cohort), there was no research to systematically analyse how others felt about the contents of the previous programme and how we should change it. Consequently, using the knowledge acquired from university education and drawing mainly from our personal experiences in science teaching at secondary school, the review team (the three of us teaching on that programme) developed 22 science unit outlines (as stipulated by the *Secondary Course Structure*) placing more focus on science methodology in relation to the new *Science in the National Curriculum of Seychelles* (SNCS) published in 2001. Since this experience in 2002 to 2004, especially with no previous experience in the field of teacher education, several questions about the science units have been haunting me (and possibly the other members of the secondary science review team). Questions such as: Are we providing our student teachers with authentic experiences in science teaching? Did we include the relevant components or knowledge base? Are our assessments tasks (assignments) appropriate? What are the similarities and differences between our pre-service science course and that of another institution? In general, as a science teacher educator and course developer, I am interested gaining better understanding of initial secondary science teacher education by comparing the initial secondary science teacher education programme at the National Institute of Education (NIE) with that of the University of Canterbury College Of Education (UCCE), in terms of content, focus on theory, connections between theory and practice and assessment. This need to better understand the components of initial teacher education is well documented. For example, referring to teacher education in New Zealand, Cameron and Baker (2004) observe a “lack [of] basic description of the curriculum or understanding of the pedagogy of initial teacher education and of the core knowledge and skills that student teachers are expected to know before they graduate" (p. 68). The potential of this research is imminent especially since NIE looking into the possibility of offering degree level course in 2010 (A. Souffe, personal communication, June 4, 2008).

My expectation is that the research will serve to:

1. Assist my professional development as well as the professional development of other teacher educators and programme developers.
2. Enhance my confidence and knowledge so that I could contribute effectively towards the development of secondary science teacher education programmes and teacher education in general in Seychelles.
3. Help the science teacher educators in Seychelles and elsewhere to gain the perspective, and critically examine pre-service science teacher education from UCCE in New Zealand and from NIE in Seychelles.
4. Guide the teacher educators in Seychelles and elsewhere in their future decision-making.
5. Contribute to the research bank in Seychelles.

1.1.2 Broad aims of the research

The aims of the research are to:

1. Describe the initial secondary teacher education (ISTE) programme offered to prospective secondary science teachers at NIE and at UCCE;
2. Compare the components/contents of the ISTE programme at NIE and UCCE;
3. Compare the knowledge base offered by the science education course(s) at NIE and at UCCE;

4. Identify the pedagogical approaches used in the initial secondary science teacher education (ISSTE) classes at the two institutions;
5. Identify how prospective secondary science teachers are assessed in the ISSTE classes at NIE and at UCCE.
6. Understand and compare how decisions are made about the components to be included in the secondary science education courses at the two institutions.

1.2 Setting the context: Teacher education in Seychelles and New Zealand

In this section, I establish the context for initial teacher education (ITE) Seychelles and New Zealand with specific focus on the National Institute of Education and the University of Canterbury College of Education.

1.2.1 Teacher education in Seychelles

Teacher education in Seychelles is offered by only the National Institute of Education (NIE), the sole teacher education provider in the country. NIE offers both pre-service and in-service teacher education as stipulated by Ministry of Education’s (2000) education policy *Education for a learning society: Policy statement of the Ministry of Education Seychelles.* The policy states that:

> Teacher Education and Training will be delivered through a unified system which promotes life-long learning, with initial and in-service training being viewed as a continuum. (Ministry of Education, 2000, p. 14)

The Ministry of Education (2000) has also set out the requirements for a “coherent system of pre- and in-service education and training” (p. 13). These requirements include:

- master his/her subject discipline(s) and demonstrate knowledge of the methodologies and procedures necessary for effective teaching, as well as commitment to the learner and to the profession
- employ a range of teaching strategies appropriate to the age, ability, interests, needs, experiences and attainment level of students, based on a thorough understanding of the psychology of learners, and making judicious use of education

technology

- initiate and/or participate in classroom-based action-research, and engage in self-appraisal and critical evaluation of his/her work (Ministry of Education, 2000, p. 13)

In addition, the National Institute of Education has developed a "set of professional teaching competencies for the newly qualified teachers" to guide the pre-service teacher education programmes (National Institute of Education, 2001, p. 3).

All teacher education programmes in Seychelles are offered free of charge to aspiring Seychellois teachers, however, all student teachers are bonded by a five year legal agreement with the Ministry of Education. To date, the student teachers received a study allowance from the Ministry of Education. On successful completion of their teacher education programme, the new teachers are all employed by the Ministry of Education.

1.2.1.1 Initial teacher education at the National Institute of Education

NIE became operational in October 1999 by the merger of the School of Education and Community Studies (SECS), and the Curriculum Development Section (CDS) of the Ministry of Education. Under the auspice of the Technical and Further Education (TFE) Division of the Ministry of Education, NIR has the mandate for continuous improvement in teaching and learning through teacher education, national curriculum development and school-based educational research development.

To date, NIE offers 9 different teacher education courses (programmes), (two pre-service and seven in-service) available either through face-to-face or distance mode of delivery on a full-time or part-time basis as illustrated in Table 1.1 below.

Table 1.1: Teacher education courses (programmes) offered by NIE

Initial teacher education	
Full-time face-to-face teacher education courses	**Duration**
1. Diploma in Primary Teacher Education A. Early childhood (teaching at crèche to P2) B. Generalist (teaching at P3 to P6)	Four years
2. Diploma in Secondary Teacher Education	Two years
In-service teacher education	
Part-time face-to-face teacher education courses	
3. Certificate in Education: Music and Dance	One year
4. Certificate in Education: Physical Education	One year
5. Certificate for Day-care Operators/Attendants	One year
6. Post Graduate Certificate in Education	18 months
7. Advanced Diploma in Education Leadership and Management	18 months
Full-time teacher education courses offered through distance education	
8. Master in Education Leadership and Management (in collaboration with Lincoln University in the United Kingdom)	One year (since 2004)
Part-time teacher education courses offered through distance education	
9. Diploma for in-service primary teachers holding a Trained Teacher Certificate (with on-going face-to-face tutorial at school level – Tutorial Centre)	Two years (since 2006)

Hitherto, upon successful completion of the two-year Diploma in Secondary Teacher Education, the beginning teachers have the opportunity to study for a Bachelor of Education at the Edith Cowan University in Australia.

1.2.2 Teacher education in New Zealand

Unlike Seychelles and many other countries around the world, pre-service teacher education in New Zealand is provided by different providers namely: private training establishments; polytechnics; universities; and three wānanga (New Zealand tertiary education institutions). There are 131 different teacher education programmes (encompassing early childhood, primary and secondary teacher education) and 85 different qualifications (undergraduate diploma, degree and graduate diploma) offered by the 27 institutions, all leading to teacher registration in New Zealand, (Kane et al., 2005).

The New Zealand Teachers Council, a governmental professional body, has the mandate for the accreditation and auditing of pre-service teacher education programmes, as well as the registration of teachers in New Zealand. In order "to establish and maintain standards for qualifications that lead to teacher Registration” among other functions, in 2007, the New Zealand Teachers Council (NZTC) published a set of seven standards, which become mandatory from 2008, for graduates entering the teaching profession (NZTC, 2007). The first three standards focus on ‘Professional Knowledge’; standards four and five focus on ‘Professional Practice’ and the last two focus on ‘Professional Values & Relationships’. According to the NZTC (2007), graduating teachers:

1. Know what to teach
2. Know about learners and how they learn
3. Understand how contextual factors influence teaching and learning
4. Use professional knowledge to plan for a safe, high quality teaching and learning environment
5. Use evidence to promote learning
6. Develop positive relationships with learners and the members of learning communities
7. Are committed members of the profession

1.2.2.1 Initial teacher education at the University of Canterbury College Of Education

The College of Education (UCCE) is the result of the formal integration of the former Christchurch College of Education (established in 1877) with University of Canterbury in January 2007. The UCCE offers a range of undergraduate, graduate, postgraduate and professional development qualifications, (such as: Bachelor of Teaching and Learning; Master in Science Education; Masters of Teaching and Learning; and Doctor of Philosophy), in different areas, like: educational leadership, and clinical teaching (College of Education international prospectus 2008). The programmes are available on a full-time or part-time basis, through face-to-face or distance mode of delivery for a duration ranging from one year to four years full-time, and up to a maximum of six years part-time. The initial teacher education programmes in early childhood, primary and secondary offered by the UCCE are summarised in Table 1.2 below.

Table 1.2: Initial teacher education programmes offered by UCCE

Initial teacher education programmes	Duration (full-time)
1. Bachelor of Teaching and Learning (Early Childhood)	Three years
2. Graduate Diploma in Teaching and Learning (Early Childhood) A. (for university degree graduates) B. (for those with a primary teacher qualification who are eligible for New Zealand teacher registration)	 Two years 15 months.
3. Bachelor of Teaching and Learning (Primary)	Three years
4. Graduate Diploma in Teaching and Learning (Primary)	15 months (minimum)
5. Bachelor of Education (Physical Education)	Four years
6. Bachelor of Teaching and Learning (Hons)	Four year
7. Graduate Diploma in Teaching and Learning (Secondary)	One year (34 weeks)

(Source: College of Education international prospectus 2008)

1.3 Usage of terms

Education is a field with ill-defined terminologies; a field where different terminologies have different contextual meanings for different people, and the difference is even more so from one country to another, as evinced in this comparative study between New Zealand and Seychelles. The term 'unit' used by the NIE in Seychelles is synonymous to the term 'course' at the UCCE in New Zealand. The term 'programme' and 'course' are two other terms showing disparities: the term 'course' in Seychelles is synonymous to the term 'programme' in New Zealand. Henceforth, to establish a common ground of understanding, the terms 'course' is used to represent the contents to be studied over a certain period as assigned by the respective institution. The term 'programme' is used to refer to the study of the different courses leading to a qualification at the respective institution.

Analogous to Cameron and Baker's (2004) approach, in this report the term 'teacher education' is used as opposed to 'teacher training', the traditionally "dominant epistemology of technical rationality" (Smyth, 1987, as cited in Barnes, 1989, p. 17). Cameron and Baker (2004) maintain that the term training limits the complexities of teaching and views "teacher education as the technical acquisition and demonstration of a set of skills that can be unproblematically applied to any classroom" (p. 13). By contrast, although teacher education, "may contain some aspects of training" (p. 3) it educates teachers in becoming "professionals who are equipped to make sound decisions about their practice in the best interests of all students" (p. 3) and acknowledges that the complexities of teaching cannot be addressed by "a training model" (p. 13).

Similarly, the term teacher educator is used instead of the terms teacher trainer and lecturer, to represent the institutions' full-time teacher. The terms 'pre-service teacher', 'student teacher' or 'prospective teacher', and 'aspiring teachers' used interchangeably in this report, describes "someone who is undertaking a programme of initial or pre-service teacher education" (Cameron and Baker, 2004, p. 14). The terms 'pre-service teacher education' and 'initial teacher education', also used interchangeably, obviously represents the preparation of the pre-service teachers', or the 'student teachers''. Part-time teacher or part-timer refers anyone who teaches on the programmes or into a course on a part-time basis. Last but not least the term science educator is used to encompass both the science teacher educators and the part-time teachers teaching into the science methodology courses at NIE.

Chapter 2: Review of Literature

2.1 Introduction

Research on teacher education is becoming increasingly prolific (Cameron & Baker, 2004; Kane et al., 2005; Korthagen et al., 2006) and "teacher education is beginning to be better recognized and valued as an object of academic research" (Korthagen et al., 2006, p. 1020). However, various aspects of teacher education remain relatively unexplored such as: the "critical components of effective teacher education programmes" (p. 68) and teacher educators' professional development, work, beliefs and decision making (Cameron & Baker, 2004). Research that exclusively explores the components and contents of initial secondary science teacher education programmes are limited; hence, I use for this review an eclectic sample of literature focussing on teacher education, science teacher education, and science education in general in my effort to understand the praxis of initial secondary science teacher education and to eventually meet the aims of the study.

2.2 Teaching and teacher education: acknowledging complexities

Teaching is a demanding and immensely complex profession (Cameron & Baker 2004; Cooper et al., 2002; Shulman, 1986/2004c; Wilson, 2004). In the article *The wisdom of practice: Managing complexity in medicine and teaching*, Shulman (1987/2004b) declares that teaching is even far more complex than medicine. Shulman claims that a teacher needs a wide spectrum of knowledge to enable the transformation of his or her subject matter knowledge "into the content of instruction" Shulman (1986/2004c, p. 195) and to "manage the complexities of classroom life" (Shulman, 1987/2004, p. 258). While, a teacher's professional knowledge develops with experience in the field (Darling-Hammond & Baratz-Snowden, 2005; Shulman, 1986/2004c, 1987/2004a, 1987/2004b) or with "the wisdom of practice" (Shulman, 1986/2004c, p. 203), the foundation of such knowledge is systematically organised and delivered through teacher education. It is important to highlight that in Shulman's (1986/2004c) view the number of years of experience does not necessary mean professional knowledge growth: Professional knowledge growth is established through quality teaching experienceThis view is corroborated by Abd-El-Khalick's (2006) research on the "pre-service and experienced secondary biology teacher's global and specific subject matter structures" (p. 1).

Science teacher education (or teacher education, for that matter) should preferably be considered as a continuous learning process starting with the declaration of a person's interest to become a teacher and ending with retirement (Coble & Koballa, 1996). But, in reality, it occurs in two distinct phases: the 'in-service phase' which entails knowledge and skills enhancement through on-going participation in workshops; and the 'pre-service phase', (the focus on this study) which comprises "coursework in science and professional education and field experiences" as the traditional "requirement of a baccalaureate degree" (Coble & Koballa, 1996, p. 462) or other relevant qualification.

2.3 The characteristics of a coherent and effective programme

"Programmes of initial teacher education are the first step in a professional journey that requires the right conditions to support teacher development", (Cameron & Baker, 2004, p. 63). Different scholars (Coble & Koballa, 1996; Darling-Hammond & Baratz-Snowden, 2005; Howey, 1996; Korthagen, et al., 2006) have researched and expressed different views regarding the guiding principles of coherent and effective initial teacher education programmes. A desirable coherent programme, according to Buchmann and Floden (1990), is one that allows the student teachers to establish relationships "among various areas of knowledge and skills", but leaves loose ends to encourage the "reweaving of beliefs and ties to the unknown" (as cited in Howey, 1996, p. 150). For Darling-Hammond and Baratz-

Snowden (2005), the common characteristics of a coherent and effective teacher education programme include:

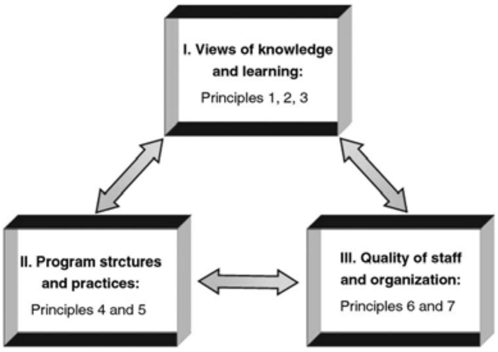
- a core curriculum grounded in knowledge of development, learning, subject matter pedagogy, and assessment taught in context;
- well-defined standards of practice and performance used to guide the design and assessment of coursework and clinical work;
- extended clinical experiences . . .that are interwoven with coursework and are carefully monitored;
- strong relationships between universities and schools that share standards of good teaching which are consistent across courses and clinical work;
- the use of case study methods, teacher research, performance assessments, and portfolio examinations that relate teacher's learning to classroom practice (p. 38).

Korthagen et al. (2006) have examined the effective characteristics of teacher education programmes in Australia, Canada, and the Netherlands. They have proposed "seven fundamental principles to guide the development of responsive teacher education programs that make a difference" (p. 1020). Korthagen et al.'s (2006) seven principles state that: learning about teaching:

1. "involves continuously conflicting and competing demands" (p. 1025);
2. "requires a view of knowledge as a subject to be created rather than as a created subject" (p. 1027):
3. "requires a shift in focus from the curriculum to the learner" (p.1029);
4. "is enhanced through (student) teacher research" (p. 1030);
5. "requires an emphasis on those learning to teach working closely with their peers" (p. 1032);
6. "requires meaningful relationships between schools, universities and student teachers" (p. 1034); and
7. "is enhanced when the teaching and learning approaches advocated in the program are modelled by the teacher educators in their own practice" (p. 1036).

Korthagen et al. (2006) explain that those principles are interconnected and "represent three main components of programs or program change". The three components are: "(1) the views of knowledge and learning that direct the practices of the teacher educators, (2) program structures and specific practices, and (3) the quality of staff and organization" (p.1037). The interconnections between those seven principles and their integration into the three main components as illustrated by Korthagen et al. (2006, p. 1037) is shown below as Figure 2.1.

Figure 2.1: “Clustering of the seven principles into components of programs and program change” (Korthagen et al., 2006, p. 1037, Fig. 2)



Darling-Hammond and Baratz-Snowden’s (2005) and Korthagen, et al.,’s (2006) frameworks provide the basis for understanding the features of a coherent and possibly effective teacher education programmes or, to reiterate Korthagen et al. (2006), “programs that make a difference” (p. 1020). In general, both frameworks suggest that learning to teach occurs in a collaborative, interactive and complex milieu that allows the student teachers to: create knowledge about issues relating to teaching and learning; develop effectively relationship; and experience authentic teacher education practices.

A coherent secondary science teacher education programme should endeavour to assist prospective secondary science teachers in learning what they need to know and understand to teach secondary science (Coble & Koballa, 1996). The question that begs here is: what do initial secondary science teachers need to know and understand to teach science?

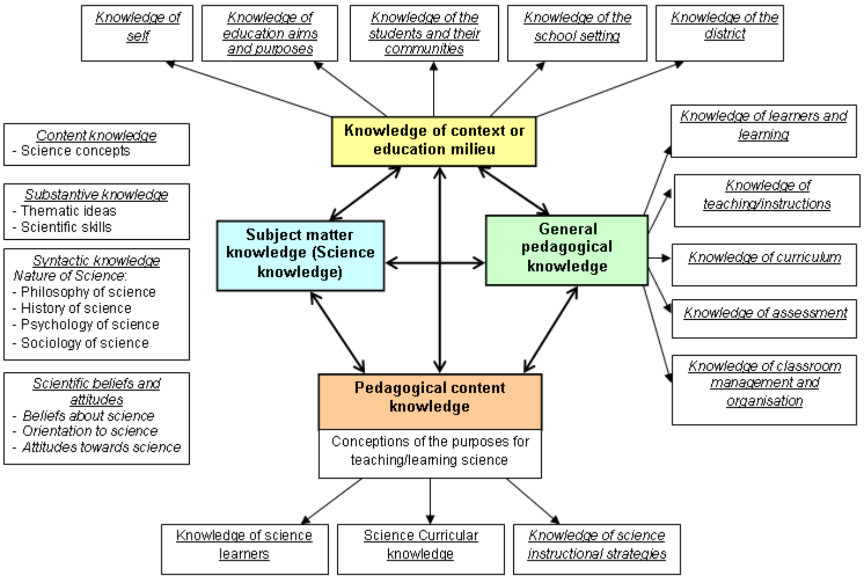
2.4 Initial secondary science teacher education curriculum: what pre-service secondary science teachers need to know

What teachers need to know has been the topic of many research studies. Shulman (1986/2004c) among others sharing the same interest, have raised several pertinent questions regarding the knowledge that guides the teachers' decisions regarding their practice, in other words, the teachers' know-how. According to Shulman, (1987/2004a), teachers' knowledge base can be distinctly categorised as: (a) subject matter content knowledge; (b) pedagogical content knowledge (PCK); (c) curriculum knowledge; (d) general pedagogical knowledge; (e) knowledge of learners and their characteristics; (f) knowledge of educational contexts; and (g) knowledge of educational aims, goals, and purposes. Grossman (1990) has reduced Shulman's seven categories: (a) general pedagogical knowledge, (b) subject matter knowledge, (c) pedagogical content knowledge, and (d) knowledge of context. On the other hand, Darling-Hammond and Baratz-Snowden (2005) have advanced three broad categories of knowledge for successful teachers: (a) knowledge of subject matter and curriculum goals; (b) knowledge of learners and their development; and (c) knowledge of teaching.

Coble and Koballa's (1996) knowledge base for science teachers is rather similar to that of Shulman. In their review of science education in America, Coble and Koballa (1996) classify the major elements of the science teachers' knowledge base as: (a) science content knowledge which includes: science concepts, science as a human endeavour, history of science, thematic ideas, scientific attitudes, and science skills; (b) knowledge of science learners; (c) knowledge of teaching; (d) curriculum knowledge; and (e) pedagogical content knowledge.

All these categorisations offer valuable insights about teacher's knowledge. The components of each those schemes are interconnected (Darling-Hammond & Baratz-Snowden, 2005) (shown by the darker arrows in Figure 2.2). For this study, I have adopted a framework that represents an amalgamation of the common features of the four categories of teachers' knowledge base discussed above. Grossman's (1990) knowledge base and "model of teacher knowledge" (p. 5) form the basis of this framework. Such a framework is necessary to provide a better representation of the teachers' knowledge in relation to science education: The knowledge base of science teachers are evidently different from that of other subject teachers, say Mathematics or English, teachers. The framework also facilitates the analysis of the contents of the science education course document(s) at the two institutions being researched. It can also be used to guide the review or construction of science teacher education programmes. The knowledge base and their components of this framework are illustrated in Figure 2.2. Evidently, in practice the components of each knowledge base influence each other as well as the components of other knowledge bases: They are all interconnected.

Figure 2.2: The knowledge base of science teachers (derived from Coble and Koballa, 1996; Darling-Hammond & Baratz-Snowden, 2005; Grossman, 1990; Shulman, 1986/2004c)



2.4.1 Subject matter knowledge/Science knowledge

> Inspirational science teaching occurs when a teacher is not only enthusiastic about the science topic being taught but also understands that topic fully in order to present it in a comprehensible and meaningful way to each pupil. (Council for Science & Technology, as cited in Cooper, et al., 2002, Section 2: *Do we need physicists to teach physics?*)

Teachers have the responsibility to guide their students in the acquisition and creation of knowledge. The extent to which they can confidently discuss and teach a particular subject is influenced by various factors, including the subject matter knowledge (SMK) or subject knowledge (used interchangeably). Grossman, Wilson, & Shulman (1989) claimed that their research revealed that "teachers' subject matter knowledge affected both the content and process of instruction, influencing both what they teach and how they teach" (p. 26).

To Grossman et al., (1989), SMK encompasses four interdependent dimensions: the content knowledge; the substantive knowledge and syntactic knowledge; and the "beliefs about the subject matter" (p. 27). The multiple components of SMK and their interactions imply that a teacher needs more than the mere subject content knowledge to be successful with their students (Anderson & Mitchener, 1994; Darling-Hammond and Baratz-Snowden, 2005; Grossman et al., 1989; Shulman, 1986/2004c). Grossman et al. (1989), claim that there are "differences between the subject matter knowledge necessary for teaching and subject matter knowledge per se" (Grossman et al., 1989, p. 24), a conception originated form Dewey (1983). Accordingly, Dewey claims that: "every study or subject thus has two aspects: one for the scientist as a scientist; the other for the teacher as a teacher. These two aspects in no sense opposed or conflicting. But neither are they immediately identical" (as cited in Grossman et al., 1989, p. 24). Hence, as Shulman (1986/2004c) avers:

> Teachers must not only be capable of defining for students the accepted truths in a domain. They must also be able to explain why a particular proposition is deemed warranted, why it is worth knowing, and how it relates to other propositions, both within the discipline and without, both in theory and in practice (p. 202)

In the same vein, other scholars have recommended that teachers need to have "flexible understanding of subject matter" (Darling-Hammond and Baratz-Snowden, 2005, p. 17; Anderson & Mitchener, 1994). Flexible understanding is particularly important in science education because of the nature of science and scientific knowledge. Flexible understanding in science is best achieved by understanding the substantive and syntactic knowledge of science.

2.4.1.1 Content Knowledge

Content knowledge refers to the "'stuff' of the discipline: factual information, organising principles, central concepts" (Grossman et al. 1989, p. 27). Research indicates that a teacher's content knowledge of a subject greatly influences what and how the teacher teaches that subject (Cooper, et al., 2002; Grossman et al., 1989; Grossman, 2005). Teachers who possess good science content knowledge are able to identify, define, and discuss different science concepts and understand how scientific concepts are inter-related as well as how scientific ideas relate to concepts in other disciplines (Cooper, 2002; Grossman et al. 1989). By contrast teachers with weak content knowledge may avoid engaging students into discussion for fear of exposing their lack of knowledge, as such they end up teaching from textbooks (Cooper, et al., 2002) Research also suggests that the teachers' content knowledge growth is an on-going process. For instance, Grossman et al.'s (1989) research with novice teachers showed that teachers learn new subject content as they teach, irrespective of their educational qualification.

2.4.1.2 Substantive structures/knowledge

The substantive structures of a subject are "the explanatory frameworks or paradigms" "that guide the focus of inquiry, dictating, in many ways, the questions researchers ask and the direction they pursue" including their interpretation of data (Abd-El-Khalick, 2006; Schwab, 1978, as cited in Grossman et al., 1989, p. 29; Grossman, 1990). In other words, it is the different "ways in which the basic concepts and principles of the discipline are organized to incorporate its facts" (Shulman, 1986/2004c, p. 202). A teacher's knowledge of the substantive structures of a subject, which presumably are acquired through university coursework, influences how and what he or she chooses to teach (Grossman et al., 1989). With this in mind, Grossman et al. (1989) emphasise the importance for teacher educators to provide student teachers with the opportunity to discuss the substantive structures of their respective subject.

2.4.1.3 Syntactic structures/knowledge

The syntactic structures, on the other hand, refer to "the tools of inquiry within the subject matter" (Grossman et al., 1989, p. 29). They focus on how the 'truth' or knowledge is established and modified within the discipline as well as the origin of the discipline (Abd-El-Khalick, 2006; Grossman et al., 1989; Shulman, 1986/2004c). From their study, Grossman et al. (1989) observe that knowledge or the lack of knowledge of the syntactic structures influences the novice teachers' pedagogy. Pre-service teachers' lack of syntactic knowledge can limit their abilities to gain new knowledge in their subject area—preventing them from distinguishing the warranted from the unwarranted knowledge within the subject (Grossman, et al., 1989, Shulman, 1986/2004c). Scholars have thus proposed that teacher educators should ensure that pre-service teachers "receive adequate foundation in the syntax of their discipline" (Grossman et al., 1989, p. 30).

The syntactic knowledge in science corresponds to the understanding of the nature of science (NOS), (Abd-El-Khalick & BouJaoude, 1997). To Jules and Conner (in press), the phrase nature of science refers to "the characteristics of science and scientific knowledge (Lederman

& Niess, 1997, p. 1) as informed by the philosophy, history, sociology, and psychology of science (Clough, 2007; McComas et al., 1998)". Refer to McComas and Olson (1998) for a brief description of the philosophy, history, sociology and psychology of science. Without some knowledge of the NOS, science education could result in what Matthews (1994) called "a distorted science education" (p. 84) and this, according to McComas (1996), is perhaps the main cause of misconceptions in science.

Hence, teacher education should provide student teachers with knowledge about NOS. Moreover, having a sound knowledge of NOS will not only enhance the student teachers' instructional delivery, making learning more interesting and meaningful to students (Mathews, 1994; McComas, Clough & Almazroa, 1998), it will also enhance the student teachers' own learning of science content; their understanding of science; their ability to make informed decisions; and their abilities to effectively address controversial issues (like evolution and creationism) in science education (McComas et al., 1998) and make sense of students' "alternative (or 'naïve') conceptions or "children's science" (Tytler, 2004, p. 23). For example: knowledge of the history of motion would allow teachers to fit students' conceptions of motion into the different 'pattern' of the inertial concept: antiperistasis theory, impetus theory (including the alternative conceptions of the medieval impetus theory), and the inertial theory.

2.4.1.4 Beliefs and Attitudes about the subject matter

Knowledge and beliefs or "personal epistemologies" (Kang, 2007, p. 3) about a subject matter are two different things: the knowledge of a subject matter is 'objective' and based on evidence, whereas the beliefs about the subject matter are more 'subjective' and more debatable (Grossman, et al., 1989). Grossman, et al. (1989) have categorised teachers' beliefs as: (a) the beliefs about "the content that they teach" which influence the teachers' decisions about what content to teach and how to teach that content; and (b) the "'orientation' towards the subject matter" which focuses on the teacher's "conception of what is important to know and how one knows" (p. 31). Several researchers and educators posit that a teacher's prior beliefs about their subject matter play a powerful role in their teaching as well as in their learning (Grossman, et al., 1989; McComas et al., 1998; Kang, 2007; Stoddart et al., 1993) possibly because very often "teachers treat their beliefs as knowledge (Grossman, et al., 1989, p. 31).

2.4.2 General Pedagogical Knowledge

General pedagogical knowledge encompasses "body of general knowledge, beliefs, and skills related to teaching" (Grossman, 1990, p. 6) focusing on the: (i) curriculum such as the goals, aims, scope and structure; (ii) general principles of teaching and instruction like instructional approaches (e.g. problem-solving & role-play), and organisational strategies (e.g. group work); (iv) learners and learning including learning styles, learning theories, human development; (iv) assessment: for example types assessment items and methods, designing, administering and scoring assessment, and interpreting results; and (v) and classroom management and organisation such as approaches to deal with disruptive behaviours, and how to maximising learning time (Darling-Hammond & Baratz-Snowden, 2005; Turner-Bisset 2001). Brief details about those components, in relation to science, are addressed under pedagogical content knowledge.

2.4.3 Pedagogical Content Knowledge (PCK)

Pedagogical content knowledge (PCK) is a term coined by Shulman (1986/2004c) to differentiate the teacher's knowledge from that of a subject specialist (Shulman 1987/2004a). Essentially, for Shulman (1986/2004c, 1987/2004a), PCK is a special kind of knowledge that teachers need in order to teach a particular content knowledge in a manner that could be understood by a particular group of students to enable students to learn. The PCK for a particular topic is rooted in “the wisdom of practice” and research and intertwined with the teachers’ knowledge of appropriate teaching strategies for a particular topic as well as their knowledge of the learners’ conception and learning difficulties (Shulman 1986/2004c). For Shulman (1986/2004c, p. 3) PCK of the most frequently taught topics of a subject, includes

> The most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations - in a word, the ways of representing and formulating the subject that make it comprehensible to others.
> . . . an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons.

Since Shulman, PCK has been researched and debated by many scholars and has taken different contextual meaning or conceptualisation (van Driel et al., 1998). For instance, van Driel et al. (1998) quoted Cochran, DeRuiter, and King (1993) who “renamed PCK as pedagogical content *knowing* [emphasis original] (PCKg) to acknowledge the dynamic nature of knowledge development” (p. 677). Jones and Moreland’s (2003) conceptualisation of PCK intertwines with the teachers’: subject content knowledge, knowledge of the learners and learning, curricular knowledge, and general pedagogical knowledge. Jones and Moreland (2003) describe PCK as:

> . . . a complex blending of pedagogy and subject content and includes aspects related to an understanding of what is to be taught, learned and assessed, an understanding of how learners learn, an understanding of ways to facilitate effective learning, and an understanding of how to blend content and pedagogy to organize particular topics for learners (as cited in Fraser, 2008, p. 52).

The importance of PCK in science education has been noted by many scholars, such as: Abd-El-Khalick (2006); Coble and Koballa (1996); Davis, Nelson, & Beyer, (2008); van Driel et al (1998). Davis et al. (2008), remark that although “PCK is typically conceptualized as topic-specific, teachers also need discipline-specific knowledge about how a discipline works” such as “PCK for scientific inquiry . . . and PCK for scientific modeling” (introduction section, para. 1). In this study, PCK for science includes four components: science curricular knowledge; knowledge of science learners; knowledge of instructional strategies specific to science; and knowledge of assessment in science, (Darling-Hammond and Baratz-Snowden, 2005; Davis et al., 2008) as shown in Figure 2.2.

2.4.2.1 Curricular knowledge

Science teachers, who have the responsibility to translate the content of the science curriculum for their students, need specific knowledge about the science curriculum materials like the contents of the science curriculum, the learning intentions and goals of science education, as well as the "knowledge of alternative curriculum materials" (Abd-El-Khalick, 2006, p. 3), such as textbooks, films and other resources relevant for teaching science. In addition, Shulman (1986/2004) recommends that teachers also understand lateral curricular knowledge and vertical curricular knowledge. Lateral curricular knowledge refers to "knowledge of the various subjects being taught within a certain grade level in a given year" while vertical curricular knowledge deals with "knowledge of what has been and what will be taught in the same subject, [in this case, science], in earlier and following years" (Abd-El-Khalick, 2006, p. 3; Shulman, 1986/2004c). As the key curriculum decision-makers (McGee, 2008), student teachers should be thoroughly prepared to make confident, appropriate and informed curriculum decisions which will positively influence their students' learning.

2.4.2.3 Knowledge of the science learners

Students enter the science classroom with different common preconceptions about scientific concepts, which affect what and how they learn (Loughran, Berry, & Mulhall, 2006; Tytler, 2004). The constructivist pedagogies allow teachers to acknowledge and identify students' prior knowledge and build from those to help the learners to actively reconstruct or modify that knowledge. Currently, a substantial body of research is urging teachers to promote the social constructivist view to learning and teaching in their classes (Kang, 2007; Tytler, 2004). Social constructivist learning calls on the teacher "to promote a community in which students and the teacher co-construct knowledge" (Tytler, 2004, p. 27). In such classes, science is seen as a way making sense of "natural phenomena and science teaching as facilitation of student learning through science inquiry", (Kang, 2007, p. 2). Hence, among other general pedagogical knowledge regarding students learning, prospective science teachers should know and understand 'children's science' and how to address them using constructivist pedagogies, especially social constructivist learning approaches, that will allow their science learners to actively construct new meanings and understandings in science.

2.4.2.3 Knowledge of science instructional strategies

With reference to the purpose of science education and the understanding of students' preconceptions and how they learn, teachers should be knowledgeable about instructional approaches that will display the characteristics of science and scientific knowledge as well as challenge students' preconceptions. According to Loughran et al. (2006), science teaching is more likely to be effective if teachers understand and draw on "common student alternative conception" "to shape their teaching" (p. 19). They should endeavour to move away from the approaches which promote the transmission of knowledge or "telling students what they should think and why" (Goodrum, 2004; Loughran et al., 2006, p. 20; Tytler, 2004) and perpetuate the students' naive beliefs and indifference about the nature of science itself. By contrast, "it is crucial that teachers create meaningful and engaging activities, practices and discussion between students and/or between teacher and student(s) about science ideas and ways that these differ from everyday understandings" (p. 20).

As such aspiring science teachers need to learn about instructional strategies and representations that are relevant for teaching a particular science topic (Grossman, 1990).

Goodrum (2004) has proposed some instruction principles for the teaching of science: “explanation follows experience”; “recognising prior experience”; “student involvement”; “student discussion”; “developing conceptual understanding”; and “questions and questioning” (pp. 58-61). Models of teaching/learning that have proved particularly useful in Australian science classrooms, according to Goodrum, includes “the 5E model”, “the generative learning model”, and “the interactive model” (pp. 61-62). Other useful strategies in include: cooperative learning and group work, concept mapping, and predict-observe-explain POE (Goodrum, 2004). Exposing student teachers to some or all of those approaches will provide them with a range of constructivist pedagogical approaches.

2.4.4 Knowledge of education contexts

Another important knowledge base that teachers draw from to “adapt their more general knowledge to specific school setting and individual students” is knowledge of context (Grossman, 1990, p. 9). Classroom teaching and learning is “context-specific” (Grossman, 1990, p. 9) in that it occurs in the specific milieu in which the teacher operates. While certain aspects of those knowledge can be learnt in teacher education programmes, much of the knowledge of context is acquired in-situ during practice and is ever evolving because the dynamic education system and the dynamics of the society. For example, new policies are implemented every now and then, and students transferring from one school or district to another.

Knowledge of context includes: (i) knowledge of the district they work in: such as “the opportunities [like the presence of a factory, farm, or a wetland which can provide invaluable educational experiences for the students], expectations and constraints posed by the district” (Grossman, 1990, p. 9). (ii) Knowledge of the school setting: such as knowing about the school ethos, the school guidelines as well as “departmental guidelines” such as the procedures/guidelines for requesting materials for science experiments and for organising field trips, and all “other factors at the school level that affect instruction” (Grossman, 1990, p. 9). (iii) Knowledge of the students and their communities: such as the “students’ background, families, particular strengths, weaknesses, and interests” (Grossman, 1990, p. 9), will help teachers to better meet the expectations of the communities and more importantly, plan appropriate learning experiences for their students so that they can all achieve success. (iv) Knowledge of education aims and purposes including ideologies, policies and political purpose of education and the curriculum (Turner-Bisset, 2001). (v) Knowledge of self: “the self is important in teaching” as it impacts teaching while it is impacted by teaching: “the learning involved in learning to teach is affective as well as cognitive” (Turner-Bisset, 2002 p. 109). To develop knowledge of self, student teachers should engage in reflection: “reflection-in-action” and “reflection-on-action” (Schon, 1987, as cited in Turner-Bisset, 2001, p. 111).

2.5 Pedagogy of teacher education: how to teach and assess pre-service teachers

In this section, I discuss some of the pedagogical approaches to teaching and assessing prospective secondary science teacher. Incorporated in this discussion, is the understanding of how to help student teachers learn.

2. 5.1 Addressing the problems of learning to teach

“A vicious cycle of mediocrity continues in teaching wherein teachers continue to teach as they are taught” (Howey, 1996, p. 145). Evidently, student teachers are grounded in experience: they bring with them a wide range of experiences, including previous conceptions, perceptions and philosophies about teaching and learning (Darling-Hammond & Baratz-Snowden, 2005; Kang, 2007). Moreover, prospective science teachers “are themselves products of traditional education . . . that has failed to adequately describe the epistemic base and the nature of knowledge in science” (Kang, 2007, p. 2). In addition, studies show that, notwithstanding initial teacher education, pre-service teachers' knowledge and beliefs rarely reflect the current view of science and science learning (Abd-El-Khalick & BouJaoude, 1997; Nang, 2007; Stoddart et al., 1993). The challenge then for teacher education is to provide student teachers with the opportunities to both change and improve their conceptual understanding about teaching and learning. By assimilating or accommodating new knowledge, skills and values into existing ideas, the prospective secondary science teachers will be able to elaborate on their ways of thinking and their action.

Teacher education programmes should not only focus on what student teachers need to learn, but focus also on how student teachers learn (Darling-Hammond & Baratz-Snowden, 2005). In addition, teacher education needs "to address three common problems associated with learning to teach: misconceptions about teaching; the problem of enactment, the problem of complexity" (Darling-Hammond & Baratz-Snowden, 2005, p. 33). Darling-Hammond and Baratz-Snowden have proposed that "structured discussion and guided observation of classrooms" are used to confront student teachers' misconceptions such as the belief that teaching is merely the transmission of knowledge. The problem of enactment—ability to put theoretical knowledge into practice can be addressed by providing aspiring teachers with "well-supervised practicum opportunities, closely connected to coursework, where they can learn from expert veterans who can model and coach effective teaching" (p. 36). Finally, the problem of complexity which acknowledges the uncertainty and complexities of teaching requires that prospective teachers learn to analyse teaching and learning and "make sound decisions about curriculum, instruction, assessment, and classroom management" with reference to knowledge of their learners (p. 35).

2. 5.2 Pedagogy of teacher education

Grossman (2005) asserts that "in the professional preparation of teachers, the medium *is* [emphasis original] the message" (p. 425). Hence teacher educators should model effected approaches, as Meichtry (1998) suggested in the discussion about approaches for teaching NOS in elementary teacher education

> By modeling effective teaching strategies for use with . . . students, providing 'real' [emphasis original] science experiences for the pre-service teachers to construct their own knowledge of the nature of science [and science teaching], allowing time for reflection on new understandings, and making an explicit connection between the learning of pre-service and [secondary] students, pre-service teachers not only develop their own understandings while learning effective teaching strategies; they also gain insights about the ways their future students experience learning" (p. 231).

This view is also proclaimed by Korthagen et al. (2006) in their discussion of how to use "the conflicting and competing demands" of teacher education to help student teachers "to simultaneously be both learners of learning and learners of teaching" (p. 1026); and how to enhance learning in teacher education. Korthagen et al. (2006) further explicate that when modelling the approaches it is also vital that the student teachers clearly understand their teacher educators' "pedagogical reasoning" so that they can "access the ideas and feelings associated with taking risks and learning about teaching in meaningful ways" (Korthagen et al., 2006, p. 1037; Loughran & Berry, 2005). According to Loughran, (2002) "talking aloud" is a way of accomplishing this goal (as cited in Korthagen et al. 2006, p.1037)

While research on the pedagogy of pre-service teacher education is lacking (Darling-Hammond & Baratz-Snowden, 2005; Grossman, 2005), evidence indicates that apart from the 'commonly used' strategies like demonstrations, micro-teaching and role plays, several "pedagogies have emerged in response to the perennial problems of learning to teach" (Darling-Hammond & Baratz-Snowden, 2005, p. 42). Some promising pedagogy in teacher education, if properly implemented, include: student teaching; case methods; teachers' research; teaching portfolios (Darling-Hammond & Baratz-Snowden, 2005; Grossman, 2005). However, Abd-El-Khalick, (2006) reminds us that those innovative approaches "would serve to enrich prospective teachers' experiences. Such pieces, nevertheless, cannot equip them with the kind of knowledge they will need in their own classrooms", (p. 25).

2.5.2.1 Emerging pedagogies in teacher education

Pedagogy as characterised by Grossman (2005) includes classroom instructions and interaction, and tasks and assignment. Hence, those emerging pedagogies serve two purposes in teacher education—they can be used to teach student teachers, as well as to assess student teachers' learning. Those pedagogies are authentic to teacher education because they promote Newmann and Archbald's (1992) characteristics that reflect the kind of mastery of adults—in this case expert science teachers. They focus on:

- production of knowledge instead of reproduction or response only to the produced works of others
- disciplined enquiry, dependent on:
    - a prior knowledge base (to be used to help produce knowledge);
    - in-depth understanding (rather than superficial awareness); and
    - integration—the production of knowledge requires the ability to 'organise, synthesise, and integrate information in new ways'; and
- value beyond assessment—aesthetic, utilitarian, or personal value. (as cited in Cumming & Maxwell, 1999, p. 178-179)

<u>Student teaching</u>

"Knowledge of teaching differs from knowledge about teaching" (Smith, & Lev-Ari, 2005, p. 291) and according to Munby et al. (2001), research evidence suggests that "knowledge of teaching is acquired and developed by the personal experience of teaching" (as cited in Smith, & Lev-Ari, 2005, p. 291). Professional experience, teaching practice or 'the practicum' provides the context for student teachers to put the acquired theoretical knowledge into practice (Darling-Hammond & Baratz-Snowden, 2005; Korthagen et al, 2006; Smith, & Lev-

Ari, 2005) and to start developing their own "teaching competence" (Smith, & Lev-Ari, 2005, p. 291).

The structure and timing of teaching practice in a teacher education programme can benefit or limit the kind of experience that student teachers have during the practice (Darling-Hammond & Baratz-Snowden, 2005). There is a general understanding that student teachers should start their teaching practice early on in the programme. Korthagen et al. (2001) for example, assert that for student teachers to successfully develop their knowledge of teaching, they should "start a non-threatening practicum from the very beginning of the program" (as cited in Smith, & Lev-Ari, 2005, p. 290) where they should be "guided through their experiences through reflection and deliberation of this reflection (Eisner, 2002) with teacher educators, peers and other significant members in their family and social circles" (Smith, & Lev-Ari, 2005. p.231). A parallel view is expressed by Darling-Hammond and Baratz-Snowden (2005).

Case methods

Case methods (Darling-Hammond & Baratz-Snowden, 2005; Grossman, 2005), case study methods (Heitzmann, 2007) or vignettes (Veal, 2002) have been seen as a powerful pedagogical strategy for promoting critical thinking and pedagogical reasoning (Darling-Hammond & Baratz-Snowden, 2005; Grossman, 2005; Heitzmann, 2007; Veal, 2002). Heitzmann (2007) even refers to case study methods as a potential panacea for instructional strategies in teacher education. Case methods are pictures or descriptions that simulate reality or "capture the context of teaching" (Veal, 2002, abstract) and learning and "offers many opportunities and strategies for perspective teachers to gain insight into events that occur within the school and classroom" (Heitzmann, 2007, p. 523).

Darling-Hammond and Baratz-Snowden (2005), Heitzmann (2007), and Veal (2002) have suggested how to use case study successfully. For instance, Veal (2002) suggested that "pedagogy and content items are used synergistically" so that prospective teachers can effectively "develop characteristics of teaching necessary for pedagogical content knowledge development" (use of vignettes, section, para. 4). (See Darling-Hammond & Baratz-Snowden, 2005 for instruction that promote case readers and writers' understanding).

Teacher research

Teachers need to develop the skills and practices of systematic, purposeful inquiry and critical reflection in order to improve on their practices for the betterment of their students (Darling-Hammond & Baratz-Snowden, 2005). Teacher research as pedagogy for teacher education offers the opportunities for teachers to engage in classroom-based or school-based research. Research shows that these experiences allow student teachers: (ii) "to learn to think as teachers and reformers" (Cochran-Smith, 1991, as Grossman, 2005, p. 445); (iii) to view "teaching itself as a form of inquiry or experimentation" (Tabachnick & Zeichner, 1999, as cited in Grossman, 2005); (iv) to understand and deal with the complexity of practice; and (v) to "overcome some of the limitations of the preconceived notions about teaching" (Darling-Hammond & Baratz-Snowden, 2005, p. 50). Other benefits as well as limitations of teacher research have been documented (Grossman, 2005).

Performance tasks and teaching portfolio

Various authentic tasks are used in teacher education to help student teachers to develop specific performance in teaching and learning. These task which also form the basis for coursework and assessment in teacher education classrooms are: "planning and conducting lessons, delivering a lecture, managing a discussion, completing and teaching a curriculum unit" (Darling-Hammond & Baratz-Snowden, 2005, p. 45). Moreover, those performance tasks are also requirements for teaching standards for entry into the teaching profession in America (Darling-Hammond & Baratz-Snowden, 2005; Zeichner & Wray, 2001), in New Zealand (NZTC, 2007), in Seychelles (NIE, 2001) and other countries worldwide (Zeichner & Wray, 2001). Often these performance tasks are compiled to form a teaching portfolio (Darling-Hammond & Baratz-Snowden, 2005; Grossman, 2005; Zeichner & Wray, 2001).

A teaching portfolio, as a more authentic form of assessment, is a documentation of "student teachers' experiences, thoughts, actions, and subsequent learning about teaching", (Loughran & Corrigan, 1995, p. 565). The different types of teaching portfolios, their purposes, benefits and shortcomings, and their application in teacher education are well documented (see Darling-Hammond & Baratz-Snowden, 2005; Grossman, 2005; Loughran & Corrigan, 1995; Zeichner & Wray, 2001).

2.5 Conclusion

There are no complete answers, no description, no prescriptions for teacher education but rather orientation to important attributes of teacher education programmes (Howey, 1996). Teacher education takes place in a complex and uncertain milieu, and as Kane et al. (2005) observe "determining appropriate and relevant content of ITE [initial teacher education] and organising this into meaningful learning experiences for student teachers is a challenging and complex endeavour" (p. 223). Teachers' knowledge is wide, varied and intertwined and research suggests that it is still unclear how teachers enact all those theories. However, there are insights about how to help student teachers to develop into the successful teachers or "adaptive experts" (Darling-Hammond & Baratz-Snowden, 2005, p. 31) that we all hope to see in every classroom: insights about what we could teach them, how we could teach them and how we could assess them are well documented.

Chapter 3: Research Methodology

3.1 Introduction

The purpose of this research was to compare the praxis of initial secondary science teacher education at the National Institute of Education in Seychelles with that of the College of Education at the University of Canterbury in New Zealand. In this chapter, I discuss the methodology that was used for the research. Initially, I discuss the rationale for using the qualitative research approach. I next provide a description of the research design, and the justifications for each of the data gathering tools employed for the research. I also discuss how issues of credibility, and ethics were addressed in the study. Finally, I explain how I analysed and made sense of the data.

3.2 Rationale for using the qualitative research approach

Qualitative research is an inquiry process, "based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting" (Creswell, 1994, p. 2). Qualitative research allows the researchers to know "how things look and feel down under" (Becker et al., 1961, as cited in Bogdan & Biklen, 2007, p. 248); providing detailed information about the participants, their experiences, perspectives and understandings, as well as the context and setting in which they occur.

Qualitative research acknowledges that the researcher as 'research instrument' influences the conduct of the study: the researcher influences the research design, the collection of data, the analysis and interpretation of the data (Bogdan & Biklen, 2003, 2007; Janesick, 2003) because the "researchers bring their own specific background to the study" (Bogdan & Biklen, 2007, p. 55). This research is not an exception. My personal relationships with the participating teacher educators from the National Institution of Education (NIE); my personal interest and involvement in the development of the current initial secondary science teacher-education (ISSTE) courses; and my commitment to improving teacher education at NIE are the backgrounds that I bring to this study. Another researcher sharing the different or even same interest may interpret the same data differently. Consequently, to reduce the influence (Bogdan & Biklen, 3003) a series of measures (to be discussed later) have been taken to ensure the credibility and trustworthiness of the study.

3.3 Research Design

For this research, I have used comparative case studies, a form of multi-case studies (Bogdan & Biklen, 2003). Historical organizational, documents, observational and life-history are some of the other types of case studies in qualitative research (Bogdan & Biklen, 2003). The term case study has different interpretation. For Bogdan and Biklen (2003) a case study is a choice for inquiry which entails “detailed examination of one setting, or a single subject, a single depository of documents, or a particular event” (p. 54). Creswell (2007) on the other hand, viewed a case (bounded system) study both as a methodology and a product of inquiry wherein the researcher investigates one or multiple cases “overtime through detailed, in-depth data collection involving **multiple sources of information** [emphasis original]” . . . and reports a case **description** [emphasis original] and case based themes” (p. 73). A case under study can be a program, an institution, an event or an individual which is bounded by time and place (Bogdan & Biklen, 2003; Creswell, 2007).

Comparative case study was appropriate for this inquiry because it allowed the in-depth comparison between the two cases of initial secondary science teacher education programmes, that of the NIE and that UCCE, and between the institution(s) and relevant literature. However, I have no intention to generalise the findings emerging from this study.

3.3.1 Data gathering tools

Consistent with the case study research, data for this research were collected through the following qualitative research methods: document analysis, semi-structure in-depth interviews; and participant-observation, (Bogdan & Biklen, 2007; Janesick, 2003; Lincoln & Guba, 1985; Mutch, 2005). Document analysis was the primary source of data for the study.

3.3.1.1 Document analysis

"Document analysis is an easily accessible way to gather data to answer a question", (Mutch, 2005, p. 128). I used document analysis because it "opened up new source of understanding" (Taylor & Bogdan, 1998, p. 130; Lincoln & Guba, 1985). Lincoln and Guba (1985) define a document as "any written or recorded material . . . that was not prepared for the purposes of the evaluation or at the request of the inquirer" (p. 277). Documents can be classified as primary or secondary documents (Lincoln & Guba, 1985; Mutch, 2005). Because documents are the stable source of information grounded in the setting and language in which they occur, (Lincoln & Guba, 1985), they provided the opportunity for longer periods of study (Frechtling et al., 1997; Lincoln & Guba, 1985).

<u>Documents used from UCCE and NIE</u>

Through document analysis I was able to determine: the components of the ISTE programme; and the contents and assessments included in the science education courses. After explaining my intentions to the person in-charge of the programme at the two institutions, I was given access to several documents, such as: the Course Content Outlines, Policy Documents, Course Structure, and Framework Documents. The documents from UCCE and NIE that were analysed in the study are shown in Table 3.1 below.

Table 3.1: Documents analysed from UCCE and NIE

Documents analysed from	
UCCE	**NIE**
EDSC308 Outlines and readings. (Conner & Buyers, 2007).	22 Science course (unit) outlines
EDTP306-08T1 (C) Term Three 2008 Teaching Practice 1. (UC, n.d.a).	Task details for the different science courses
EDTP307-08T3 (C) Term Three 2008 Teaching Practice 2. (UC, n.d.b).	*Competency framework for newly qualified teachers* (NIE, 2001)
Graduate Diploma in Teaching and Learning (Secondary) (UC, n.d.c).	*Diploma in secondary teacher education: The secondary course structure* (NIE, 2007)

Documents for analysis from the UCCE were very accessible: the key informant was very conversant with the relevant documents that guide teacher education both at the UCCE and in New Zealand in general. By contrast, obtaining documents from NIE was a bit more tedious. The electronic versions of those documents were forwarded to me via emails by Ms Finesse, the secretary of the Maths, Science, Environment, and Information Technology (MSEIT) Faculty—my liaison person at NIE.

3.3.1.2 Interview

> The qualitative research interview is a construction site of knowledge. An interview is literally an inter view, an exchange of views between two people conversing about a theme of mutual interest" (Kvale, 1996, p. 2).

Interviews provided the opportunities to gain new insights and to explore the topics and clarify questions and situations arising from document analysis and participant-observation (Frechtling et al., 1997; Glesne, 1999). Semi-structured interviews were used to give direction to the research. Semi-structured interviews, like all other interviews, are very time consuming and difficult to transcribe. Hence, I used for this study, a small purposeful sample: that is, I interviewed participants who would provide information that is useful and relevant to the study (Bogdan & Biklen, 2003, 2007; Frechtling et al, 1997; Glesne, 1999). Hence, to gain the perspectives of the people who develop and deliver; and those who follow the respective programmes, I interviewed two teacher educators and three student teachers respectively from each institution.

The interview questions

I chose interview questions that were relevant to both my research topic and the "respondents' cultural reality" (Glesne, 1999, p. 70), an approach which also helped to ensure rigor in data collection. Semi-structure interview questions allow for flexibility, hence based on the participants' responses, I was able to modify, rephrase and probe the respondents so as to clarify their views and/or enlighten my study (Glesne, 1999). Open-ended questions, ('how', 'what' and 'why') form the basis of qualitative research questions. The following focus questions were used to elucidate the teacher educators' and the prospective secondary science teachers' perceptions of their teacher education programme:

1. Describe the initial secondary science teacher education programme. How do you feel about the components/contents, duration and structure of the programme?
2. How are the student teachers assessed in the science education course(s)? What types of assessments tasks do they perform? How do you feel about those?
3. What types of teaching strategies/approaches are used in teacher education classes? How do you feel about those approaches?
4. How is the teaching practice organised? Who supervises and assesses the student teachers' performance during practicum?

The science teacher educators were asked these additional focus questions.

5. Who decide what to include in the science education course? How are decisions made about what components to include in the science education course?

<u>The interview participants</u>

The student teachers (people who follow the programme)

Initially, I set out to interview three aspiring secondary science teachers following the initial secondary teacher education programme at NIE and UCCE. In the end I interviewed two of those current student teachers (still following the programme) and one former student teacher (had completed the programme) from each institution. The choice to interview a former student teacher was to acquire the views of someone who had completed the programme. The former student teacher from NIE had completed the two-year programme in December 2007 and was in employment. The former student teacher from UCCE completed the cross-year programme in June 2008 and was seeking for employment. The interview participants from NIE and UCCE and their assigned pseudonyms/code names are shown in Table 3.2.

Table 3.2: The interview participants and their assigned pseudonyms

Interview number	Institution	Participant status	Pseudonyms / code names
1	UCCE	Teacher educator	UCCETEB
2	UCCE	Teacher educator	UCCETEC
3	NIE	Teacher educator	NIETEB
4	UCCE	Student teacher	UCCESTA
5	UCCE	Student teacher	UCCESTE
6	NIE	Student teacher	NIESTA
7	NIE	Student teacher	NIESTE
8	UCCE	Student teacher	UCCESTI
9	NIE	Student teacher	NIESTI
10	NIE	Teacher educator	NIETEC

The interview participants are identified by the name of their institution, (NIE or UCCE) their status (‘TE’ for teacher educator, ‘ST’ for student teacher) and a letter (consonants ‘B’ and ‘C’ for the teacher educators and vowels ‘A’, ‘E’, and ‘I’ for the student teachers), (I just wanted to make them sound like names).

The teacher educators (people who develop and deliver the programme)

Two science teacher educators from each institution were chosen for the interview. The two teacher educators chosen at UCCE were both teaching the *EDSC308: Science Education Years 7-13* course. The teacher educators from the NIE were a science teacher educator teaching on the secondary science programme and the former MSEIT Head of Faculty (HOF) who is also a science educator but teaches on the primary science programme. The HOD was chosen because of her knowledge of the setting and involvement in the development of the science courses. This decision was influenced by my personal knowledge of the setting. (My insider status at the two institutions is discussed in section 3.3.2).

The interview settings

The face-to-face interviews were conducted with all participants at UCCE at a location that was convenient, available, physically comfortable and private, and at a time convenient to the interviewees so that they did not feel threatened and/or under pressure (Glesne, 1999; Kvale, 1996). The participants from NIE were interviewed over the telephone; as a result special pieces of equipment, a telephone recorder and a Sony digital voice recorder, were purchased for the overseas interviews. Because of time difference, New Zealand being eight hours ahead of Seychelles, most of the interviews with the participants from Seychelles were set for the weekends. Each participant was interviewed once for a period of 25-30 minutes.

The interview process

Each interview started with an exchange of greetings and a vote of thanks for the interviewee’s acceptance to participate in the research. After introducing myself, I briefly reviewed of the purpose of research and the expected duration of the interview (30 minutes). This was followed by a statement of the interviewee’s ethical rights: voluntary participation;

anonymity; confidentiality; privacy; as well as their rights not to answer any question they were not comfortable with; and their rights to review or retrieve any information provided and the redraw from the interview at anytime. I informed the interviewee that the interview is being audio recorded using two digital recording devices as a backup. However, in the case of the telephone interview only one device was used. During the interview, I listened carefully to the interviewee who did most of the talking, took notes and probed to clarify information. During the face-to-face interview I maintained eye contact and used other non-verbal cues (example, nodding and smiling) as signs of interest in the participant's responses. For the telephone interview occasionally restating views expressed, probing for clarification, and the occasional 'OK', were used to show interests in the conversation. At the end of the interview, I thanked the interviewee for his/her time and contribution to the study and reminded him/her of his/her right to amend or withdraw his/her information from the research. After transcribing the interviews, I forwarded a copy of the transcript on to the interviewee and invited him/her to verify the accuracy of the information and to amend the transcript if and as necessary before I used his/her information in my report. A process referred to a member-checking (Lincoln, & Guba, 1985).

3.3.1.3 Participant-observation

Observation provides the researcher with firsthand "information about behaviour of individuals and groups" (Frechtling et al., 1997). Participant observation is very common to qualitative research. Taylor and Bogdan (1998) have identified a range of protocols for participant observation; such as negotiating role and establishing rapport. Participant observation allows the researchers to unobtrusive enter into and understand situation/context and processes (Taylor & Bogdan, 1998; Frechtling et al., 1997). Participant observation is time consuming, strenuous, and the selective perception of the observer may distort the data (Ely et al., 1991; Taylor & Bogdan, 1998). Consequently, participant observers are advised to engage in prolonged observation in order to give a ‘true’ representation of the ‘reality’ of the observed (Ely et al., 1991; Taylor & Bogdan, 1998).

After receiving necessary permission to observe two ISSTE classes at UCCE, I decided to take the role of a passive observer – ‘observer as participant’ rather than being an active observer – ‘participant as observer’ (Cohen, Manion, & Morrison, 2000; Taylor & Bogdan, 1998). I adopted the aforementioned role because my commitments to my other courses clashed with some of the scheduled sessions of the classes being observed. Consequently, the number of sessions I could observe, and the prolonged engagement needed to establish the rapport of a “genuine member of the setting” (Taylor & Bogdan, 1998, p. 52) were limited.

I observed the delivery of nine initial secondary science teacher education sessions in two different classes at UCCE to obtain different perspectives. The schedule of the participant observation is given in Table 3.2. As far as possible, each observation which lasted for two hours was recorded as soon as possible after leaving the setting (Taylor & Bogdan, 1998). A column was included for noting the observer’s comments and reflections. During the first two observations I took notes of everything in order to understand the setting and identify the emerging themes. I consequently narrowed my focus in relation to the main purpose of the observation which was to identify the teaching approaches used in the ISSTE at UCCE. This persistent observation eventually led to data saturation: the point where “information becomes redundant” (Bogdan & Biklen, 2003, p. 62).

Table 3.3: Participant observation schedule

Observation	Date	Class
1	11.02.2008	X
2	13.02.2008	X
3	26.02.2008	X
4	26.02.2008	Y
5	28.02.2008	Y

Observation	Date	Class
6	03.06.2008	X
7	05.06.2008	Y
8	10.06.2008	X
9	10.06.2008	Y

3.3.2 My role as the researcher: insider status

As the researcher my insider status in both institutions, especially at NIE has facilitated the data gathering process. Prior to my starting this Master in Science Education degree in 2007, I was a science teacher educator, the team leader of the secondary science review team, and a Course Leader at the NIE. Hence, I am very conversant with the setting: the people I needed contact to obtain relevant information; the documents that I needed to focus on to answer my research questions; and I also have access to electronic copies of some documents, like the unit (course) outlines. I have knowledge of the research participants, especially the former student teachers and teacher educators. I have also developed and taught several of the current science education courses. At the UCCE, with one of my supervisors being a science teacher educator, my involvement in the setting and access to information and documents were made easy. However, having such knowledge can inevitably lead to bias. Hence, to minimize the potential for bias, I have taken measures to increase the credibility of the study as discussed below.

3.4 Credibility (Rigours and trustworthiness)

Harrison, MacGibbon and Morton (2001) have explored the trustworthiness of qualitative research in terms of “criteria of validity, credibility and believability” (p. 324). To Denzin and Lincoln (1994) “trustworthiness consists of four components: credibility, transferability, dependability and conformability” (p. 508). Lincoln and Guba (1985) have added "authenticity" (p. 300) to the list and claimed that credibility and trustworthiness in qualitative research are established through data collection, analysis and reporting. There are different strategies to ensure credibility in qualitative research. Creswell (2007) has recommended the use of at least two of those approaches in any qualitative research in order to ensure credibility.

3.4.1 Addressing the issue of credibility

The credibility of this research was established by:

- Providing the interview participants with the focus questions prior to the interview.
- Member checking was used to obtain feedbacks from the participants regarding the accuracy of the recorded information.
- Data source triangulation—the use of multiple data sources to gain understanding of a phenomenon (Creswell, 2007; Ely et al., 1991; Lincoln & Guba, 1985) was achieved by using data obtained from documents, interviews and participant observation.
- Persistent observations which provided me with the opportunity to "identify those characteristic and elements that are most relevant to the question being pursued and focus on them in detail" (Lincoln, & Guba, 1985, p. 304).
- Using detailed description throughout the report, and giving voice to the research participants (the use of quotations) when reporting findings (Creswell, 2007; Lincoln & Guba, 1985).

3.5 Ethics in qualitative research

Qualitative research "is an ethical endeavor" (Ely et al., 1991, p. 218). An interview, according to (Kvale, 1996) "is a moral enterprise" where "the personal interaction in the interview affects the interviewee and the knowledge produced by the interview affects our understanding of the human situation", p. 109). Research ethics encompass the whole aspect of the research (Kvale, 1996) and codes of ethics serve as guidelines for sensitising researchers of possible "dilemma and moral issues" they will encounter; and as a form of protection for the researcher against legal problems (Bogdan & Biklen, 2003, p. 43; Kvale, 1996). In accordance with the University of Canterbury (2007) *Human ethics committee: Principles and guidelines*, three main ethical implications were identified and addressed prior to the inquiry. These were: a) informed and voluntary consent; b) respect for rights of privacy and confidentiality; and c) limitation of deception.

3.5.1 Addressing ethical issues

As required by the University of Canterbury, the ethical application for the research proposal was sent to and was approved by the College of Education Ethical Clearance Committee. (Refer to Appendix A for a copy of ethical approval). Following the ethical approval, letters seeking permission to carry the research at UCCE and NIE were sent to the Dean of UCCE and Director of NIE respectively. This was followed by letters to the research participants. (Refer to Appendix B for copies of the all letters of information and consent forms sent to the different groups of participants).

3.5.1.1 Informed and voluntary consent

To ensure informed and voluntary consent, the research participants were initially informed in writing of the purpose of the study; the broad areas of focus; the data will be collected; how the findings will be used; their voluntary participant and informed consent; and their rights to privacy and confidentiality. As required by the University of Canterbury Ethic Committee, they were asked to sign the consent form as evidence of the informed consent and voluntary participation. In the case of the interview, I negotiated a convenient time and place for the interview. Moreover, as mentioned in the interview process I reminded them of the ethical rights and invited them to contact if they wished to review or retrieve the information they have provided.

3.5.1.2 Respect for rights of privacy and confidentiality

Respect for rights of privacy and confidentiality are important in protecting the participants' identity so that the collected data do not harm or embarrass them (Bogdan & Biklen, 2007; Ely et al., 1991; Kervin et al., 2006; Kvale, 1996). The participants' rights to anonymity and confidentiality were achieved: by using and treating their information confidentially; by the use of pseudonyms; and by conducting the interviews in private (Bogdan & Biklen, 2003, 2007; Kvale, 1996). For participants from the UCCE, I ensured that each of the face-to-face interviews was conducted privately in a vacant room. Whereas, for the participants from NIE, at the start of each telephone interview, I could only advised the interviewee to ensure that he/she was alone and would not be disturbed. Because of the small number of science teacher educators at the two institutions, there is a high risk that they could being identified. Although, I could not promise their anonymity, I treated their information confidentially; used pseudonyms and reported the data in a way that did not differentiate between the sexes.

3.5.1.3 Limit to deception

To limit deception, the interviewees were given clear written and verbal explanation of the purpose of the research. Interviewees were informed in advanced (in the letter) and reminded at the time of the interview that the interview will be audio recorded and confidentially stored and that the findings will be published.

3.6 Data analysis in qualitative research

Qualitative data analysis requires methodological and intellectual competence. Analysis is not adhering to a set of right techniques; it is imaginative, artful, flexible and reflexive. It should also be methodical, scholarly, and intellectually rigorous. (Coffey & Atkinson, 1996, p. 10)

To Miles and Huberman (1994) “data analysis consists of three concurrent flows of activity: data reduction, data display, and conclusion drawing/verification” (p. 21). Bogdan and Biklen (2007) treat data analysis as having two parts; the analysis and the interpretation. "Analysis involves working with data, organizing them, breaking them down into manageable units, coding them, synthesizing them and searching for patterns” (p. 156). Interpretation, on the other hand, involves “explaining [and] framing ideas”; clarifying and justifying the importance the findings in relation to the theory (p. 156).

In qualitative data analysis, the researcher searches for patterns, themes and topics, and assigns coding categories, (words and phrases describing those emerging themes, patterns, etc.), (Bogdan & Biklen, 2003, 2007; Coffey & Atkinson, 1996; Kervin et al., 2006; Miles & Huberman, 1994). Coding is “a variety of approaches to and ways of organizing qualitative data” (Coffey & Atkinson, 1996, p. 27). Essentially, coding is not an end to data analysis but rather a means to an end; it is a way to relate data to ideas about data in preparation for data interpretation (Bogdan & Biklen, 2003, 2007; Coffey & Atkinson, 1996; Miles & Huberman, 1994). Bogdan and Biklen (2003) have suggested the following coding families: setting/context codes; definitions of the situation codes; perspectives held by subjects; subject’s ways of thinking about people and objects; process codes; activity codes; event codes; strategy codes; relationship and social structure codes; methods codes; and pre-assigned codes (pp. 162-168).

Crucial to qualitative research is the ongoing data analysis whereby the researcher interweaves data collection and analysis. This process serves as a guide for the research process, allowing the researcher to: identify areas for future focus; identify data saturation; clarify issues early during the research; and if necessary, return to participants (Bogdan & Biklen, 2003, 2007; Coffey & Atkinson, 1996; Creswell, 2007; Ely et al., 1991; Miles & Huberman, 1994).

3.6.1 The data analysis process

I transcribed the interview at the earliest possible, leaving a column in the transcript for writing comment and tentative emerging themes (Bogdan & Biklen, 2003, 2007; Coffey & Atkinson, 1996; Kervin et al., 2006; Miles & Huberman, 1994). A similar procedure was used for the observations. The interview transcripts were forwarded to the participants for member-checking. I began the analysis by familiarising myself with the data. I perused the data over and over again and made notes about tentative thoughts/ideas (Coffey & Atkinson, 1996; Kervin et al., 2006) in the observers' column. I then searched for patterns, themes and topics and assign coding categories. Using Bogdan and Biklen's (2003) coding system as the basis, I started developing my own coding system and consequently assigned codes that were more precise and meaningful (Bogdan & Biklen, 2003; Miles & Huberman, 1994) to the study.

For example, for the participant observations some of the early emerging categories included: class organisation; student teachers' activities; teaching approaches; and teaching style. I searched for patterns in the ways events took place in the two ISSTE classes at UCCE. The second stage of the analysis, involved juxtaposing this data with relevant categories emerging from the interviews with student teachers and teacher educators at UCCE, and again looking for patterns. The third stage of the analysis was to compare the data from UCCE with data from interviews with participants from NIE. I then had to recode the data looking for similarities and differences between the institutions. Similar procedures were used for the analysis of data gathered from the interviews. Interview data from each institution were analysed at different levels: at the level of: the teacher educators; the student teachers; and the institution (comparison of data from the student teachers with those from teacher educators). The analysis of interview data ended with the comparison between the two institutions.

Document analysis followed more or less procedure, except that some cases, pre-assigned categories were used. For instance, for the SMK the pre-assigned categories were: content knowledge; substantive knowledge; syntactic knowledge, and beliefs. Hence, the topics covered in the science education course(s) (the 21 course outlines at NIE and the EDSC308 course from UCCE) were matched into those categories. (Refer to Appendix E for the classification of the contents of the science education course(s)). It should be noted that the analysis was limited to the subject matter knowledge (SMK), pedagogical content knowledge (PCK) and general pedagogical knowledge (GPK) offered by the science education course(s) at NIE and UCCE.

Chapter 4: Research findings

4.1 Introduction

In this chapter I present the findings gathered from document analysis, semi-structured interviews and participant observation. The discussions and implications of the research findings are offered in chapter five. With reference to the research aims listed on pages 4-5, the data gathered are addressed under two main topics:

Part 1: *Initial secondary teacher education programmes for the aspiring secondary science teachers at NIE and UCCE*

Part 2*: Insights from inside the initial secondary science teacher education classes*

Part 1: Initial secondary teacher education programmes for the aspiring secondary science teachers at NIE and UCCE

In this section, I report the main similarities and main contrasting differences relating to the context, components and structure of the initial secondary teacher education (ISTE) programme(s) offered to prospective secondary science teacher at the National Institute of Education (NIE) and at the University of Canterbury College of Education (UCCE). The findings are presented under these two themes in two separate sections:

Section 4A: The context and structure of ISTE programmes at NIE and UCCE.

Section 4B: The components of ISTE programmes at NIE and UCCE

Section 4A: *The context of the ISTE programmes at NIE and UCCE*

The initial secondary teacher education (ISTE) programme(s) offered to the aspiring secondary science teachers at the National Institute of Education (NIE) in Seychelles and the University of Canterbury College of Education (UCCE) in New Zealand differ in terms of the qualification; the entry requirements; the duration; and the number of subject specialisation as summarised in Table 4A.1.

Table 4A.1: The qualification, entry requirements and duration of ISTE programmes at NIE and UCCE

	NIE	UCCE
Qualification(s) awarded to aspiring secondary science teachers	Diploma in Secondary Teacher Education in respective curriculum subject area; e.g. DSTE(Science)	- Graduate Diploma in Teaching and Learning (Secondary) OR - Bachelor of Education and Graduate Diploma in Teaching and Learning (Secondary) specialising in PE
What is the minimum academic entry requirement?	- GCE 'O-Level'/IGCSE in at least 5 subjects, including English, - Principal passes at GCE 'A-level' in biology, chemistry, or physics	For GradDipTchLn(Secondary) - university degree or equivalent in subject of specialisation - IETLS for students whom English is their second language
What is the maximum duration of the programme?	2 years full time	GradDipTchLn(Secondary): - 1 year full time course **or** - up to three years part-time (BEd/GradDipTchLn(Secondary) - 4 years full time

4A.1 The qualification offered by NIE and UCCE

At NIE, the Diploma in Secondary Teacher Education (DSTE) is the only secondary teacher qualification hitherto offered only to the residents of Seychelles. Prospective secondary science teachers follow the Diploma in Secondary Teacher Education (Science) (in short, DSTE(Science)) programme.

The University of Canterbury College of Education, on the other hand, offers two qualifications to the aspiring secondary science teachers residing in New Zealand and elsewhere internationally. The availability of different routes for becoming a certified secondary teacher is common in universities in New Zealand (Kane et al, 2005) and elsewhere around the world (Darling-Hammond & Baratz-Snowden, 2005). At UCCE, aspiring secondary science teachers can enrol on the Graduate Diploma in Teaching and Learning (Secondary) (in short GradDipTchLn(Secondary) programme and opt for the science courses either as a major and/or minor (second) teaching subject. Alternatively, they can choose the conjoint double degree Bachelor of Education and Graduate Diploma in Teaching and Learning (Secondary) specialising in Physical Education (BEd/GradDipTchLn(Secondary)) programme and study science as a minor teaching subject. The secondary science education course for both qualifications is offered under the GradDipTchLn(Secondary) programme.

4A.2 Academic entry requirement

Entry into teacher education programmes requires the candidates possess a certain level of academic competence. In the case of NIE and UCCE, both institutions require that their candidates possess a certain level of academic achievement in relevant subjects , and language and communication skills for admission into the ISTE programmes. However, the academic requirements for entry into the ISTE programme at NIE and UCCE vary considerably.

Candidates on the DSTE programme require: (i) at least a General Certificate of Education - Ordinary Level, (GCE O-Level) grade C or above, or an equivalent International General Certificate of Secondary Education (IGCSE) in at least 5 subjects, of which English is compulsory; and (ii) a Principal pass in the British General Certificate of Education - Advanced Level (GCE A-level) in their respective curriculum subject area. For the DSTE(Science) programme, the student teachers require a GCE A' level Principal pass in at least one of the three sciences: biology, chemistry, or physics.

Similar to many initial secondary teacher education programmes in New Zealand (Kane et al, 2005) and in America (Shanker, 1996), the GradDipTchLn(Secondary) at UCCE is open to prospective secondary teachers who already possess a university degree or equivalent. The degree should include 300-level programme(s) relevant to the students' major teaching subject(s) and a 200-level programme relevant to the second teaching subject (University of Canterbury, n.d.c). In addition, student teachers whom English is not their first language need to "provide evidence of [International English Language Testing System] IELTS (Academic) 7.0 with no individual score below 7.0" (University of Canterbury, n. d.c).

4A.3 The duration of the DSTE and the GradDipTchLn(Secondary) programmes

The DSTE(Science) programme is a two-year full-time programme which runs from mid-January to early December. The GradDipTchLn(Secondary), by contrast, is normally offered as a one-year full time programme running from February to November or cross year from mid-July to June. Alternatively, candidates can enrol on a part-time basis for up to three years. Meanwhile, the BEd/GradDipTchLn(Secondary) is a four-year full time programme.

Section 4B: The components and structure of the ISTE programmes at NIE and at UCCE

The data relating to the components and structure of the two ISTE programmes are presented as follows:

Section 4B1 The components of the ISTE programmes at NIE and UCCE

Section 4B2: Weightings assigned to the different components of the programmes

Section 4B3 The structure of the ISTE programmes at NIE and UCCE

4B1 The components of ISTE programmes at NIE and UCCE

The DSTE programme at NIE and the GradDipTchLn(Secondary) programme at UCCE are both structured around six components. The terminologies assigned to the components of the two ISTE programmes are different and rather confusing. For instance, although the terms Educational Studies (NIE) and Education Studies (UCCE) appear very similar indeed, they encompass different contents. Yet, despite the terminological differences, content analysis revealed that the contents of each of the components of the DSTE programmes correspond to the contents of a particular component of the GradDipTchLn(Secondary) programme, as listed in Table 4B.1.

Table 4B.1: The pairs of analogous components of the two ISTE programmes

DSTE (NIE)	**GradDipTchLn(Secondary) (UCCE)**
Elective Studies	Selective Studies
Context Studies	Education Studies
Support	Information and Communication Technology (ICT) Studies
Educational Studies	Professional Studies
Curriculum Practice	Teaching studies
Professional Experience	Teaching practice

All these components are integral to the professional development of a prospective secondary science teacher; however, my focus is on the science (the *Curriculum Practice* (NIE) *and Teaching Studies* (UCCE)) component of the ISTE programme. Hence, I restrict the comparison to the *Curriculum Practice* (NIE) *and Teaching Studies* (UCCE) components to characterise the findings in Part 2. However, for future references, relevant details about those components are given in Appendix C.

Curriculum Practice at NIE and Teaching Studies at UCCE

The Curriculum Practice and Teaching Studies components of the two ISTE programmes allow the aspiring secondary teachers to explore issues related to their specific teaching subject(s). Aspiring secondary teachers at NIE are required to study only one core curriculum subject, that of their DSTE programme. Student teachers on the DSTE(Science) programme study only science education and do not specialise in any of the sciences: biology, chemistry and physics. The Curriculum Practice (Science) component consist of 22 science courses of which almost a quarter are academic courses, 15 are science methodology courses and two are designated for student teachers' individual research project. Introduction to research methodology is covered under the Educational Studies component.

Conversely, prospective secondary teachers at UCCE must enrol in two teaching subjects. With the relevant academic pre-requisite, the student teachers can take either two major teaching subjects (double major), or a major and a minor (second) teaching subject. Those wishing to teach science can choose science education either as their major teaching subject or as their second teaching subject. Science as a major provides the opportunity for specialisation in one of the sciences. Further details about science as a major teaching subject and as a second teaching subject at UCCE are given in Appendix C, section C5.1 and C5.2 respectively. The Teaching Studies (Science) component offers one core course in science education, the senior curriculum study subjects (biology, chemistry and physics); and additional courses in electronics and biotechnology.

4B2 Weightings assigned to the different components of the programmes

The two institutions devote different amount of emphasis to the different components of their ISTE programme. It should be noted that while the weightings allocated to the components at

UCCE is based on a point system, such system is not in use at NIE. Hence, in this study, the weightings for the components at NIE is based on the 30 hours contact time stipulated for each course (each course requires around 60 hours Trainee Engaged Time: 30 hours contact time and 30 hours independent study (NIE, 2004)) and the eight hours that the student teachers spend in school each day during their practicum. The weightings allocated to each component of the two programmes are shown in Table 4B.1 and Table 4B.2.

Table 4B.2: Weightings allocated to each component of the DSTE programme

<table>
<tr><th colspan="2">Component</th><th colspan="2">Number of courses</th><th>Time allocated (hours)</th></tr>
<tr><td colspan="2">Curriculum Practice</td><td colspan="2">22</td><td>660</td></tr>
<tr><td colspan="2">Educational Studies</td><td colspan="2">10</td><td>300</td></tr>
<tr><td colspan="2">Context Studies</td><td colspan="2">2</td><td>60</td></tr>
<tr><td rowspan="4">Support</td><td>A - ICT</td><td>2</td><td rowspan="4">8</td><td rowspan="4">240</td></tr>
<tr><td>B - Subject academic</td><td>3</td></tr>
<tr><td>C - Environmental education</td><td>2</td></tr>
<tr><td>D - Graphic communication</td><td>1</td></tr>
<tr><td colspan="2">Elective</td><td colspan="2">2</td><td>60</td></tr>
<tr><td colspan="2">Professional Experience</td><td colspan="2">17 weeks</td><td>680</td></tr>
<tr><td></td><td colspan="3">Total weightings (hours)</td><td>2000</td></tr>
</table>

Table 4B.3: Weightings assigned to each component of the GradDipTchLn(Secondary) Programme (Adapted from the University of Canterbury (2008)

<table>
<tr><th colspan="2">Components</th><th colspan="2">Points</th></tr>
<tr><td colspan="2">Teaching Practice</td><td colspan="2">40</td></tr>
<tr><td colspan="2">Professional Studies</td><td colspan="2">20</td></tr>
<tr><td colspan="2">Education Studies</td><td colspan="2">8</td></tr>
<tr><td colspan="2">ICT Studies</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">Teaching Studies</td><td>Major Teaching Subjects</td><td>24</td><td rowspan="2">36</td></tr>
<tr><td>Additional Teaching Subjects</td><td>12</td></tr>
<tr><td colspan="2">Selected Studies</td><td colspan="2">12</td></tr>
<tr><td></td><td>Total weightings (points)</td><td colspan="2">120</td></tr>
</table>

Figure 4B.1 shows a scaled diagrammatic comparison based on the percentage weightings assigned to the different components of the DSTE and the GradDipTchLn(Secondary) programmes.

Figure 4B.1: A comparison of the weightings given to the components of the ISTE programme at NIE and at UCCE

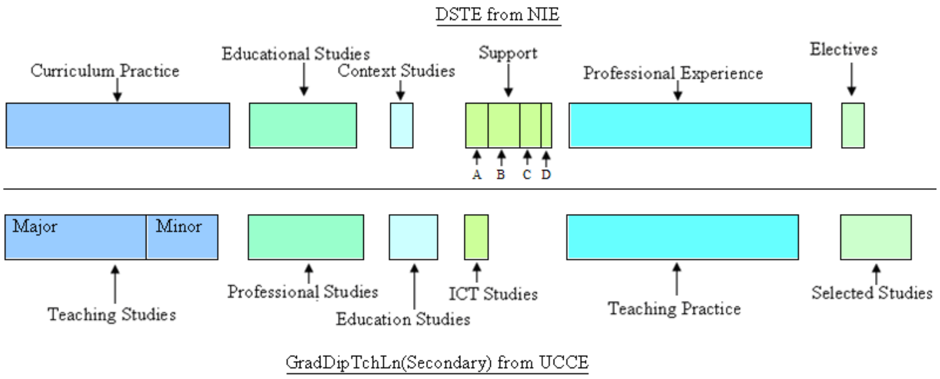


Figure 4B.1 shows a similar trend in the weightings allocated to three analogous components of the two programmes: Professional Experience (NIE) and Teaching Practice (UCCE) have the most weighting, followed closely by Curriculum Practice (NIE) and Teaching Studies (UCCE). Educational Studies (NIE) and Professional Studies (UCCE) come in third. Figure 4B.1 also shows that the two institutions assign more or less the same weighting to each of those three corresponding components. The evidence suggests that those three analogous components are the most important aspect of a teacher education programme. This is in line with literature from Coble and Koballa (1996)—in their description of pre-service science education; and Kane et al. (2005)—in their findings on teacher education in New Zealand.

Significant differences exist between the three remaining corresponding components, as illustrated by Figure 4B.1. With its eight compulsory courses it is not surprising for Support to be the fourth important component at NIE while ICT Studies as its analogous component at UCCE is given the least importance. Interestingly, the importance of ICT on the two ISTE programmes is relatively low and similar. Meanwhile, Selected Studies and Education Studies at UCCE are given more emphasis than their corresponding Elective and Context Studies at NIE.

4B3 The structure of ISTE programme at NIE and UCCE

The structure of the two ISTE programmes differs considerably. At NIE, the student teachers need to successfully complete a total of 44 courses and the 17 weeks of Professional Experience to be awarded a Diploma in Secondary Teacher Education. The DSTE courses at NIE are structured in six academic terms over two years. With the exception to the research project course which runs over two terms (20 weeks), all courses on the DSTE programme last for one term. Student teachers take eight courses on average each term alongside one to five weeks of Professional Experience. Appendix D (Figure D1) illustrates the structure of the DSTE(Science) programme.

At UCCE, a total of at least 120 points is required to qualify with a Graduate Diploma in Teaching and Learning (Secondary). The courses on the one-year GradDipTchLn(Secondary) programme are structured in four academic terms. (The programme structure for a GradDipTchLn(Secondary) student teacher majoring in Math and Science is given in Appendix D, Figure D2). It should be noted that the programme structure for another student teacher may be different because of the flexibility the have in choosing their courses. During the one-year programme, a student teacher engages in two seven-week blocks of teaching practice and takes five classes on average each term. Most of the courses on the GradDipTchLn(Secondary) are full-year courses. A student teacher explained:

. . . on average I'm taking five classes at a time. The least amount that I'm ever in is three, which is in block three . . . just because some classes like general science stops for block three but then come back in block four. Most students will be taking about five classes. Some have chosen or opted to take more, so they might be even in six, but that's not the norm or the average.

Part 2: Insights from inside the initial secondary science teacher education classes

The findings for Part 2 provide insights from inside the initial secondary science teacher education (ISSTE) classes and are presented under these two themes:

Section 4C: *The integration of theory and practice in the ISSTE classes at NIE and UCCE*

Section 4D: *Decision makings about the contents of the science course(s)*

Section 4C: The integration of theory and practice in the ISSTE classes at NIE and UCCE

Giving voices to the research participants (the italicised texts), in this section, I compare how theory and practice are integrated in ISSTE classes at NIE and UCCE. The findings are addressed under four sub-themes as follows:

4C1 Knowledge base of the science education course(s): what are student teachers taught?

4C2 Pedagogical approaches in the ISSTE classes: how are student teachers taught?

4C3 Approaches to assessment/assignment in the ISSTE classes: how are student teachers assessed?

4C4 Approaches to teaching practice in the ISSTE classes: when do student teachers practice what they have learnt?

4C1 Knowledge base of the science education course(s): what are student teachers taught?

"Determining appropriate and relevant content of ITE [initial teacher education] and organising this into meaningful learning experiences for student teachers is a challenging and complex endeavour", (Kane et al., 2005, p. 223). Generally, researchers have categorised teachers' knowledge into different knowledge base: subject matter knowledge (SMK); pedagogical content knowledge (PCK); general pedagogical knowledge (GPK); and knowledge of context (as discussed Chapter 2). This section compares the contents or knowledge base offered by the 22 science education courses at NIE and the core course (*EDSC308: Science Education Years*, *7 to 13*) at UCCE in terms of SMK, PCK and GPK.

4C1.1 The knowledge base of the science education course(s) at NIE and at UCCE

Holistically, document analysis of the science education course(s) at NIE and at UCCE reveals that the science component of the ISTE programme at NIE and that of UCCE offers subject matter knowledge, pedagogical content knowledge, and general pedagogical knowledge to their aspiring secondary science teachers. However, a closer look at the contents or the broad topics offered by the science courses at NIE and the EDSC308 course at UCCE reveals two interesting findings. First of all, the two programmes offer rather similar PCK and similar GPK to their prospective secondary science teachers. The contents (broad topics) of each of the knowledge base covered in the science education course(s) at NIE and UCCE are shown in Appendix E. However, I would caution that the content as listed may not represent the entire array of knowledge that are offered by the science course(s) because during the teaching process, the teacher educators may incorporate other contents not stipulated in the course outlines as observed in two of the ISSTE classes at UCCE. The teacher educators incorporated 'narratives' into one of their session. For instance, a teacher educator informed the class that "*although the use of narratives is not in the course, [name the other science* *educator] and I have found this interesting to incorporate in the course*" (Observation 7, 10.06.2008).

Secondly, the contents of the subject matter knowledge (science knowledge) differ considerably. The subject matter knowledge at NIE does not address the syntactic knowledge, that is, nature of science which has been shown to be integral to the teaching and learning of science (Clough, 2007; Lederman, 2004; Mathews, 1994; McComas, 1996; McComas et al., 1998). By contrast, syntactic knowledge of science is present in the science course at UCCE. Another difference between the science knowledge base is that while the science education courses at NIE include five courses that specifically address science content knowledge (two in each, chemistry and physics and one in biology), there is no special focus on science content knowledge in the science education course at UCCE. This is because, according to a teacher educator, "the course is not long enough" and the student teachers already possess relevant University degree (Interview 1, UCCETEB). However, the student teachers are exposed to some science contents during the ISSTE classes, as a teacher educator explained:

> *. . . we don't see ourselves as delivering information about science content, we use those as part of our pedagogical practice so some of the content ideas come through as we provide experiences of the pedagogy.* (Interview 1, UCCETEB)

4C1.2 Other significant findings

Generally, each course document from the two institutions stipulates: the rationale and the aims of the course; the expected learning outcomes; the content areas for study; the assignments; and the relevant references. The striking difference between the course document(s) from NIE and UCCE is the way in which this information are presented. At UCCE, this information including the resources and the essential readings for the one-year science education course are compiled in a course booklet or course reader. Conversely, at

NIE this information is presented in a 22 separate course documents known as the 'unit outlines'. By looking at the course (unit) outline, there is no clue of the resources including essential readings that are relevant to the course and the extent that content should be covered. This apparently, according to a teacher educator, becomes problematic for the new science educators (part-time teachers and teacher educators, especially those who did not write the course) teaching into the courses but more importantly for NIE "*in terms of ensuring consistencies in the contents covered and standard of the qualification*" (Interview 10, NIETEC).

4C2 Pedagogical approaches in ISSTE classes: how are student teachers taught?

Pedagogy, according to Grossman (2005), encompasses: the instructional strategies that the teacher educators use and the assessment tasks or assignments that the student teachers complete in the teacher education classes. Pedagogical approaches in this study refer to the organisational strategies like whole-class, group or individual approaches; and the instructional strategies like problem solving, demonstration and role-play (Turner-Bisset, 2001) that the teacher educators use in their ISSTE classes to teach the aspiring science teachers.

4C2.1 Similarities and differences

Interviews with the student teachers and teacher educators at NIE and UCCE, and participant observation at UCCE reveal that the science teacher educators from both institutions use a variety of pedagogical approaches in their ISSTE classes. The use of a variety of pedagogical approaches, according to Turner-Bisset (2001), is important as it reduces "boredom and disaffection" (p. 153). For example, the 'pedagogical repertoire' (Turner-Bisset, 2001) of the science educators (teacher educators and part-time teachers) at NIE include: laboratory practical work, demonstrations, microteaching, role plays, pair work, discussions, explanations, and lecturing—an approach acknowledged only by the student teachers. However, the type of pedagogical approaches used in the ISSTE classes at NIE and UCCE differ significantly.

The practice of one science teacher educator at NIE is as follows:

> *It* [the pedagogical approach] *depends on individual lecturer and the type of unit being taught. I like to give students first hand and active learning experiences, so I tend to use practical work as often as possible in my teaching. I also use demonstration, microteaching, role play,* {short pause} *pair work, discussions, and explanations but I do not lecture, I also ask for students' input. Students need those examples; they need to experience those approaches, so I try to model them . . . we are training them, so we have to be careful how we do it. They should know and see that the models of teaching chemistry, the models of teaching biology, and models of teaching physics are different*. (Interview 3, NIETEB)

The above quotation might lead someone to believe that the ISSTE classes at NIE promote: active, collaborative and student-centred pedagogical approaches, and the importance of modelling in teacher education. Unfortunately, that is not the norm in the ISSTE classes at NIE. According to the student teachers, the ISSTE classes are rather passive and teacher-centred predominated lectures. The two current student teachers who began the DSTE (Science) programme in January 2007 remarked:

> *Most of them use lectures; they speak almost throughout the whole session.* (Interview 7, NIESTE).
>
> *. . . there are lecturers who issue a lot of photocopies and lecture all the time; we don't do much talking or activities, we just sit and listen.* (Interview 6, NIESTA)

Apparently, this practice began in January 2007 in those classes taught by the part-time teachers, as the former student teacher who completed the two-year DSTE(Science) programme in 2007 observed:

> *The first year [2006] was more student-centred . . . But during the second year [2007], the teaching was slightly more teacher-centred, the different part-time lecturers who were teaching the different units were mainly lecturing.* (Interview 9, NIESTI)

The student teacher's disappointment with the practice of certain science educators is clearly reflected in this interesting but rather unfortunate remark claiming that the science educators do not practice what they preach.

> *You know what's funny about those lecturers* [lecturers who issue photocopies and lecture all the time], *Mrs Jules? They talk about active teaching strategies and expect us to use active teaching strategies in schools, yet they themselves do not practice what they preach. How will we know how to do certain things if they don't show us how?* (Interview 6, NIESTA)

The question that might be asked here is: why is lecturing the most popular and most frequently used approach in the ISSTE classes at NIE? Multiple justifications were advanced by the student teachers. For one current student teacher it was because *"as student teachers [they] are expected to be independent learners"* (Interview 7, NIESTE). For the other it is because of the small size of their group (Interview 6, NIESTA). The former student teacher in return contemplated that lecturing prevails because of the part-time teachers' inexperience in teacher education; their belief that the role of the lecturer is to lecture; and their commitments to their full-time work hinder their preparation.

> *It's probably because they* [the part-time lecturers] *did not know what we need; they probably did not have enough experience in teacher training. Also, maybe because they are referred to as lecturers so they believed that they have to lecture, I don't know,*

> {laugh}. *Also they have other work commitments elsewhere; they may not have enough time to prepare*. (Interview 9, NIESTI)

Whatever the reasons might be, this predominance of lectures in the ISSTE classes at NIE is not unique: this passive didactic approach appears to be a common practice in teacher education classes. Stoddart et al. (1993) for instance have observed that "even when teachers are taught about cognitive approaches to instruction they are presented with this knowledge in the form of lectures about children's naive scientific theories" (p. 232).

By contrast, juxtaposing interviews with science student teachers and science teacher educators together with participant observation in two different ISSTE classes at UCCE, the study revealed that the UCCE science teacher educators use interactive and learner-centred pedagogical approaches. The teacher educators at UCCE run their science education classes as workshops and aim to model different approaches and activities that their student teachers could eventually apply to their own teaching. Modelling approaches is crucial to teacher education: it helps the student teachers to develop deep understanding (Darling-Hammond & Baratz-Snowden, 2005; Korthagen et al., 2006; Loughran & Berry, 2005; Meichtry, 1998). Lectures form no part of the UCCE science teacher educators' pedagogical repertoire. A teacher educator elucidated their practice at UCCE:

> *We try to model a range of different types of teaching that our students could use in their own teaching. So it's the whole range from directive, instructions, we don't lecture to our students as such, we tend to run interactive seminars, or kind of workshops, I guess they are all workshops really, because there's a little of bit of up front, you know, pragmatic, "this is what we're going to do today", and then there's also built in practical activities, so it's a mix of interactive group activities and theory,* {short pause} *I guess, we can call what we do as workshop or seminar-based teaching,*

> *. . . so we don't do big lectures around the table* {laugh}. *We only have interactive workshop type approach*. (Interview 1, UCCETEB)
>
> *We try to appropriate the tasks that we do and the ways we offer our students according to what we want in terms of an outcome. . . . we appropriate the method to the outcome. And that is what we hope all our students do, that they use a whole range of things not just one main method of teaching or one main kind of strategy, or procedure or whatever way you want to call the ways of operating.* (Interview 1, UCCETEB

A student teacher concurred:

> *I feel that it's very much learner centred. In some cases because basically we're told maybe what today's tasks is, say the topic is electricity, and then we're given some resources that will be helpful to teach lessons on electricity, and we're asked to brainstorm ways which we could, you know, introduce the topic to our students. I don't find that it's a lot of a lecturer speaking to us, but more collaborative and a lot of us finding out for ourselves what works or doesn't work.* (Interview 5, UCCESTE)

Collaborative learning is central to the pedagogical approaches used in the ISSTE classes at UCCE.

> *Perhaps we focus on that [collaborative learning] more than individual, individual targeted learning, directed learning because* {short pause} *it's the interactive ways of operating either in pairs or in small groups that our students are least familiar with; so that's why we try to encourage them to do more, experience these ways of learning. There's very little individual work that they're required to do as part of the course.* (Interview 1, UCCETEB)

The extolled interactive or collaborative inquiry-based student-centred approaches are further supported by participant observation in the two initial secondary science teacher education classes. Interestingly, the nine sessions observed all followed a similar pattern:

1. the teacher educator making a short introduction;
2. the student teachers engaging in a range of collaborative learning activities which normally included: small group discussions; working on task cards; laboratory practical work. On rare occasions the small group discussions are preceded by individual tasks;
3. the teacher educator leading whole class discussions, or feedback sessions where groups reported back to the whole class;
4. the teacher educator making concluding statements or comments.

4C2.2 Student teacher's concerns about their teacher educators' pedagogical practice

Student teachers from both institutions have expressed their concerns about the pedagogical approaches that the teacher educators used in the ISSTE classes. In the case of NIE, the student teachers have unanimously emphasised the need for all science educators to model the approaches that they are expected to use and have called on their science educators to practice what they preach, which is basically the active, student-centred approaches. One current student teacher eloquently explained a repeated demand:

> *I've always said during practicum debriefings that NIE lecturers should do more of the things that they expect us to do during practicum, so that we would know how to go about doing those; we need to see or experience how those approaches work. I know that to some extent, the small number of students, only five of us, on the course prevents the lecturers from using certain strategies, like group work, but that does not mean that they should just give us photocopies and lecture. There are strategies that they can practice, like role play and pair work.* (Interview 6, NIESTA)

In the same vein the other agreed:

I know that we're not in secondary school, but we need to see the rhythm of things, they should not only tell us what to do they should show us how; give us examples, because we are learning how to teach science, it's different. For example, they tell that you can introduce a topic this way or that way, wouldn't it be better for them to introduce that topic the way they would like us to do in schools? Or they could ask you to practice, they could watch and comment and give advice for improvement. You know, Miss, I don't mind them giving us handouts to read. But when you're reading you should be able relate to what was done in class, you get the example; it helps you to understand better and then you're more confident to apply it in school. Sadly, not all lecturers think this way. (Interview 7, NIESTE)

A contrasting scenario exists at UCCE. While all the student teachers strongly favoured the interactive student-centred approach, they have expressed the need for more inputs, like more examples and explanations, from their teacher educators. Two student teachers claimed:

Sometimes I really like that [finding out for ourselves], *sometimes I wished that we were maybe spoken to a bit more, or maybe told about experiences where they have taught it, or how maybe they would to do it, so that we can see different ideas, rather than just saying here's a unit on electricity, and then just showing us resources. Maybe give an example of how to go about it so that you could maybe draw on that. That may be helpful.* (Interview 5, UCCESTE)

I'm happy with the teaching approaches, they give you enough; they talk about scaffolding and they do the same thing with us that they would do with teenagers or school children. And that really helps, they give you confidence, that's what you really need. You need confidence to do the job. But then I think the ideas is you need to build on your own learning, and know how to think and learn, you know. It helps you *especially when you reflect on what happened afterwards. But sometimes I find some things very hard, and then I think the lecturers could have done it better, they could have given more explanation because some topics are harder*. (Interview 4, UCCESTA)

4C3 Approaches to assessment/assignment in the ISSTE classes: how are student teachers assessed

In this section, I present the findings about how students are assessed in the ISSTE classes at NIE and at UCCE. The data for this section are grouped under two headings: the types of assessment/assignment tasks; and assessment processes: individual and group assessments/assignments

4C3.1 Types of assessment/assignment tasks

Analysis of the science education course document(s) from both institutions revealed that the science teacher educators assess their student teachers through a variety of assessment tasks. The types of assessment tasks performed in the ISSTE classes at NIE and at UCCE are shown in Table 4C.2 and Table 4C.3 respectively. Assessment tasks focussing on lesson planning, assessment, and unit planning are common to both ISSTE classes.

Table 4C.1: The variety of assessment tasks that prospective secondary science teachers perform in their science education course at UCCE

Task	Types of assessment tasks
1	Lesson planning
2	Level 1 science achievement standard assessment (marking a level 1 science assessment and deciding on achievement standard)
3	Preparing a unit of work
4	Essay on the student teachers' personal philosophy for teaching science.

Table 4C.2: The variety and frequency of the assessment tasks that prospective secondary science teachers perform in their 22 secondary science education courses at NIE

Types of assessment tasks		Frequency	
Exams	Continuous assessment	4	11
	End of course (unit) examination	7	
Preparing units of work (aka. resource/teaching package)			7
Laboratory work (practical experiments and laboratory reports)			6
Peer/micro teaching			5
Lesson planning (on different topics from the science curriculum)			4
Designing, administering and evaluating a test			1
Seminar (paper and presentation on an issue in science education)			1
Essay (on scientific process skills)			1
Exhibition (based on model constructed from recycle materials)			1
Case study (on practical work in the secondary school)			1
Research project (conducting a research and writing the report (similar to a dissertation))			1
	Total number of assessment task		**39**

The most striking difference regarding the type of assessment tasks is the presence and prevalence of examination in the science courses at NIE. A teacher educator explained that the prevalence of examination in the science courses is because exam is the best way: to assess the content of the academic science courses (as stated earlier, five courses focus on science content or academic science knowledge); and to ensure the authenticity of students' knowledge, skills and attitudes. However, the teacher educator has also cautioned teacher educators to ensure that their exams assess not only subject knowledge, but skills and attitudes as well.

> *However, lecturers should design exams not only to test the subject matter, but other components like attitudes and skills. These are very important. We tend to neglect these areas because some lecturers do not know how to test them.* (Interview 3, NIETEB)

Student teachers on the DSTE(Science) programme at NIE engage in far more assessment tasks than their counterparts on GradDipTchLn(Secondary) do. The prospective secondary science teachers at NIE perform 39 science assessment tasks (on top of other assessment tasks from other courses) over their two-year programme, while those at UCCE perform only four science assessment tasks during their one-year programme. Surprisingly, the student teachers from both institutions have unanimously expressed their satisfaction with the variety and the quantity of assessment tasks they have to perform in the science course(s). The variety of tasks helps to enhance the student teachers' creativity and confidence (Interview 7, NIESTE; Interview 8, UCCESTI) and reduces the boredom of déjà-vu or repetitive tasks (Interview 7, NIESTE). In addition, two student teachers, one from each institution, found the assessment tasks useful and relevant to their teaching. A student teacher from UCCE claimed:

> *I feel that all four assignments are adequate; in a sense that we kind of started more simple and got more advance with respect to creating lesson plans and unit plans etc. And we were also required to mark an assessment which I think it's something very important because we'll have to do that in schools. So they're all very useful assignments, I guess.* (Interview 5, UCCESTE)

A similar comment was made by the former NIE student teacher:

> *The assignments were good. By doing those assignments we also learned how to do certain things. Some of the assignments have been very useful for us, like the teaching packages we developed when at NIE; we are using and sharing those in school.* (Interview 9, NIESTI)

Despite, the NIE student teachers' satisfaction regarding the quantity of assessment tasks they have to perform, studies reveal that multiple assessment tasks can limit the "opportunities for deep understanding, synthesis and reflection" (Kane et al., 2005, p. 222)

4C3.2. Assessment processes: individual and group assessments/assignments

The term assessment processes is used to refer to the ways in the assessment tasks are executed: individually and/or in groups. The study reveals one striking difference between the assessment processes at NIE and at UCCE. All assessment tasks in the science education courses at NIE are performed individually as a student teacher highlighted: "*well, so far all science assignments are done individually*", (Interview 6, NIESTA). By contrast, assessment tasks in the science education course at UCCE are performed either individually or in small groups: assessment tasks 2 and 4 are done individually while tasks 1 and 3 are performed in groups of three and in pairs respectively (see Table 4C.2 above for the tasks). Despite this difference, all participants share more or less similar views about the potential benefits of individual assignments and group assignments.

4C3.2.1 Individual assessment/assignment: the benefits

Teacher educators and student teachers from the two institutions agreed that individual tasks help to show that the student teacher can work independently. For example, a student teacher from UCCE claimed:

I think that it's important to have individual assignments so that you know yourself you can complete that task and that you are capable of producing quality work on your own. (Interview 5, UCCESTE)

A student teacher from NIE succinctly concurred and added that individual assignments help to boost their confidence:

Well, I think it's to make sure that we can perform the different tasks on our own. It helps build your confidence, when you see that you can do it. (Interview 7, NIESTE)

A more eloquent explanation was given by a teacher educator from NIE:

Individual work is important because it's the best way to test students writing skills, reading skills, organizing skills, time management skills, thinking patterns. It helps students to make their own learning and helps us to ensure that the students have the knowledge, skills and attitudes necessary for them to start teaching, to ensure that they are competent in the area assessed. {short pause} *It also makes learning more meaningful and helps students to become increasingly creative since they have to find different ways for doing certain things.* (Interview 3, NIETEB).

4C3.2.2 Group assessment/assignment

<u>Potential benefits</u>

Three benefits of doing assignment in teams have been identified. Although there is no group assignment in the science education courses at NIE, the student teachers and teacher educators from NIE have indentified two benefits similar to those of their counterparts from UCCE. Firstly, the teacher educators as well as student teachers from both institutions claimed that collaborative or group assignments increase the student teachers' learning and creativity. For example a UCCE teacher educator briefly remarked:

Those people who do it [assignment] *together tend to have enhanced ideas and creativity, I guess around the planning that goes into that, and I think they learn from*

> *each other as much as, you know, they would learn if, or more than if, they've done it by themselves.* (Interview 1, UCCETEB)

A former NIE student teacher commented:

> *You get the chance to share your ideas with another student and as well as learn from your colleagues. It helps you to be more open-minded and see things in different perspectives, which is important when you start teaching; it helps you not impose your ideas on your students. You'll also get different ideas of how to approach or teach certain topic when you go to school. You also learn to respect other people's opinions, and work as a team to achieve the best.* (Interview 9, NIESTI)

A teacher educator from NIE concurred that "s*eeing things from different perspectives will also enhance their* [the student teachers'] *learning and creative thinking*" (Interview 3, NIETEB)

The second benefit, according to all participants, is that group assignments provide the opportunity for the student teachers to develop collaborative or team work, thus preparing them for the existing practice in school. For instance, the eloquent explanation by a teacher educator highlights this point.

> *The importance with that* [doing assignments in groups] *is in schools it's a collaborative environment anyway, and you're going to need to work collaboratively, to share your great ideas you've come up with, what worked and also share the things that haven't worked . . . I think that the culture they* [the student teachers] *move from . . . more often that not, (moving from undergraduate degree into a graduate diploma), is that the undergraduate degree has been almost entirely based on their personnel attainment and individual tasks, individual assignments, individual exams. That will conflict with the culture that teachers should have within the school practice. So we have to begin to model, and begin to induct them into collaborative ways of working,*

that will be the more efficient ways of working in schools, a collaborative environment. (Interview 2, UCCETEC)

A student teacher from UCCE (UCCESTA) and a teacher educator from NIE (NIETEB) concurred:

> *I mean the reality in teaching is not about learning how to do things by yourself; it's about using resources, other people's resources and discussions. So there's no winning or losing; at the end of the day it's teaching the kids. How best we can all do it together, and that's what good about group assignment.* (Interview 4, UCCESTA)

> *Group assignments will provide the opportunity for the student teacher to practice team work, how people should work together to achieve something . . . It'll be a good preparation for team work in the schools; they do a lot of team planning in schools.* (Interview 3, NIETEB)

A third potential benefit of assignment was pointed out only by the student teachers, more explicitly by two student teachers from UCCE. They claimed that it will help them to adapt and work with different people as well as respect opinions of others. A student teacher stated:

> *It makes you experience different situations: sometimes you are happy with your group, sometimes you are not, but it's the outcome you are most interested in. . . . It's not anybody's concern if you could or could not corporate with your team mates. It's about you doing your assignments, you know, it's a tough time but you have to cope with, to deal with it. It can happen that you do not to like your colleagues, but you have to do your job.* (Interview 8, UCCESTI)

The other student teacher concurred:

> *Sometimes you might have to work with individuals that you might not necessarily meet eye to eye with and I think that that's very practical in a sense and I think that could be*

the same in the department: you might have to work with individuals you don't necessarily get along with. So getting use to that or just adapting to that I think is important. (Interview 5, UCCESTE)

The perceived constraints

However, a teacher educator and a student teacher from UCCE have remarked that having a group assessment early in the programme was an inconvenience for the student teachers. For the student teacher it is because they have not yet established proper relationship with their peers.

> *My first one was a nightmare just because I found it very difficult to communicate with my team. You know, it was our first block, you've just started to know your colleagues, but because it's just a short period of time and the first five weeks we already had probably more than ten assignments, you don't have time to look around you and to make connections with the others, you are so busy.* (Interview 8, UCCESTI).

For a teacher educator at UCCE, the hardship with group assignment is mainly because of student teachers' previous experience and success with individual work and perhaps their inexperience and underdeveloped collaborative skills.

> *They [student teachers] come from very individual learning environment, generally undergraduate degrees, you know, require that often, and they've been successful in a system where working individually have benefited them. I find it produces conflict for them, personally, when they find that they have to collaborate on assignments. The real problem is that the skills that they haven't developed yet and it's identifying their own skills, weaknesses, and nobody really likes that, nobody likes having their weakness pointed out. That's where the biggest protest comes in, early in the course, when they're expected to work together collaboratively.* (Interview 2, UCCETEC).

4C4 Approaches to teaching practice in the ISSTE classes: *when do student teachers practice what they have learnt?*

Teaching practice also referred to as professional experience or practicum (use interchangeably) provides the opportunity for the student teachers to observe teaching and translate into practice the knowledge and skills that they have acquired in the teacher education courses. Using data from document analysis and interviews with student teachers and teacher educators from both teacher education institutions, I compare the approaches to teaching practice in the ISSTE classes at NIE and UCCE in terms of: the frequency and duration of teaching practice; the teaching practice requirement; and practicum supervision.

4C4.1 Frequency and duration of teaching practice at NIE and UCCE

The frequency and duration of teaching practice on the DSTE programme offered by NIE differs from that of the GradDipTchLn(Secondary) programme offered by UCCE. At NIE the aspiring secondary teachers are involved in six blocks of practicum, one block each term, during the two-year programme. The schedule and general purpose of the different teaching practice blocks at NIE is given in Table 4C.4

Table 4C.3: The schedule and general purpose of the different teaching practice blocks at NIE

Year	Block	Term	Number of weeks	General purpose of the teaching practice
1	1	1	1	In-house workshop
	2	2	2	observation & team teaching in school
	3	3	3	11 weeks of individual teaching in schools
2	4	4	3	
	5	5	5	
	6	6	3	3 weeks used mainly for research project
	Total		**17 weeks**	

Conversely, the UCCE prospective secondary teachers engage in two seven-week blocks of teaching practice: the first block is offered in term one and the second block is offered in term three as shown in Table 4C.4.

Table 4C.4: The schedule and general purposes of the different teaching practice blocks at UCCE

Block	Term	Number of weeks and general purpose of the teaching practice	
1	1	7	Observation, planning and teaching
2	3	7	Planning and teaching

Each block is seen a stage in the student teachers' development to become a teacher. However, I have no intention of providing details about the different stages of practicum at NIE and at UCCE.

All student teachers from NIE have expressed their concerns about the duration of the professional experience: they are generally happy with the longer practicum block (five weeks) but they find the two-week and three-week practicum blocks too short to establish relationship with their students and to practice what they have learnt. For example one student explicated:

> *The five weeks for the final practicum is good. But the others, the two weeks and three weeks are too short. You know, you don't get enough time to know the students; when you start to get to know your students, start to understand them, you have to leave. Moreover, we teach different classes at different levels, S1 – S4 and of different abilities. If we were teaching all the sessions in a class it might have been different, you know.* (Interview 6, NIESTA)

This view was also expressed by a teacher educator who in addition claimed that the length of the practicum does not allow the student teachers to get enough specialist visits or to receive panel visits ("*visit by a team of NIE lecturers comprising the Course [programme] Leader or the Head of Programme, a science lecturer and an educational studies lecturer*", (Interview 3, NIETEB)).

> *I'm not satisfied with that the amount of practical teaching hours in the schools. It's too short: students don't get enough teaching practice; they don't get enough visits from us [science lecturers]. They don't get panel visits. It's only those failing or getting a distinction who get a panel visit*. (Interview 3, NIETEB)

The concern of the student teacher regarding short practicum block appears to be well documented. In the same vein, Darling-Hammond and Baratz-Snowden (2005) highlight the problem of short practicum:

> Multiple short placements reduce the opportunities to deeply understand a group of students and a kind of practice, and may make it difficult for student teachers to learn how what came before influences what is happening now in the classroom (p. 43).

4C4.2 Teaching practice requirement

With regards to the teaching practice requirement, there is one main difference between the two institutions: the student teachers from NIE have to teach science during their practicum while student teachers at UCCE are only required to take up science teaching during theirs. At NIE, the student teachers on the DSTE(science) programme specialise in science only, then they definitely have to teach science through out the their teaching practice. Conversely, student teachers at UCCE who have to specialise in two teaching subjects are not compelled to teach science, especially if science is their second major or their minor teaching subject.

The two current student teachers from UCCE; one doing a double major in maths and science and the other majoring in Physical Education and taking science as a second subject, claimed that they have not taught science during their first teaching practice, but might take up science teaching during their second teaching practice.

> *I haven't actually taught science at school yet, because on my first teaching practice I only did math, and it's only for the second teaching practice that I'll get involved in science.* (Interview 4, UCCESTA)
>
> *I have not* [taught science]*; I have only taught physical education, so it's a hope that on my next teaching practice I'll get an opportunity to teach science.* (Interview 5, UCCESTE)

To further illustrate that science teaching is not compulsory, the former student teacher, who took science as the minor teaching subject and who was seeking for employment at the time of the interview, successfully completed the GradDipTchLn(Secondary) programme without teaching any science during the two teaching practices.

> *In my teaching practices, no, I didn't* [teach science]. . . . *Only math*, (Interview 8, UCCESTI)

The study also revealed that there are two groups of student teachers who do not teach science during teaching practice at UCCE: those who want to teach science but cannot; and those who choose not to teach science. For those who want to teach science but cannot do so, it is mainly because the school cannot conveniently assign them some science lessons. A teacher educator explained the 'unfortunate' situation:

> *Surprisingly some of the people doing the science course as a second major, for example, if they are doing maths and science or physical education and science . . . they may not have taught science on teaching practice or may not have time to practice science teaching in a school, because they may have been targeting their first*

curriculum area, say math, when they've been out in the school or it may have not been convenient for that school to have given them a science class or something. So that's unfortunate because we would really want them to have experience to draw on. (Interview 1, UCCETEB)

For those student teachers who choose not to teach science, it is because: (i) they may have been targeting their first subject area (Interview 1, UCCETEB); (ii) they may have lost touch with science, like a current student teacher remarked: "*the thing that I have with science is, because I studied twenty years ago, a lot of things I've sort of forgotten*" (Interview 4, UCCESTA); or (iii) they do not want to risk their teaching practice, by coupling teaching practice which is seen as a tough period, with science teaching which is considered as difficult. Below is the former student teacher's response to this question: *Could you tell me why you didn't teach science at all?*

> *Because I didn't want to. I tried to avoid it, teaching practice is a very tough time, I try to make it as easy as possible for myself. So taking only math classes it was much easier for me to pass.*
>
> *Teaching science I think it is difficult, just because it incorporates . . . Chemistry, biology, physics, astronomy and geology, five different subjects in one. In* [country of origin] *we have five different teachers teaching those. So it is very difficult to teach science in New Zealand from my perspective, but if, probably if I had been graduated here I would have tried to teach science. But because of my experience I didn't afford to.* (Interview 8, UCCESTI)

4C4.3 Practicum supervision: the role of the teacher educator

Practicum supervision of secondary science student teachers at NIE is conducted mainly by the science teacher educators and the educational studies teacher educators. The science teacher educators are responsible for the specialist science visits. The Educational Studies (EDST) teacher educators observe across subjects, (like the professional studies teacher educators at UCCE) and the school Science Head of Department (HOD) provide on-going support visit. If a student teacher is either on the verge of failing the final professional experience or getting a distinction, he/she receives a panel visit to confirm the status. At the end of each practicum, a report form appropriate to the stage of the practicum is compiled by teacher educators who visited the student teacher (Interview 3, NIETEB).

Conversely, students from UCCE are supervised mainly by the associate teacher in schools and the professional studies teacher educators who observe across curriculum. Unlike, the secondary science student teachers from NIE, the secondary science student teachers at UCCE do not receive any specialist visits from the science teacher educators: specialised science observation is done mainly by the associate teachers. Their practicum report is collaboratively compiled by the professional studies teacher educators and the associate teacher. (Interview 2, UCCETEC) The four major differences between the practicum supervision of the secondary science student teachers at NIE and those at UCCE as summarised in Table 4C.5

Table 4C.5: The main differences between practicum supervision of the secondary science student teachers at NIE and UCCE

	NIE	UCCE
Who is the main practicum supervisor?	The science teacher educators	The associate teacher in schools
Who give specialist science visits?	The science teacher educators	The associate teacher in schools
Who else visit the student teachers?	The EDST teacher educators and the school science HOD	The professional studies teacher educators
Who compile the student teacher's performance report?	The science and the EDST teacher educators	The professional studies teacher educators and the associate teacher in schools

Section 4D: Decision makings about the contents of the science education course(s)

In this section, I present the data that provide insights about the construction of the science education course(s) at NIE and UCCE.

4D1.1 Who decides on the contents of the science education course(s)?

The study reveals that in both cases, the decisions about what contents to include in the science education course(s) are made by the science teacher educators teaching into science education course(s). A teacher educator at NIE stated:

> *It's basically the science lecturers teaching on the course who more or less decide what to include in the different units* [courses]. (Interview 10, NIETEC).

Similarly, the two teacher educators at UCCE pointed out that as the only ones teaching into the EDSC308 course, they are free to choose what they want to include in their teacher education programme (Interview 1, UCCETEB; Interview 2, UCCETEC). A teacher educator explained:

> *We're given the freedom to choose what to put in our teacher education programme. There is no national teacher education curriculum. I know in some countries there is, in Bangladesh for example I know that there is a national teacher education curriculum menu, you're sort of told what you must teach in teacher education, but in New Zealand we get to choose . . . just like school teachers get to choose as a flow-up or flow-down, I think or whatever you like to call it, so we choose what we do and how we do it.* (Interview 1, UCCETEB).

4D1.2 Factors influencing the decision-makers

Decisions about what to include in the science education course(s) are influenced by many factors: some factors are common to both institutions while others are specific as discussed in the next two sub-sections. However, the quotes used may contain both types of factors, separating the factors from individual quotes will distort the context in which they were formulated.

4D1.2.1 Factors common to the decision makers in both institutions

The interview with the teacher educators reveal that the decision makers from both institutions are influenced by five factors: (i) their science curriculum; (ii) their EDST course or Professional Studies course; (iii) their standard document(s) for newly qualified or graduating teachers; and (iv) knowledge of the previous course (UCCE: Interview 1, UCCETEB; Interview 2, UCCETEC; NIE: Interview 3, NIETEB; Interview 10, NIETEC)

The factors influencing the teacher educators' decision makings about the contents of the science courses at NIE are highlighted by this quote:

> *. . . we had to write new science units [courses] for the secondary course[programme] . . . the previous units focussed only on academic science knowledge. The three of us teaching the secondary course decided on the contents of the different units with reference to the science curriculum, the EDST units and {short pause} the competency document. We all took some units to develop. Then all the science lecturers in the faculty met to review the different units.* (Interview 3, NIETEB)

The NIE *Competency framework for newly qualified teachers*, a document which 'articulates a set of competency standards for the National Institute of Education's newly qualified teachers' (NIE, 2001, p. 4).

The following quotes from two teacher educator elucidate the decision-making process and the factors influencing it at UCCE:

> *Part of it is historical, from what was included previously, you know, previous courses, we just modify what was done previously. Part of it is dictated by the school curriculum and directives from the Ministry of Education, particularly things like health and safety requirements and the curriculum documents and assessments prescriptions and outlines. . . . But apart from that we consider, in terms of content, a content balance, a process balance as well. So we're looking for kind of a spread of touch by material world, physical world, living world and planet earth and beyond, the four strands of the science curriculum.*
>
> *We have to comply with . . . course descriptions . . . that dictate the learning outcomes* {short pause} *and therefore, we have to make sure that this course* [the EDSC308 course] *will allow the students to meet those outcomes, and that's in line with the Teachers' Council requirements. There's an overall umbrella, Teachers Council document that describes the teachers' standards, teaching standard. So the teachers' standards sort of dictate what we do, but not prescriptively . . . they are more global goals*. (Interview 1, UCCETEB).

The New Zealand Teachers Council (NZTC) is the 'professional body' responsible for teachers' registration and approval of initial teacher education programmes. It describes the standards for the graduating teachers (Interview 1, UCCETEB; Interview 2, UCCETEC; New Zealand Teachers Council, n.d.).

4D1.2.1 Context-specific factors

The study shows that in addition, decision makers at NIE are greatly influenced by other science teacher educators (see quote form Interview 3, NIETEB) and the decision makers' own knowledge and experience. A teacher educator explained:

. . .maybe just relying on people's own experience, relying on the few books we've always had around . . . I'm almost hundred percent sure that it is the knowledge that we had during our training, you know, what we came with at the NIE, that we are using as the basic to develop the units. We are doing our best but, you know, none of us have been trained as teacher trainers. We've gone abroad for our Degree, we've taught in schools, then we come here and we are in-charged of the profession. I think that people need further training or guidance to help them to do their job satisfactorily. Well, people try, people have certain experience, certain knowledge, they've been through teacher training institution, so there is a rough idea of what should be there, but these are only ideas, not exactly maybe what we should know, what experience we should have to contribute fully to the development of the units, to the delivery, and to the entire running of the institution. (Interview 10, NIETEC)

The availability of relevant references is also a powerful factor (Interview 3, NIETEB; Interview 10, NIETEC). For example a teacher educator lamented:

Our biggest problem I think is in terms of books, in terms of empirical research literature. Most of the books at NIE are quite dated; we lack current general and subject specific references, like books, journals of empirical research on teaching, learning, teacher education, etc. Moreover, we cannot list down our personal textbook as reference for the units. (Interview 3, NIETEB).

Additional factors that influence the decisions makers at UCCE are: (i) the directives from the Ministry of Education; and (ii) the course descriptions (Interview 1, UCCETEB above).

An unexpected finding from NIE, is that the teacher educators might not be giving due importance to all the documents guiding the practice teacher education in Seychelles.

> *I think we are not giving due importance to these guidelines, which are essential guidelines to guide us through. There is something somewhere maybe which is lacking, getting people to realise that you just don't go blindly into it* [teaching education]. *You have to ensure that these are your goals, these are your leading sort of document, I don't think that we are not doing* {short pause} *I think we are but to be really conscious of.* (Interview 10, NIETEC)

Summary of findings

Initial secondary teacher education at the National Institute of Education and the University of Canterbury College of Education differs in terms of their qualification; the academic entry requirement; the duration of the programme; and the number of subject specialisations. However, both programmes are structured around six analogous components with more or less equal emphasis on the three most important components: Professional Experience (NIE) and Teaching Practice (UCCE); Curriculum Practice (NIE) and Teaching Studies (UCCE); and Educational Studies (NIE) and Professional Studies.

Curriculum Practice (NIE) and Teaching Studies (UCCE) under which the science education course are offered, offer similar knowledge base to their aspiring secondary science teacher: both offers SMK, PCK and GPK. However, the focus on SMK differs because (i) at NIE student teachers are offered academic science courses and science methodology courses, as opposed to UCCE which focuses only on science methodology; and (ii) while UCCE offers syntactic science knowledge to its prospective secondary science teachers, such focus is lacking in the science education courses at NIE.

The pedagogy of the two initial secondary science teacher education as a way to integrate theory into practice also differs considerably. They differ in terms of the pedagogical approaches, the assessment tasks, and practicum requirement. While teacher educators in the ISSTE classes at the two institutions used a variety of pedagogical approaches, at UCCE they focus on strategies that promote collaborative, inquiry-based, student-centred learning. By contrast, although such an approach is evident in some cases, most of the ISSTE classes are teacher-centre predominated by didactic lectures. Assessment tasks in the ISSTE classes at UCCE and NIE are varied but there is an emphasis on examination at NIE, a task not used in the science education course at UCCE. The major difference is that at NIE all tasks are performed individually, while at UCCE assessment tasks are also performed collaboratively—a process which participants from NIE have welcomed. In terms of practicum requirement, three main differences exist: (i) student teachers at NIE engage in five short practicum placement (two, three or five weeks long) while those at UCCE are exposed to two blocks of seven weeks long; (ii) while student teachers at NIE are experiencing the teaching of science (even if it is a must), their counterparts at UCCE are not obliged to teach science during practicum; and (iii) at UCCE the school-based teachers (associate teachers) are the main subject supervisor and evaluator of the student teachers performance as opposed to NIE where these responsibilities lie on the shoulders of the subject teacher educators.

The teacher educators teaching into the courses are the ultimate decision-makers regarding the contents of the science education course(s). However, their decision making is influenced by several factors such as the relevant policies and guidelines, and the school science curriculum. Decision-making at NIE is also greatly influenced by the availability of the academic resources and the teacher educators' knowledge base.

Comment [RD2]: English language is quirky in that sometimes concepts like decision-making imply plural when literally they are singular. But we refer to decision-making as a process (therefore singular).

Chapter 5: Discussion and Conclusion

5.1 Introduction

The purpose of this study was to compare the praxis of initial secondary science teacher education (ISSTE) at the National Institute of Education in Seychelles and at the University of Canterbury College of Education in New Zealand. Towards achieving the goal of this study, the praxis of Diploma in Secondary Teacher Education (DSTE) at NIE and the Graduate Diploma in Teaching and Learning (Secondary) (GradDipTchLn(Secondary)) at UCCE has been scrutinised on two levels. On the first level, the study focussed on the context, components, and the structure of the initial secondary teacher education (ISTE) programmes for the prospective secondary science teachers at NIE and UCCE. On the second level, the study provided insights from inside the ISSTE classrooms about the integration of theory and practice in terms of: the knowledge base offered by the science education course(s); the pedagogical approaches used to translate that knowledge; the assessment tasks and processes used to assess that knowledge; the opportunities for student teachers to translate that knowledge into practice in schools; and decisions about the choice of knowledge provided. The implications of the main similarities main differences between the ISTE programmes at the two institutions are discussed below.

5.2 The Discussion

The study shows that there are limited similarities but considerable differences between the initial secondary teacher education programme at NIE and that at UCCE. A holistic view of the research findings reveals that the two ISTE programmes: (i) are similar in terms of: their components; and to a great extent the knowledge base offered by the science education course(s); and (ii) differ significantly in terms of: the qualification awarded; the academic entry requirement; the subject matter knowledge (with reference to the syntactic, and the science content knowledge); the pedagogical approaches; the assessment processes; and the practicum requirement and supervision. On the one hand, it could be argued that such findings are not surprising because they are two different qualifications offered by two different types of institutions: the ISTE programme at NIE is a Diploma (DSTE(Science)) housed by akin to a college, while that of UCCE is a Graduate Diploma (GradDipTchLn(Secondary)) offered by a university. Moreover, literature shows that initial teacher education varies from institution to institution within a country, and from country to country (Coble & Koballa, 1996; Darling-Hammond & Baratz-Snowden, 2005; Kane, 2005). On the other hand, reiteratively since both programmes are providing initial teacher education to aspiring secondary science teachers, those differences are causes for concern, especially for NIE which endeavours to take on board degree level programme in 2010 (A. Souffe, personal communication, June 4, 2008).

Although, internationally the constituents of the core knowledge in a teacher education programme is contestable, (Kane et al., 2005), it is interesting to find that the DSTE programme at NIE and the GradDipTchLn(Secondary) programme at UCCE are both structured around six analogous components. The analogous Professional Experience (NIE) and Teaching Practice (UCCE); and Curriculum Practice (NIE) and Teaching Studies (UCCE) are central to those two ISTE programmes.

Interestingly and somewhat surprisingly, notwithstanding the difference in the qualification awarded to the student teachers, and limitations of the course developers at NIE (like lack of recent references and lack of relevant training in teacher education), the Curriculum Practice component at NIE and Teaching Studies component at UCCE (or the science education course(s)) share some common knowledge base: subject matter knowledge (SMK); pedagogical content knowledge (PCK); and general pedagogical knowledge (GPK). Moreover, science course developers at NIE and UCCE have included rather similar PCK and

GPK in their science education courses. Nevertheless, their emphasis on the SMK differs with regards to science content knowledge and the syntactic knowledge: the courses at NIE do not offer syntactic knowledge while that UCCE pays very little attention to science content knowledge. The lack of focus on the syntactic knowledge in the science education courses at NIE is probably because: unlike New Zealand, the strand nature of science (NOS) is not present in the science curriculum in Seychelles; and the decision-makers' were probably "unaware of the multiple aspects of NOS since NOS was not explicitly emphasised as part of their schooling or teacher education" (Jules & Conner, in press). While the NIE science course developers' knowledge may have been adequate to incorporate contents in their science education courses that are similar to those of the science course of a Graduate Diploma qualification, I would argue that unless their current limitations are addressed, with the tentative nature of knowledge and the increasing research on teacher education, development in teacher education at NIE will lag behind.

Science teaching is rather complex, even if teachers specialise in one science discipline, like biology, in reality they are generally expected to teach across all the science disciplines in the science curricula (Cooper et al, 2002), especially when teaching science at lower secondary levels. Hence, science teachers need to have substantial content knowledge in all the disciplines (example: biology, chemistry, physics, and earth science) of the schools science curricula. However, the short length of the GradDipTchLn(Secondary) programme does not allow space for inclusion of additional science content knowledge. The lack of focus on content knowledge at UCCE is similar to many teacher education programmes in New Zealand (Cameron and Baker, 2004, Kane et al, 2005), in America (Cobble & Koballa, 1996) and in the United Kingdom (Finlayson et al., 1998). The lack of content knowledge probably explains the student teachers' fear of taking on board science teaching during their practicum. Because student teachers require a university degree relevant to science for entry into the

GradDipTchLn(Secondary) programme, there is a general assumption that they posses sufficient science content knowledge and only need "to develop pedagogic skills and classroom competences" during their teacher education preparation (Anderson & Mitchener, 1994; Grossman et al., 1989; Finlayson et al., 1998, p. 45; Stoddart et al., 1993). However, studies suggest that although student teachers possess university degree, their science knowledge may not be parallel with the content of the secondary science curriculum (Cameron & Baker, 2004). Moreover, a teacher educator at UCCE has observed that all the student teachers "*come in with content gaps because they've got their own specialism that they have gone through with their degrees*" (Interview 1, UCCETEB). This means that the students tend to learn the scope of the content knowledge they need as they prepare to teach it.

The focus on science content knowledge at NIE is perhaps to reduce the content knowledge gap that student teachers bring into the DSTE(Science) programme: the academic entry into the programme requires only an A' level in one of the sciences. This 'low' entry requirement is not specific to Seychelles: In a survey carried out in the UK, Cooper et al. (2002) found that "for all science subjects there is a significant amount of teaching by teachers without even an A-level in the particular specialism" (section 2, para. 3). The focus on academic science also corroborates the teacher educator's (Interview 3, NIETEB) justification for the amount of examination tasks in the science education courses.

A well-known adage in teacher education is "the medium is the message" (Grossman, 2005, p. 425). But what message are the teacher educators giving the student teachers? The study shows that teacher educators in the ISSTE classes at UCCE and NIE are sending two contrasting messages to their aspiring secondary science teachers. The science teacher educators at UCCE emphasise and model student-centred approaches predominated by collaborative inquiry–based learning, while for the most part, their counterparts at NIE tended towards teacher-centred approaches predominated by the didactic lecture approach, accompanied by multiple handouts. This message by NIE science educators is also promoting a view inconsistent with the nature of science. The student teachers from UCCE have commended the student-centred collaborative inquiry-based approaches used by the teacher education, even if at time they feel that there should be more input from the teacher educators. Research suggests that collaborative group learning promotes the construction of meaningful knowledge (Syh-Jong, 2007). By contrast, NIE student teachers have admonished this practice and appealed to their teacher educators to teach what they preach. It is incongruous for the teacher educators to expect their prospective teachers to use active teaching/learning approaches when they keep indoctrinating the teacher-centred, passive learning paradigm. The disappointment is consistent with student teachers elsewhere (Korthagen et al., 2006). Literature suggests that lecturing, which was not used in the ISSTE classes at UCCE, is definitely not the best means for teaching the aspiring teachers (Stoddart et al., 1993; Syh-Jong, 2007). For instance, Stoddart et al. (1993) claim that “didactic methods are rarely effective in changing learners’ preconceptions. Their deeply rooted beliefs and conceptions remain untouched by the words of text or instructors”, (p. 230). Moreover, several research studies suggest that teacher education “should be moving away from lectures as a means of instruction and increase opportunities for students to discuss experimental results and issues related to content and the nature of the discipline” (Syh-Jong, 2007, p. 66).

Different reasons have been advanced by student teachers to justify the prevalence of lectures in their ISSTE classes: reasons which may hold true for some if not all of those science educators at NIE. For example, NIE student teachers’ assumption that part-time teachers lack knowledge about teacher education is not farfetched, because a teacher educator has observed that very few teacher educators at NIE have received training in teacher education (interview 10, NIETEC). Hence, if the full-time teacher educators are facing such deficiency, then we should not expect part-time teachers to be better. Perhaps, the strongest reason behind this didactic teacher-centred approach might be the science educators' unfamiliarity with the contents to be taught. The course outlines, as presently written provide very limited or no support in terms of the depth of content coverage, possible pedagogical approaches and relevant readings. As Grossman (1989) observed, when teachers have to teach materials that are not acquainted with, they tend to: "rely heavily on textbooks", which explains the multiple handouts given out to the student teachers; and "lecture rather than soliciting student questions, which could lead them into unknown territory" (p. 28). Stoddart et al. (1993) have also remarked that "teachers who do not understand the content conceptually themselves are unlikely to be able to develop conceptual understanding of subject matter in students" (p. 232). But as Korthagen et al. (2006) caution:

> So long as teacher educators advocate innovative practices that they do not model, illustrate, and read as text in their own teacher education classrooms, teacher education reform will continue to elude us. (p. 1036)

The student teachers' concerns provide leverage of the teacher educators from both institutions to review their practice to better help the learners to learn about teaching as well as learn how to teach. Perhaps, one question that begs here is: what is the best pedagogical approach for the science teacher educators to use in the ISSTE classes? Evidently, there is no single best approach to teach student teachers. A teacher educator from UCCE pointed out that there is not just one best teaching approach suitable for teaching their student teachers (Interview 1, UCCETEB). This is also supported by Cochran-Smith's (1999) overt explanation "there are no recipes, no best practices, no models of teaching that work across differences in schools, communities, cultures, subject matters, purposes and home-school relationships", (as cited in Schulz, 2005, p. 165). While there is no single best approach for teaching student teachers, "model engaging and innovative teaching procedures" (Loughran & Berry, 2005, p. 193) that the prospective secondary science teachers could learn, experience, and eventually apply in their own classes appears to be crucial to the practice of teacher educators. Moreover, it will allow the student teachers to develop deep understanding (Darling-Hammond & Baratz-Snowden (2005) thus bridge the gap between theory and practice. As Korthagen, et al. (2006) emphasise:

> "what they [student teachers] experience as learners of teaching dramatically shapes their views of practice. Therefore, modelling approaches that create opportunities for student teachers to be cognizant of their learning about learning and their learning about teaching need continually to be made explicit" (p. 1025).

The study has also showed that the with the exception to the exams in the science courses at NIE, the assessment tasks in the science education course(s) at NIE and at UCCE are authentic to teacher education: they are performance tasks which allow students to develop certain competencies and to meet NIE standards for newly qualified teachers and the NZTC standards for graduating teachers. The use of performance tasks in the initial teacher education classes at NIE and UCCE is consistent with many other programmes elsewhere (Darling-Hammond & Baratz-Snowden, 2005; Grossman et al., 2005). The major difference between these two ISSTE classes is that at NIE all assessment tasks are performed individually, while at UCCE assessment tasks are performed either individually or collaboratively—a strategy welcomed by all the participants from NIE. Each approach having their unique benefits, but as highlighted by the participants collaborative assessment tasks relate more closely with the practices in schools. The use of collaborative work in teacher education is well documented (Darling-Hammond & Baratz-Snowden, 2005; Korthagen, et al, 2006; Syh-Jong, 2007) However, the execution of collaborative approaches to assessment tasks could be somewhat problematic for the ISSTE classes at NIE because of the usually small cohort size.

"Professional practice experience [practicum] is an essential component of ITE and is critical if student teachers are to have opportunities to make sense of how theory and practice are inter-dependent”, (Kane et al, 2005, p. 173). Similarly, teaching practice in both programmes start early on in the programme which is a good practice (Darling-Hammond & Baratz-Snowden, 2005; Korthagen et al., 2001, as cited in Smith, & Lev-Ari, 2005) as it allows the student teachers to address their misconceptions about teaching and learning and the problem of complexity (Darling-Hammond & Baratz-Snowden, 2005). The study shows that there are three differences between practicum at the two institutions. Firstly, the student teachers and a teacher educator at NIE found the multiple short teaching practices as a limitation to their experience and development—a view also expressed by Darling-Hammond and Baratz-Snowden (2005). Secondly, while student teachers at NIE are gaining experience in the teaching of science, their counterparts UCCE are not obliged to teach science during practicum. Finally at UCCE, the associate teachers (school-based teachers) play a major role in providing subject supervision and evaluating the student teachers’ performance; as well as the professional studies lecturers. Conversely at NIE science teacher educators are the main supervisors and evaluators of the student teachers. The practice probably suggests that UCCE has an effective partnership with the schools and the school-based teachers. By saying this, I am by no means implying that such partnership does not exist between NIE and the schools. It may just be that this practice at NIE is something historical or perhaps NIE does not want to place extra burden on the school-based teachers who are often overloaded with school-based duties.

5.3 Limitations of the study

This study is limited by the number of student teachers and teacher educators interviewed and the number of participant observations carried out in the initial secondary science teacher education classes at the University of Canterbury College of Education. Although I had not intended to generalise the findings, they would have provided a wider range of perspectives. A second limitation is the inability for in situ research at the National Institute of Education in

Seychelles to corroborate the pedagogical approaches used by the teacher educators in their ISSTE classes. Last but not least, as remarked in the methodology chapter, as a 'research instrument' the qualitative researcher's subjectivity can also influence the study. My personal interest to better understand teacher education; my involvement in the development of the current DSTE(Science) Curriculum Studies courses (the secondary science education courses) at NIE; and my commitment to improve initial teacher education at NIE might have come into play when deciding the relevant aspects/issues to report. Another researcher may interpret and report the same data differently. Consequently, a series of measures, such as data triangulation and member check, were taken with the anticipation to ensure the credibility and trustworthiness of the study.

In spite of the limitations mentioned above, this comparative case study has provided invaluable insights about the praxis of initial secondary science teacher education at the National Institute of Education in Seychelles and the University of Canterbury College of Education in New Zealand. This in-depth analysis of certain aspects of the two programmes has revealed information that can be applied to improve the praxis of initial secondary science teacher education at NIE and UCCE.

5.4 Further research potential

The findings and discussion of this study provide insights for further study related to secondary science teacher education at NIE. (Nonetheless, those same topics can be addressed by UCCE). Further research could be carried out to:

1. identify the needs and expectations of science teacher educators, part-time teachers, and student teachers with respect to initial secondary science teacher education;
2. assess the effectiveness of the science education courses and how the contents relate to the reality in schools;

3. compare how the different principles and policies that guide teacher education at NIE (like assessment policy) relate to practice in the ISSTE classes;
4. Establish the relationship between the Educational Studies and the Curriculum Studies components (science education courses) of the DSTE programme at NIE.

5.5 The Recommendations to the teacher education institutions

Based on the findings of this comparative study, several recommendations are being proposed to relevant parties at the National Institute of Education in Seychelles and the University of Canterbury College of Education in New Zealand.

5.5.1 Recommendations to NIE

Eight recommendations emerge for the science educators (teacher educators and part-time teachers); the DSTE(Science) curriculum (course) developers; and the National Institute of Education. These are:

1. NIE should ensure that all its science educators (teacher educators and its part teachers) (as well as all educators of other subject areas) are given relevant pedagogical support and are conversant with the expectation of teacher education including relevant policies, authentic pedagogical approaches and assessment tasks. The connotation that the lecturer lectures should be eradicated.
2. NIE should encourage the development of Course Readers for the different courses to:
   (i) ensure more consistency in the content delivered to the different cohorts;
   (ii) facilitate the work of the science educator especially the part-time teachers teaching into the different courses, who have other work commitments;
   (iii) alleviate the pressure of the limited relevant references available for the courses.
3. The science educators should use and model pedagogical approaches that would bridge the gap between theory and practice and between the student teachers'

experiences in the teacher education classes and real-life experiences in schools during teaching practice.

For instance, the emphasis on the didactic teacher-centred lectures should be removed. Learner-centred approaches that encourage interactive or collaborative and inquiry-based approaches should be promoted. Such approaches will allow the student teachers to not only consume, but also produce knowledge, through first-hand experience of those approaches that they could eventually emulate and apply in their own classroom. A word of caution though, is not to get carried away by the approach; the science educators should acknowledge the different learning styles and previous learning experiences of their student teachers. They should also recognise that their inputs and their own lived experiences (narratives) are crucial learning experiences for their student teachers. In providing this example, I am by no means implying that such pedagogical approach is the panacea for teacher education, because clearly there is no single best pedagogical approach (Schulz, 2005). But perhaps the middle way for the science educators could do is to appropriate their methods or activities to the outcomes and model approaches that they expect their student teachers to demonstrate (UCCE teacher educator, Interview 1, UCCETEB). The teacher educators may need to undertake some professional development to become more familiar with interactive participatory approaches.

4. The DSTE(Science) curriculum developers should review the science education courses to include aspects of the syntactic knowledge of science by introducing the nature of science (NOS) in a course.

5. NIE should ensure that science teacher educators and experienced science teachers in schools (as well as other subject teachers) share a more collaborative partnership towards the practicum supervision and assessment. This will help:

(i) the school teachers and the school to feel more responsible towards the professional development of the student teachers and probably make the student teachers' experience more worthwhile.;

(ii) to show the teachers in schools that NIE values and respects their expertise and experiences

(iii) to ensure that the student teachers received adequate subject visit and support during their practicum;

(iv) to considerably reduce the pressure on the teacher educators to provide sufficient subject visit while having responsibilities towards other classes. As a result, NIE might have to organise relevant training workshop(s) for the relevant parties in schools to convey its expectations and the protocols relevant to practicum supervision and assessment.

6. NIE should ensure that the assignments/assessment tasks and assessment processes are authentic.

Hence, it might not be possible or feasible to remove examinations from this repertoire, the exams should be made authentic in the sense that they should "provide students with situations that engage their science process and inquiry abilities and employ their science understandings in the context of solving problems", (Emery, 2001, p. 227). Students should also perform some tasks collaboratively to promote the type of culture that is expected in schools.

7. NIE need to make provision to provide student teachers with longer practicum periods that allow them to develop deeper understanding of the teaching/learning process. (Darling-Hammond & Baratz-Snowden, 2005)

8. NIE should urgently update the references to provide student teachers as well as teacher educators with appropriate and recent references.

5.5.2 Recommendations to UCCE

Three recommendations have been proposed UCCE as a result of this study.

1. UCCE should create the opportunity for aspiring science teachers to review or enhance their science content knowledge so that they feel confident to take on board science teaching during practicum and after they graduate. Although, the student teachers enter the programme with a degree relevant to science, they possess huge content knowledge gaps (Interview 1, UCCETEB). Moreover, while research indicates that novice teachers' subject content knowledge develops as they teach (Grossman et al., 1989), other studies show that science teachers require "good subject knowledge in order to develop the <u>subject related</u> [emphasis original] pedagogical knowledge, skills and competence" required for effective science teaching (Council for Science and Technology cited in Cooper, et al., 2002, Section 2: *Do we need physicists to teach physics?*).
2. UCCE should make provision for student teachers who opt for science either as a second major or a minor teaching subject to engage in teaching some science classes during their practicum in order to promote the development of their pedagogical content knowledge for science (Shulman 1986/2004c).
3. While their pedagogical practice has been commended by their student teachers, they should from time to time provide more inputs, like explanations and examples, during the ISSTE classes, because student teachers come with different backgrounds and experiences. Moreover, as one of teacher educators remarked: by applying the constructivist paradigm in the ISSTE classes, the student teachers' "*current paradigm, which is usually experiencing the transmission paradigm, is being challenged and undermined, and they aren't comfortable with their current understanding being undermined and challenged*". (Interview 2, UCCETEC)

5.6 Concluding statement

My main reason for conducting this study, as mention in the Chapter one, was to address several questions regarding the construction and contents of the initial secondary science education courses at NIE in Seychelles by comparing the ISSTE programme at NIE with that at UCCE in New Zealand. This study has on one hand shown some favourable outcomes: it showed that (i) as teacher educators, it is our responsibility to decide what to include in our programme with reference to relevant policies and guidelines; (ii) with our limited experience in teacher education and limited access to recent literature and empirical research, as decision-makers or course developers, we have, perhaps unknowingly, included the relevant knowledge base in our science education courses; and (iii) most of our assessment tasks are authentic to teacher education (although the assessment strategies should be reviewed).

On the other hand, the results have identified several limitations in the ISSTE programme at NIE with regards to the integration of theory and practice: they have called for: (i) thorough analysis and review of the pedagogical approaches used in the ISSTE classes; (ii) review of the course outline to incorporate the syntactic structures (nature o science); (iii) better understanding of the policies, principles and demands of teacher education; (iv) review of the assessment strategies to promote and cultivate collaborative ways of working ; (v) the development of course readers; (vi) current references and literature; (vii) review of the duration of practicum periods; and (viii) school-based teachers to have a greater role in practicum supervision and evaluation. Those limitations have been turn into recommendations for NIE. Hopefully, NIE and the relevant parties will take heed to the advice as a 'wake-up call' in order to provide aspiring secondary science teachers with relevant if not authentic experience for secondary science teaching in its endeavour to the raise the quality of teachers and the quality of education in Seychelles.

Finally, the study has provided a sound background for my personal and professional development as a teacher educator.

REFERENCES

Bekalo, S. A. & Welford, A.G. (1999). Secondary pre-service teacher education in Ethiopia: its impact on teachers' competence and confidence to teach practical work in science. *International Journal of Science Education 21*(12) 1293 - 1310

Abd-El-Khalick, F. & BouJaoude, S. (1997). An exploratory study of the knowledge base for science teaching. *Journal of Research in Science Teaching, 34*(7), 673–699

Abd-El-Khalick, F. (2006). Preservice and experienced biology teachers' global and specific subject matter structures: implications for conceptions of pedagogical content knowledge [Electronic version]. *Eurasia Journal of Mathematics, Science and Technology Education, 2*(1) 1-29

Anderson, R. D. & Mitchener, C. (1994). Research on Science Teacher Education. In D. L. Gabel (Ed.), *Handbook of research on science teaching and learning* (pp. 3 - 44). New York: Macmillan Publishing Company.

Bogdan, R. C., & Biklen, S. K. (2003). *Qualitative research for education: An introduction to theory and methods* (4th ed.). USA: Pearson Education Group, Inc.

Bogdan, R. C., & Biklen, S. K. (2007). *Qualitative research for education: An introduction to theory and methods* (5 ed.). USA: Pearson Education Group, Inc.

Cameron, M. & Baker, R. (2004). *Research on initial teacher education in New Zealand: 1993-2004 – Literature review and annotated bibliography*. New Zealand: Ministry of Education.

Clough, M.P. (2007). Teaching the nature of science to secondary and post-secondary students: questions rather than tenets. *The Pantaneto Forum*, issue 25. Retrieved on October 15, 2007, from http://www.pantaneto.co.uk/issue25/clough.htm

Cobble, C. R., & Koballa Jr., T. R. (1996). Science education. In J. P. Sikula, T. J. Buttery & E. Guyton (Eds.), *Handbook of research on teacher education: A project of the Association of Teacher Educators* (2 ed., pp. 459-484). New York: Macmilllan Library Reference USA.

Coffey, A. & Atkinson, P. (1996). *Making sense of qualitative data*. London: Sage.

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education* (5th ed.). London ; New York : RoutledgeFalmer, 2000

College of Education international prospectus 2008: Teacher education & sport coaching. Retrieved March 25, 2008, from http://www.education.canterbury.ac.nz

Conner, L. & Buyers, P. (2007). *EDSC308 Outlines and readings.* University of Canterbury

Cooper, P., Britton, P., Reynolds, H., Jennison, B., Scott, P., Davies, K., et al. (2002). *Physics teacher supply: A report of the Institute of Physics.* London: The Institute of Physics. Retrieved April 5, 2008, from ***http://www.iop.org/activity/policy/Consultations/Education/file_3639.doc***

Creswell, J. W. (2007). *Qualitative inquiry & research design: choosing among five approaches* (2nd ed.). Thousand Oaks : Sage Publications

Cumming, J. & G. Maxwell (1999). Contextualising authentic assessment. *Assessment in Education 6*(2), 177-194.

Darling-Hammond, L. & Baratz-Snowden, J. (Eds.) (2005). *A good teacher in every classroom: Preparing the highly qualified teachers our children deserve*. USA: Jossey-Bass

Davis, E.A., Nelson, M. & Beyer, C. (2008). *Using educative curriculum materials to support teachers in developing pedagogical content knowledge for scientific modelling.* Proceedings of the NARST 2008 Annual Meeting

Denzin, N. K. & Lincoln, Y. S. (Eds.) (1994). *Handbook of qualitative research*. Thousand Oaks: Sage Publication

Ely, M. et al., (1991). *Doing qualitative research: Circles within circles*, Falmer Press,

Emery, D. E. (2001). Authentic assessment in high school science: A classroom perspective. In D. P. Shepardson (Ed.), *Assessment in Science*, (pp. 227-247). Netherlands: Kluwer Academic Publishers

Finlayson, H., Lock, R., Soares, A. & Tebbutt, M. (1998). Are we producing teaching technicians or science educators? The consequences of differential demands on trainee science teachers [Electronic version]. *Education Review, 50*(1) 45-54

Fraser, D. (2008). Teaching that makes a difference. In C. McGee, & D. Fraser. *The professional practice of teaching* (3rd ed.) (pp. 45-64). Australia: Cengage Learning Australia Pty Limited

Frechtling, J. et al. (Eds.) (1997). *User-friendly handbook for mixed method evaluations*. Retrieved October 5, 2007, from http://www.ehr.nsf.gov/EHR/REC/pubs/NSF97-153/START.HTM#TOC

Glesne, C. (1999). *Becoming qualitative researchers: An introduction* (2nd ed., pp. 67-94). New York: Longman.

Goodrum, D. (2004). Teaching strategies for science classrooms. In G. Venville, & V. Dawson (Eds.) *The art of teaching science*. Australia: Allen & Unwin

Grossman, P. (2005). Research on pedagogical approaches in teacher education. In M. Cochran-Smith & K. M. Zeichner (Eds.), *Studying teacher education – The report of AERA panel on research and teacher education* (pp. 425-476). New Jersey: Lawrence Erlbaum Associates, Inc., Publishers

Grossman, P.L (1990). *The making of a teacher: teacher knowledge and teacher education*. New York: Teachers College Press.

Grossman, P.L., Wilson, S.M., & Shulman, L.S. (1989). Teachers of substance: Subject matter knowledge for teaching. In M.C. Reynolds (Ed.), *Knowledge base for the beginning teacher* (pp. 23-36). New York: Pergamon.

Harrison, J., Macgibbon, L. & Morton. M. (2001). Regimes of trustworthiness in qualitative research: The rigors of reciprocity. *Qualitative Inquiry*, 7(3), 323-345

Heitzmann, R. (2007). Case study instruction in teacher education: opportunity to develop students' critical thinking, school smarts and decision making. *Education, 128*(4), 523-542

Howey, K. (1996). Designing coherent and effective teacher education programs. In J. P. Sikula, T. J. Buttery & E. Guyton (Eds.), *Handbook of research on teacher education: A project of the Association of Teacher Educators* (2 ed., pp. 143-170). New York: Macmilllan Library Reference USA.

Janesick, V. J. (2003). The choreography of qualitative research design. In N.K. Denzin & Y. S. Lincoln (Eds.), *Strategies of qualitative inquiry* (2nd ed., pp. 46-79). Thousand Oaks, CA: Sage

Jules, R.P.C. & Conner, L. (in press). Nature of Science in Science in the National Curriculum of Seychelles: Recommended policy and practice changes. *Asia Pacific Journal of Education*

Kane, R. G., Burke, P., Cullen, J., Davey, R., Jordan, B., McMurchy-Pilkington, C., et al. (2005). *Initial teacher education policy and practice – Final report.* Wellington: Ministry of Education & the NZ Teachers Council.

Kang, N.-H. Learning to teach science: Personal epistemologies, teaching goals, and practices of teaching. *Teaching and Teacher Education* (2007), doi:10.1016/j.tate.2007.01.002

Kervin, L. et al., (2006). *Research for educators*. South Melbourne: Thomson Social Science Press.

Korthagen, F., Loughran, J., & Lunenberg, M. (2005). Teaching teachers—studies into the expertise of teacher educators: an introduction to this theme issue [Electronic version]. *Teaching and Teacher Education 21*, 107–115

Korthagen, F., Loughran, J., & Russell, T. (2006). Developing fundamental principles for teacher education programs and practices. *Teaching and Teacher Education 22* (2006) 1020–1041

Kvale, S. (1996). *Interviews: An introduction to qualitative research interviewing*. Thousand Oaks, CA: Sage.

Lederman, N.G. (2004). Syntax of nature of science within inquiry and science instruction. In L.B. Flick & N.G. Lederman (Eds.) *Scientific inquiry and nature of science,* (pp. 301-317). Netherlands: Kluwer Academic Publishers

Lincoln, Y. S. & Guba, E. G. (1985). *Naturalistic inquiry.* London: Sage Publication

Loughran, J. & Berry, A. (2005). Modelling by teacher educators [Electronic version]. *Teaching and Teacher Education 21*, 193–203

Loughran, J. Corrigan, D (1995). Teaching portfolios: a strategy for developing learning and teaching in preservice education. *Teaching & Teacher Education, 11*(6), 565 577

Loughran, J., Berry, A. & Mulhall, P. (2006). Understanding and developing science teacher pedagogical content knowledge. The Netherlands; Sense Publishers

Matthews, M. (1994). *Science teaching; The role of history and philosophy of science*, New York: Routledge.

McComas, W. F. (1996). Ten myths of science: re-examining what we think we know about the nature of science. *School Science and Mathematics, 96*(1), 10. Retrieved January 28, 2008, from Academic Research Library database. (Document ID: 9262163).

McComas, W.F., & Olson, J.K. (1998). Nature of science in international science education standards documents. In W.F. McComas (Ed.) *The nature of science in science education: Rationales and strategies* (pp. 41-52). London: Kluwer Academic Publishers

McComas, W.F., Clough, M.P., & Almazroa, H. (1998). The role and character of the nature of science in science education. In W.F. McComas (Ed.) *The nature of science in science education: Rationales and strategies* (pp. 3-40). London: Kluwer Academic Publishers.

McGee, C. (2008). Understanding Curriculum. In C. McGee, & D. Fraser. *The professional practice of teaching* (3rd ed.). Australia: Cengage Learning Australia Pty Limited

Meichtry, Y. (1998). Elementary science methods: Developing and measuring student views about the nature of science. In W.F. McComas (Ed.) *The nature of science in science education: rationales and strategies* (pp. 277-293). London: Kluwer Academic Publishers.

Miles, M. B., and Huberman, A. M. (1994). *Qualitative data analysis: an expanded sourcebook,* 2nd ed. Newbury Park, CA: Sage.

Ministry of Education (2000). *Education for a learning society, policy statement of the Ministry of Education Seychelles*. Retrieved December 10, 2007, from http://www.education.gov.sc/policies1.html

Mutch, C. (2005). *Doing educational research; A practitioner's guide to getting started*. Wellington: NZCER PRESS

National Institute of Education, (2001) *Competency framework for newly qualified teachers*. Seychelles: Ministry of Education.

National Institute of Education, (2007). Diploma in secondary teacher education: The secondary course structure (unpublished)

New Zealand Teachers Council, (2007). Graduating teacher standards: Aotearoa New Zealand. Retrieved March 28, 2008, from http://www.teacherscouncil.govt.nz/education/gts/

New Zealand Teachers Council, (n.d.). New Zealand Teachers Council - Ū ki te ako, tu tangata ai apōpō. Retrieved September 20, 2008, from http://www.teacherscouncil.govt.nz/

Schulz, R. (2005). The practicum: More than practice. *Canadian Journal Of Education, 28*(1 & 2), 147-167

Seychelles Nation (October 2005, 05). *President James Michel's Teachers' Day message: 'Give teachers the respect and support they deserve'*. Retrieved December 10, 2007, from http://www.nation.sc/

Shanker, A. (1996). Quality assurance: What must be done to strengthen the teaching profession. *Phi Delta Kappan, 78*(3), 220-224.

Shulman, L. S. (2004a). Knowledge and teaching: Foundations of the new reform. In S.M. Wilson (Ed.), *The wisdom of practice: Essays on teaching, learning and learning to teach*. (pp. 219 – 248). San Francisco: Jossey-Bass. [Original work published in 1987, in *Harvard Educational Review, 57*(1), 1 – 22].

Shulman, L.S. (2004b). The wisdom of practice: Managing complexity in medicine and teaching. In S.M. Wilson (Ed.), *The wisdom of practice: Essays on teaching, learning and learning to teach*. (pp. 251 – 271). San Francisco: Jossey-Bass. [Original work published in 1987, in D.C. Berliner & B.V. Rosenhine, (Eds.) *Talks to Teachers: A festschrift for N.L Gage.* (pp. 369-387). New York: Random House.

Shulman, L.S. (2004c). Those who understand: Knowledge growth in teaching. In S.M. Wilson (Ed.), *The wisdom of practice: Essays on teaching, learning and learning to teach*. (pp. 187 – 215). San Francisco: Jossey-Bass. [Original work published in 1986, in *Educational Researcher, 15*(2) 4 – 14].

Smith, K. & Lev-Ari, L. (2005). The place of the practicum in pre-service teacher education: the voice of the students [Electronic version]. *Asia-Pacific Journal of Teacher Education 33*(3) 289–302.

Stoddart, T., Connell, M., Stofflett, R., & Peck, D. (1993). Reconstructing elementary teacher candidates' understanding of mathematics and science content [Electronic version]. *Teacher & Teacher Education, 9*(3), 229-241

Syh-Jong, J. (2007). A study of students' construction of science knowledge: talk and writing in a collaborative group. *Educational Research, 49*(1) 65–81

Taylor, S. J. & Bogdan, R. (1998). *Introduction to qualitative research methods*, 3rd ed. USA: John Wiley & Sons, Inc.

Turner-Bisset, R. (2001). *Expert teaching – knowledge and pedagogy to lead the profession.* London: David Fulton Publishers Ltd.

Tytler, R. (2004). Constructivist views of teaching and learning. In G. Venville, & V. Dawson (Eds.) *The art of teaching science*. Australia: Allen & Unwin

University of Canterbury, (2007). *Human ethics committee: Principles and guidelines*. Retrieved January 4, 2008, from http://www.canterbury.ac.nz/ucpolicy/index.aspx

University of Canterbury, (n.d.a). *EDTP306-08T1 (C) Term Three 2008 Teaching Practice 1.* Retrieved April 20, 2008, from http://www.canterbury.ac.nz/courseinfo/GetCourseDetails.aspx?course

University of Canterbury, (n.d.b). *EDTP307-08T3 (C) Term Three 2008 Teaching Practice 2.* Retrieved April 20, 2008, from http://www.canterbury.ac.nz/postgrad/qualifications/education/graddip(sec).shtml

University of Canterbury, (n.d.c). *Graduate Diploma in Teaching and Learning (Secondary) GradDipTchLn(Secondary).* Retrieved April 20, 2008, from http://www.canterbury.ac.nz

van Driel, J. H., Verloop, H., de Vos, W. (1998) Developing Science Teachers' Pedagogical Content Knowledge [Electronic Version]. *Journal of Research in Science Teaching, 33*(6) 673–695

Veal, W.R. (2002). Content Specific Vignettes as Tools for Research and Teaching. *Electronic Journal of Science Education, 6*(4).

Wilson, S. M. (2004). Introduction. In Lee S. Shulman, & S. Wilson, (2004). *The wisdom of practice: Essays on teaching, learning and learning to teach*. (pp. 1 – 14). San Francisco: Jossey-Bass.

Zeichner, K. & Wray. S (2001) The teaching portfolio in US teacher education programs: what we know and what we need to know. Teaching and Teacher Education 17, 613–621

APPENDIX A

Ethical Approval from the College Of Education Ethical Clearance Committee

Human Ethics Committee
Secretary
Tel: +64 3 364 2241, Fax: +64 3 364 2856, Email: human-ethics@canterbury.ac.nz

UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Ref: HEC 2008/12/CoEdn

11 March 2008

Ms Rosianna P C Jules
School of Educational Studies and Human Development
College of Education
UNIVERSITY OF CANTERBURY

Dear Rosianna

Thank you for providing a revised application and supporting documents for the College of Education Ethical Clearance Committee's further consideration. I am very pleased to inform you that your research proposal "The praxis of pre-service secondary science teacher education in a developing and a developed country: A comparison between Seychelles and New Zealand" has been granted final ethical approval.

Should circumstances relevant to this current application change please note that you are required to reapply for ethical clearance / approval.

If you have any questions regarding this approval please let me know.

We wish you well for your research.

Yours sincerely

Dr Missy Morton
Chair
Ethical Clearance Committee

"Please note that Ethical Approval and/or Clearance relates only to the ethical elements of the relationship between the researcher, research participants and other stakeholders. The granting of approval or clearance by the Ethical Clearance Committee should not be interpreted as comment on the methodology, legality, value or any other matters relating to this research."

University of Canterbury Private Bag 4800, Christchurch 8140, New Zealand. www.canterbury.ac.nz

APPENDIX B

Letters and Consent Forms sent to participants

Letter 1A
Request for Permission to Research the Pre-Service Secondary Science Teacher Education at the College Of Education

Master of Science Education
Education Department
University of Canterbury
New Zealand
Date:

(To insert name of the Dean)
Dean of Education
College of Education
University of Canterbury

Dear *(insert name of the Dean)*

REQUEST FOR PERMISISON TO RESEARCH THE PRE-SERVICE SECONDARY SCIENCE TEACHER EDUCATION AT THE COLLEGE OF EDUCATION

I wish to seek for permission to research the pre-service secondary science teacher education programme at the College of Education. Being a science teacher educator and programme developer from the National Institute of Education in Seychelles, I am interested in comparing the components of our pre-service secondary science teacher education programme with that of the College of Education at the University of Canterbury in New Zealand in terms of content, focus on theory, assessment, and connections between theory and practice.

My research is entitled: *The Praxis of Initial Secondary Science Teacher Education in Seychelles and New Zealand: A comparison between the National Institute of Education and the College of Education at the University of Canterbury*

The aims of the research are to:

1. Describe the initial secondary teacher education (ISTE) programme offered to prospective secondary science teachers at NIE and at UCCE;
2. Compare the components/contents of the ISTE programme at NIE and UCCE;
3. Compare the knowledge base offered by the science education course(s) at NIE and at UCCE;
4. Identify the pedagogical approaches used in the initial secondary science teacher education (ISSTE) classes at the two institutions;
5. Identify how prospective secondary science teachers are assessed in the ISSTE classes at NIE and at UCCE.
6. Understand and compare how decisions are made about the components to be included in the secondary science education courses at the two institutions.

I will be using a qualitative research methodology to elucidate the construction of a pre-service secondary science teacher education programme at the College of Education, University of Canterbury, New Zealand and compare it to that of the pre-service programme at the National Institute of Education in the Seychelles. This research project will be carried out during 2008. I will employ the following qualitative research methods: document analysis, semi-structured in-depth interviews and participant-observation.

Consequently I am seeking permission to:

1. Interview members of the programme development team/committee; the programme educators; student teachers, as and when necessary to gain the perspectives of: the people who develop; those who deliver; and those who participate in the programme.
2. Observe the delivery of some pre-service science teacher education sessions and possible working team meeting for the development of the programmes.
3. Access and analyse official documents that guide the practice of the pre-service secondary science teacher education programme: documents such as Course Content Outlines; Policy Documents; Course Structure; Framework Documents; and any other relevant document. Document analysis will help me determine: the policies and principles that guide the development of the pre-service science teacher education programme; and the contents and assessment included in the science education courses

The research is being carried out *as a requirement for Master of Science Education* by Rosianna P.C Jules under the supervision of Dr Lindsey Conner and Dr Missy Morton who can be contacted at +64 3 364 2987 extension 44463 and extension 44312 respectively. They will be pleased to discuss any concerns you may have about your participation in the project.

The project may be published. My expectation is that the research will serve to:

1. Assist my professional development as well as the professional development of other teacher educator and programme developer.
2. Enhance my confidence and knowledge so that I could better contribute to the development of science teacher education programmes and teacher education in general in Seychelles.
3. Help the science teacher educators in Seychelles and elsewhere to gain the perspective, and critically examine teacher education from New Zealand and Seychelles.
4. Guide the teacher educators in Seychelles and elsewhere in their future decision-making.
5. Contribute to the research bank in Seychelles.

The project has been reviewed ***and approved*** by the University of Canterbury College of Education Ethical Clearance Committee. If you agree to approve my request to carryout this research at your institution, please sign the form attached as evidence of informed consent.

Please be informed that complaints may be addressed to:

Associate Professor J Greenwood, Chair, Ethical Clearance Committee
College of Education, University of Canterbury
Private Bag 4800, Christchurch Telephone: 345 8390

Thanking you in advance, and hoping that my request will meet your highest consideration and approval, I remain,

Yours sincerely

Rosianna Jules (Mrs.)

Contact Address:
Rosianna Jules
9 Maidstone Road, Ilam PB 4760, Christchurch 8020, New Zealand,
Telephone: +64 (03) 341 1500 extension 54443, Email: rpc39@student.canterbury.ac.nz

Letter 1B
Request for Permission to Research the Pre-Service Secondary Science Teacher Education at the National Institute of Education

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Master of Science Education
Education Department
University of Canterbury
New Zealand
Date:

(To insert name of the Director)
Director
National Institute of Education
Mont Fleuri
Seychelles

Dear *(insert name of the Director)*

REQUEST FOR PERMISISON TO RESEARCH THE PRE-SERVICE SECONDARY SCIENCE TEACHER EDUCATION AT THE NATIONAL INSTITUTE OF EDUCATION

I wish to seek for permission to research the pre-service secondary science teacher education programme at the National Institute of Education. Being a science teacher educator and programme developer from the National Institute of Education in Seychelles, I am interested in comparing the components of our pre-service secondary science teacher education programme with that of the College of Education at the University of Canterbury in New Zealand in terms of content, focus on theory, assessment, and connections between theory and practice.

My research is entitled: *The Praxis of Initial Secondary Science Teacher Education in Seychelles and New Zealand: A comparison between the National Institute of Education and the College of Education at the University of Canterbury*

The aims of the research are to:

1. Describe the initial secondary teacher education (ISTE) programme offered to prospective secondary science teachers at NIE and at UCCE;
2. Compare the components/contents of the ISTE programme at NIE and UCCE;
3. Compare the knowledge base offered by the science education course(s) at NIE and at UCCE;
4. Identify the pedagogical approaches used in the initial secondary science teacher education (ISSTE) classes at the two institutions;
5. Identify how prospective secondary science teachers are assessed in the ISSTE classes at NIE and at UCCE.
6. Understand and compare how decisions are made about the components to be included in the secondary science education courses at the two institutions.

I will be using a qualitative research methodology to elucidate the construction of a pre-service secondary science teacher education programme at the College of Education, University of Canterbury, New Zealand and compare it to that of the pre-service programme at the National Institute of Education in the Seychelles. This research project will be carried out during 2008. I will employ the following qualitative research methods: document analysis, semi-structured in-depth interviews and participant-observation.

Consequently I am seeking permission to:

1. Interview members of the programme development team/committee; the programme educators; student teachers, as and when necessary to gain the perspective of: the people who develop; those who deliver; and those who participate in the programme.
2. Access and analyse official documents that guide the practice of the pre-service secondary science teacher education programme: documents such as Course Content Outlines; Policy Documents; Course Structure; Framework Documents; and any other relevant document. Document analysis will help me determine: the policies and principles that guide the development of the pre-service science teacher education programme; and the contents and assessment included in the science education courses

The research is being carried out *as a requirement for Master of Science Education* by Rosianna P.C Jules under the supervision of Dr Lindsey Conner and Dr Missy Morton who can be contacted at +64 3 364 2987 extension 44463 and extension 44312 respectively. They will be pleased to discuss any concerns you may have about your participation in the project.

The project may be published. My expectation is that the research will serve to:
1. Assist my professional development as well as the professional development of other teacher educator and programme developer.
2. Enhance my confidence and knowledge so that I could better contribute to the development of science teacher education programmes and teacher education in general in Seychelles.
3. Help the science teacher educators in Seychelles and elsewhere to gain the perspective, and critically examine teacher education from New Zealand and Seychelles.
4. Guide the teacher educators in Seychelles and elsewhere in their future decision-making.
5. Contribute to the research bank in Seychelles.

The project has been reviewed ***and approved*** by the University of Canterbury College of Education Ethical Clearance Committee. If you agree to approve my request to carryout this research at your institution, please sign the form attached as evidence of informed consent.

Please be informed that complaints may be addressed to:
Associate Professor J Greenwood, Chair, Ethical Clearance Committee
College of Education, University of Canterbury
Private Bag 4800, Christchurch Telephone: 345 8390

Thanking you in advance, and hoping that my request will meet your highest consideration and approval, I remain,

Yours sincerely

Rosianna Jules (Mrs.)

Contact Address:
Rosianna Jules
9 Maidstone Road, Ilam PB 4760
Christchurch 8020, New Zealand
Telephone: +64 (03) 341 1500 extension 54443
Email: rpc39@student.canterbury.ac.nz

Letter 2A
Letter to Pre-Service Secondary Science Teacher Educators from the College Of Education in New Zealand

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Master of Science Education
Education Department
University of Canterbury
New Zealand
Date:

(Insert name of teacher educator)
School of Sciences and Physical Education
College of Education
University of Canterbury

Dear teacher educator *(insert name)*

LETTER OF INTRODUCTION FOR RESEARCH INTERVIEW

You are invited to participate as a subject in the research project entitled *The Praxis of Initial Secondary Science Teacher Education in Seychelles and New Zealand: A comparison between the National Institute of Education and the College of Education at the University of Canterbury.*

The aims of the research are to:

1. Describe the initial secondary teacher education (ISTE) programme offered to prospective secondary science teachers at NIE and at UCCE;
2. Compare the components/contents of the ISTE programme at NIE and UCCE;
3. Compare the knowledge base offered by the science education course(s) at NIE and at UCCE;
4. Identify the pedagogical approaches used in the initial secondary science teacher education (ISSTE) classes at the two institutions;
5. Identify how prospective secondary science teachers are assessed in the ISSTE classes at NIE and at UCCE.
6. Understand and compare how decisions are made about the components to be included in the secondary science education courses at the two institutions.

In this study, I am interested in comparing the pre-service secondary science teacher education programme from the National Institute of Education (NIE) in Seychelles with that of the College of Education at the University of Canterbury (UCCE) in New Zealand in terms of content, focus on theory, assessment, and connections between theory and practice.

As part of the research, I will be interviewing a sample of pre-service secondary science teacher educators from NIE and CE. It is expected that the interview will be a conversation that will last about 30 minutes; however, as the research progresses, I may need to contact you for further information. The interview will be audio recorded and will be held at a time and place that is convenient to you.

The focus questions to elucidate your perceptions of the teacher education programme are as follows:

1. Describe the initial secondary science teacher education programme. How do you feel about the components/contents, duration and structure of the programme?
2. How are the student teachers assessed in the science education course(s)? What types of assessments tasks do they perform? How do you feel about those?
3. What types of teaching strategies/approaches are used in teacher education classes? How do you feel about those approaches?

4. How is the teaching practice organised? Who supervises and assesses the student teachers' performance during practicum?
5. Who decides what to include in the science education courses? How are decisions made about what components to include in the science education courses?

The interview is voluntary and strictly confidential. If at any time during the interview you do not want to answer a question or you want to withdraw from the interview process altogether you are entitled to do so. Please feel free to contact me soon after the interview if you wish to amend or withdraw any information. Once I have transcribed the interview I will forward a copy on to you. You have the right to amend the transcript in anyway or withdraw your information from the research. After the completion of my study, I will delete the audio recording. The interview transcript will be destroyed or returned to you if you prefer.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public. To ensure anonymity and confidentiality, the information will be securely stored and confidential treated. Your anonymity will be maintained by the used of pseudonyms.

My expectation is that the research will serve to:

1. Assist my professional development as well as the professional development of other teacher educator and programme developer.
2. Enhance my confidence and knowledge so that I could better contribute to the development of science teacher education programmes and teacher education in general in Seychelles.
3. Help the science teacher educators in Seychelles and elsewhere to gain the perspective, and critically examine teacher education from New Zealand and Seychelles.
4. Guide the teacher educators in Seychelles and elsewhere in their future decision-making.
5. Contribute to the research bank in Seychelles.

The research is being carried out *as a requirement for Master of Science Education* by Rosianna P.C Jules under the supervision of Dr Lindsey Conner and Dr Missy Morton who can be contacted at +64 3 364 2987 extension 44463 and extension 44312 respectively. They will be pleased to discuss any concerns you may have about your participation in the project.

The project has been reviewed ***and approved*** by the University of Canterbury College of Education Ethical Clearance Committee. If you accept to participate in the research, please sign the form attached as evidence of informed consent.

Please be informed that complaints may be addressed to:
Associate Professor J Greenwood, Chair, Ethical Clearance Committee
College of Education, University of Canterbury
Private Bag 4800, Christchurch Telephone: 345 8390

Thank you for giving up your time to participate in this research. I look forward to meeting with you soon.

Yours sincerely

Rosianna Jules (Mrs.)

Contact Address:
Rosianna Jules
9 Maidstone Road, Ilam PB 4760, Christchurch 8020, New Zealand
Telephone: +64 (03) 341 1500 extension 54443, Email: rpc39@student.canterbury.ac.nz

Letter 2B
Letter to Pre-Service Secondary Science Teacher Educators from the National Institute of Education in Seychelles

Master of Science Education
Education Department
University of Canterbury
New Zealand
Date:

(Insert name of teacher educator)
National Institute of Education

Dear teacher educator *(insert name)*

LETTER OF INTRODUCTION FOR RESEARCH INTERVIEW

You are invited to participate as a subject in the research project entitled *The Praxis of Initial Secondary Science Teacher Education in Seychelles and New Zealand: A comparison between the National Institute of Education and the College of Education at the University of Canterbury.*

The aims of the research are to:

1. Describe the initial secondary teacher education (ISTE) programme offered to prospective secondary science teachers at NIE and at UCCE;
2. Compare the components/contents of the ISTE programme at NIE and UCCE;
3. Compare the knowledge base offered by the science education course(s) at NIE and at UCCE;
4. Identify the pedagogical approaches used in the initial secondary science teacher education (ISSTE) classes at the two institutions;
5. Identify how prospective secondary science teachers are assessed in the ISSTE classes at NIE and at UCCE.
6. Understand and compare how decisions are made about the components to be included in the secondary science education courses at the two institutions.

In this study, I am interested in comparing the pre-service secondary science teacher education programme from the National Institute of Education (NIE) in Seychelles with that of the College of Education at the University of Canterbury (UCCE) in New Zealand in terms of content, focus on theory, assessment, and connections between theory and practice.

As part of the research, I will be interviewing a sample of pre-service secondary science teacher educators from NIE and CE. It is expected that the interview will be a conversation that will last about 30 minutes; however, as the research progresses, I may need to contact you for further information. You will be interviewed over the telephone at a time that is convenient to you.

The focus questions to elucidate your perceptions of the teacher education programme at NIE are as follows:

1. Describe the initial secondary science teacher education programme. How do you feel about the components/contents, duration and structure of the programme?
2. How are the student teachers assessed in the science education course(s)? What types of assessments tasks do they perform? How do you feel about those?
3. What types of teaching strategies/approaches are used in teacher education classes? How do you feel about those approaches?
4. How is the teaching practice organised? Who supervises and assesses the student teachers' performance during practicum?

5. Who decides what to include in the science education courses? How are decisions made about what components to include in the science education courses?

The interview is voluntary and strictly confidential. If at any time during the interview you do not want to answer a question or you want to withdraw from the interview process altogether you are entitled to do so. Please feel free to contact me soon after the interview if you wish to amend or withdraw any information. Once I have transcribed the interview I will forward a copy on to you. You have the right to amend the transcript in anyway or withdraw your information from the research. After the completion of my study, I will delete the recording. The interview transcript will be destroyed or returned to you if you prefer.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public. To ensure anonymity and confidentiality, the information will be securely stored and confidential treated. Your anonymity will be maintained by the used of pseudonyms. However, because of the very small number of secondary science educators at the NIE, the risk of being identified is high; hence, I cannot promise anonymity.

My expectation is that the research will serve to:

1. Assist my professional development as well as the professional development of other teacher educator and programme developer.
2. Enhance my confidence and knowledge so that I could better contribute to the development of science teacher education programmes and teacher education in general in Seychelles.
3. Help the science teacher educators in Seychelles and elsewhere to gain the perspective, and critically examine teacher education from New Zealand and Seychelles.
4. Guide the teacher educators in Seychelles and elsewhere in their future decision-making.
5. Contribute to the research bank in Seychelles.

The research is being carried out *as a requirement for Master of Science Education* by Rosianna P.C Jules under the supervision of Dr Lindsey Conner and Dr Missy Morton who can be contacted at +64 3 364 2987 extension 44463 and extension 44312 respectively. They will be pleased to discuss any concerns you may have about your participation in the project.

The project has been reviewed ***and approved*** by the University of Canterbury College of Education Ethical Clearance Committee. If you accept to participate in the research, please sign the form attached as evidence of informed consent.

Please be informed that complaints may be addressed to:

Associate Professor J Greenwood, Chair, Ethical Clearance Committee
College of Education, University of Canterbury
Private Bag 4800, Christchurch Telephone: 345 8390

Thank you for giving up your time to participate in this research. I look forward to interviewing you soon.

Yours sincerely

Rosianna Jules (Mrs.)

Contact Address:
Rosianna Jules
9 Maidstone Road, Ilam PB 4760, Christchurch 8020, New Zealand
Telephone: +64 (03) 341 1500 extension 54443, Email: rpc39@student.canterbury.ac.nz

Letter 3A
Letter to Pre-Service Secondary Science Student Teachers from the College of Education in New Zealand

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Master of Science Education
Education Department
University of Canterbury
New Zealand
Date:

(Insert name of student teacher)
College of Education
University of Canterbury

Dear student teacher *(insert name)*

LETTER OF INTRODUCTION FOR RESEARCH INTERVIEW

You are invited to participate as a subject in the research project entitled *The Praxis of Initial Secondary Science Teacher Education in Seychelles and New Zealand: A comparison between the National Institute of Education and the College of Education at the University of Canterbury.*

The aims of the research are to:

1. Describe the initial secondary teacher education (ISTE) programme offered to prospective secondary science teachers at NIE and at UCCE;
2. Compare the components/contents of the ISTE programme at NIE and UCCE;
3. Compare the knowledge base offered by the science education course(s) at NIE and at UCCE;
4. Identify the pedagogical approaches used in the initial secondary science teacher education (ISSTE) classes at the two institutions;
5. Identify how prospective secondary science teachers are assessed in the ISSTE classes at NIE and at UCCE.
6. Understand and compare how decisions are made about the components to be included in the secondary science education courses at the two institutions.

In this study, I am interested in comparing the pre-service secondary science teacher education programme from the National Institute of Education (NIE) in Seychelles with that of the College of Education at the University of Canterbury (UCCE) in New Zealand in terms of content, focus on theory, assessment, and connections between theory and practice.

As part of the research, I will be interviewing a sample of pre-service secondary science student teachers from NIE and CE. It is expected that the interview will be a conversation that will last about 30 minutes; however, as the research progresses, I may need to contact you for further information. The interview will be audio recorded and will be held at a time and place that is convenient to you.

The focus questions for the interview are:

6. Describe the initial secondary science teacher education programme. How do you feel about the components/contents, duration and structure of the programme?
7. How are the student teachers assessed in the science education course(s)? What types of assessments tasks do they perform? How do you feel about those?
8. What types of teaching strategies/approaches are used in teacher education classes? How do you feel about those approaches?

9. How is the teaching practice organised? Who supervises and assesses the student teachers' performance during practicum?

The interview is voluntary and strictly confidential. If at any time during the interview you do not want to answer a question or you want to withdraw from the interview process altogether, you are entitled to do so. Please feel free to contact me soon after the interview if you wish to amend or withdraw any information from the interview. Once I have transcribed the interview I will forward a copy on to you. You have the right to amend the transcript or withdraw your information from the research. After the completion of my study, I will delete the audio recording. The interview transcript will be destroyed or returned to you if you prefer

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public. To ensure anonymity and confidentiality, the information will be securely stored and confidential treated. Your anonymity will be maintained by the used of pseudonyms.

My expectation is that the research will serve to:

1. Assist my professional development as well as the professional development of other teacher educator and programme developer.
2. Enhance my confidence and knowledge so that I could better contribute to the development of science teacher education programmes and teacher education in general in Seychelles.
3. Help the science teacher educators in Seychelles and elsewhere to gain the perspective, and critically examine teacher education from New Zealand and Seychelles.
4. Guide the teacher educators in Seychelles and elsewhere in their future decision-making.
5. Contribute to the research bank in Seychelles.

The research is being carried out *as a requirement for Master of Science Education* by Rosianna P.C Jules under the supervision of Dr Lindsey Conner and Dr Missy Morton who can be contacted at +64 3 364 2987 extension 44463 and extension 44312 respectively. They will be pleased to discuss any concerns you may have about your participation in the project.

The project has been reviewed ***and approved*** by the University of Canterbury College of Education Ethical Clearance Committee. If you accept to participate in the research, please sign the form attached as evidence of informed consent.

Please be informed that complaints may be addressed to:
Associate Professor J Greenwood, Chair, Ethical Clearance Committee
College of Education, University of Canterbury
Private Bag 4800, Christchurch Telephone: 345 8390

Thank you for giving up your time to participate in this research. I look forward to meeting with you soon.

Yours sincerely

Rosianna Jules (Mrs.)

Contact Address:
Rosianna Jules
9 Maidstone Road, Ilam PB 4760, Christchurch 8020, New Zealand
Telephone: +64 (03) 341 1500 extension 54443, Email: rpc39@student.canterbury.ac.nz

Letter 3B
Letter to Pre-Service Secondary Science Student Teachers from the National Institute of Education in Seychelles

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Master of Science Education
Education Department
University of Canterbury
New Zealand
Date:

(Insert name of student teacher)
National Institute of Education

Dear student teacher *(insert name)*

LETTER OF INTRODUCTION FOR RESEARCH INTERVIEW

You are invited to participate as a subject in the research project entitled *The Praxis of Initial Secondary Science Teacher Education in Seychelles and New Zealand: A comparison between the National Institute of Education and the College of Education at the University of Canterbury.*

The aims of the research are to:

1. Describe the initial secondary teacher education (ISTE) programme offered to prospective secondary science teachers at NIE and at UCCE;
2. Compare the components/contents of the ISTE programme at NIE and UCCE;
3. Compare the knowledge base offered by the science education course(s) at NIE and at UCCE;
4. Identify the pedagogical approaches used in the initial secondary science teacher education (ISSTE) classes at the two institutions;
5. Identify how prospective secondary science teachers are assessed in the ISSTE classes at NIE and at UCCE.
6. Understand and compare how decisions are made about the components to be included in the secondary science education courses at the two institutions.

In this study, I am interested in comparing the pre-service secondary science teacher education programme from the National Institute of Education (NIE) in Seychelles with that of the College of Education at the University of Canterbury (UCCE) in New Zealand in terms of content, focus on theory, assessment, and connections between theory and practice.

As part of the research, I will be interviewing a sample of pre-service secondary science student teachers from NIE and CE. It is expected that the interview will be a conversation that will last about 30 minutes; however, as the research progresses, I may need to contact you for further information. You will be interviewed over the telephone at a time that is convenient to you.

The focus questions for the interview are:

1. Describe the initial secondary science teacher education programme. How do you feel about the components/contents, duration and structure of the programme?
2. How are the student teachers assessed in the science education course(s)? What types of assessments tasks do they perform? How do you feel about those?
3. What types of teaching strategies/approaches are used in teacher education classes? How do you feel about those approaches?
4. How is the teaching practice organised? Who supervises and assesses the student teachers' performance during practicum?

The interview is voluntary and strictly confidential. If at any time during the interview you do not want to answer a question or you want to withdraw from the interview process altogether, you are entitled to do so. Please feel free to contact me soon after the interview if you wish to amend or withdraw any information from the interview. Once I have transcribed the interview I will forward a copy on to you. You have the right to amend the transcript or withdraw your information from the research. After the completion of my study, I will delete the audio recording. The interview transcript will be destroyed or returned to you if you prefer.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public. To ensure anonymity and confidentiality, the information will be securely stored and confidential treated. Your anonymity will be maintained by the used of pseudonyms.

My expectation is that the research will serve to:

1. Assist my professional development as well as the professional development of other teacher educator and programme developer.
2. Enhance my confidence and knowledge so that I could better contribute to the development of science teacher education programmes and teacher education in general in Seychelles.
3. Help the science teacher educators in Seychelles and elsewhere to gain the perspective, and critically examine teacher education from New Zealand and Seychelles.
4. Guide the teacher educators in Seychelles and elsewhere in their future decision-making.
5. Contribute to the research bank in Seychelles.

The research is being carried out *as a requirement for Master of Science Education* by Rosianna P.C Jules under the supervision of Dr Lindsey Conner and Dr Missy Morton who can be contacted at +64 3 364 2987 extension 44463 and extension 44312 respectively. They will be pleased to discuss any concerns you may have about your participation in the project.

The project has been reviewed ***and approved*** by the University of Canterbury College of Education Ethical Clearance Committee. If you accept to participate in the research, please sign the form attached as evidence of informed consent.

Please be informed that complaints may be addressed to:

Associate Professor J Greenwood, Chair, Ethical Clearance Committee
College of Education, University of Canterbury
Private Bag 4800, Christchurch Telephone: 345 8390

Thank you for giving up your time to participate in this research. I look forward to meeting with you soon.

Yours sincerely

Rosianna Jules (Mrs.)

Contact Address:
Rosianna Jules
9 Maidstone Road, Ilam PB 4760, Christchurch 8020, New Zealand
Telephone: +64 (03) 341 1500 extension 54443, Email: rpc39@student.canterbury.ac.nz

Letter 4
Letter to Teacher Educators concerning classroom observation

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Master of Science Education
Education Department
University of Canterbury
New Zealand
Date:

(Insert name of teacher educator)
School of Sciences and Physical Education
College of Education
University of Canterbury

Dear teacher educator *(insert name)*

LETTER OF INTRODUCTION FOR CLASSROOM OBSERVATION

You are invited to participate as a subject in the research project entitled *The Praxis of Initial Secondary Science Teacher Education in Seychelles and New Zealand: A comparison between the National Institute of Education and the College of Education at the University of Canterbury.*

The aims of the research are to:

1. Describe the initial secondary teacher education (ISTE) programme offered to prospective secondary science teachers at NIE and at UCCE;
2. Compare the components/contents of the ISTE programme at NIE and UCCE;
3. Compare the knowledge base offered by the science education course(s) at NIE and at UCCE;
4. Identify the pedagogical approaches used in the initial secondary science teacher education (ISSTE) classes at the two institutions;
5. Identify how prospective secondary science teachers are assessed in the ISSTE classes at NIE and at UCCE.
6. Understand and compare how decisions are made about the components to be included in the secondary science education courses at the two institutions.

For this project, I am seeking your permission to observe some of your classes. The observation will be on-going from mid February to end of June 2008. The purpose of the observation is to gain further information about the pre-service secondary science teaching education programme in terms of content, focus on theory, assessment, and connections between theory and practice. Please be assured that the observation is not to judge your practice and/or that of your class: you have the right to withdraw from the project at any time, including withdrawal of any information provided.

As a follow-up to the classroom observations, you may be interviewed for clarification of the data gathered. The interview is voluntary and strictly confidential. The interview will last for about 10-15 minutes and it will be held at a time and place that is convenient to you. If at any time during the interview you do not want to answer a question or you want to withdraw from the interview process altogether you are entitled to do so. Please feel free to contact me soon after the interview if you wish to amend or withdraw any information. Once I have transcribed the interview I will forward a copy on to you. You have the right to amend the transcript in anyway or withdraw your information from the research. After the completion of my study, I will delete the audio recording. The interview transcript will be destroyed or returned to you if you prefer.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public. To ensure anonymity and confidentiality, the information will be securely stored and confidential treated. Your anonymity and that of your class will be maintained by the used of pseudonyms.

My expectation is that the research will serve to:

1. Assist my professional development as well as the professional development of other teacher educator and programme developer.
2. Enhance my confidence and knowledge so that I could better contribute to the development of science teacher education programmes and teacher education in general in Seychelles.
3. Help the science teacher educators in Seychelles and elsewhere to gain the perspective, and critically examine teacher education from New Zealand and Seychelles.
4. Guide the teacher educators in Seychelles and elsewhere in their future decision-making.
5. Contribute to the research bank in Seychelles.

The research is being carried out *as a requirement for Master of Science Education* by Rosianna P.C Jules under the supervision of Dr Lindsey Conner and Dr Missy Morton who can be contacted at +64 3 364 2987 extension 44463 and extension 44312 respectively. They will be pleased to discuss any concerns you may have about your participation in the project.

The project has been reviewed ***and approved*** by the University of Canterbury College of Education Ethical Clearance Committee. If you accept to participate in the research, please sign the form attached as evidence of informed consent.

Please be informed that complaints may be addressed to:
Associate Professor J Greenwood, Chair, Ethical Clearance Committee
College of Education, University of Canterbury
Private Bag 4800, Christchurch Telephone: 345 8390

Thank you for giving up your time to participate in this research. I look forward to meeting with you soon.

Yours sincerely

Rosianna Jules (Mrs.)

Contact Address:
Rosianna Jules
9 Maidstone Road
Ilam PB 4760
Christchurch 8020
New Zealand
Telephone: +64 (03) 341 1500 extension 54443
Email: rpc39@student.canterbury.ac.nz

Consent 1A

CONSENT FORM (for the Dean/Director)

Rosianna P. C. Jules
9 Maidstone Road, Ilam PB 4760, Christchurch 8020, New Zealand
Telephone: +64 (03) 341 1500 Extension 54443
Email: rpc39@student.canterbury.ac.nz

Date

The Praxis of Initial Secondary Science Teacher Education in Seychelles and New Zealand: A comparison between the National Institute of Education and the College of Education at the University of Canterbury.

I have read and understood the description of the above-named project. On this basis I give you permission to research the pre-service secondary science teacher education at my institution and I consent to publication of the results of the project.

NAME (please print): …………………………………………………………….

Signature: ……………………………….. Date: ………………..

Consent 1B

CONSENT FORM (for participants)

Rosianna P. C. Jules
9 Maidstone Road, Ilam PB 4760, Christchurch 8020, New Zealand
Telephone: +64 (03) 341 1500 Extension 54443, Email: rpc39@student.canterbury.ac.nz

Date

The Praxis of Initial Secondary Science Teacher Education in Seychelles and New Zealand: A comparison between the National Institute of Education and the College of Education at the University of Canterbury.

I have read and understood the description of the above-named project. On this basis I agree to participate as a subject in the project, and I consent to publication of the results of the project with the understanding that anonymity will be preserved.

I understand also that I may at any time withdraw from the project, including the withdrawal of any information I have provided.

NAME (please print): …………………………………………………………….

Signature: ……………………………….. Date: ………………..

APPENDIX C

Details about the components of the initial secondary teacher education (ISTE) programme at NIE and at UCCE.

C1 Electives (NIE) and Selected Studies (UCCE)

The Electives and the Selective Studies component of the two programmes, as their name encapsulate, offer student teachers with the opportunity for further or in-depth study in areas of their interest to meet the requirements of their programme. At UCCE, the student teachers can select courses from three different components of the programme, namely Teaching Studies, Education Studies, and ICT Studies to meet the 12 points required for Selected Studies. For their two Elective courses, the student teachers at NIE may choose to: (i) study the special educational topics on offer (which vary every year); (ii) carry out individualised research project of their preference; or (iii) specialise in a subsidiary cross-curricular subject such as ICT and Environmental Education by successful completing the third ICT or Environmental Education course.

C2 Support (NIE) and ICT Studies (UCCE)

The knowledge and skills in ICT is becoming increasing vital in education in this 21st Century. Prospective teachers from the two institutions are given the opportunity to develop their knowledge and skills in ICT so as to 'inform and support their practice" (University of Canterbury, n.d.c). The ICT Studies at UCCE offers two ICT courses of which one, *EDIT400: Strategies for E-Learning,* is compulsory. At NIE, the two compulsory ICT courses are constituent of the Support component which offers eight mandatory courses: two in ICT; three in subject academic (science academic); two in environmental education; and one in graphic communication.

C3 Context Studies (NIE) and Education Studies (UCCE)

The DSTE programme at the NIE addresses issues relating to "the role of education in society [and] the context in which teachers function" (NIE, 2004, p.4), under the Context Studies components in two compulsory courses: *NEPE01: Education Perspectives*; and *SPSE11: Exploring Humanitarian Law*. At UCCE, the Education Studies component offers one compulsory course, *EDED402: Education Studies*, which addresses "issues surrounding the history, sociology, philosophy, politics, cultural contexts, and psychology of education" as a preparation for dealing "with problems that are often social, political and ethical in nature", (University of Canterbury, n.d.c).

C4 Educational Studies (NIE) and Professional Studies (UCCE)

Through Educational Studies and Professional Studies courses student teachers learn about contents related to teaching and learning in general. At NIE, the Educational Studies components include 10 compulsory courses while the Professional Studies component at UCCE offers one basic compulsory course. Both components encompass topics related to: lesson planning and preparation; classroom organisation, management and control; individuals and their development; learning theories and practice; assessment, measurement and evaluation; special educational needs; school practices; and teaching and learning strategies. In addition student teachers at NIE receive an introductory course in educational research

C5.1 Science as a major teaching subject at UCCE: The three possible options

To major in science, the student teachers have to take different science education courses to meet the required 24 points. By majoring in science, the student teachers specialise in one of the three sciences in order to teach at senior level. The three possible options for a major in science education are shown in Table C1 below.

Table C1: The three possible options for a major in science education

Options	Course Code/Title	Points
Science Education with Biology	EDSC308: Science Education Years 7-13	12
	EDSC357: Biology Curriculum Years 11-13	8
	EDSC398: Biotechnology Years 7-11 **OR**	4
	EDSC399: Electronics	4
Science Education with Chemistry	EDSC308: Science Education Years 7-13	12
	EDSC367: Chemistry Curriculum Years 11-	8
	EDSC398: Biotechnology Years 7-11 **OR**	4
	EDSC399: Electronics	4
Science Education with Physics	EDSC308: Science Education Years 7-13	12
	EDSC377: Physics Curriculum Years 11-13	8
	EDSC398: Biotechnology Years 7-11 **OR**	4
	EDSC399: Electronics	4

Source: adapted from the University of Canterbury (2008, p. 153).

C5.2 Science as a second teaching subject at UCCE: The four possible options and pre-requisites

Prospective science teachers require at least 12 points in science as a minor teaching subject. The four possible alternatives and pre-requisites are shown in Table C2. However, even if the core course, EDSC308, is enough as a minor teaching subject, taking additional science courses seems to increase employability, as a teacher educator remarked:

Researcher: But let's say you have a student who has taken science as a second teaching subject, then can he/she . . . take EDSC 308 and qualified to teach science from years 9 to 11?

UCCETEC: Yes, well, it's what's written for the paper itself; at the end of the day it's down to the schools as to what they employ somebody to teach. The reality is that most schools will be looking for teachers with suitable endorsement, if you like, on their teaching qualification to teach in that area. But with teacher shortages, some schools will encourage teachers *to teach more in an area than perhaps the teachers will be expected to.*

(Interview 2, UCCETEC)

Table C2: The four possible options and pre-requisites for a minor in science education

Options	Course Code and Title	Points	Pre-requisites
Science Education	EDSC308: Science Education Years 7-13	12	200-level Science, non science major Teaching Subject
Science Education with Biology (for those majoring in Chemistry or Physics)	EDSC357: Biology Curriculum Years 11-13	8	EDSC308 and 200-level Biology, Science Major Teaching Subject
	EDSC398: Biotechnology Years 7-11 OR	4	Science Major Teaching Subject
	EDSC399 : Electronics	4	Science Major Teaching Subject
Science Education with Chemistry (for those majoring in Biology or Physics)	EDSC367: Chemistry Curriculum Years 11-13	8	EDSC308 and 200-level Chemistry, Science Major Teaching Subject
	EDSC398: Biotechnology Years 7-11 OR	4	Science Major Teaching Subject
	EDSC399: Electronics	4	Science Major Teaching Subject
Science Education with Physics (for those majoring in Biology or Chemistry)	EDSC377: Physics Curriculum Years 11-13	8	EDSC308 and 200-level Physics, Science Major Teaching Subject
	EDSC398: Biotechnology Years 7-11 OR	4	Science Major Teaching Subject
	EDSC399: Electronics	4	Science Major Teaching Subject

Source: adapted from the University of Canterbury (2008, p. 154).

APPENDIX D

ISTE Programme Structure at NIE and UCCE

Figure D1: Diploma in Secondary Teacher Education (Science) Programme Structure

	Year 1			Year 2		
Component	**Term 1**	**Term 2**	**Term 3**	**Term 1**	**Term 2**	**Term 3**
Curriculum Practice	Science 1	Science 5	Science 9	Science 13	Science 16	Science 19
	Science 2	Science 6	Science 10	Science 14	Science 17	Science 20
	Science 3	Science 7	Science 11	Science 15	Science 18	Science 22: Research
	Science 4	Science 8	Science 12		Science 21: Research	
Educational Studies	EDST 1	EDST 3	EDST 5	EDST 7	EDST 9	EDST 10
	EDST 2	EDST 4	EDST 6	EDST 8		
Context Studies					Education Perspective	Human Rights
Support	Support 1: Study Skills	Support 3: Environment education 1	Support 5: ICT 2	Support 7: Environment education 2		Support 10: Science academic 3
	Support 2: ICT 1	Support 4: Science academic 1	Support 6: Science academic 2	Support 8: Graphic Communication		
				Support 9: ICT 3		
Professional Experience	Prof. Experience 1: 1 week block	Prof. Experience 2: 2 week block	Prof. Experience 3: 3 week block	Prof. Experience 4: 3 week block	Prof. Experience 5: 5 week block	Prof. Experience 6: 3 week block
Elective					Elective 1	Elective 2

Figure D2: The GradDipTchLn(Secondary) Programme structure for a student teacher who is majoring in Mathematics and Science

Component		**Term 1**	**Term 2**	**Term 3**	**Term 4**
Teaching Studies	**Subject 1**	EDMS 307: Mathematics Teaching Years 7-10 (12 points)			
		EDMS 319 Mathematics Teaching Years 11-13 (12 points)			
	Subject 2	EDSC308: Science Education Years 7-13 (12 points)			EDSC308: Science Education Years 7-13
		EDSC377: Physics Curriculum Years 11-13 (8 points)			
Professional Studies		EDPS 305: Professional Studies (20 points)			
Educational Studies		EDED402: Education Studies (8 points)			
Information and Communication Technology Studies		EDIT400: Strategies for E-Learning (4 points)			
Teaching Practice		EDTP306: Teaching Practice (7 week block) (15 points)		EDTP307: Teaching Practice 2 (7 week block) (25 points)	
Selected studies				EDSC399: Electronics (4 points)	