

**UNIVERSITY OF DERBY**

**Exploring Secondary School Science Teacher  
Professional Identity: Can it be influenced  
and reshaped by experiences of professional  
development programmes?**

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## Table of Contents

<b>Tables and Figures</b> .....	<b>iii</b>
Tables .....	iii
Figures .....	v
<b>List of Appendices</b> .....	<b>vi</b>
<b>List of Abbreviations and Acronyms</b> .....	<b>viii</b>
<b>Preface</b> .....	<b>ix/x</b>
<b>Abstract</b> .....	<b>xi</b>
<b>Acknowledgement</b> .....	<b>xiii</b>
<b>Dedication</b> .....	<b>xiv</b>
<b>Chapter 1: Introduction</b> .....	<b>1</b>
1.1 Purpose of Research and Main Research Question .....	4
1.2 Rationale for research .....	6
1.3 Benefits of research .....	15
1.4 Focus of research, aims, objectives, and supporting research questions .....	16
1.5 Context of research .....	19
1.6 My positionality .....	22
1.7 My perspective on science teacher professional identity .....	23
1.8 Key terminologies .....	26
1.9 Structure of thesis .....	30
<b>Chapter 2: Review of the literature</b> .....	<b>32</b>
2.1 Strategy in literature search .....	34
2.2 Self, identity, and professional identity .....	39
2.3 Situating my research in the literature .....	49
2.4 Theoretical framework underpinning my research .....	61

## Table of Contents (continued)

<b>Chapter 3: Research methodology</b> .....	<b>72</b>
3.1 Research paradigm, ontology, and epistemology .....	73
3.2 Methodological approach .....	76
3.3 Framework of research process .....	79
3.4 Research design .....	81
3.5 Principles of analysis .....	110
3.6 Analysis of evidence .....	113
3.7 Generalisability vs transferability .....	126
3.8 My subjectivity and reflexivity .....	128
<b>Chapter 4: Findings</b> .....	<b>130</b>
4.1 Science teachers' professional identities prior to research .....	136
4.2 Findings of science teachers' experiences from interviews .....	148
4.3 Findings from questionnaire .....	195
4.4 Synthesis of findings from interviews and questionnaire .....	198
4.5 Science teachers' professional identity at end of research .....	202
<b>Chapter 5: Discussion of findings</b> .....	<b>219</b>
5.1 Findings and supporting research questions .....	221
5.2 Theoretically informed discussions of findings .....	238
5.3 Conceptual model of science teachers' professional identity .....	249
<b>Chapter 6: Conclusions</b> .....	<b>253</b>
6.1 Key findings and knowledge claims .....	257
6.2 Implications of findings .....	266
6.3 Limitations of research .....	269
6.4 Contributions from findings, theory, and methodology .....	272
6.5 Future studies .....	275
6.6 Summation .....	277
<b>References</b> .....	<b>281</b>
<b>Appendices</b> .....	<b>I</b>

## Tables and Figures

### List of Tables

<b>Table</b>	<b>Title</b>	<b>Page</b>
Table 2.1	Search results from the University of Derby Digital Library	36
Table 2.2	Search results from Ontario College of Teachers Digital Library	37
Table 2.3	Matrix of Selection Criteria vs Title of Publications	37
Table 3.1	Congruence Between Supporting Research Question and Research Methods	87
Table 3.2	Succession of Events in Research Process	88
Table 3.3	Process of Obtaining Evidence	93
Table 3.4	Date, Time, and Locations for Interviews in Pilot Study	97
Table 3.5	Demographics of Science Teachers in Main Research	103
Table 3.6	Profile of Science Teachers in Main Research	105
Table 3.7	Date, Time and Locations of Interviews in Main Study	108
Table 3.8	Codes Assigned to Science Teachers to Report Findings	115
Table 3.9	Processes Involved in Analysis of Evidence	119
Table 3.10	Mapping Clusters of Codes, Themes, and Categories	122
Table 3.11	Relating Clusters of Codes and Themes to Dimensions of Experiences	123
Table 4.1	Roles of Science Teachers in Modules	133
Table 4.2	Context of Sessions of Modules	134
Table 4.3a	Comparison of Science Teachers' Experiences in Module 1 – Culminating Activity for Inquiry	161
Table 4.3b	Comparison of Science Teachers' Experiences in Module 2 – English Language Learners	179
Table 4.3c	Comparison of Science Teachers' Experiences in Module 3 – Motivating the Unmotivated	192

## Tables and Figures (continued)

### List of Tables

<b>Table</b>	<b>Title</b>	<b>Page</b>
Table 4.4	Synthesis of Science Teachers' Dimensions of Experiences based on Questionnaire	196
Table 4.5	Science Teachers' Overall Experiences of Professional Development Programme based on Interviews and Responses to the Questionnaire	199
Table 4.6a	Science Teachers' Experiences of Cognitive Development across Modules	203
Table 4.6b	Science Teachers' Experiences of Social Interactions across Modules	205
Table 4.6c	Science Teachers' Experiences of Emotional Changes across Modules	207
Table 4.6d	Science Teachers' Experiences of Changes in Beliefs and Classroom Practice across Modules	209
Table 5.1	Science Teachers' Experiences of Professional Development Programme	223
Table 5.2	Science teachers' Experiences, Changes in Beliefs, and Influence on Their Professional Identity	230
Table 5.3	My Findings Compared to Indicators of Changes in Professional Identity in Literature	234

### List of Figures

<b>Figure</b>	<b>Title</b>	<b>Page</b>
Figure 1.1	Representation of Professional Development Programme in this Research	20
Figure 2.1	Theoretical Framework Underpinning Research	63
Figure 3.1	Framework of Research Process	80
Figure 3.2	Diagram of the Professional Development Programme in Pilot Study	95
Figure 3.3	Model of Hermeneutic Circle as a Spiral	111
Figure 5.1	Conceptual Model of Science Teacher Professional Identity in this Study	250

## LIST OF APPENDICES

Appendices	Title	Page
<b>Appendix A</b>	<b>Ethical Issues for Main Study</b>	<b>I</b>
A1	Ethics Application to the University of Derby	I
A2	Ethics Approval from the University of Derby	XVII
A3	Permission from school board to Conduct Research	XVIII
A4	Invitation to Participate in Main Study	XIX
A5	Letter of Agreement to Participate in Main Study	XXI
<b>Appendix B</b>	<b>Original Tools (Pilot Study)</b>	<b>XXII</b>
B1	Written Narrative Schedule	XXII
B2	Narrative Interview Schedule	XXIII
B3	Questionnaire	XXIV
B4	Rubric for Non-participant Observations	XXVIII
<b>Appendix C</b>	<b>Amended Tools (Main Research)</b>	<b>XXXI</b>
C1	Written Narrative Schedule	XXXI
C2	Narrative Interview Schedule	XXXII
C3	Questionnaire	XXXIII
C4	Semi-structured interviews	XXXVII
<b>Appendix D</b>	<b>Narrative Interview Transcripts</b>	<b>L</b>
<b>Appendix E</b>	<b>Converting Responses for Questionnaire into Text</b>	<b>CXLII</b>
E1	Matrix of Science Teachers' Experiences of Cognitive Development	CXLII

### LIST OF APPENDICES (Continued)

Appendices	Title	Page
E2	Matrix of Science Teachers' Experiences of Social Interactions	CXLIII
E3	Matrix of Science Teachers' Experiences of Emotional Changes	CXLIV
E4	Synthesis of Science Teachers' Experiences from Questionnaire	CXLV
<b>Appendix F</b>	<b>Experiences of Science Teachers based on Interviews and Questionnaire</b>	<b>CXLVII</b>
F1	Comparison of Experiences of Cognitive Development Based on Interviews and Questionnaire	CXLVII
F2	Comparison of Experiences of Social Interaction Based on Interviews and Questionnaire	CL
F3	Comparison of Emotional Changes Based on Interviews and Questionnaire	CLIV
<b>Appendix G</b>	<b>Comparison of Science Teachers' Dimensions of Experiences across Modules</b>	<b>CLIX</b>
G1	Comparison of Experiences of Cognitive Development among Science Teachers across Modules	CLIX
G2	Comparison of Experiences of Social Interaction among Science Teachers across Modules	CLX
G3	Comparison of Emotional Changes among Science Teachers across Modules	CLXI
G4	Comparison of Changes Experienced among Science Teachers across Modules	CLXIII

## List of Abbreviations and Acronyms

Abbreviations and Acronyms	Meanings
ACL	Assistant Curriculum Leader
AMGEN	Applied Molecular Genetic
CAI	Culminating Activity
CL	Curriculum Leader
CLC	Collaborative Learning Community
CoP	Community of Practice
ELL	English Language Learners
ESL	English as a Second Language
GLACIE	Great Lakes Association for Cooperation in Education
IHP	Interpretive Hermeneutic Phenomenology
IL	Instructional Leader
IPA	Interpretive Phenomenological Analysis
MU	Motivating the Unmotivated
NRC	National Research Council
OECD	Organisation for Economic Co-operation and Development
PDP	Professional Development Programme
PI	Professional Identity
PISA	Programme for International Student Assessment
PLC	Professional Learning Community
STAO	Science Teachers' Association of Ontario
STEM	Science, Technology, Engineering and Mathematics
VITAE	Variations in Teachers' Work, Lives and Effectiveness

## **Preface**

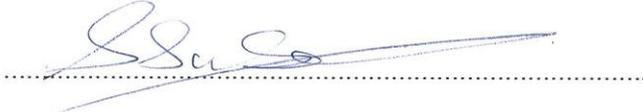
I declare that this thesis is a testament of my own research and that I have written the contents therein which has not been submitted previously for any tertiary degree at any other institution. This research has been conducted with the approval of the Research Ethics Committee of the University of Derby (2012/2013).

.....

Shubhashnee Subryan

### Preface

I declare that this thesis is a testament of my own research and that I have written the contents therein which has not been submitted previously for any tertiary degree at any other institution. This research has been conducted with the approval of the Research Ethics Committee of the University of Derby (2012/2013).

A handwritten signature in blue ink, appearing to read 'Shubhashnee Subryan', is written over a horizontal dotted line.

Shubhashnee Subryan

## **Abstract**

International test results posed concerns about the future of science education in Canada, the UK, and the USA. Stakeholders such as Let's Talk Science and AMGEN Canada and The Royal Society, UK observed that fewer students were pursuing post-secondary studies and careers in science, technology, engineering, and mathematics (STEM) related fields in their countries, compared to their counterparts in China, India, and Singapore. These stakeholders contended that science teachers required the agency to enhance their classroom efficacy and to challenge their students to pursue post-secondary studies and careers in STEM related fields. Reform initiatives, including professional development programmes, have been established across western countries to support science teachers' agency to act as change agents. This study was based on two assumptions: firstly, science teachers need professional development experiences to shape their professional identity to act as change agents in science education reform, and secondly, science teachers' professional identity may be influenced and reshaped through experiences during professional development.

This research explored the influence on secondary school science teachers' professional identity by their experiences of professional development programmes. A methodological approach of hermeneutic phenomenology facilitated the understanding of science teachers' experiences, while a sociocultural theoretical framework based on Wenger's community of practice, underpinned the research. Narrative interviews, semi-structured interviews, and a questionnaire provided evidence from thirteen purposefully selected science teachers in one school board in Canada for this study. Interpretive phenomenological analysis of interviews and qualitative survey analysis of the questionnaire, identified cognitive development, social interactions, emotional changes, and change in beliefs and classroom practice as the science teachers' experiences of their professional development programme. Such experiences are regarded as indicators of influence on professional identity.

The cognitive development, social interactions, and emotional changes experienced by the science teachers, are considered as their dimensions of experiences during learning. Although nine science teachers experienced changes in their practice, two of them reported changes in their professional beliefs. It is significant that eleven science teachers did not experience a change in their beliefs, despite changes in their classroom practice. The science teachers who did not experience a change in their beliefs were confident of their existing

professional identities that influenced their learning and their views regarding changes in their beliefs and practice. It appears that science teachers' prior professional identity was a determining factor in influencing and reshaping their professional identities. Nevertheless, findings from this study imply that, to some extent, science teachers' professional identity was influenced, perhaps not reshaped, by their experiences of their professional development programme. Findings from my research have implications for science education reform-minded stakeholders and providers of in-service professional development programmes. They would be informed of research on the role of professional identity in professional learning and classroom practice in a climate of science education reform, as well as the role of prior professional identity in such initiatives.

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## **Dedication**

I dedicate this thesis, posthumously, to my parents, Ramessar and Muthelama Dhanesar. I thank both of you for believing in me and providing the opportunities for me to make this journey against all odds and in an age when, and in a society where, it was frowned upon to educate daughters. You believed in me and raised me up. You gave me wings so that I soared in the skies and I was able to move mountains.

## Chapter 1: Introduction

My interest in exploring secondary school science teachers' professional identity stemmed from concerns of the future of science education based on the PISA 2012 report (OECD 2014). The Programme for International Student Assessment (PISA) reports are triennial international surveys that test 15-year-olds worldwide for competence in mathematics, reading, and science. OECD (2014) reported that the PISA 2012 report revealed that Canada, the UK, and the USA had mean scores in science of 525, 514, and 497 respectively. As such, these three countries ranked within the ranges of 5th – 8th, 10th – 15th, and 17th – 25th respectively out of 34 OECD countries. However, despite relatively favourable PISA 2012 results for Canada and the UK, the progress of science education in these countries did not appear to be advancing at the same rate as that in eastern countries (Let's Talk Science and AMGEN Canada 2014; The Royal Society, UK 2014). As such, stakeholders have expressed concerns about the state of science education in their countries because their science students scored less than those of their eastern counterparts (OECD 2014). Stakeholders felt that enhancing science teachers' agency in the classroom through professional development may be one of the ways to address their concerns about science education in their countries. Therefore, I set out to explore whether secondary school science teachers' professional identity can be influenced and reshaped through professional development to enhance their agency in the classroom.

Such concerns have gained traction in the twenty first century although they were expressed over a decade earlier. Reports about the state of science education in Canada (Let's Talk Science and AMGEN Canada 2014; Fawcett 1991), the UK (The Royal society, UK 2014; Smith 2010), and the USA (National Science and Technology Council, USA 2013; Mathews 2007) can attest to the history of such concerns. The PISA 2012 report, that alerted stakeholders in these countries that they might lose their positions as world leaders in science and technology (The Royal Society, UK 2014; AMGEN Canada 2012), appeared to prompt this traction. The result was the call for science education reform initiatives to maintain their country's positions as world leaders in science, technology, engineering, and mathematics (STEM) related fields (Let's Talk Science and AMGEN Canada 2014; AMGEN Canada 2012; The Royal Society, UK 2014; National Science and Technology Council, USA 2013).

The re-education of science teachers, through professional development programmes, was one of the science education reform initiatives identified by stakeholders. The rationale was that science teachers would acquire the agency to inspire students to pursue further education and careers in STEM related fields (The Royal Society, UK 2014). Agency among science teachers represents their power and influence in the classroom and it is connected to their professional identity (Moore 2007). As such, the re-education of secondary school science teachers (science teachers from hereon) with the intention to reshape their professional identity, is forefronted in science education reform initiative discussions. I consider professional identity of science teachers in this study as a “trajectory” that reflects the landscape of their learning environment (Wenger 2010: 5). Here, science teachers’ competence, relationships, emotions, and stories coalesce to shape “the trajectory going forward” (Wenger 2010: 5).

Professional identity is one aspect of one’s core identity. Core identity comprises one’s genetic makeup together with one’s beliefs and values developed over time within the context of one’s relationships, learning, and emotions. Gee (2001: 111) describes ‘core identity’ as one that is “potentially changing” and is a “trajectory” in which some experiences recur and others do not in combination with one’s narratives of oneself. Applying this concept of core identity to science teachers, I argue that it can be regarded as a composite of dimensions of identity represented by their contextual (situated), professional (learning), and personal (early life) identities as Day, Stobart, Sammons, Kington, Gu, Smees, and Mujtaba (2009) argue.

Science teachers can benefit professionally if their professional identities can be influenced and reshaped by their experiences of their professional development programmes. The result would be that they could have the agency to enhance their classroom efficacy and their roles as change agents in science education reform would be significant in that they would be empowered to do so. Therein lies my reason to conduct this research to find out if reshaping of science teachers’ professional identity by influences due to experiences of professional development programmes, is possible so that they can act as change agents in an era of science education reform.

I contend that awareness of their professional identity, provides science teachers with the agency they require to voice their inputs in instituting successful science education reform initiatives. I would argue that science teachers’ voice is important in the decision-making

process of science education reform initiatives. However, as in any reform initiative, science teachers “have been, to some extent, excluded from” the decision-making process for science education reform (Qablan, Juradat, and Al-Momani 2010: 162). Consequently, their voices are absent in the literature on science education reform policies and initiatives. Given that the success of reform strategies depends on teachers’ central role in implementing reform initiatives in the classroom (Garet, Porter, Desimone, Burman, and Yoon 2001), there is need for inclusion of science teachers’ input in reform strategies.

Teachers’ professional identity and their beliefs are mutually dependent not only during learning, but also in their practice. Teachers’ beliefs are shaped by contexts that reflect school reform initiatives, and their beliefs affect their decisions in the classroom (Laskey 2005). As O’Connor (2008: 123) argues:

Whilst teachers will always reflectively adjust the roles they play in order to navigate institutional demands, such demands are negotiated according to the individual’s professional beliefs and definition of a situation.

To date, reform initiatives, then, have little effect on shaping established professional identities and beliefs unless informed by teachers’ voice. In fact, established professional identities and beliefs can affect the outcomes of reform initiatives (Laskey 2005). As such, attempts to shape professional identity through the use of professional development programmes may not enhance classroom efficacy, or bring about changes in science education unless teachers are given a voice in the process. I contend that giving science teachers a voice in planning science education reform initiatives is likely to result in favourable outcomes for science education reform. Furthermore, science teachers could negotiate their positions based on their established professional identities and beliefs, and they may be persuaded to change both in the process.

## **1.1 Purpose of research and main research question**

The purpose of this research was to explore whether secondary school science teachers' professional identity could be influenced by experiences of their professional development programme. I argue that enhanced science teachers' knowledge and skills would not only influence their professional identity but may result in "reform-minded" science teachers (Luehmann 2007: 823). Reform-minded science teachers are willing to cope with science education reform strategies (Beijaard, Meijer, and Verloop 2004), whereby they can "implement innovations in their own teaching practice" to reflect their professional identities (Beijaard, Verloop, and Vermunt 2000: 750).

My intention was to seek a connection between science teachers' professional identity and their learning within a professional learning community. A research question drives the study and determines its outcome, and as such, my main research question, which stemmed from a review of the literature, was: Can secondary school science teachers' professional identity be influenced and reshaped by their experiences of their professional development programmes? Such a question warranted a sociocultural theoretical framework that focused on Wenger's (1998) community of practice (discussed in detail in chapter 2: 32), since teacher learning involves teachers' cognitive development and opportunities to learn (Melville and Wallace 2006). Hermeneutic phenomenology (discussed in detail in chapter 3) was considered an appropriate methodological approach to address the research question to understand narratives of science teachers' experiences (Heidegger [1962] 2008), and the supporting arguments. The main research question resonated with the concerns of local and wider science educational community with respect to science teachers' professional identity and science education reform (Let's Talk Science and AMGEN Canada 2014; AMGEN Canada 2012; The Royal Society, UK 2014; National Science and Technology Council, USA 2013).

### **Spring board for study**

In conducting this research, I built on, and contributed to one aspect of the VITAE (Variations in Teachers' Work, Lives and Effectiveness) study conducted between 2001 and 2005. That study was conducted "to investigate the factors contributing to variations on teachers' effectiveness at different phases of their careers" (Day et al. 2009: vi). They initiated their work in response to the need for education reform in the UK. I conducted my research in response to the call for re-education of science teachers to enhance classroom practice (Let's

Talk Science and AMGEN Canada 2014; AMGEN Canada 2012; The Royal Society, UK 2014; and the National Science and Technology Council, USA 2013) .

The supporting research question in the VITAE study: “What are the roles of biography and identity?” (Day et al. 2009: viii), was relevant to my research. I paralleled the Day et al. (2009) study in that I conducted my research in order to explore whether science teachers’ professional identity was able to be influenced and reshaped by experiences of their professional development programme as a science education reform initiative. The Day et al. (2009) study focused on factors that promoted effectiveness at various phases of the professional careers of primary and secondary teachers as an education reform measure. The main thrust of the Day et al. (2009) study was on factors that promoted teacher effectiveness. As such, their research question on the roles of biography and identity in their study, was of interest to me. Like Day et al (2009), I recognised the importance of prior professional identity in teachers’ learning and classroom practice and as such, I emphasised it in my research (Marcelo 2009; Luehmann 2007; Day, Kington, Stobart, and Sammons 2006a).

In addressing the role of biography and identity, Day et al. (2009) focused on the professional, personal, and situated factors that interacted to construct teacher identity. To address the supporting research question in the VITAE study above, Day et al. (2009) studied teachers’ experiences of their continuing professional development throughout their teaching careers. In contrast, I studied the influence on, and the reshaping of science teachers’ professional identity as a result of their participation in a specific professional development programme. Their mixed methods, longitudinal study spanned 4 years and involved 300 primary and secondary teachers of various subject areas in 100 schools in England. In their study, Day et al. (2009) examined influences that affected teachers’ personal and professional lives, and their identities in terms of effectiveness at various professional phases at which the teachers were, at the time of their study. In contrast, my research was an in-depth exploration to gain insight into the influence on science teachers’ professional identities by perceptions of their professional development experiences rather than that of a wider spread of teachers. I conducted a qualitative, cross-sectional study utilising a phenomenological approach. I targeted a limited number of secondary school science teachers to study their experiences of their professional development programme in a Canadian province.

## **1.2 Rationale for research**

Three reasons prompted me to explore whether science teachers' professional identity can be influenced by experiences of their professional development programmes. Firstly, stakeholders in Canada, the UK, and the USA argued that their countries must continue to lead in science, technology, engineering and mathematics (STEM) to maintain their country's positions as world leaders in science and technology (Let's Talk Science and AMGEN Canada 2014; The Royal Society, UK 2014; National Science and Technology Council, USA 2013). As such, they recommended the re-education of science teachers to provide the agency required to inspire students to pursue STEM related higher education and careers. An exploration of whether science teachers' professional identity can be influenced and reshaped as they mediate their professional development programmes would inform whether they acquire the agency to inspire students to pursue STEM related learning and careers.

Secondly, it appears that there is little published research on secondary school science teachers' professional identity and science education reform in Canada. A survey of the literature on science teachers' learning and the development of their professional identity in Canada revealed that the published studies focused mainly on preservice and elementary school science teachers (e.g. Pedretti, Bencze, Hewitt, Romkey, and Jivraj 2008; Yoon, Pedretti, Bencze, Hewitt, Perris, and van Oosterveen 2006). No study was found that addressed secondary school science teachers' professional identity and how it might be influenced as they mediated their experiences of their professional development programme. Findings from this study could contribute to and extend the knowledge on the re-education of science teachers, their professional identity, and their efficacy in the classroom as a reform initiative.

Thirdly, as a former science teacher who supported the progress of science education, STEM initiatives and science teachers' professional development sparked my interest. I appreciated the merits of science education and the need for sound pedagogical skills to inspire and challenge students to continue studying science. However, my experiences of professional development programmes were not about STEM related pedagogical skills, but about teacher-wellness and classroom management. As such, I explored whether science teachers' professional identity can be influenced and reshaped by their experiences of STEM related

professional development programmes to learn whether such experiences affect their classroom practice.

### **Need for science education reform**

Stakeholders in North America and the UK have two main concerns about science education trends in their countries. Firstly, students opt to discontinue the study of science after they have completed the minimum requirements to graduate from secondary school (The Royal Society, UK 2014; AMGEN Canada 2012) and secondly, they are not prepared for studies in senior science courses (National Math and Science Initiative (NMSI), USA 2015). AMGEN Canada (2012) opined that, despite their favourable PISA 2012 report, many students discontinue studies in science which indicated that Canada was failing to attract students to study science beyond secondary school or pursue careers in science. Internationally, the UK has witnessed declining enrolment of students in areas of advanced level chemistry and physics for over two decades (Smith 2010). The Royal Society, UK (2014: 8) reported “a persistent dearth of young people taking science...after the age of 16 across the UK”. Similarly, Mathews (2007) identified shortcomings in science education in secondary schools in the USA. She reported that the state of precollege science education (Grades K to 12) in the USA was such that students’ performance was not at the level of their international counterparts. Furthermore, NMSI, USA (2015) reported that the USA was ranked 20th among the 34 OECD countries in science education and that 69% of high school students were not prepared for college-level science. Therein lies stakeholders’ current concerns about the future of STEM-related education and careers in their countries, which justifies their call for science education reform initiatives. More than a decade earlier, McKenzie (1994) and Fawcett (1991) had recommended expertise in subject specialism and pedagogy together with science teachers’ professional roles to improve science education. Yet the problem persisted.

Retrained science teachers assume roles to accomplish science education reform initiatives because they develop confidence to change their practice through transformed beliefs (Lumpe, Czerniak, Haney, and Beltyukova 2012). Proponents of STEM education, such as NMSI, USA (2015), Let’s Talk Science and AMGEN Canada (2014), The Royal Society, UK (2014), and AMGEN Canada (2012), stressed the need for certified science teachers in science education reform. They argued that such teachers can spark students’ interest in science or inspire them to pursue careers in STEM related fields. As such, they recommended

investment in science teacher preparation and professional development programmes to address the issue of STEM education. Such a strategy reflected Kent's (2004: 428) premise that the re-education of science teachers in the USA could improve teacher quality and professional growth through professional development, which "is a vital and daily aspect of personal and professional identities".

Professional development of science teachers is important in school reform initiatives because of the link between school reform and classroom practice. NMSI, USA (2015), Let's Talk Science and AMGEN Canada (2014), The Royal Society, UK (2014), and AMGEN Canada (2012) argue that science teachers' professional status and self-efficacy can be enhanced through professional development. Professional status positions a science teacher within the science teaching community while self-efficacy, signifying science teachers' sense of professional identity (Canrinus, Helms-Lorenz, Beijaard, Butink, and Hofman 2011a; Day et al. 2009), can change science teachers' perspectives about science teaching. Currently, recommendations by NMSI (2015), The Royal Society (2014), and AMGEN Canada (2012) to focus on enhancing STEM education, foreground the issue that science teachers can develop self-efficacy and professional roles through professional development programmes. Developed self-efficacy and professional roles can foster science education reform in the USA, the UK, and Canada respectively.

I propose the following arguments on the use of professional development as science education reform initiatives to justify my decision to conduct this research. Firstly, experiences of professional development programmes can enhance science teachers' professional status and can result in inspired teachers within the landscape of science education reform (Marcelo 2009). Secondly, the self-efficacy and change in beliefs that science teachers may experience can empower them as professional agents of reform in science education. In this way, they can negotiate and construct meaningful conceptions of who they are and their abilities to realise goals set out in science education reform (Pyhalto, Pieterinen, and Soini 2012; Tymms, Merrell, Thurston, Andor, Topping, and Miller 2011). Thirdly, science teachers' sense of 'self' or identity as agents of action is connected to their practice (Wenger 1998), their personal mastery of knowledge and confidence to take initiatives (Senge 1990), and their sense of self-efficacy (Lumpe et al. 2012; Tymms et al. 2011). Fourthly, science teachers' professional identities, which reflect their knowledge,

skills, beliefs, and attitudes towards subject and pedagogical knowledge and their school reform efforts, can improve through professional development (Lustic 2011; Hoffman-Kipp 2008). Fifthly, acquiring new attitudes, values, beliefs, and understandings together with commitments to enhance pedagogy and routines through professional development may result in science teachers developing identities as change agents in science education reform (Hoffman-Kipp 2008). Lastly, the agency of change can transform science teachers' professional identity in ways that may influence the decisions they make to achieve positive classroom outcomes (Etelapelto, Vähäsantanen, Hokka, and Paloniemi 2014; Moore 2007).

### **International studies on professional identity and professional development programmes**

In the preceding section, I highlighted the relationship between science teachers' professional identity and their learning regarding the role of professional development in science education reform. Of note is that not all professional development programmes are suitable for development of science teachers' professional identity which is contextual and depends on their needs, students' needs, and demands of the educational community (Cordingley, Higgins, Greany, Buckler, Coles-Jordan, Crisp, Saunders, Coe 2016; Avalos 2011; Beijaard et al 2004). Avalos (2011) reviewed publications in *Teaching and Teacher Education* over a ten-year period and she has cited a number of international studies, including some from Canada, the UK, and the USA, on the professional development of teachers. She has identified several publications that focused on the effectiveness of such programmes in terms of the development of teachers' cognition, their beliefs, and the outcome of their practices, all of which contribute to the renegotiation of teacher professional identity. There appears to be a movement "away from the traditional in-service teacher training (INSET) model" to one in which "teacher learning and development" is recognised as a "complex process" (Avalos 2011: 17) involving contextual factors, teachers' needs, and the culture of the countries involved (Cordingley et al 2016; Avalos 2011; Beijaard et al 2004).

There appears to be a trend in conducting professional development programmes that focuses on developing professional identities by utilising the socio-cognitive approach. This approach emphasises learning as holistic, whereby "actual identity" becomes "designated identity" (Sfard and Prusak 2005: 1) and context is considered crucial in influencing and reshaping professional identity (Beauchamp and Thomas 2009). A number of international professional development programmes conducted with the development of professional identity in mind

are published in the literature. Among these publications are: Farnsworth and Higham (2012) in Canada; Woolhouse and Cochrane (2014; 2010) in the UK; Bakkenes et al (2010) in the Netherlands; Cohen (2010), Musanti and Pence (2010), Battey and Franke (2008), Grier and Johnson (2008), and Lee and Luft (2008) in the USA; and Jurasite-Harbison (2005) in Lithuania and the USA. The outcome of each programme was one in which the teachers experienced a change in their professional identity as a result of participating in the professional development programmes.

### **Professional identity as a contentious issue**

The issue of professional identity of teachers is contentious because of the manner in which it is negotiated. On the one hand, there is the managerialist professional identity whereby stakeholders and school administrators tend to follow a top-down style of instituting educational changes that result in a “standardization of practice rather than quality” (Sachs 2001: 156). On the other hand, there is the democratic professional identity whereby others may invite teachers to be involved in planning such changes in which case, the result is “engagement with economic and political activity to provide development of their new potential” (Sachs 2001: 154).

Issues of teacher professional identity are in the foreground of educational reform in countries such as Australia, Canada, the UK, and the USA. Current international debates about reform measures in science education focus on the reshaping of science teachers’ professional identity, their learning, and their professional practice. Sachs (2015) calls for a different approach to education reform than the top-down system practiced by stakeholders internationally. With a top-down system, there is an absence of teachers’ voice in the decision making process. She advocates a system that involves teachers, “collectively and individually”, to “reshape” their “professional practice and identity” (Sachs 2015: 414). She argues that “a more collaborative or research-engaged teaching profession could develop and thrive” if “common shared vocabulary about practice and how to improve practice, strategies are in place to improve practice”, and “social transformation” of teachers as lifelong learners, are in place (Sachs 2015:414).

In an era of rapid educational changes, professional identity should be viewed as being in a state of flux whereby it is constantly being evolved. A change from the managerial professionalism, mandated and controlled by state, to democratic professionalism, due to

collaboration and cooperation between teachers and stakeholders is recommended (Sachs 2001) and is evidenced by the study conducted by Avalos (2011). Collaboration and cooperation can be achieved if professional development programmes are conducted within a community of practice where professional identities can be renegotiated and re-established. Participation in a community of practice such as Wenger's (1998) model can result in five dimensions of identity defined as: "negotiated experiences" achieved through participation; "community membership" by the colleagues with whom they interact; a "learning trajectory" defined by teachers' past and their future, a "nexus of multi membership" by synthesising multiple identities into one; and membership in the "local and global" science education community (Wenger 1998: 149). For science teachers, this implies that their experiences (in and out of schools), "their beliefs and values of what it means to be a teacher and the type of teacher they aspire to be" have a pivotal role in the shaping of their professional identities (Sachs 2001: 154).

### **Gap in the literature**

Studies of teacher professional identity are many and varied (Flum and Kaplan 2012; Akkerman and Meijer 2011; Beijaard et al. 2004). As such, teacher professional identity is situated in the "foreground of the educational arena" (Flum and Kaplan 2012: 240). Theorists and researchers acknowledge the importance of studies on teacher professional identity in relation to educational reform to enhance practice. As Lave and Wenger (1991:115) posit, "learning and a sense of identity are inseparable" whereby Wenger (1998: 263) reinforced the relationship between learning and identity when he recommended that "issues in education should be addressed first and foremost in terms of identities".

Debates about the expectations of teachers and their actual classroom practice (Cohen 2008) resulted in a series of international studies covering various aspects of teacher professional identity. For instance, as early as in 2000 Beijaard et al. conducted a study on in-service secondary school teachers who taught languages, mathematics and science, social studies and humanities, and the arts in the Netherlands. In 2006, both Findlay and Watson studied secondary school teachers who taught English in the UK. In the same year, Soreide focused her study on a female elementary (primary) school teacher in Norway, while Yoon et al. studied elementary science teachers in Canada. Another study on pre-service science teachers in Canada was conducted by Pedretti et al. in 2008. Continuing in the year 2008, Battey and

Franke researched the development of professional identities of middle school mathematics teachers in the USA. A year later, Upadhyay (2009) focused on the identity of one primary school science teacher in the USA while Day et al. (2009) published their report on the VITAE project they conducted four years earlier in the UK. Then Lawrence, Anthony, and Ding (2009) researched the professional identities of mathematics teachers in New Zealand. Further research in the UK were conducted by Findlay (2010) on humanities teachers and by Woolhouse and Cochrane (2014; 2010) who studied two cohorts of chemistry/physics teachers/trainees in a special teacher-training programme in the UK. Noticeably absent was a study on the professional identity of secondary school science teachers' professional identity in Canada.

Researchers have approached the study of teacher professional identity from different theoretical perspectives and methodological approaches. Among such perspectives are identity theories (Gee 2001), teachers' personal and professional lives (Day, Sammons, Kington, and Gu 2006b; Soreide 2006), teachers' emotions (Shapiro 2010; Reio 2005; Zembylas 2005; 2003), and community of practice (Woolhouse and Cochrane 2014; 2010). The different quantitative and qualitative methodological approaches of such studies include: Lamote and Engels' (2010) quantitative study on teacher education and professional identity, Day et al.'s (2009) mixed methods approach to teacher effectiveness and professional identity, and Soreide's (2006) qualitative work on factors that shaped new teachers' identities, to name a few. No known research appeared to be approached from the perspective of Wenger's (1998) community of practice that focused on sociocultural theories of learning and dialogue during professional development coupled with a methodological approach of hermeneutic phenomenology. This research was warranted to bridge such a gap and would contribute to, and extend, the growing body of knowledge on teacher professional identity. In embarking on this study to bridge the gap in the literature, I justify my rationale to conduct this doctoral research.

The gap in the literature on science teachers' professional identity might be due to inadequate emphasis placed on STEM education before the 21st century. Results of PISA reports since 1998, together with the perception that countries such as China and India can easily overtake more developed countries in STEM related fields, have sparked renewed interest in STEM education at the end of the 20th century and foregrounded it in the 21st century. Canada, the

UK, and the USA are taking initiatives to re-educate science teachers through professional development programmes and as such, the body of research into science teachers' learning and classroom practice regarding STEM education is growing. Published works are increasing and my study will contribute to the growing body of literature in this field.

### **My interest as a science teacher**

My interest in science teachers' professional identity was framed by my professional identity, my classroom practice, and my professional development efforts as a science teacher. My knowledge and passion for science added an aesthetic dimension to my teaching and shaped how I engaged with science teaching (Hobbs 2012a). My professional identity is a construct of my education, my past experiences in schools, and my vision of the type of teacher I imagined I would be (Wenger, 2010; MacGregor 2009; Flores and Day 2006; Gee, 2001). The growing emphasis on STEM education in western countries requires science teachers to participate in professional development programmes to cope with curricular changes and to develop confidence to enhance their classroom practices to inspire and challenge their students (The Royal Society, UK 2014). As a science teacher, I can appreciate such an initiative and therein lays my interest to find out how science teachers address the challenge that mandated STEM education poses for them.

I wondered whether my professional identity, influenced by my experiences of professional development programmes, is different from those of science teachers teaching STEM subjects currently. Professional development programmes prior to STEM education initiatives were one-time events that did little to alleviate teachers' feelings of inadequacy (Flint, Zisook, and Fisher 2011). The ethos of a closed-door system in western countries hindered collaboration among teachers as a means of discussing their classroom experiences with colleagues (Fullan, Rincon-Gallardo, and Hargreaves 2015; Darling-Hammond, Wei, Andree, Richardson, and Orphanos 2009). However, that ethos is slowly changing in most countries and teachers are able to collaborate and learn from each other in a more meaningful manner (Fullan et al. 2015; Flint et al. 2011; Darling-Hammond et al. 2009). As I explored the literature on teacher professional development initiatives and their classroom practice, I realised that collaborative engagement can help teachers to obtain new subject and pedagogical knowledge to improve their classroom practice and change their perceptions of their professional identities (Day et al. 2006b; Lave and Wenger 1991). As such, I questioned whether science teachers'

professional identities would be affected in a similar manner by their experiences of professional development programmes.

### **1.3 Benefits of research**

Studies on science teachers' professional identity and professional development are significant in light of the current emphasis on STEM education and science education reform. According to Wenger (2010: 2), social learning within a professional learning community is "a meaning-making entity" and the social world is "a resource for constituting an identity". As a result, science teachers who participate in a collaborative professional development programme could become "certain" science teachers who can claim "competence" in teaching science (Wenger 2010: 3). The elements of learning, such as experience, practice, community, emotions, and identity (Wenger 2010) classify science teachers as members of the science teaching profession and highlight their relationships (community), their beliefs about their abilities to teach science (competence), and their classroom efficacy (practice). Canrinus et al. (2011a) argue, and I concur, that teachers' commitments, their classroom efficacy, change in motivation, and job satisfaction are indicators of their professional identity. Classroom efficacy is related to teachers' beliefs and their commitments, whereas, classroom efficacy and job satisfaction are related to motivation to work due to "interrelated beliefs and emotions" (Canrinus et al. 2011a: 120).

Awareness of professional identity enhances science education reform initiatives. It empowers science teachers, highlights their learning and teaching styles, and influences the decisions they make in their classrooms (Beijaard et al. 2004). Luehmann (2007: 823) argues that professional identity goes beyond acquiring knowledge and skills and leads to "reform-minded science teachers". Professional identity can influence teachers' abilities to "cope with educational change and to implement innovations in their own teaching practice" (Beijaard et al. 2000: 750). Findings can inform stakeholders and providers of professional development programmes, locally and internationally, of the importance of teacher professional identity in learning within professional learning communities and in developing attitudes to sustain educational reform.

#### **1.4 Focus of research, aims, objectives, and supporting research questions**

My research focused on science teachers' professional identity and how it could be influenced by experiences of their professional development programme. I viewed science teachers' narratives of their experiences through the lens of socioculturalism to explore such an influence. Science teachers' learning, according to the tenets of socioculturalism, occurs as a result of social interactions. It involves science teachers interacting with their peers, lead teachers, and their instructional leaders (social interactions) within a professional learning community (cultural context), which influences their learning (Hodkinson, Biesta, and James 2008; Vygotsky 1978). As such, science teachers' learning within a professional learning community, reflects collective learning in which they construct knowledge in their social context (professional learning community). In the process, they share insights and artefacts which reflect Wenger's (1998) joint enterprise, mutual engagement, and shared repertoire of resources. Hodkinson et al. (2008) and Lave and Wenger (1991) consider such learning as situated in activity.

Within a professional learning community, situated learning can result in the development of both professional knowledge (pedagogy) and professional identities (Lave and Wenger 1991). As such, my aim was to explore whether science teachers' professional identity might be influenced by experiences of professional development programmes as Lave and Wenger (1991) argue. According to Lave and Wenger (1991), learning within a community of practice, (professional learning community for teachers), creates knowledge of teaching and knowledge of identity. That is, "learning and a sense of identity are inseparable" (Lave and Wenger 1991: 115). A detailed discussion on this follows in chapter 2: 32. In this study, I foregrounded science teachers' professional learning.

Science teachers' learning during professional development within a professional learning community results in cognitive development, social interactions, and emotional changes. Illeris (2009) identified these dimensions of learning as content dimension (knowledge and skills), interaction dimension (social interactions), and incentive dimension (emotions and feelings). He argues that teacher learning may result in positive or negative outcomes depending on the tensions among these three dimensions. According to Wenger's (2009) social theory of learning, learning implies social participation and, as such, science teachers' learning in their professional learning community, involves cognitive development through

social interactions. Cognition and social interactions result in emotional changes as Geijssel and Meijer (2005) argue. From their perspective, emotions “have a key role” in the process of “identity learning” (Geijssel and Meijer 2005: 424) and as such, emotions as a dimension of experience, warrant equal consideration as cognitive development and social interactions in exploring science teachers’ professional identity as a result of learning. I refer to these experiences as dimensions of experiences, which align with three of the seven dimensions of experiences identified by McNally and Blake (2012) in their study of new teachers’ learning and which, Illeris (2009) argued in his seminal work on contemporary learning (further discussions in chapter 2: 32). Notably, McNally and Blake’s (2012) new teachers reported more experiences of social interactions and emotional changes than cognitive development.

In this study, I focused on, and interpreted science teachers’ narratives of their experiences of their professional development programme. Wenger’s (2009) social theory of learning within a community of practice guided my interpretations. In understanding science teachers’ experiences of their professional development programme, I gained insight into whether their professional identities were influenced by those experiences (Beijaard et al. 2000). As such, the objectives of this study incorporated the three dimensions of experiences which contributed to my definition of science teacher professional identity (Chapter 2: 32).

Teachers’ beliefs and their classroom practice are linked to professional identity. Marcelo (2009) and Luehmann (2007) have established that a direct relationship exists among teachers’ professional identity, their beliefs, and their classroom practice. Lamote and Engels (2010) argue that experience in practice indicates professional growth and a perception of teachers’ competence or efficacy. As such, I included insight into changes in beliefs and classroom practice as part of my research objectives. Of note is that I did not intend to evaluate the professional development programme itself, programme providers or participating teachers, but I set out to interpret and understand science teachers’ experiences. My main objectives, then, were to:

- Understand the science teachers’ perceptions of their professional identity prior to commencing their professional development programme
- Understand the overall experiences of the science teachers as they participated in the professional development programme

- Explore whether the science teachers applied their new knowledge and skills in their classrooms
- Explore whether the science teachers changed their beliefs and classroom practice as a result of their experiences
- Explore whether the science teachers' professional identities were influenced and reshaped by their experiences of their professional development programme.

Five supporting research questions that realised these objectives were:

- What were science teachers' professional identities prior to commencing the professional development programme?
- What did science teachers experience during the professional development programme in relation to their professional identity?
- To what extent did science teachers apply any new ideas they learnt in their classrooms?
- Are there changes in beliefs and classroom practice because of science teachers' experiences?
- Were science teachers' professional identities influenced by their experiences of their professional development programme?

## **1.5 Context of research**

Teacher training and excellence in the classroom in the province in Canada where this research was conducted has gained momentum since 2004 (Ministry of Education 2007). The Ministry of Education (2007; 2004) produced discussion papers which focused on the continuum of professional development for teachers at every stage of their career in its effort to support such an initiative. As such, ongoing professional development programmes, not new to the province, are now more effective (Ministry of Education 2004) for experienced teachers than they were previously. Such programmes focus on addressing teachers' needs as opposed to the "controlled PLP or Professional Learning Program unilaterally imposed" on teachers by the previous government (Ministry of Education 2004: 1). Of note is that the Ministry of Education governs all school boards in the province.

About 17, 000 teachers in the school board within which this study was conducted educate over 230, 000 students in 600 schools (The School Board, Anonymised 2014). In its initiative to enhance science teachers' knowledge in their subject areas and pedagogy, to cope with, and implement changes in STEM education, the school board has implemented coordinating job-embedded programmes for science teachers at all levels. Such job-embedded learning opportunities or professional development programmes, which are voluntary, take the form of various professional learning models (The School Board, Anonymised 2012). Professional development programmes, provided by the school board, depend on "system needs, teachers' interests, and current research and policy" (The School Board, Anonymised 2012: 4). Observation Classrooms, Student Engagement with Teachers, and Teacher Leadership are some of the professional development programmes provided. Each professional development programme comprised a number of modules as seen in Figure 1.1: 20.

\*

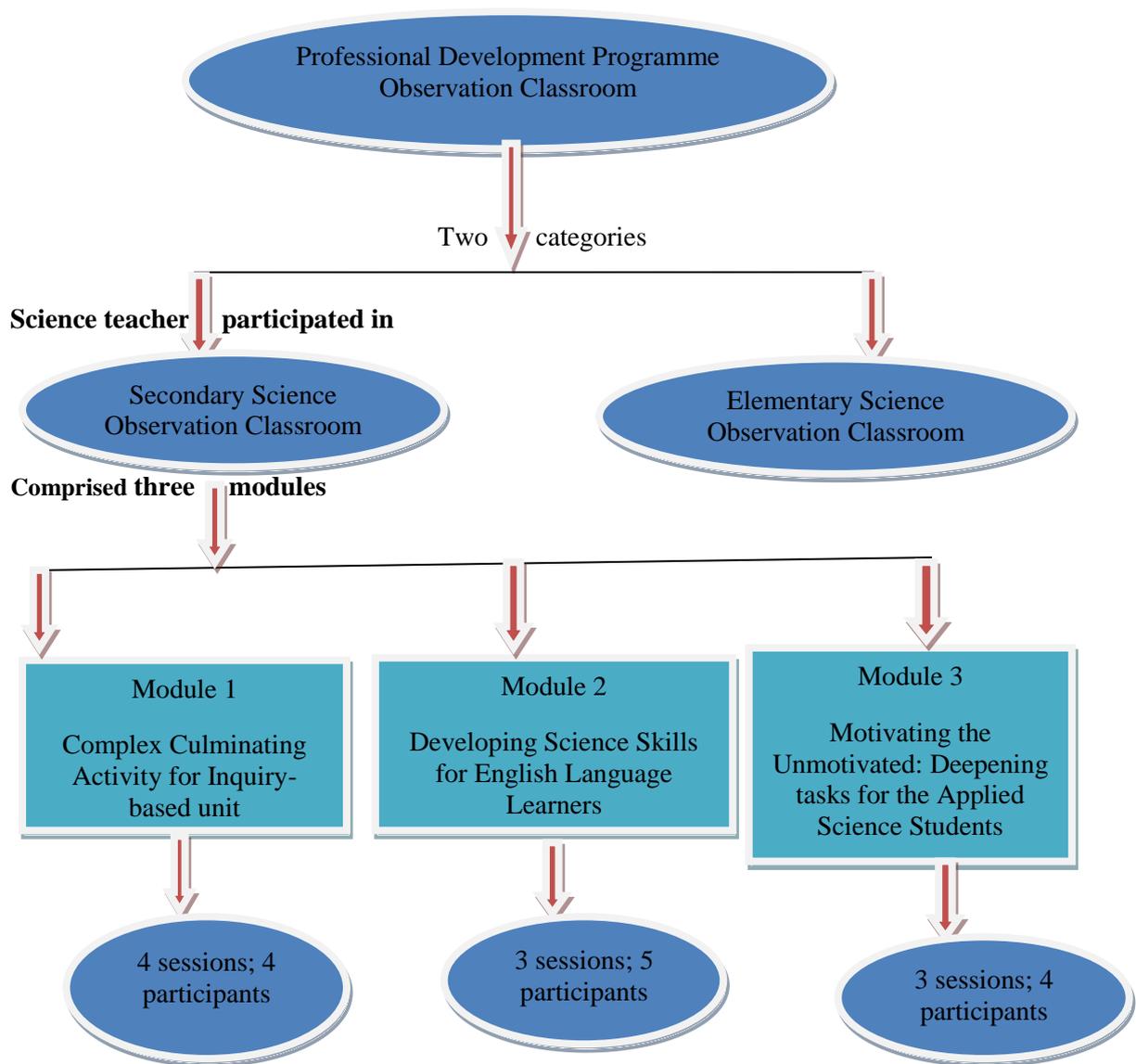


Figure 1.1: Representation of Professional Development Programme in this Research

\* The source of this diagram is original and entirely my own

The Observation Classroom programme in this research comprised two areas of learning – the Secondary Science Observation Classroom and the Elementary Science Observation Classroom. This study explored the professional identity of science teachers in terms of their experiences of The Secondary Science Observation Classroom programme. The professional development programme in which the science teachers participated explored and implemented curriculum and pedagogy within a professional learning community (The School Board, Anonymised 2012). Science teachers observed and collaborated with their peers and reflected on their thoughts and actions. The objective of each module was to “develop shared practice of observing, discussing, and analysing student learning as descriptive feedback to instruction” (The School Board, Anonymised 2012: 85). The science teachers attended 10 sessions in the professional development programme which commenced in October 2013 and ended in May 2014. During this time, science teachers engaged in collaborative discussions among themselves, with lead teachers, and with the Instructional Leader (IL). Both Modules 1 and 3 had two lead teachers who planned and delivered the sessions. Module 2 had one lead teacher who performed both duties.

I explored science teachers’ experiences to discover whether their professional identities could be influenced by such experiences during participation in the modules. My underlying purpose was to understand and make sense of science teachers’ experiences in terms of their cognitive development, social interactions, and emotional changes. Experiences such as these are the dimensions of experiences that I consider important to the reshaping of science teachers’ professional identity in this study.

## **1.6 My positionality**

I embarked on the journey as a researcher with pre-existing notions about science teaching and experiences of professional development programmes. I recognised my subjectivity as I conducted interviews, as I tried to understand not only science teachers' narrations of their experiences, but my observations as well. I extended awareness of my experiences to my analysis of the evidence and so I acknowledge and address my pre-understandings and positionality, which I discuss at length in section 3.5, in chapter 3. It is important for me to acknowledge my positionality in this study to ensure its ethical integrity, enhance the research process, analyse and interpret the evidence I obtained, and uphold its trustworthiness (Mosselson 2010; Bourke, Butcher, Chisonga, Clarke, Davies, and Thorn 2009).

## 1.7 My perspective on science teachers' professional identity

Enhanced learning may result from science teachers' experiences of their professional development programmes. Such learning may change beliefs and classroom practice thereby linking enhanced learning to changes in professional identities (Marcelo 2009; Luehmann 2007). Teacher professional identity and changes in beliefs and classroom practice are reciprocal (Marcelo 2009; Luehmann 2007). That is, as changes in beliefs and classroom practice occur, teacher professional identity is reshaped or, as professional identity is reshaped, changes in beliefs and practice occur. As such, throughout my study, I focused on the questions below to guide my thinking although, they do not supplement the supporting research questions.

- ▶ Can science teacher' professional identities be influenced by their cognitive development, social interactions and emotional experiences?
- ▶ Does the influence of science teachers' experiences depend on their professional identities at the start of the professional development programme?
- ▶ Can science teachers' experiences of their professional development programme change their beliefs about their professional selves and their classroom practice?
- ▶ Can changes in beliefs and classroom practice among science teachers result in changes in their professional identities?

I contend that professional identity is a "key factor" in determining science teachers' efficacy (Flores and Day 2006: 220) in science education reform initiatives. As such, commitment, motivation, and efficacy are linked to teacher professional identity (Marcelo 2009; Luehmann 2007; Flores and Day 2006; Day, Elliot, and Kington 2005). I argue that teacher commitment and efficacy, together with professional identities are crucial in science education reform since they influence how science teachers teach and how well they adapt to changes (Marcelo 2009; Day 2008). Teachers' commitment, then, is determined by their professional identity. Day (2008: 254) connects the who, what, and how of committed teachers when he describes committed teachers as those who:

have an enduring belief that they can make a difference to the learning lives and achievements of students (efficacy and agency) through *who* they are (their identity), *what* they know (knowledge, strategies, skills) and *how* they teach (their beliefs, attitudes, personal and professional values embedded in and expressed through their behaviours in practice settings) (Italics in text).

Furthermore, participating in a professional learning community contributes to the development of such committed teachers with professional identities that reflect their efficacy and agency (Luehmann 2007). As science teachers collectively make sense and meaning of the content they learn within a community of practice, they engage in a common practice (ten Dam and Blom 2006) which implies joint enterprise, mutual engagement, and shared repertoire of resources (Wenger 2010; 1998). As such, learning within a professional learning community can shape science teachers' professional identity and prepare them to cope with science education reform initiatives.

My perspective on the role of science teachers' professional identity in terms of their professional development and science education reform was informed by literature. I explore this perspective further in chapter 2. The Royal Society, UK (2014) predicted that focusing on enhancing science, technology, engineering, and mathematics (STEM) education through professional development would enable science teachers to deliver science lessons more effectively. Relatedly, Lumpe et al. (2012) and Marcelo (2009) argue that science teachers' enhanced subject and pedagogical knowledge can boost their confidence to try new ideas to challenge and inspire their students. Lumpe et al. (2012) and Tymms et al. (2011) argue that new found confidence, changing roles, and change in classroom practice among science teachers are a possible outcome of science education reform efforts. As a result, science teachers may emerge with different identities, which Day and Gu (2010) describe as positive teacher professional identity. They view such positive professional identities as a way to address the challenge of teacher classroom practice which is aligned with stakeholders' premise regarding science education reform. The success of reform initiatives, then, depends on science teachers assuming roles as change agents in science education reform processes (Moore 2007).

I propose several arguments to support my view that professional identities and professional roles influence actions in that one affects the other. I argue that: firstly, such professional roles influence actions and behaviours that reflect the objectives in science education reform initiatives. Secondly, the re-education of science teachers, through professional development programmes may contribute to their assuming such roles to enhance practice by inspiring their students and promoting student learning (Beijaard et al. 2000). Thirdly, changing roles may resonate with factors that contribute to the development of professional identities (Hoffman-

Kipp 2008). Fourthly, the concept of science teachers' roles as change agents in science education reform is a facet of their professional identity (Vloet and van Swet 2010; Lee and Luft 2008). Fifthly, changes in science teachers' beliefs of their professional roles and in their classroom practice can influence changes in their professional identity (Marcelo 2009). Lastly, a change in professional identity may lead to a change in beliefs and classroom practice. I believe that ultimately, science teachers' professional identity is important in influencing their motivation and efficacy, and determines the actions they take.

## **1.8 Key terminologies**

I utilised several terms throughout this thesis in order to elucidate arguments, perspectives, and discussions. As such, they warrant clarification.

### **Agency**

For teachers, agency implies the power, knowledge, and influence they require to make classroom decisions and to transform their practice (Beijaard et al. 2004). Day et al (2009: 49) summarise teachers' "sense of agency" as being:

developed when an individual feels able to pursue their goals within the context of positive and negative interactions within and between internal, situated (e.g. colleagues, school context, leadership) and personal (e.g. health, family) factors, and external, professional factors (e.g. workload, career structure).

Priestley, Biesta, and Robinson (2012: 3) regard agency as "a quality of *engagement* of actors with temporal-relational contexts-for-action", not as a way to describe the actors. They argue that teacher agency is due to past knowledge and experiences which motivate future actions to cope with the demands of their profession. In this study, science teacher agency depended on their learning, experiences, and the drive to transform their classroom practice as a result of their professional identities.

### **Beliefs**

Teachers' beliefs are conceptualised in the essence of their teaching based on their past experiences in learning, their emotions, and the results of changes. Teachers' beliefs are shaped by their personal experiences, formal knowledge, and the school and classroom (Marcelo 2009). Accordingly, when teachers "are performing professional development activities" their beliefs "affect the interpretation and importance" they "attach to their education experiences" (Marcelo 2009: 13).

### **Change agents**

Change agents are teachers who act as catalysts to develop and improve their classroom practice through knowledge and social interaction. Fullan (1993: 4) considers teachers who are life-long learners, and are "able to stimulate students to be continuous learners", as change agents.

### **Change in professional identity**

Change in professional identity can occur as a result of changes in learning, social relationships, emotions, and beliefs (Marcelo 2009; Luehmann 2007). When change in professional identity occurs as a result of novice teachers undergoing initial teacher training, it is referred to as construction of professional identity (Etelapelto et al. 2014). When in-service teachers undergo professional development, their professional identities are either shaped or negotiated as a result of their experiences of their professional development measures (Etelapelto et al. 2014). Throughout this thesis, I align with Etelapelto et al. (2014) in referring to changes in science teacher professional identity as either shape(d), reshape(d), negotiate(d), or renegotiate(d).

### **Dimensions of experiences**

Illeris (2009) describe teacher learning as comprising cognitive development, social interactions, and emotional changes. Mc Nally and Blake's (2012) and McNally, Blake, Corbin, and Gray's (2008) seven dimensions of learning for new teachers informed the utilisation of the expression dimensions of experiences in this study. I explored three of the dimensions of experiences namely cognitive development, social interactions, and emotions (Illeris 2009), which I adopted for in-service science teachers' professional identity development, from the perspective of their experiences of their professional development programme within a professional learning community.

### **Efficacy and science teacher efficacy**

Efficacy implies the power to produce a desired result. When applied to teachers and schools, efficacy is denoted as teacher efficacy. Teacher efficacy is the power teachers have to produce the desired result in student achievement. Canrinus, Helms-Lorenz, Beijaard, Butink, and Hofman, (2011b: 119) consider "teachers' self-efficacy" as a factor that "contributes to teachers' occupational commitment". A decade earlier, Tschannen-Moran and Hoy (2001) identified two facets of teacher efficacy – teachers' beliefs in students' abilities and teachers' beliefs that students can learn from them. When applied to science teachers, efficacy implies that they believe in their students' abilities to excel in science, and in the students to do so under their instructions. Such an implication reflects teachers' commitment to which Canrinus et al. (2011b) refer in their discussion on teacher efficacy.

### **‘Interpretive’ and ‘Qualitative’ Research**

Although expressions such as ‘interpretive’ and ‘qualitative’ can be used interchangeably to describe a research paradigm, I use ‘interpretive’ research to describe the paradigm and ‘qualitative’ to describe the research process as I write my thesis because my study involved a significant degree of interpretation while I treated the analysis and findings qualitatively.

### **‘Languaged Data’, ‘Evidence’, and ‘Data’ obtained**

My study involved use of “languaged data” which Polkinghorne (2005: 137) describes as words and descriptions. Interviews and written accounts represent ‘languaged data’ which were analysed to provide a body of descriptions of science teachers’ experiences of their professional development programme (Polkinghorne 2005). As such, I refrained from using the expression ‘data collected’ in my study. I conducted an interpretivist/social constructivist study which focused on the interpretation of science teachers’ descriptions of their experiences. These descriptions are ‘languaged data’ in my thesis and are referred to as ‘evidence’ rather than ‘data’.

I utilised the terms ‘evidence’, ‘evidence obtained’, and ‘obtaining evidence’ instead of ‘data’, ‘data collected’ and ‘data collection’ whenever I discuss interviews and written texts. Burn (2007: 451) describes the conversations of student teachers as “direct evidence” and her interviews with them as “indirect evidence” in her study. Hart (1998:88) referred to “evidence (data)” to consider in making claims. Methodological approaches such as action research (Burn 2007) or phenomenology as I have utilised, are interpretive in nature and sought ‘languaged data’ (Creswell 2009). More recently, Craig (2013: 28) used the term “evidence” to describe the “data” collected in her study. I align with Craig (2013), Burn (2007), Polkinghorne (2005), and Hart (1998) in choosing to describe science teachers’ descriptions of their experiences as ‘evidence’ in my study.

### **Math, Maths, and Mathematics**

Mathematics is referred to in North America as Math whereas it is Maths in the UK. I elected to use the term mathematics.

### **Narrative**

Narrative, accounts for connected events or tells a story. The connected events are organised in a temporal-spatial sequence to tell a story of participants’ meaningful experiences.

### **Professional identity**

Several thoughts on professional identity influence my concept of it. Wenger (2010: 5) views identity “as a journey through landscapes of practices” in which competence, relationships, emotions, and stories come together to shape “the trajectory going forward”. Identity is the trajectory and it is the “nexus of multimembership” (Wenger 2010: 5). Professional identity of teachers, according to Marcelo (2009: 9) is “how teachers define themselves and others” and it evolves over time. Marcelo (2009) follows other researchers (Beijaard et al. 2004; Beijaard 2000: 9) in defining professional identity of teachers as the result of “interpretation and reinterpretation of experiences”. Professional identity can be viewed as fluid and in a state of flux due to its liquidity.

### **Restorying**

Restorying is the process by which a story is rewritten to link ideas. The rewritten story and themes arising out of a story depict a “general framework” (Creswell 2006: 56). Restorying is in the form of narratives. In this study, I restoried science teachers’ narratives as a way of portraying their professional identity prior to the study.

### **Science Teachers**

Educational debates centred on curricular areas of science education consider those who teach biology, chemistry and physics as well as technology and mathematics as science teachers (The Royal Society 2014; National Science and Technology Council, USA 2013; AMGEN Canada 2012). In my study, I focus on teachers who teach biology, chemistry, integrated science and physics in secondary schools. In my thesis, I refer to such a group of teachers as science teachers.

### **Triple Hermeneutics**

Analysis of a person’s life world involves “triple hermeneutics” (Carpenter 2009: 2). It involves three levels of interpretation: participants interpreting questions asked of them, researchers utilising participants’ descriptions to interpret their life world, and the researcher inferring participants’ unspoken meanings from their words.

## **1.9 Structure of thesis.**

This thesis comprises six chapters of which chapter one sets the scene for the other five. Stakeholders' concerns about the state of science education sparked my interest in conducting this research. The main question, purpose, objectives, and the context of the research discussed in chapter one were set out to show the steps I intended to take to address those concerns. As such, chapter one provides a backdrop for my thesis. I proceed to chapter two where I discuss arguments in the literature to justify my research question. I begin chapter two by exploring contemporary conceptions of teacher professional identity as I focus on assumptions identified by Rodgers and Scott (2008). These assumptions influenced my perspectives on characteristics of identity (Akkerman and Meijer 2011), and dimensions of experiences identified by McNally and Blake (2012), Illeris (2009), Geijsel and Meijer (2005), Wenger (1998), and Lave and Wenger (1991), based on teacher learning. To expand on my concept of science teacher professional identity, I formulated a definition of science teacher professional identity that framed and informed my study. My definition of science teacher professional identity guided my analysis of science teachers' narratives of their experiences of their professional development programme.

Continuing on in chapter two, I focus on arguments on teacher learning and professional identity in support of my research question. I review debates and studies centred on the development of teacher identity to situate my study in the literature, in terms of theoretical frameworks, methodologies, and findings, and to compare my findings with them. Lastly, I formulate the theoretical framework that underpinned this study. The theoretical framework focused on Wenger's (1998) community of practice. I approach this theoretical framework from a sociocultural perspective to situate science teachers' learning within their professional learning community. As such, sociocultural theories elucidated how learning by the science teachers can result in cognitive development, social interactions, and emotional changes (dimensions of experiences) as they participate in a professional development programme. My choice of theoretical framework, together with the research question, determined my methodological approach.

I discuss my methodological approach of this research in chapter 3 as, firstly, I present my research paradigm from which unfolded my ontological and epistemological assumptions. These assumptions justify my methodological approach of hermeneutic phenomenology. The

framework of my research methodology, based on the theoretical framework, research paradigm and methodological approach, informed my research design. The research design involves: identifying the evidence required to address the research question, the research methods and tools required to obtain evidence, ethical considerations, trustworthiness, and the pilot study, adjustments to the tools and research process, sample selection process, and the method of obtaining evidence. I explain the coding process during the analysis, which reflects the tenets of interpretive phenomenological analysis (Smith and Osborn 2008) and qualitative analysis of the questionnaire (Jansen 2010). Having obtained and analysed the evidence, I present my findings in chapter four based on the themes that reflect the dimensions of experiences. I draw on science teachers' narratives to support and add to the richness and rigour of my findings. Narratives illustrate science teachers' experiences which I compare to identify common themes.

In chapter five, I analyse my findings based on theoretically informed discussions. I draw on the theoretical framework and literature to explore the supporting research questions. Among those in the literature that guided my discussions were works by Beauchamp and Thomas (2009); Beijaard et al. (2004); Bukor (2014); Day and Kington (2008); Day et al. (2009); Etelapelto et al. (2014); Luehmann (2007); Marcelo (2009); Reio (2005); Rodgers and Scott (2008); Shapiro (2010); Vähäsantanen, Hokka, Etelapelto, Rasku-Puttonen, Littleton (2008); Wenger (1998; 2010; 2012); and Zembylas (2005; 2003). The themes I identified during analysis are discussed and related to the theoretical framework. Subsequently, I illustrate my perception of science teachers' professional identity that I gleaned from my findings. In the concluding chapter I evaluate my findings and highlight the implications of this research in terms of renegotiation of science teachers' professional identity in light of science education reform initiatives. Concurrently, I evaluate my study in terms of theory and methodology, and I identify limitations of the study. Finally, I discuss my recommendations, identify areas for further research as a way forward, and reveal my final thoughts.

## **Chapter 2: Review of the Literature**

In introducing this thesis, I observed that science teachers' professional identity was foregrounded in studies on re-education of science teachers as a science education reform initiative. Yet there is no consensual definition of teacher professional identity in the literature (Beauchamp and Thomas 2009; Rodgers and Scott 2008; Beijaard et al. 2004). Akkerman and Meijer (2011) and Beijaard et al. (2004) are among researchers who have noted that the role of teacher professional identity in the classroom or in reform initiatives, has not been clarified. As such, it is necessary not only to develop a definition for teacher professional identity, but to understand how it is influenced during professional development and its role in reform initiatives (Rodgers and Scott 2008; Flores and Day 2006).

A number of researchers and theorists regard the re-education of science teachers as a viable science education reform initiative. Avraamidou (2016), Day and Gu (2010), Marcelo (2009), Rodgers and Scott (2008), and Day, Stobart, and Sammons (2006c) argue that such an initiative would address the challenge of classroom practice. They argue further that it would enhance teacher learning, which in turn can not only reshape their professional identities, but would provide agency to change their classroom practice. Avraamidou (2016) predicts that professional identity, due to such reform initiatives, together with science teachers' agency, can result in positive outcomes for success. Findings from research in this area can inform the science teaching community about the dynamics of science teachers' learning, their professional identity, and their agency in the classroom with respect to science education reform initiatives. An understanding of the relationship between science teacher professional identity, their agency, and their role as change agents is warranted at this point.

### **Science teacher professional identity, agency, and change agents**

Science teachers' professional identity stems from their self-concept, their visions of themselves, and their peers' views of them. Construction and reconstruction of past and present experiences (Beijaard et al. 2004), as well as their learning, social relationships, emotions, and beliefs (Marcelo 2009; Luehmann 2007) form teachers' professional identity. The relational aspect of teacher professional identity together with the social learning that occurs during professional development which are contextual, results in multiple identities for each science teacher. Together, they explain the characteristics of teacher professional identity (multiplicity, discontinuity, and relationality). In this way, science teachers' professional identities are

reshaped during professional development, which can result in a degree of professional agency (Day et al. 2009).

Professional agency does not define science teachers. It reveals their “quality of *engagement...with temporal-relational contexts-for-action*” (Priestley et al. 2012: 3). Science teachers’ past knowledge and experiences influence their future actions and together, they contribute to teachers’ concept of their agency. Day et al. (2009: 49) summarise teachers’ “sense of agency” as their perceptions of their abilities “to pursue their goals within the context of their situated...and personal...factors, and external, professional factors”. Science teachers’ situated factors represent their classrooms and colleagues in the science department; their personal factors represent their families and well-being; and their external, professional factors represent their career goals and teaching duties. Science teachers’ agency, then, is described as the initiatives they take to influence and bring about positive changes in science instructions in their classrooms (Moore 2007).

Science teachers with the agency to enact instructional improvements in their classrooms through knowledge and social interactions, then, are referred to as change agents. Change agents are life-long learners who are “able to stimulate their students to be continuous learners” (Fullan 1993: 4). It is their vision of what science teaching is all about. The degree to which science teachers act on their vision depends on their negotiated professional identity, the extent of their agency, and their perspectives (Moore 2007). In an era of science education reform, initiatives made available to science teachers should take into account their negotiated identity (multiple professional identities), their agency, and their perspectives as change agents.

In this chapter, I discuss existing literature on identity, professional identity, teachers’ professional identity and science teachers’ professional identity to justify the research question. Accordingly, I explain and define these concepts as I develop a definition for science teacher professional identity appropriate for my study. I then focus on, and critically analyse the outcomes, methodologies, and theories of previous researches on teachers’ and specifically, on science teachers’ professional identity. Such analyses and debates relating to teachers’ professional identity, provide insights into science teachers’ professional identity and situates my study in literature. Lastly, I discuss the theoretical framework underpinning my study. But, I begin this chapter with an overview of my literature search.

## **2.1 Strategy in literature search**

I present an overview of the literature search and selection criteria utilised in selecting the studies that I identified and interrogated for review in this chapter. The research question was: Can secondary school science teachers' professional identity be influenced and reshaped by their experiences of their professional development programmes? A comprehensive search of studies with the potential to elucidate the various aspects of science teachers' professional identity was initiated by using databases, search engines and a set of search terms that were defined by the research question and supporting questions in chapter one. A systematic literature search using electronic databases initially involved the use of two institutional bodies: The University of Derby and the Ontario College of Teachers. The British Education Index (BEI) was accessed from the University of Derby. The Ontario College of Teachers allowed access through the Elton B Stephens Company (EBSCO), to the Academic Search Complete (ASC), Canadian Reference Centre (CRC), Education Reference Complete (ERC), and the Education Resource Information Centre (ERIC). Further literature search was conducted through these institutions using electronic journal services which allowed access to journals such as Educational Leadership, School Effectiveness and School Improvement, British Journal of Educational Research, The Canadian Journal of Educational Administration and Management, and School Leadership and Management, to name a few. Citations from other sources, Google Scholar search engine as well as other websites, were also used where appropriate.

### **Search Terms**

The search terms used were directly related to identity, professional identity, teachers' professional identity, secondary school teachers' professional identity, and science teachers' professional identity. The terms were: Identity, identity in education, identity in secondary education, secondary school teacher professional identity, science teachers' professional identity, teachers' beliefs, identity and professional development, teacher professional identity and school reform, teacher identity and student outcomes.

### **Selection Process**

The selection process involved a series of steps in which the title and abstract of each publication were checked against the search term and the research question to determine its

inclusion in the collection of studies harvested. This systematic search process was initiated at the start of the PhD programme in 2011 and continued until 2013. Literature search after this period was mainly via Google Scholar. There was an overwhelming proliferation of literature resulting from the period 1975 to 2013 in each institution with a total of 67, 978 from the University of Derby and 43, 770 from the Ontario College of Teachers. I decided to limit the search within the timeline of 2006 to 2013 in order to obtain the most recent results in each case, as well as having a more manageable number of studies. The yield resulting from the University of Derby was 6, 755. It was not an easy task to eliminate the earlier studies from the Ontario College of Teachers library.

Compounding the situation of the large number of publications, was the number of duplications among databases within each institution and between the two institutions. About 5% of the studies between 2006 and 2013, which amounted to 367 publications, were selected from the University of Derby whereas 0.2% or 84 of the 43, 770 articles were selected from the Ontario College of Teachers library. The publications selected were obtained from several databases associated with each library and are listed in tables 2.1 and 2.2 on pages 36 and 37 respectively. Each table illustrates the distribution of articles per search term for each database, the possible number of articles identified and chosen, and the percent of those chosen.

### **Selection Criteria to Short List Publications**

The 367 publications from the University of Derby databases and the 84 publications from the Ontario College of Teachers databases were sorted and classified into genres of studies such as ‘science’ and ‘non-science’ related; ‘most recent (2011 to 2013)’; and older but from ‘frequently cited authors’. Each genre of study was interrogated using the selection criteria as shown in Table 2.3 as a matrix (page 37) for convenience and facilitation in analysis during the short listing process. This process was continuous. The short-listed publications were utilised in the definition of science teachers’ professional identity (section 2.2), situating this study in the literature (section 2.3), in discussing the theoretical framework of this study (section 2.4), and in chapter 5 to discuss findings.

**Table 2.1: Search Results from the University of Derby Digital Library**

<b>Search Terms</b>	<b>Results (#of Articles 1975 - 2013)</b>	<b>Databases</b>	<b># Possible Articles (2006 – 2013)</b>	<b>Number Chosen</b>	<b>% Articles Chosen</b>
Identity	3483	British Education Index (BEI)	2242	-	-
Identity in Education	2808	BEI	1955	-	-
Identity in Secondary Education	587	BEI	415	-	-
Teachers' Professional Identity	511	BEI	389	52	10
Secondary School Teacher Professional Identity	73	BEI	61	13	18
Science Teachers' Professional Identity	19	BEI	9	6	32
Teachers' Beliefs	941	BEI	593	123	13
Identity and Professional Development	336	BEI	263	46	13
Teachers' Professional Identity and School Reform	23	BEI	14	6	26
Teacher Professional Identity and Student Outcomes	13	BEI	11	4	31
Search Terms Above	803	ELSEVIER	300	32	4
		EBSCO	190	64	8
		ERIC	313	21	3

**Table 2.2: Search Results from Ontario College of Teachers Digital Library**

<b>Search Terms</b>	<b>Results (# of Articles)</b>	<b>Databases*</b>	<b># of Possible Articles</b>	<b>Number Chosen</b>	<b>% Articles Chosen</b>
Professional Identity of Secondary School Science Teachers	43, 770	CRC	324	2	0.2
		ERC	5	4	0.4
		ASC	26,613	26	3
		ERIC	860	37	4
		EBSCO	15,968	15	1.7

\*Canadian Reference Centre – CRC

Education Research Complete – ERC

Academic Search Complete – ASC

Education Resource Information Centre – ERIC

Elton B. Stephens Company – EBSCO

**Table 2.3: Matrix of Selection Criteria vs Title of Publications**

<b>Title of Publication</b>	<b>Selection Criteria</b>									
	<b>Focus on Secondary School science</b>	<b>Focus on other subject areas</b>	<b>Time line: 2006 - 2013</b>	<b>Purpose and Research Question</b>	<b>Context</b>	<b>Literature Review</b>	<b>Research Method</b>	<b>Clearly laid out Evidence and Analysis</b>	<b>Implications</b>	<b>Contributions to my Research</b>

In the next part of this chapter, I focus on concepts such as self, identity, and professional identity to define science teacher professional identity. I explored the four contemporary conceptions of teacher professional identity that Rodgers and Scott (2008) identified which informed my perspectives on characteristics of identity (Akkerman and Meijer 2011). These conceptions are:

- Identity is dependent upon and formed within multiple *contexts* which bring social, cultural, political, and historical forces to bear upon that formation
- Identity is formed in *relationship* with others and involves *emotions*
- Identity is *shifting, unstable, and multiple*
- Identity involves the construction and reconstruction of meaning through *stories* over time (italics theirs) (Rodgers and Scott 2008: 733).

## **2.2 Self, identity, and professional identity**

Several factors determine how researchers think about ‘self’, ‘identity’, and by extension, professional identity. According to Jenkins (2008) and Gee (2001), the exponential growth in cultural and racial diversity, rapid advances in science and technology, global communications, global recognition due to travel, and communications such as social media are some of the factors that influence the ways in which ‘self’ and ‘identity’ are viewed. Undoubtedly, a relationship exists between ‘self’ and ‘identity’ although there is no clear distinction between the two concepts (Monrad 2013; Leary and Tangney 2012; Jenkins 2008; Rodgers and Scott 2008). Oyserman, Elmore, and Smith (2012) argue that thoughts of self, self-concept, and identity are influenced by contextual factors. They regard ‘self’, self-concept and ‘identity’ as “nested elements” (Oyserman et al. 2012: 74) which, they explain, comprise sense of self and identity, which are part of self-concept, and which are the mental images people have of themselves. Gee (2001), on the other hand, argues that ‘self’ and ‘identity’ can connote different meanings, while Day et al. (2006c) maintain that ‘self’ and ‘identity’ are interchangeable and Jenkins (2008) posits that ‘self’ represents aspects of ‘identity’. The relationship and lack of distinction between the concepts of self and identity make it difficult to formulate a definition of either concept.

Despite the lack of a consensual definition of ‘self’, certain commonalities of ‘self’ can be seen among those put forth by researchers. I regard teachers’ ‘self’ as the impression they convey, the roles they assume as teachers, and their memberships within teaching communities. Leary and Tangney (2012) and Jenkins (2008) consider ‘self’ to be contextual and argue that a person’s sense of ‘self’ reflects their experience, perceptions, thoughts of the world and about themselves, and how they regulate their behaviour. Relatedly, Jenkins (2008: 59) finds it difficult to separate ‘self’ from the ‘person’ easily since he thinks it is “implausible” to imagine “identity without selfhood”. He describes the ‘self’ from a reflexive perspective as unitary selfhood. Monrad (2013), on the other hand, argues that ‘self’ reflects relationships and social structure and therefore ‘self’ comprises identities. The common thread that runs through these thoughts are context, relationships, and perceptions and they inform my understanding of self. Such an argument accounts for the multiple conceptions of identity and its relationship to ‘self’.

Science teachers' sense of 'self' during learning, determines how they make sense of their experiences, and the professional choices they make, which reflect their professional identity. The 'self' can ground science teachers and motivate them to learn (Oyserman et al. 2012) during their professional development. I maintain that within the society of a professional learning community, science teachers' sense of self influences their professional identity and their professional identity influences their learning. In a learning situation, science teachers' sense of self and identity can be shaped as they reflect on and react to their experiences and social interactions within the changing context of their professional development programme. A change in context (situations during professional development) causes 'self' and its 'identity' to intertwine to form the 'self', which is central to determining teacher professional identity argue Leary and Tangney (2012), Oyserman et al. (2012), and Jenkins (2008). In the same vein, social interaction, reflection, and language can result in 'self' and society influencing each other (Monrad 2013; Oyserman et al. 2012; Stets and Burke 2005). At a broader level, the professional learning community influences science teachers' sense of self while individual science teachers' selves can influence their professional learning.

Science teachers' professional identity, which is a "multidimensional and comprehensive construct" (Avraamidou 2016: 3), can be viewed either from the perspective of institutionalism or from individualism. Gee (2001) approaches his argument about identity from the perspectives of both institutionalism and individualism. From the perspective of institutionalism, he sees identity as stable and consistent, while from the perspective of individualism, he sees identity as subjective and therefore potentially multiple. Jenkins (2008), on the other hand, perceives identity as evolving from being stable and consistent, to being fragmented and individualised. As science teachers interact with and interpret their world (professional learning environment), their professional identity can become fragmented and therefore individualised (Day et al. 2009). Like Jenkins (2008) and Gee (2001), I believe that fragmented identities may lead to multiple identities and as such, I view the characteristics of science teacher professional identity as multiple, discontinuous, and relational, although aspects of singularity, continuity, and individuality exist. I argue, then, that these characteristics of science teachers' professional identity result from what they learn (cognitive development), with whom they interact during learning (social interactions), and the emotional fallout (emotional changes) from experiences of learning and interacting.

### **Characteristics of professional identity**

As such, experiences of learning and interacting can influence and reshape science teacher professional identity since each new learning situation can lead to changing characteristic. As teachers interact socially they become part of the history, politics and culture which describe their identities (Rodgers and Scott 2008) and which explain characteristics of professional identity. By arguing that science teacher professional identity becomes discontinuous with contextual changes leading to multiple identities, and that it is relational when they interact with their peers, I demonstrate how they acquire multiple identities. As contexts and relations change, science teachers experience emotions, which reflect those changes and account for the emotional dimension of their identities (Rodgers and Scott 2008). As such, various emotions result because of changing contexts and interactions. As science teachers collaborate and interact with their peers in a professional development programme, they assume various roles as they share their expertise or experiences (Jenkins 2008; Rodgers and Scott 2008). In the process, they individually and collectively verify their identities (Jenkins 2008), and may acquire several identities, which can change as they learn, interact, and react within the context of a professional development programme.

Evidence of the importance of context when considering characteristics of identity, is observed in Gee's (2001) concept of professional identity. Using identity as an analytic lens for research in education, Gee (2001) focuses on the contextual ways in which people behave and recognise identities. He contends that changing contexts result in multiple identities, which are connected to performances. He views identity in four ways: as nature, institution, discourse, and affinity, all of which co-exist in a given context or across contexts and are interwoven as one acts within a specific context. In applying Gee's (2001) argument, science teachers' nature identities can be defined at the start of a professional development programme, while their institutional identities can be defined as they respond to institutional authority laid down by the professional development providers. Similarly, their discourse identities may develop as they engage in discourses with their peers during their learning activities, while their affinity identities may develop as they interact, share ideas, and learn. These identities situate science teachers as members of an affinity group (science teaching community) engaged in learning within a professional learning community (Gee 2001). Such distinct identities in a professional learning community constitute science teacher professional identity (Wenger 2010).

While I recognise the concept of duality of identity (multiple and unitary) in my study, I focus on these changing identities which exhibit characteristics of multiplicity, discontinuity, and relationality. Multiplicity of identity can result as science teachers become experts in general subject knowledge, specific subject knowledge, or pedagogy as a result of their learning. Such expertise can be regarded as boundary-crossing. As Wenger (2010: 6) argues, multiplicity of identity occurs as one travels across “boundaries” in the “landscape of professional practice”. Others have supported the concept of multiplicity of identity, albeit in different ways. For example, Beijaard et al. (2004) describe professional identity of teachers as the sub-identities teachers acquire due to different contexts and relationships. The teachers in Beijaard et al.’s (2000) study view themselves as experts in subject knowledge, pedagogy, and didactics. Such forms of identity or sub-identities imply multiplicity (Sutherland, Howard, and Markauskaite 2010; Beauchamp and Thomas 2009; Rodgers and Scott 2008; Beijaard et al. 2004). Avraamidou (2016: 3) regards multiplicity of identity as a “comprehensive construct that provides a useful analytical tool for examining science teacher learning and development”.

Teachers’ professional identity, then, becomes a function of the interaction of their sub-identities, or of the effect of one sub-identity over the others (Day et al. 2009). The interaction of teachers’ professional, situational, and personal identities (Day and Kington 2008) may result in one of four possibilities. If an imbalance exists among the three identities, roles and expertise can change, which can result in four types of professional identities – unstable and positive (multiple), stable and positive (unitary), unstable and negative (multiple), and stable and negative (unitary) (Day et al. 2009; Day and Kington 2008). These are the sub-identities that determine teacher effectiveness and resilience (Day et al 2009), and I argue, multiplicity of identity during learning.

Teachers’ professional identities may reflect the qualities of a good teacher based on governing policies and social expectations (Mockler 2011; Day and Kington 2008). Their situated identities may reflect their positions within their schools, subject departments and classrooms, and their professional learning community (Mockler 2011; Wenger 2010; Day et al. 2009) while their personal identities may stem from their lives outside the school due to family and social relationships (Burke and Stets 2009; Day and Kington 2008). These different sub-identities converge to define science teachers during learning depending on their contexts. As Day et al. (2006c) argue, multiplicity of identity does not occur solely as a result

of changing roles and expertise of teachers. Although to them, 'self' and 'identity' are neither stable nor unstable, they cannot say whether identity changes as a result of changes in roles and expertise.

Different contextual circumstances lead to discontinuity in teacher professional identity (Leary and Tangney 2012; Jenkins 2008). Such discontinuities, which occur due to teachers' culture, common interests, relationships, and emotions, can be shifting and fluid (Akkerman and Meijer 2011), and may interact with each other (Flum and Kaplan 2012). Personal, political, and professional lives often overlap and interact actively because of changing circumstances (Mockler 2011) such as participating in a professional development programme. Science teachers' reactions to such circumstances can result in a series of interpretations and reinterpretations of experiences (Beijaard et al. 2004), or a "construction and reconstruction of meaning" (Rodgers and Scott 2008: 733) during learning. In this way, teachers cope with contextual and institutional changes (Mockler 2011; Beauchamp and Thomas 2009; Rodgers and Scott 2008) leading to changes in professional identities. I concur with Beauchamp and Thomas (2009) as I argue that when science teachers interact within a professional context such as learning in a professional learning programme, their professional identities are shaped and reshaped. The implications are that such constructions and reconstructions of meanings, through action and reflection among science teachers, can result in discontinuity of identity.

As teachers participate in a professional development programme, they may exchange ideas, share artefacts, and behave in a manner defined by their professional learning community (Wenger 2010). Such actions reflect relationality and the social nature of identity because social interactions contribute to identity development (Wenger 2010; Burke and Stets 2009; Rodgers and Scott 2008; Gee 2001). Researchers have argued that social interactions are pivotal to the development of a teacher's professional identity (Cohen 2010; 2008; Billet and Pavlova 2005). Teachers "can construct and sustain identities through discourse and dialogue" which represent their "D-Identities" or identities due to their relationality or social interactions (Gee 2001: 103).

The three characteristics of professional identity are interrelated and influence each other. New professional identities (multiplicity) are formed (discontinuity) due to changing contexts and social interactions (relationality). A change in any characteristic influences a change in

the other two. These characteristics surface as a result of science teachers participating in collaborative professional development programmes such as the professional learning community in this study. During learning, science teachers experience what McNally and Blake (2012) refer to as the dimensions of experiences during professional development. Experiences such as these result in multiplicity of identities, discontinuity of identity due to changing circumstances, and relationality as a result of social interactions during learning. I consider these three dimensions of experiences as the main contributing factors that establish the characteristics of professional identity and therefore as the factors that influence and re-shape the professional identity of science teachers in this study.

### **Dimensions of experiences and identity**

To reiterate, dimensions of experiences, such as cognitive development, social interactions, and emotional changes, shape professional identities during staff development initiatives (McNally and Blake 2012; Illers 2009; Wenger 1998). As teachers learn within a professional learning community, they may share ideas, collaborate, and develop common behaviour through social interactions (Wenger 2010; 2009; 2000). They also learn from more informed others (Vygotsky 1978), and engage in dialogue (Hermans 2001). The outcome of the learning process may be cognitive development and new relationships. As learning occurs, science teachers engage in discussions and “use of tools...consistent with the practices of the community” (Scott and Palincsar 2013: 4), as Wenger (1998) argues in his discussions of professional identity within a community of practice. According to Wenger (1998: 215) “learning transforms who we are and what we can do” and so, “it is an experience of identity”. Consequently, science teachers’ professional identities may be defined by common practices and behaviours unique to their professional learning community so that they can be recognised as specific types of teachers (Wenger 2010; Gee 2001) thereby contributing to their multiple identities.

I argue that cognitive development (subject and pedagogical) and social interactions (collaborations and sharing) lead to emotional changes (feelings of happiness, regrets, pride), which influence identity. Both theoretical and empirical literature support this argument. Zembylas (2005; 2003) regards emotional changes as significant in teacher learning and identity formation, while Hodgen and Askew (2007) consider them as major in some cases. As “emotions and cognition are intricately linked” (Hobbs 2012a: 719), teachers interact to

become specific teachers adding to their multiple identities. As such, “the social context of learning to teach can evoke positive and negative emotions” (Timoštšuk and Ugaste 2012: 423) which also contributes to multiple identities. These three dimensions of experiences are therefore pivotal in the development of teachers’ professional identity during professional development in that they promote the characteristics of multiplicity, discontinuity, and relationality. Science teacher professional identity can be considered as a construct of the subject and grade level they teach (cognitive development), their professional interactions (social interactions), and their emotions due to their professional involvement (emotional changes), which position them within their professional learning community and the wider educational community.

### **Definition of science teacher professional identity**

Conceptualisation of teacher professional identity in a study depends on the theoretical framework that underpins that study. My interpretation informs me that teacher professional identity is defined in terms of their knowledge, interactions, emotions, and beliefs. In their survey of the literature, Beijaard et al. (2004) found a variety of descriptions of teachers’ professional identity, each of which connotes a different meaning with no specific relationship between identity and self. For instance, teacher professional identity can be described in terms of their expertise of subject knowledge, pedagogy, and didactics as in the study by Beijaard et al. (2000). Another perspective is that of relationships and emotions that Rodgers and Scott (2008) utilised to describe teachers’ professional identity in terms of relationships, multiplicity and emotions, and the context that influence such identities. A third example is seen in the study by Day et al. (2009), who approached their study from the perspective of teachers’ personal, professional, and situated lives. While each description of the concept of teacher identity cited here touches on various ways in which one can assess teacher professional identity, no specific framework with any of them in mind or in the literature fitted the purpose of my study.

Each framework, on its own, did not address fully, my research question. It was crucial, then, that I included various aspects of these frameworks to evaluate science teachers’ professional identity from the perspective of their experiences. As such, in defining science teacher professional identity in this study, I focused on science teachers’ lived experiences as they participated in their professional development programme (Wenger 1998). These experiences

resulted in the multiplicity, discontinuity, and relationality that characterised their professional identity (Akkerman and Meijer 2011).

The interrelated multiplicity, discontinuity, and relationality (characteristics of professional identity) have compounded the problem of finding a consensus on the definition of science teacher professional identity. Firstly, science teachers' multiple professional identity results from situational, personal, and professional identities (Day et al. 2009; Day and Kington 2008; Gee, 2001). Secondly, the discontinuous nature of professional identity is a product of changes that science teachers experience within their professional development landscape (Mockler 2011; Beauchamp and Thomas 2009; Day et al. 2009; Dotger and Smith 2009). Lastly, the relationality of identity results from the relationships and new knowledge that science teachers experience (Akkerman and Meijer 2011; Cohen 2010; Cohen 2008; Billet and Pavlova 2005). As such, characteristics of professional identity add other dimensions to the concept of teacher professional identity thereby increasing its complexity. To "replace" the 'modernist' characteristics of identity in defining teachers' professional identity would be 'untenable' (Akkerman and Meijer 2011: 309). Modernist characteristics of identity indicate uniformity, continuity, and individuality, thereby portraying it as stable. The instability of teacher professional identity from the perspectives of multiplicity, discontinuity, and relationality, needs to be balanced and controlled by the stability portrayed by uniformity, continuity, and individuality of teacher professional identity (Rodgers and Scott 2008). Yet I focused on the multiplicity, discontinuity, and relationality of professional identity since my worldview reflects social constructivism as I contemplate science teachers' learning within a social learning environment.

The characteristics of professional identity and dimensions of experiences inform the development of my definition of science teacher professional identity. The interrelated concepts of these characteristics and dimensions of experiences resonate to form science teacher professional identity. A symbiotic relationship exists between characteristics and dimensions of experiences as they resonate with each other and result in new identities. Thus as I define science teacher professional identity I focused on their dimensions of experiences which lead to changes in the characteristics of professional identity.

Science teachers' professional identity sits at the nexus of the characteristics of identity and the dimensions of experiences. Whenever one of the dimensions of experiences changes, there is a corresponding change in the other dimensions thereby influencing the characteristics. The dynamics between characteristics of science teachers' professional identity and dimensions of experiences explain the symbiotic relationship between them whereby they resonate harmoniously among themselves to reshape science teachers' professional identity during professional development in this study. As such, I define science teachers' professional identity in this study in terms of their cognitive development, social interactions, and emotional changes during learning.

### **Theoretical model for researching science teacher professional identity**

I outline my conceptual and theoretical perspectives that establish my epistemology in researching science teachers' professional identity as a result of their learning. I view science teacher learning through the lens of sociocultural theories which conceptualise how they learn in a professional learning community. These sociocultural theories of learning focus on situated learning (Lave and Wenger 1991), social theory of learning (Wenger 2009) and a community of practice (Wenger 1998), social constructivism (Vygotsky 1978), and discourse and dialogue (Hermans 2001). I focused a repertoire of factors originating from these theories to understand how science teachers' professional identities are influenced by experiences of their professional development programme.

Central to my analysis of science teachers' narratives is Wenger's (1998) community of practice and his social theory of learning in identity construction (Wenger 2009). He argues that the "concept of identity" is the "pivot between the social and the individual" and it represents the "lived experience of identity" (Wenger 1998: 159). Wenger's (1998) community of practice is rooted in his social theory of learning (Wenger 2010) and it provides a framework that depicts science teachers' learning as a social activity. That is, it locates their learning "in the relationship between a social people in a social world (Wenger 2010: 1) which involves participation. Here, learning is due to collaboration, reflection, and discourse (participation) and the production of artefacts "that reflect the shared experience" (reification) (Wenger 2010: 1).

In professional development programmes, teachers learn by enhancing their cognition in pedagogy (cognitive development). This represents a "regime of competence" (Wenger 2010:

2) of their community of practice as science teachers and, in the process, they build relationships since “learning is a social becoming” in which they learn from each other (social interactions) (Wenger 2010: 3). This line of reasoning positions identity centrally in the theory of situated learning. Another aspect of science teachers’ learning within their professional learning community is due to social constructivism whereby they learn from more informed others such as the lead teachers or the instructional leader (Vygotsky 1978). Embedded in these forms of social learning are the dialogue and discourse in which the science teachers engage (Hermans 2001). Analysis of science teachers’ experiences of cognitive development and social interactions, then, provides insights into the influences of those experiences on science teachers’ professional identity.

Emotions are involved in any activity in which new learning, social interactions, and dialogue exist (Zembylas 2003). Such emotions can range from happiness at one end of the emotional spectrum to anger at the other end (van Veen, Slegers, and van de van 2005). Learning is motivated by goals set by the science teachers to improve their practice and the realisation of such goals involves emotions (van Veen et al. 2005). In addition, social interactions can result in a power imbalance which also lead to emotional experiences (Laskey 2005). As such, emotions of science teachers are pivotal in influencing their professional identity and therefore, warrant consideration when analysing science teachers’ experiences of their professional development programme.

An established body of literature on teachers’ knowledge, their social interactions, their professional development, and their emotions inform me about influences on professional identities. Literature has emphasised that professional identity is a complex construct of knowledge, memberships, and emotions, which can result from professional development activities. I established that the result of such activities can lead to dimensions of experiences such as cognitive development, social interactions, and emotional changes. Together, these dimensions of experiences result in multiplicity, discontinuity, and relationality which are characteristics of professional identity. As such, in the next section, I review studies conducted on teachers’ professional development and their cognitive development, social interactions, and emotional changes to guide my discussion of findings and to situate my study among them in support of my research question.

### **2.3 Situating my research in the literature**

The studies on teacher professional identity that I selected, represent a fraction of those in literature that address this topic in all disciplines. In order to situate this research in the literature, I selected works that explored professional identities and teacher learning, which were underpinned by a sociocultural theoretical framework. Such published works addressed professional development, cognitive development, social interactions, and emotional changes which explain how teachers learn and develop their professional identities (Akkerman and Meijer 2011; Battey and Franke 2008; Beijaard et al. 2004). However, despite my extensive search of the literature, I could not find many research that focused on professional identity, professional learning, and (science) education reform especially in Canada. I found research on other aspects of secondary school science teachers' professional identities, inservice science teachers and their learning, and the professional identity of those in second careers.

One such study was on hybridised professional identity of second career vocational secondary school science teachers in one school board in Canada by Farnham and Higham (2012). Internationally, two studies on science teacher's learning were conducted by Woolhouse and Cochrane (2014; 2010) in the UK, another was in Australia (Melville and Wallace 2006), and three were in the USA (Dreon and McDonald 2012; Lustic 2011; Gilmore, Hurst, and Maher 2009). However, there was no connection among factors such as science teacher professional identity, their professional development, and the role of these factors in science education reform in these studies. Establishing a connection among these concepts, may shed light on initiatives to enhance science education. As such, the present study intends to illustrate the benefits of researches that consider these concepts. In this section of the chapter, I synthesise the findings of researches conducted on teachers' cognitive development, social interactions, and emotional changes.

#### **Cognitive development**

Rooted in time is Shulman's (1986) idea that factors such as subject matter knowledge and pedagogical skills determine teacher efficacy. However, over the years, a marked difference between these two factors emerged that shapes current attempts to define teacher efficacy. The result is that subject knowledge expertise is lost in the shuffle and the focus is now on how teachers perform in the classroom (Shulman 1986). In most professional development programmes, cognitive development connotes pedagogical knowledge. Most of the studies

selected for discussion in this study focus on teachers' classroom practice while a few of them were conducted on both their knowledge and practice.

Teachers learn in diverse (Jurasite-Harbison 2005) and informal environments (Katz, McGinnis, Hestness, Riedinger, Maarbach-Ad, Dai, and Pease 2011). As such, learning can occur in and out of the classroom. Such learning situations require teachers to reflect on their participation as active learners (Schon 1983). Learning by reflection can influence teacher professional identity (Lumpe et al. 2012; Opfer, Pedder, and Lavicza 2011; Marcelo 2009; ten Dam and Blom 2006). Influences on learning can be due to interaction among learning, beliefs, and practice in a community of practice (Opfer et al. 2011; ten Dam and Blom 2006). In some cases, teachers in a professional learning community learn from more informed teachers who draw on participating teachers' previous knowledge (Vygotsky 1978) as a way of scaffolding their learning. Concurrently, most of the learning can occur among teachers during group work as members of their professional learning community (Wenger 2010; 1998; Lave and Wenger 1991). Apart from "acquiring skills and information" a teacher becomes a "certain person" whose knowledge is determined by the culture of the professional learning community (Wenger 2010: 2). Teachers require a certain degree of competence within specific contexts in order for them to become that 'certain person', whereby their professional identity changes (Wenger 2010; Beijaard et al. 2004). As Wenger (2010: 3) argues, a "central element" of the social theory of learning is that new identities evolve through cognitive development within a community of practice.

Arguably, knowledge of subject matter is important for teachers in the early stages of their career. This justifies a review of studies on subject matter development. Beijaard et al. (2000) conducted a mixed-methods study of 80 secondary school teachers' perceptions of their professional identity and found most of the teachers described themselves as subject matter experts in addition to pedagogical and didactical experts. Notably, more teachers saw themselves as subject matter experts in the early part of their career and they shifted their perceptions to pedagogical and didactical experts as their careers progressed. Teachers' perceptions of themselves during the study compared to the beginning of their careers revealed a shift in professional identity as they became more experienced. On the other hand, Melville and Wallace (2006) found that their non-university science teacher's limited subject matter knowledge influenced his practice, behaviour, and professional identity throughout his

career. They adopted a sociocultural theoretical framework with a narrative methodological approach in their study. They found that the teacher, who was college-trained as an engineer, had difficulties in understanding the subject and struggled to negotiate the meanings associated with the practices in science education. They argued that in a subject area like science, where learning is enhanced by inquiry, science teachers need to know the subject matter. This was not the case with the science teacher in their study.

Findings from cross-boundary or non-specialism studies reflect Melville and Wallace's (2006) argument that science teachers need to understand their subject matter to enhance their practice. Crossing boundaries implies entering an unfamiliar territory, such as teaching a subject without being qualified to do so (Akkerman and Bakker 2011). Woolhouse and Cochrane's (2014; 2010) and Hobbs' (2012b) studies illustrate the importance of subject knowledge for science teachers who cross boundaries. Woolhouse and Cochrane's (2010) Foucauldian, mixed methods study of 29 secondary chemistry and physics teachers in a specialism course revealed that science teachers emerged from the programme as subject specialists with enhanced classroom practice and more confidence. In 2014, they conducted another mixed-methods study which involved about 200 science teachers who also participated in the specialism course within a community of practice. They reported that those teachers benefitted from their enhanced subject knowledge as a result of their professional development, in that they felt an increasing sense of self as science teachers. Hobbs (2012b), who conducted a qualitative pilot study from a sociocultural perspective that involved 10 science teachers, found similar results. Her teachers reported that they were willing to seek subject-specific knowledge to cope with their roles as cross-boundary teachers. She reported that the teachers in her study felt that if they acquired subject knowledge they would enhance their classroom practice. Findings from these studies are similar despite the disparity in sample sizes, research methodology, or theoretical framework in each case. Clearly, subject matter knowledge should be foregrounded and not overlooked (Shulman 1986) since clear understanding of the subject is essential in science teaching.

Teachers' subject knowledge competence which results in new professional identities (Shulman 1986), enhances classroom practice (Wenger 2010). Pegg, Schmooch, and Gummer (2010), who conducted a sociocultural study of the role of mentoring in developing science teachers' subject knowledge, found that enhanced subject knowledge among their 14 teachers

closely matched their classroom practice. Luehmann and Markowitz (2007) and Robinson, Anning, and Frost, (2005), who also conducted their research from a sociocultural perspective, illustrate how enhanced subject knowledge can result in a change in professional identity. Luehmann and Markowitz (2007) found that their teachers' credibility increased when their subject knowledge increased while Robinson et al.'s (2005) participants experienced an enhanced sense of professional identity. However, enhanced subject knowledge does not necessarily indicate enhanced classroom practice in some cases at either the secondary or primary level.

Smith's (2007) study supports this argument whereby change in subject matter knowledge had very little effect on his teachers' classroom practice and their professional identities. He focused on developing professional identity and subject knowledge of primary school science teachers and found that novice teachers did not understand science concepts although they gained subject matter knowledge. Similarly, Dreon and McDonald (2012) conducted a phenomenological study of beginning secondary school science teachers' experiences in an inquiry lesson and found moments of discomfort and uncertainty among teachers. Such emotions were due to lack of confidence in their subject knowledge although they were qualified to teach science. Another mixed-methods phenomenological study conducted by Jones, Gardener, Robertson, and Robert (2013) on the impact of participation on teacher learning in a science professional learning community found similar results regarding subject matter knowledge and classroom practice. They found that although the 65 elementary science teachers changed their assessment strategies and the manner in which they planned their lessons, their subject knowledge did not change significantly. These findings indicate that increasing subject matter knowledge does not necessarily mean that teachers become confident to understand concepts at the primary level or change their classroom practice at the secondary level. In each case, there may not be a change in professional identity.

Undoubtedly, science teachers' subject knowledge at both the primary and secondary levels is important. Mastery of their subject establishes their credibility and their professional identities as science teachers (Wenger 2009). I concede that depending on their professional needs, enhancing teachers' subject knowledge may or may not enhance their practice or influence their professional identity. While some studies above have identified the need for mastery in subject knowledge especially among new teachers, I argue that pedagogical knowledge is

equally important to enhance classroom practice among all science teachers and may lead to a change in professional identity.

A number of theories underpin studies on pedagogical knowledge. Among these is the idea that a shift in pedagogical knowledge can occur as colleagues reflect on their classroom practice (Lee, Cawthon, and Dawson 2013; Stenberg 2010); that pedagogy is rooted in the classroom and involves planning and experimenting (Lee et al. 2013; Burn 2007); and the most “critical component of the professional status of teachers” stems from pedagogical knowledge (Lee and Luft 2008: 1344). Shulman’s (1986) theory of the use of illustrations, demonstrations and examples to make subject knowledge comprehensible reflects necessary pedagogical skills required to change classroom practice. He believes that teachers’ classroom practice can improve if they have the tools with which they can engage their students.

Some researchers have had similar findings in studies on teachers’ pedagogical knowledge and their professional identity. They have found that enhanced pedagogical knowledge can contribute significantly to teacher professional identity. For instance, a qualitative case study on experienced secondary school science teachers’ representation of their pedagogical knowledge revealed that the science teachers conducted their classroom practices on the basis of their subject specialism, years of teaching experience, and professional development experiences (Lee and Luft 2008). Katz et al. (2011: 1192) observed evidence of growth in terms of “transformative pedagogy” and identity in their study of 4 teacher candidates. Hodges and Cady (2012), who focused on a middle-grades mathematics teacher, found that she earned the respect of her peers by her choice of pedagogical approaches which aligned with her peers’ beliefs, values, and goals. Jones et al. (2013) found that their elementary teachers emphasised changes in their strategies, methods of assessing their students, lesson planning, and science instructions as a result of participating in a professional learning community. Similarly, Woolhouse and Cochrane (2014; 2010) found that the science teachers in their studies emerged with enhanced pedagogical knowledge which afforded them the choice to share ideas, make professional decisions, and converse in science-teaching terms. In most of the preceding studies, teacher learning took place in a community of practice and in each case the teachers emerged from professional development programmes with enhanced classroom practice and professional identities that reflected their new learning.

However, not all studies reported positive findings in terms of enhanced pedagogical knowledge and classroom practice. Some studies revealed marked differences as seen in Smith's (2007) study in which he found that despite training in pedagogical knowledge, his sample of 4 primary teachers utilised their knowledge to a limited extent while drawing from their past experiences and research. Another study, conducted by Battey and Franke (2008) as part of a larger study of an in-school professional development programme within a community of practice, reported similar findings. The aim of the programme was to develop pedagogical skills for middle school mathematics teachers. Battey and Franke (2008) reported that although the teachers participated in the programme and experienced enhanced pedagogical knowledge and new professional identities, their attempts to implement changes in the classroom were slow and limited. The teachers appeared to have difficulties in changing their way of teaching. Battey and Franke (2008) concluded that in order for teachers to apply their new learning in the classroom, they needed to develop identities that can negotiate learning in the classroom, which was not the case with their teachers.

Science teachers utilise their (specialised) knowledge differently from other science professionals perhaps because their pedagogical knowledge distinguishes them from other science professionals. Specialised knowledge, which is a combination of both pedagogical knowledge and subject matter knowledge, appears to set science teachers apart from other science professionals and even teachers of other subjects (Lee and Luft 2008). They identified such specialised knowledge as either integrative (separate knowledge of subject matter and pedagogy) or transformative (synthesised knowledge for teaching). Lee and Luft (2008) reported that findings of studies by Sanders et al. (1993) which focused on experienced science teachers (transformative knowledge), and by Carlson (1993) which focused on novice science teachers (integrative knowledge), were not aligned with their findings. Their findings suggested that for experienced science teachers, specialised knowledge was both integrative and transformative while for their novice teachers, knowledge was mostly integrative (domain and topic specific) but transformative at some level.

It appears that science teachers emphasised different areas of their specialised knowledge and they developed aspects of their pedagogical knowledge differently (Lee and Luft 2008). Science professionals, as teachers, utilise various aspects of their specialised knowledge at different points in their careers depending on whether they are novice or experienced teachers.

Phenomena such as these among science professionals, who become science teachers, are observed mostly among second-career teachers who become “a certain person” at the expense of peripherality or marginalisation (Wenger 2010: 2). Such a situation arises because of their later entry into teaching. Such distinctions among science professionals as teachers may result in self-categorisation (Stets and Burke 2009) which distinguishes them from other science teachers.

The values, beliefs, and understandings of science teachers, which determine their pedagogical decision-making (Battey and Franke 2008), inform their classroom practice. In a social constructivist study of the relationship between teachers’ pedagogies and their experiences of mathematics and science subject cultures, Hobbs (2012a) found that teachers’ experiences with their subjects shaped how they engaged with those subjects. According to Hobbs (2012a), decision-making, which is contextual, involves cognitive and affective domains of knowledge. She speaks of the “aesthetic dimension” of teaching, which shapes how teachers relate to the subjects they teach (Hobbs 2012a: 719), and implies merging personal and professional qualities such as commitment, creativity, and purpose. She asserts that an aesthetic component of teaching can enhance teachers’ personal and professional experiences, and can enable them to construct their identities. The teachers in her study appreciated and felt a sense of satisfaction about the subject matter, and were able to make their lessons interesting to their students. Such findings challenge Battey and Franke’s (2008) findings since the new identities of these teachers provided them with the agency to renegotiate learning in the classroom while the teachers in Battey and Franke’s (2008) study had difficulties in doing so. However, both subject knowledge and pedagogical knowledge are essential in classroom practice (Shulman 1986).

### **Social interactions**

Social interactions, whether positive or negative, may affect the other dimensions of experiences (cognitive development and emotional changes) that teachers undergo, and their professional identity. Most of the studies I explored, which focused on cognitive development and professional identity, were framed by social constructivism and a community of practice. Learning occurred because of social interactions among teachers. Similar threads emerge from other qualitative and quantitative studies conducted from various theoretical perspectives, and appear to transcend these perspectives (Friesen and Besley 2013; Vetter and

Russell 2011; Fox and Wilson 2009). The results of these studies align with each other, regardless of the number of participants, theoretical perspective, or methodological approach employed.

The extent to which teachers learn depends on the type of relationships they form with their peers, as well as with their learning environment. In Fox and Wilson's (2009) study, teachers did not form meaningful relationships with their mentors, but they did with their peers and they did learn. Similarly, Brillhart (2010) found that the 10 teachers in his study conceptualised teaching around informal experiences, memories, observing their peers, and past and current relationships. He concluded that as the teachers understood their 'selves' in relationships, and their 'selves' as teachers, they learned and developed identities. The 14 teachers in Musanti and Pence's (2010) study, which they conducted within a community of practice, co-constructed knowledge, and negotiated their identities, as they collaborated. These teachers overcame their isolation, constructed knowledge, exchanged experiences, broke down barriers, and dispelled the degree of anxiety they felt as they built trust. Similarly, the sole participant in Vetter and Russell's (2011) study experienced a change in identity. Friesen and Besley (2013) found that their 109 pre-service teachers experienced social interactions to such an extent, that their personal and social identities changed, as did their professional identities. It appears that as participants interacted, their professional identities were influenced by experiences of their professional development programme.

Not all of these studies reflect findings in a positive light. Battey and Franke (2008) and Harrison, Hofstein, Eylon, and Simon (2008) reveal common findings in their works that were not positive. In these studies, the teachers learnt from each other within a community of practice. However, Battey and Franke's (2008) 10 teachers' initial professional identities did not support social learning and they experienced difficulties applying what they learnt in their classrooms. Although the 104 science teachers from the UK and Israel in Harrison et al.'s (2008) study eventually agreed to work within a community of practice, they had to reflect on, and analyse their own practices initially, before participating. The teachers in these two studies appear to have deep-seated beliefs and values which they were not willing to change. Of interest is Dotger and Smith's (2009) study of 10 novice teachers. They found that underdeveloped social identities and professional boundaries hindered how the teachers interacted with students' parents despite their professional experiences and simulated social

interactions training. In these cases, deep-seated beliefs or failure to engage with the context in which training occurred prevented teachers from “opening...new identities...beyond” their “current state” (Wenger 1998: 263). Such an outcome could be explained by the degree of peripherality the teachers felt.

As science teachers interact they may experience self-categorisation and situated cognition, change in role identities, and multiple identities. Generally, their manner of speaking, use of specific vocabulary, shared behaviour, expertise, and experience situate them in social categories and define their role identities (Wenger 2010; Wenger 2000). In their mixed methods study of curricular role identities of science teachers, Forbes and Davis (2008) found significant differences between the curricular role identities of preservice science teachers and more experienced science teachers. Their findings revealed that the science teachers’ self and role scores increased eventually. The implication is that, in time, preservice science teachers develop curricular role identities based on an active and participatory relationship with the curriculum materials. The preservice science teachers developed confidence to critique and adapt curricular materials and conduct scientific inquiry. It appears that the novice science teachers initially experienced peripherality but as their roles and expertise changed, they no longer felt that they were on the fringe of their group (Trent 2011; Robinson et al. 2005).

As teachers reflect on their attributes, position and function within a group, they categorise themselves as certain types of teachers. They distinguish themselves within the group so that they have a “heightened social identity” by which they can “heighten group dynamics and intergroup behaviour” (Friesen and Besley 2013: 25). Such a phenomenon is situated cognition (Lave and Wenger 1991) whereby professional identities become more complex as new identities are forged (Wenger 1998). Learning environments such as communities of practice or those that involve social interactions, are contextual and foster situated learning. Dotger and Smith (2009) studied situated cognition among their teachers and found that experiences influenced not only development of professional identity as certain teachers, but also the extent to which, and the manner in which, teachers interacted with their environment. Cohen’s (2008) ethnographic study of humanities teachers’ reflections on their past experiences through reflective talk, reveals instances of self-categorisation. Here, teachers defined their roles as knowledge producers, and their identities in terms of their relationships with their peers and institutional practice, which reflected Lave and Wenger’s (1991) situated

learning. In each case, the teachers categorised themselves as certain types of teachers based on their social interactions.

Teachers' multiple identities and their self-categorisations, explain and are a product of their beliefs and values (Beauchamp and Thomas 2009; Olsen 2008; Beijaard et al. 2004). Such identities emerge from social interactions. Trent's (2011) exploration of 8 Hong Kong teachers' experiences of full-time, short-term professional development courses of academic subjects reveals self-categorisation among teachers. He reported that teachers' identities changed as they participated, gained knowledge, skills and strategies, and learned to imagine and align their thinking (Wenger 2000). The teachers saw themselves as special types of teachers such as "science-language" teachers or "history-language" teachers (Trent 2011: 627) within the teaching community. Friesen and Besley (2013) revealed similar findings in which teachers reported high perceptions of their professional identity, personal identity, and their student identity which suggested self-categorisation (Burke and Stets 2009). Those teachers who sensed that their professional identities were established, found it easier to see themselves differently within various social groups (Friesen and Besley 2013). As such, they became effective teachers with a broader sense of self resulting in multiple identities.

### **Emotional experiences**

Emotions can result in risk-taking, vulnerability, and internal and external professional changes. As teachers develop cognitively and interact socially, they experience a range of emotions. Such emotions may influence both their practice and shape their identities (Vloet and van Swet 2010). Teaching involves emotions and researchers regard emotions as part of educational reform (Kelchtermans 2005; Lasky 2005; Reio 2005; van Veen et al. 2005). Emotions shape and influence teacher professional identity significantly (Reio 2005). However, in discursive practices, a degree of power imbalance exists due to emotions (Zembylas 2003). Laskey (2005) and Reio (2005) concur with Zembylas (2003) that a power imbalance can result in both positive and negative emotions in the teaching profession. Common threads run through the debates centred on teacher identity and emotions. These threads include trust, openness and relationships at one end of the spectrum and embarrassment, pain, a sense of loss, and despair at the other end of the spectrum. Kelchtermans (2005: 995) argues that such threads abound in educational reform and identity

development, and recommends that everyone should understand how emotions affect “vulnerability” in the teaching profession.

Teachers’ beliefs, emotions and vulnerability play an important role in identity development. Laskey (2005) argues that teachers need to take risks while they uphold their beliefs in order to develop suitable teacher identities. She conducted a pilot study on political and curricular changes and their effects on secondary school teachers in Canada by utilising a mixed-methods approach. Her findings revealed that teachers experienced “inefficacious vulnerability” due to the disparity between “the teachers’ professional beliefs and the reform mandates” they faced (Laskey 2005: 904). The teachers felt powerless over their circumstances and the mandate to perform their duties in ways that contravened their beliefs. Day and Kington’s (2008) report also illustrates the effect of policies, social trends, roles, and workload on teachers’ emotions. Findings of their mixed-methods study of 300 purposefully selected primary and secondary teachers in the UK revealed conflicts among the professional, personal, and situated identities of teachers due to positive or negative influences of policies and mandates.

Teacher emotions, which are overt and important in teachers’ identities (Zembylas 2005), exist as a discursive practice which foregrounds power. In his ethnographic study of one teacher, Zembylas (2005) found the social conventions, policies and practices within a school determined and regulated the teacher’s emotional behaviour. These determinants of behaviour could range from the personal feelings of the teacher, to her choice of pedagogical approach (Zembylas 2005). Emotions which are associated with identity can influence teachers’ performance. Timoštšuk and Ugaste’s (2012) work on the role of emotions in the development of the professional identities of 45 student teachers, revealed that positive emotions led to contentment, excitement, and admiration, while negative emotions led to feelings of insecurity, anxiety, and confusion. Similarly, Van Veen et al.’s (2005) case study on the effect of reform on professional identity of one teacher revealed that the teacher experienced both positive and negative emotions. Using the cognitive socio-psychological theory to analyse the teacher’s interviews, they found that while the teacher expressed enthusiasm for her students’ performance and participation in class, she experienced negative emotions of shame, guilt, and anger due to the lack of time, heavy marking, and lack of

administrative support. They found that the emotions the teacher experienced during reform, affected her personal and professional identities.

Day et al.'s (2009) VITAE study on 300 primary and secondary school teachers in the UK focused on teachers' emotions as one of their variables. One supporting research question in their mixed methods study, was the role of teachers' biographies and identities in determining their effectiveness. In addressing this question, they found that teachers' identity comprised three dimensions: personal, professional, and situated which needed to be in balance for teachers to be effective in the classroom. They found a "dynamic relationship between identity and agency" (Day and Kington 2008:19) which determined teachers' commitments and resilience, and which was due to their awareness of their professional identities.

The foregoing synthesis of studies serves two purposes in my research. Firstly, it situates my research among studies in literature based on their theoretical and methodological approaches and findings. Secondly, I can draw on them as I engage in theoretically informed discussions of my findings in chapter 5. I now present the theoretical framework that underpinned my research. Subsequent to this, I discuss the theoretical framework in relation to characteristics of professional identity, sociocultural theories, community of practice, and dimensions of experiences.

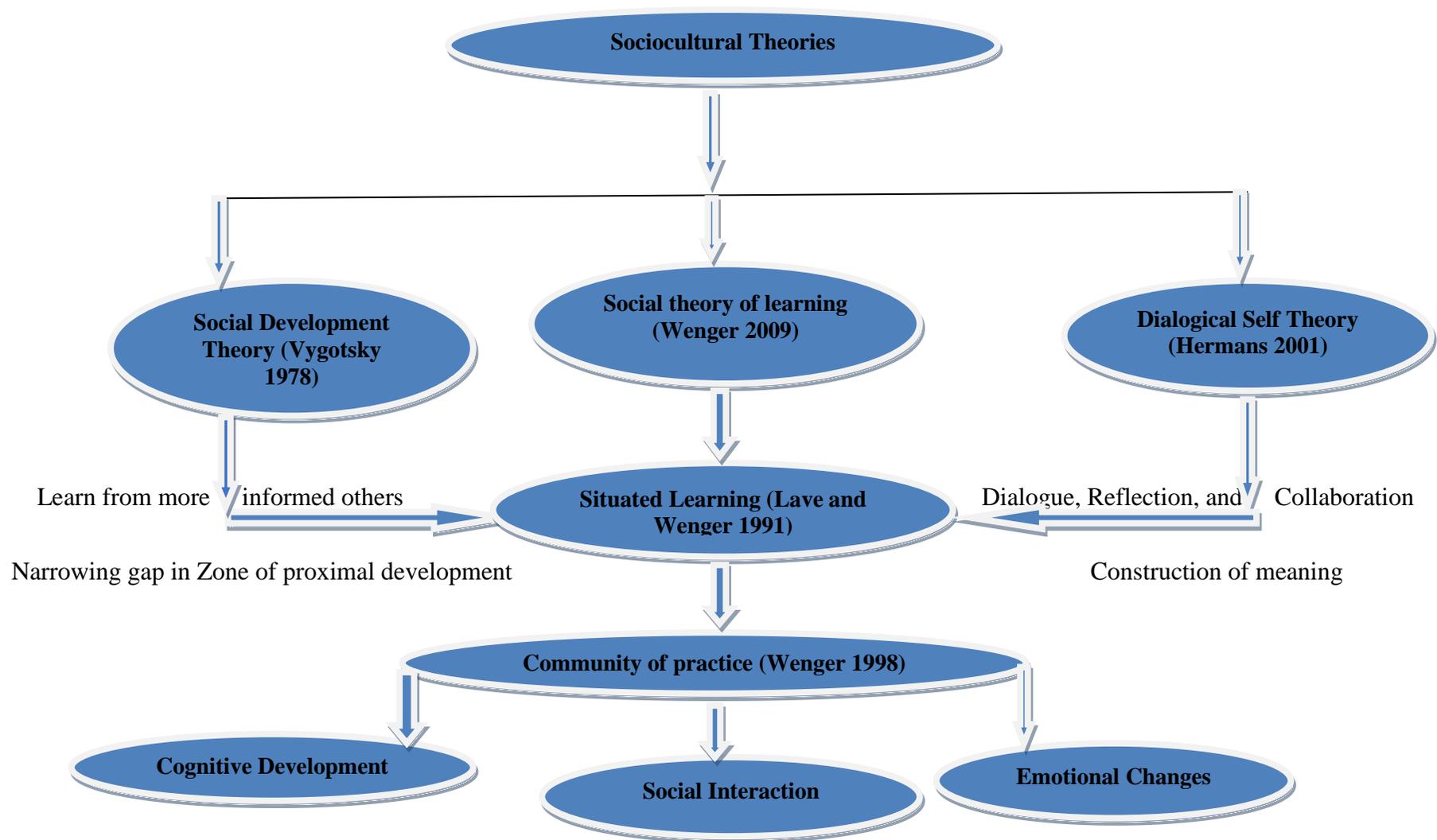
## **2.4 Theoretical framework underpinning this research**

The theoretical framework that underpinned this research stemmed from the main research question and my world view of social constructivism. This framework grounded the research through a set of theories that reflect an interpretive worldview, drove the research methodology, and guided the research design. Furthermore, this framework influenced how I analysed the evidence and interpreted the results to address the research question. Three sociocultural theories coalesced to establish the theoretical framework that underpinned this research. These are Wenger's social theory of learning (2009), Hermans' dialogical self theory (2001), and Vygotsky's social constructivist theory (1978). The resulting theoretical framework in which Wenger's (1998) community of practice subsumes the three theories, formed the basis of the framework. The sociocultural theories focus on social interactions within a specific cultural context. In this study, I considered science teachers' learning as sociocultural in nature because it involved science teachers interacting with their peers, lead teachers, and their instructional leaders (social interactions) within a professional learning community (cultural context). Such interactions can influence their learning (Wenger 2010; Hodkinson et al. 2008; Vygotsky 1978) and hence their professional identity.

The three sociocultural theories complement each other, and together, they elucidated science teachers' experiences. Such theories informed science teachers' situated learning within their professional learning community (Lave and Wenger 1991). As teachers connect with each other during learning, they "acknowledge each other as participants" in their learning environment (Wenger 1998: 149). Situated learning and social interactions contribute to the development of professional identity in a community of practice. Wenger's (2009) social theory of learning explains how science teachers can learn as they collaborate, discuss ideas, and share artefacts among themselves and within groups in the professional learning community. Some aspects of science teachers' learning can occur as they interact with more informed others such as the lead teachers. Vygotsky's (1978) social constructivism and his social learning theory explain teacher learning from more informed others. Insight into science teachers' self within a community of practice sheds light on their social relations as they interact with others through dialogue and discourse (Hermans 2001). Group discussions, through collaborations and reflection leading to construction of meanings (Hermans 2001), can be viewed through the lens of the dialogical self theory. Taken together, the three

sociocultural theories shed light on the dynamics of science teachers' learning within a community of practice.

Figure 2.1: 63 illustrates how the three theories are applied in Wenger's (1998) community of practice. While these theories are relevant to understand teachers' experiences, Wenger's (1998) community of practice provides the most appropriate lens through which the science teachers' experiences can be viewed. Social learning within a community of practice, contributes to discussions on science teachers' learning and their identities within their professional learning community. Development of teacher professional identity involves interaction between teachers and their environment. It is within such an environment that science teachers may experience cognitive development, social interactions, and emotional changes. As such, professional identity as science teachers is formed, learning occurs, and practice is honed as science teachers engage in their professional development programme in a community of practice (Wenger 1998).



**Figure 2.1: Theoretical Framework Underpinning Research**

It can be seen in figure 2.1 above that the three sociocultural theories illustrate how Vygotsky's (1978) social development theory, Wenger's (2009) social theory of learning, and Hermans' (2001) dialogical self theory contribute to situated learning which takes place in a community of practice. The social aspect of learning and identity development are foregrounded. A professional learning community defines teaching and teacher professional development as cultural activities found within a social landscape (Vygotsky 1978). The professional learning community is based on social learning and dialogue in which there is collective understanding of joint enterprise, mutual engagement, and shared repertoire of resources (Hermans 2001; Wenger 2000; 1998). As Lave and Wenger (1991: 53) argue, "learning implies becoming a different person" and "learning and a sense of identity are inseparable (Lave and Wenger 1991: 115). Wenger's (1998: 1) community of practice is a professional learning community that "locates learning" and involves the interplay between "participation and reification". As such, the theoretical framework, which includes elements of sociocultural learning and dialogue, is appropriate for this study.

### **Characteristics of teacher professional identity and theoretical framework**

Teachers are the principal actors in a community of practice where they engage in discussions and share artefacts as they learn. As such, social interactions and dialogue prevail (Flum and Kaplan 2012). The nature of social interactions and dialogue reflect the culture of the community of practice in terms of the activities in which teachers participate and the meanings they make, which implies a closed culture. As teachers participate in professional development activities they build multiple relationships which represent the closed culture of their professional learning community. Such relationships, which are based on discourse and dialogue, involve reflections (Wenger 2010; Hermans 2001) and observations within the community. In a learning environment involving multiple relationships as in a professional learning community, social learning and identity development are inevitable since a different person emerges as a result of their learning (Hermans 2001; Lave and Wenger 1991). As the subjective self and the objective "world-out-there" integrate, teachers' "past, present and future experiences" interact to synthesise their identity (Flum and Kaplan 2012: 240). Actions take place, relations are built, participation occurs, experiences are felt, and interests are developed within a professional learning community. Such activities lead to multiplicity of identities which can be discontinuous due to change, and relational due to the formation of relationships (Flum and Kaplan 2012; Hermans 2001).

## **Sociocultural theories and theoretical framework**

Teacher learning, situated in different educational settings such as classrooms, science laboratories, and training centres, involves social interactions as each teacher interacts with others. Learning is oriented socially due to collaboration, interaction, and negotiation as a result of dialogue. As such, learning affords teachers common practices, discourses, and behaviour due to membership in their learning communities (Hermans 2001; Wenger 1998). Teacher learning emerges in the context of social interactions within a professional learning community, and it can strengthen knowledge and skills (Jones et al. 2013) through collaboration and sharing. Such activities are oriented socially as teachers may learn from more informed others (Vygotsky 1978), and such learning may be “distributed across the individual, other persons, and tools” (Putnam and Borko 2000: 4). In this way learning can forge new identities (Wenger 1998) and teachers can guide and support their learning by activities, artefacts and discourses unique to their learning communities (Scott and Palincsar 2013).

Teacher learning and their professional identities can be explained through sociocultural theories such as social development, social learning, and dialogical self. These theories are complementary and they enhance my theoretical framework much more than any individual theory might have. Given the nature of learning activities within situational and social contexts through dialogue within a professional learning community, Wenger’s (1998) community of practice, is the central element in my theoretical framework. Teachers experience cognitive development as a consequence of their learning, social interactions during learning activities, and emotional changes as a result of their learning and interactions, all of which arise from the community of practice.

Negotiated memberships within a professional learning community result in new professional identities. Teacher learning and the context within which learning occurs imply situation, socialisation, and distribution (Lave and Wenger 1991) and result in negotiated memberships. Learning is facilitated and appears to occur across settings such that teachers may acquire and share knowledge as members of their professional learning community (Wenger 2010; 2000). Learning through social constructivism illustrates how active and collaborative learning occurs by connections between more skilled teachers and the less skilled teachers through social interaction of shared experiences (Vygotsky 1978). Hermans (2001) and Lave and

Wenger (1991) concur with Vygotsky (1978) that as one learns one negotiates one's membership within the community of practice in which knowledge sharing is achieved by collaboration and shared experiences among peers. It is the membership and shared experiences that result in new identities.

### **Community of practice in professional development initiatives**

A community of practice comprises a group of people with a specific focus who work together to improve their practice. In the case of teachers, such a community of practice is represented by their professional learning community. Social interactions among members of such a group are focused on learning to improve practice. A professional learning community, as a social learning system, can afford teachers the opportunity to learn by social interaction, which results in situated learning (Lave and Wenger 1991). Situated learning results in cognitive development, social interactions, and emotional changes (dimensions of experiences) which are influenced by past experiences, interactions, and collaborations. Such a professional learning community forms a "simple social system" (a community of science teachers) within a "broader conceptual framework for thinking about learning" (all subject departments within a school or school board) (Wenger 2010:1). The temporality and membership of the group of teachers can change depending on the context of the situation. According to Hermans (2001), changes can occur as contexts, circumstances, and alliances change during professional development sessions through situated learning and dialogue. The resulting changes can lead to discontinuity due to changes in context, relationality due to social interactions and dialogue, and therefore, multiplicity of identity due to changing contexts and relationships within a community of practice such as professional learning community.

The social nature of a community of practice promotes both social learning and the relational way in which teacher professional identity can evolve (Wenger 2010). Any relationship teachers may form fosters learning and situates their learning between them "and the world" (Wenger 2010: 1). Membership of such a community implies access to shared ideas, activities, and identities specific to the group (Wenger 1998). Social learning, at the intersection of the science teachers' learning community and their situated experiences, can result in conversations, activities and relationships, and facilitated learning (Hermans 2001). Such "active participation in social communities" can result in transformative learning

(Wenger 1998: 10). Wenger's (1998) model of a community of practice hinges on, and is characterised by, joint enterprise, mutual engagement, and a repertoire of resources.

Joint enterprise, mutual engagement, and a repertoire of resources (Wenger 1998) are found in communities of practice within different professions including the teaching profession. In the case of science teachers, joint enterprise represents their efforts to enhance their science teaching, mutual engagement is the process of their coming together to hone their expertise, and their repertoire of resources are the artefacts they produce in the process. Wenger (1998) points out that joint enterprise is due to negotiations, accountability, and interpretations by members of the community. He describes accountability as "mutual...among those involved" (Wenger 1998: 81). Relations of accountability, Wenger (1998) explains, are negotiating actions, while accountability provides freedom of actions; it hones those actions so that they reflect the vision of the community. Mutual engagement implies working together in social relationships where meanings of actions are negotiated through engagement (Wenger 1998). Accordingly, each science teacher in a professional learning community has a unique position and identity so that they may interact with each other during mutual engagement, but these identities do not merge (Wenger 1998). As such, there is the need for science teachers to learn from more competent others as in Vygotsky's (1978) social constructivism in this model. A shared repertoire of resources, tools, stories, artefacts, and concepts are used to gain "coherence" because "they belong to the practice of a community pursuing an enterprise" (Wenger 1998: 82). However, a shared repertoire can be ambiguous since it includes what members say, how they express what is said, and the identities of the members (Wenger 1998).

### **Dimensions of experiences and theoretical framework**

Teachers' experiences in professional development initiatives lead to cognitive development as they interact socially and as such, they undergo emotional changes. Shapiro (2010) regards these changes as significant in terms of what teachers perceive, with whom they interact, and the identities they form. Such dimensions of experiences can control science teachers' professional development and influence how they negotiate their professional identities (Reio 2005). Dimensions of experiences guide how narrative interviews are conducted, questionnaires are developed, and evidence are analysed in a study. The dimensions of experiences on which this study focused were: cognitive development which occurred as

science teachers interacted and gained experience (Sachs 2001; Dewey 1997), social interactions (Van Veen and Slegers 2006; Zembylas 2005; 2003; Wenger 2000; 1998), and their emotional changes as a result of their learning and interactions (Shapiro 2010; Reio 2005; Zembylas 2005; 2003). Dimensions of experiences contribute to form sub-identities (Burke and Stets 2009; Jasso 2002; Stets and Burke 2000) which are the multiple identities developed from social interactions, practice and the external influences on professional lives. As teachers make meaning of their social world, their professional identities are reshaped through cognition. Reshaping of professional identities occurs because teachers can construct, interpret, and shape their experiences as they learn within their professional learning community (Wenger 2010).

Cognitive development, within a professional learning community, may result in teachers seeing themselves as subject knowledge experts and pedagogical experts (Beijaard et al. 2000). As such, teachers not only acquire skills and information in the learning process, but they become “certain person(s)” with a degree of expertise (Wenger 2010: 2) which, according to Wenger’s (2009) social theory of learning, produces meaning. Science teachers’ new found knowledge may change their perception of their expertise as science teachers, whereby they become aware of new found abilities in which case they can renegotiate their professional identity. Such a professional identity, due to enhanced knowledge, may provide science teachers with the agency to make subject and pedagogical decisions and foster alignment with reform goals (Etelapelto et al. 2014; Beijaard et al. 2004). Such alignment may influence the development of new professional identities. Opfer et al. (2011), Wenger (2010), Marcelo (2009), and Luehmann (2007) maintain that attitudes, beliefs, prior practices, and current context may influence teacher learning which may lead to changes in beliefs and practice. Professional identity and changes in beliefs and practice, then, are reciprocal.

Social interactions and knowledge sharing among members of a professional learning community can influence and change professional identity (Wenger 2010; 2000; 1998). Within a professional learning community, teachers are accountable to the “joint enterprise” of teaching and they engage the teaching community as “trusted” partners and have access to a “repertoire of communal resources” (Wenger 2000: 229). Professional learning community as a community of practice may comprise teachers from different schools within a school board. Interactions in such a system have the potential to enhance classroom practice and

build professional confidence. Such confidence may provide both the agency and the social structure to develop teachers' professional identities (Wenger 1998).

Emotions, which are produced from social interactions, environmental influences, and cognitive development, result in a sense of self (Zembylas 2005; 2003). I concur with van Veen et al. (2005) and Zembylas (2003) that emotions are important in the formation of professional identity. Furthermore, emotions may stem from sharing of ideas, interpersonal interactions, fears about teaching a specific topic or a set of students, or even voicing of opinions as the curriculum changes (Timoštšuk and Ugaste 2012; Laskey 2005; van Veen et al. 2005). As such, strong emotional reactions may ensue (Hodgen and Askew 2007). Other emotional reactions such as teachers' attitudes toward specific subjects such as science subjects and the teaching of those subjects in terms of their difficulty, their "gendered nature" (male oriented) and the distinction among peers where science teachers are sometimes viewed as 'smarter' than their peers who teach subjects that are arts related, may surface (Hodgen and Askew 2007: 476). The resulting emotions can range from pride on a modest level to arrogance on a grander scale. These emotions have the potential to define the teacher as a certain type of teacher (Wenger 2010; Gee 2001) and may lead to self-categorisation (Burke and Stets 2009).

A set of events can influence the emotions teachers undergo during professional development activities and can lead to the emergence of new identities. Cognitive and affective processes influence the inter-relationship between emotions and identity of teachers. Van Veen et al. (2005) argue that the emotions teachers experience may depend on the importance placed on social interactions and the corresponding events, the interpretation of interactions and events, and the manner in which teachers manage their resulting reactions. Teachers integrate their learning with the agency they develop through their emotions and motivation as they assess a situation (van Veen et al. 2005). The result is that teachers develop a sense of professional emotions as they appraise situations which lead to cognitive and emotional impressions within their professional learning community. Also, teachers may experience a sense of happiness, pride, fear, anger, guilt or shame depending on whether they achieve their goals or not, as they evaluate their knowledge of events and encounters (van Veen et al. 2005). Such a chain of events can produce professional identities molded from perceptions of themselves as teachers as well as the type of teacher they want to be (Burke and Stets 2009; Jasso 2002;

Stets and Burke 2000). Positive emotions can lead to contentment, excitement, and admiration, while negative emotions can lead to feelings of insecurity, anxiety, and confusion (Timoštšuk and Ugaste 2012).

To reiterate as I end this chapter, I approached the study of science teachers' professional identity from two perspectives. The first was from a contemporary perspective which identified characteristics of multiplicity, discontinuity, and relationality and the second was from the perspective of dimensions of experiences in learning (McNally and Blake 2012; Illers 2009; Wenger 2009). I incorporated both of these perspectives in advancing my definition of science teachers' professional identity in section 2.2 in this study. In doing so, I developed a conceptual framework of science teacher professional identity from which I identified science teachers' professional identity at the nexus of the characteristics of identity and the dimensions of experiences of their professional development programme. Analysis of relevant literature based on studies of teacher professional identity and learning in section 2.3, informed and situated my study among them in the literature, identified gaps that existed in this area of study on teacher professional identity, and would inform analysis of my findings in chapter 5. In section 2.4 of this chapter, I developed the theoretical framework that underpinned this study. Here, I utilised the three sociocultural theories, Vygotsky's (1978) social constructivism, Wenger's (2009) social theory of learning, and Hermans' (2001) dialogical self theory, to justify my theoretical framework of Wenger's (1998) community of practice. In the process, I situated my definition of science teachers' professional identity within their community of practice. My theoretical framework reflected the research question and determined my methodological approach which I address in chapter 3.

In chapter 3, I discuss my epistemological assumption of social constructivism and ontological assumption of multiple realities, which lead to a qualitative research paradigm of interpretivism. These discussions justify my methodological approach of hermeneutic phenomenology. My methodological approach determined the research methods I used, and the method by which I analysed the evidence I obtained. In considering and discussing the research process, I focus on: the framework of the research methodology, the research design, the pilot study and amendments of the research tools as well as adjustments to the research process. In the process, I outline the sampling procedure and sample of participants, and the process by which I obtained evidence. In the process, I discuss how I upheld the

trustworthiness of my study. A discussion of the principles of interpretive phenomenological analysis (Smith and Osborn 2008), which guided my analysis of evidence obtained through both the narrative and semi-structured interviews, follows. Finally, I provide a detailed account of my coding process and how I identified the themes.

### **Chapter 3: Research Methodology**

I set out to explore whether secondary school science teachers' professional identity can be influenced and reshaped by their experiences of their professional development programme. My research question and purpose of this study informed my choice of research methodology. As seen in chapter two, understanding science teacher professional identity depends on its definition and the factors that shaped the negotiation of such identities. An interpretivist research paradigm facilitated understanding of experiences that shaped negotiation of science teachers' professional identity. As such, my ontological, epistemological, and methodological assumptions characterised this interpretivist research paradigm.

The theories that underpinned my research methodology governed the methods I utilised to obtain evidence in this study. I aimed to obtain evidence of participants' experiences through narrative interviews, semi-structured interviews, and a questionnaire. These tools provided the evidence I required to address the main research question. Through interpretive phenomenological analysis (Smith and Osborn 2008) of the interviews and qualitative survey analysis (Jansen 2010) of the questionnaire, I coded narratives, and sorted and categorised codes into themes while I synthesised responses to the questionnaire. As I begin this chapter, I discuss my assumptions that guided the research process. In the first section of this chapter, I justify my research paradigm by my ontological and epistemological stances.

### **3.1 Research paradigm, ontology, and epistemology**

I discuss my research paradigm which was characterised by my ontological and epistemological stances, before I justify my methodological approach. To address the research question, I aimed to analyse participants' narratives of their experiences, in all their "variegated aspects" (van Manen 1997: 18) within the context of their professional development programme. Participants' narratives represented their subjective experiences, which indicated a research paradigm of interpretivism (Denzin and Lincoln 2011), an ontological stance of multiple realities (Kafle 2013; Denzin and Lincoln 2011; McGregor and Murnane 2010), and an epistemological perspective of social constructivism (Creswell 2007).

#### **Research paradigm**

An interpretivist research paradigm was appropriate to establish whether participants' professional identity was influenced by their experiences of their professional development programme. Interpretivism allowed me to: understand stories told by participants, appreciate their subjectivity, be flexible, and adopt a holistic view of my research (Creswell 2006). I obtained "language data" such as narratives and descriptions, that I analysed inductively through such a paradigm (Polkinghorne 2005: 138). I connected with research participants through dialogue and engaged in purposeful sampling rather than by random sampling as I recruited them (Creswell 2014; Denzin and Lincoln 2011). I foregrounded behaviour, meanings and shared experiences that participants narrated, as I constructed knowledge culturally and socially (Creswell 2006).

I rejected a positivist approach to this study because such an approach would not satisfactorily address the research question. My aim was not to explain or analyse experiences which positivism advocates. I aimed to understand participants' experiences. I did not base this research on objectivity as afforded by positivism but rather on the subjective experiences in relation to professional identities (Creswell 2009). By using an interpretivist approach in this study, I obtained "language data" (Polkinghorne 2005 138) to understand participants' experiences rather than test theories or obtain "numbered data" measured by instruments (Creswell 2014: 4). I planned to obtain evidence by use of tools such as written interviews, narrative interviews, and a questionnaire while I analysed 'data' inductively rather than deductively. An interpretivist stance facilitated my quest to understand the "subjective world of" the participants in this study (Cohen, Manion, and Morrison 2007: 21) through

“introspection, life story, interviews” (Denzin and Lincoln 2011: 3). I employed a “range of interpretive practices ... to get a better understanding” of experiences (Denzin and Lincoln 2011: 4) to address the research question. Such a study required deep analysis and involved a relatively small number of purposefully targeted participants. My research focused on the experiences of science teachers within a specific school board in Canada. As such, my intention was not to generalise findings.

### **Ontological assumptions**

As I have established in chapter 2, science teachers’ professional identity and their professional learning can be explained and understood from a sociocultural perspective. As such, I made a number of assumptions in this study. Among them were that: meaning is situated and it depends on each participant’s social interactions (Heidegger [1962] 2008; Laverly 2003); professional identities are negotiated and renegotiated through experience (Beauchamp and Thomas 2009) and depends on dialogue (Akkerman and Meijer 2011; Hermans 2001); and realities are constantly changing because of personal, situated, and professional experiences (Day and Kington 2008).

The experiences of each participant’s professional development programme are unique, and so, individually, their realities would be different yet collectively, there may be commonalities. As Heidegger ([1962] 2008) argues, realities, which are contextual, are constructed socially from interpretations of lived experiences as a result of worldviews and negotiations. Cunliffe (2002) concurs with Hermans (2001) who posits that people’s reality depends on their interpretation of their experiences based on their contexts, and their social interactions through dialogue. Similarly, Creswell (2006: 91) argues that the “diversity of interpretations”, which results in truths due to interactions and thoughts, leads to realities. Such arguments justify my relativist ontological stance of multiple realities which requires an epistemological stance whereby meaning depends on collective awareness (Crotty 1998).

### **Epistemological stance**

Such an epistemological stance is social constructivism. The participants and I actively co-constructed knowledge during the interview process as we engaged in discourse (Creswell 2007; Hermans 2001; Bogdan and Biklen 1998) since we were “interactively linked” (Creswell 2006: 91). The meanings associated with the phenomenon of experiences produce

knowledge. I considered the knowledge obtained from the dialogic activities during collaboration, and interviews at both the social and individual levels, as evidence (Cunliffe 2002; Hermans 2001). My epistemological stance of social constructivism afforded me the opportunity to obtain relevant evidence to address each of the supporting research questions to realise the objectives of this study. The supporting research questions in this study (Section 1.4: 16), which stemmed from the research objectives (Section 1.4: 16), drew on experiences, feelings, and beliefs. Participants relied on past experiences and knowledge as well as the knowledge resulting from interactions and emotions to understand and make sense of their experiences. They have their own points of view (Creswell 2006), and so I had to focus on meanings within contexts. Concurrently, they interpreted each experience as they told their stories in the sense-making process within the context of the same temporal and spatial circumstances as each research participant (Crotty 1998).

An ontological stance of multiple realities and an epistemological stance of social constructivism serve the purpose of this study (Crotty 1998). The interpretivist and social constructivist approaches complement each other because both approaches provided understandings for the social actors (research participants and me) as we tried to find meanings. An ontological perspective of multiple realities and an epistemological stance of social constructivism, reflect the aims of hermeneutics and phenomenology, and therefore, justified a methodological approach of hermeneutic phenomenology.

### **3.2 Choice of Methodological approach**

A methodological approach of hermeneutics facilitated understanding of participants' experiences (Heidegger [1962] 2008) while phenomenology focused on their lived experiences (van Manen 1997). Hermeneutic phenomenology can shed light on participants' lived experiences and their shifting professional identities. From a hermeneutic phenomenological perspective, the participants constructed their realities based on their experiences, while the knowledge they acquired can be explained by the insights they gleaned and their individual experiences (Kafle 2013). "(L)ayers of interpretations", which resulted in different perspectives, enhanced the trustworthiness of the evidence I obtained from participants' descriptions (Frost, Nolas, Brooks-Gordon, Esin, Holt, Mehdizadeh, and Shinebourne 2010: 443). Hermeneutic phenomenology facilitated such interpretations.

I regarded methodological approaches of hermeneutic phenomenology and narrative inquiry as "across-method pluralistic approaches to qualitative research" (Frost et al. 2010: 442). Together they might have enhanced the understanding of participants' experiences in relation to their professional identity. However, hermeneutic phenomenology focuses on lived experiences and the triple hermeneutics (discussed in 1.8: 29) of sense-making of these experiences by inference (Carpenter 2009; Smith and Osborn 2008; Conroy 2003). Narrative inquiry, on the other hand, involves collaboration in which there is "mutual storytelling and restorying as the research proceeds" and it focuses on the ways in which a story is told, its structure, and linguistic form (Connelley and Clandinin 1990: 4). The triple hermeneutics implies understanding and interpretation by participants, by me, and by those who would read my report based on my inference of participants' stories. These two methodological approaches do not complement each other fully. They diverge at the point at which evidence is analysed rather than at the research methods stage of the inquiry at which point evidence is obtained.

I was part of the research process in which I was the primary research instrument "to understand, respond to and describe" the interactions that took place (Creswell 2006: 91). My intention was to understand participants' experiences of their life worlds in relation to their shifting professional identities (van Manen 2007; 1997), in their words. It was not to gain understanding by discourse analysis. Discourse analysis, argues Moen (2006), would examine the nuances of participants' accounts of their experiences, by analysing the language they use

or their body language so that interpretations could be justified. I aimed to understand participants' experiences as they lived those experiences (Finlay 2009), in order to explicate how those experiences influenced professional identities. With such an approach, I focused on experiences (the phenomenon) and my connection with the participants (Finlay 2009). Heidegger ([1962] 2008: 37) posits that "(t)he meaning of phenomenological description as a method lies in interpretation". As such, interpretation was inevitable as a result of our being-in-the-world (van Manen 1997) and so, stories of participants' experiences represented what they had already interpreted, and evidence relevant to address the research question. I did not intend to explain participants' experiences (Creswell 2006). I tried to understand and interpret participants' experiences. A hermeneutic phenomenological approach allowed me, the primary research instrument, to understand and interpret participants' experiences from their perspectives. As such, I appreciated that my interpretation of participants' narratives was subjective and therefore, it aligned with my ontological assumption of multiple realities.

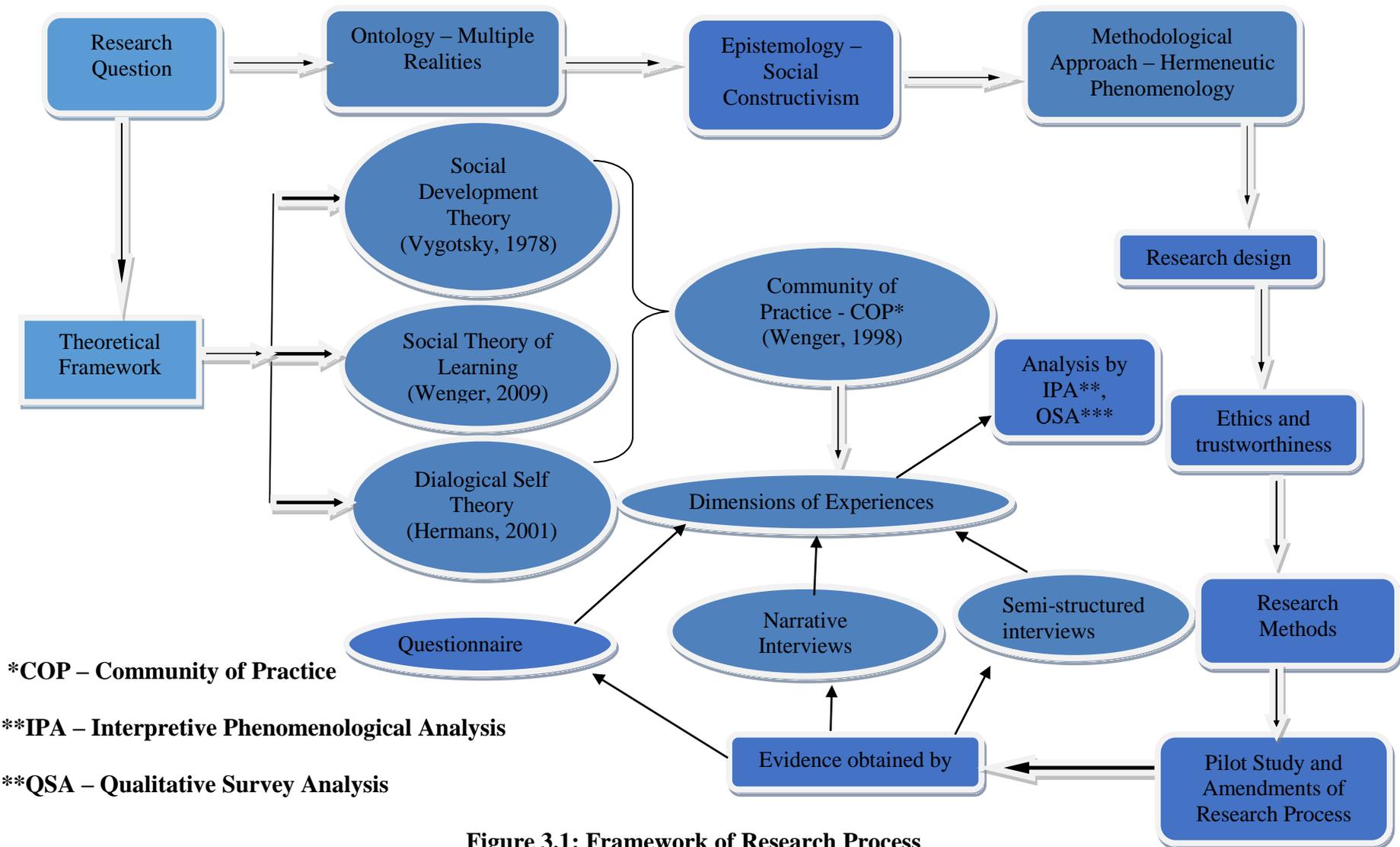
### **Theoretical perspective: Interpretive Hermeneutic Phenomenology (IHP)**

Interpretive hermeneutic phenomenology (hermeneutic phenomenology from hereon) focuses on rich descriptions of participants' lived experiences. It reflects social constructivism (Crotty, 1998) as it focuses on the philosophies that form the foundations of hermeneutics and phenomenology (van Manen, 2007). As a theoretical perspective, it has the potential to provide greater understanding of participants' experiences. Hermeneutic phenomenology endorses a phenomenological methodology which afforded me, as the researcher, an "open phenomenological attitude" (Finlay 2009: 8) so that I could analyse evidence without undue influence. In this study, hermeneutic phenomenology not only drove the research design, but it facilitated understandings of participants' lived experiences (Heidegger [1962] 2008; van Manen 2007; 1997). My research represented a "methodological concept" (Heidegger [1962] 2008: 50/28) that combined the interpretive aspects of hermeneutics and phenomenology. Phenomenology describes and interprets lived experiences or one's life world (Dreon and McDonald 2012; Finlay 2009). Concurrently, phenomenology foregrounds the "depth and richness" of meanings as participants narrated and interpreted their experiences of their life world (van Manen 1997: 11) in this study.

Heidegger's ([1962] 2008) views on phenomenological description as a means of interpretation informed my theoretical perspective of hermeneutic phenomenology. He focuses on the duality of the Dasein which he describes in terms of being and how being makes sense of its world, which is its situated meaning. He does not imply a sense of circularity due to the duality of Dasein. Heidegger ([1962] 2008) considers historicity of understanding or presuppositions necessary to understand a phenomenon since such an understanding helps to interpret a situation. My history as a science teacher, who participated in professional development programmes, afforded me a certain degree of understanding of participants' experiences. As such, hermeneutic phenomenology and its theoretical perspective informed the research methods I utilised (Creswell, 2013) to obtain evidence to address the supporting research questions. Such questions reflected the context of participants' experiences in relation to their professional identity. The "congruence" among such factors contributed to the "methodological coherence" of this study (Morse, Barrett, Mayan, Olson, and Spiers 2002: 12).

### **3.3 Framework of research process**

The theoretical framework that underpinned this study and my methodological approach influenced the framework of this research process as seen in Figure 3.1: 80 that I have envisioned. Such a framework mapped the sequence of the research process, provided signposts to understand the steps involved, and it incorporated the theoretical framework, its methodological approach, and the research design. My framework depicted the relationship between: the theoretical framework of community of practice, the evidence in the form of dimensions of experiences required to address the research question, and the tools of narrative interviews, semi-structured interviews and questionnaire to obtain the evidence. My hermeneutic phenomenological approach afforded the use of such tools. The framework expanded on the research design to trace the sequence of events during the research process.



**Figure 3.1: Framework of Research Process**

### **3.4 Research design**

Crotty's (1998) four elements of epistemology, theoretical perspective, methodology, and research method informed my design of this research. However, I reversed "the chronological succession" of these "events" (Crotty 1998: 12) in the research process because although my epistemological stance determined the nature of the research, and was central to the research process (Creswell 2013), I did not initiate this study because of my epistemological stance but because I had a research question (Crotty 1998). My research question determined the theoretical framework and methodology which in turn informed the research design. The succession of events in this research design began with the ethical considerations that were necessary so that I could uphold its trustworthiness and protect participants.

#### **Ethical considerations**

I adhered to the guidelines of the tenets of sound ethical practice stipulated by the University of Derby (2011), the British Education Research Association (2011), and the Canadian Ethics Federation (2010). As part of the research design, I incorporated ethical principles of doing no harm and protecting participants in three standards of practice (Cohen et al. 2007). I focused on standards of practice such as informed consent, signed consent, and confidentiality and anonymity. Before I began this research, I applied for and obtained ethical approval from the University of Derby (Appendices A1: I; A2: XVII), and permission to conduct research from the school board (Appendix A3: XVIII). To ensure that participants could make informed and voluntary decisions to consent to participate in this study, I informed them, in my letter of invitation, of the purpose of the research, their rights should they participate, and my duty to uphold their confidentiality and anonymity (Appendix A4: XIX). Furthermore, I advised participants of their right to withdraw from the study at any point before April 1, 2014 when analysis of evidence would have begun. Lastly, I explained my reason to conduct the research, the time line of the research, the number of interviews, and the duration of each interview. I ensured that each informed participant signed a consent letter (Appendix A5: XXI), which, not only included the information in the letter of invitation to participate, but also information on management of their interviews, on communication of findings, and on reassurances of confidentiality and anonymity.

I informed participants of my intention to uphold their confidentiality and anonymity not only in their letters of invitation and consent, but also at the start of each interview. In terms of

upholding their confidentiality, I ensured that I did not make any information or excerpts pertaining to their interviews available to others, and that I stored recordings and transcriptions of their interviews in a password protected computer, which I kept in a locked cabinet drawer when not in use. I assured participants of anonymity as I invited them to choose pseudonyms for the research, and I modified coded transcriptions of interviews to include in the appendix of the thesis and used pseudonyms to identify each transcription to protect participants. Furthermore, I informed participants that I would include excerpts from their interviews in the findings and discussion chapters of the thesis and therefore supervisors, examiners and other interested individuals would read those excerpts, which would be cited by pseudonyms. Of note is that no participant requested the opportunity to voice their input in the study.

Other ethical steps I took included the recognition of the power relationship between the participants and me. I needed to build rapport with participants to put them at ease and build trust during the interviews. Although I established some rapport when I visited the professional development programme for non-participant observations, I did not form any close friendships. Participants and I did not engage in conversations either during my non-participant observation visits, or the interviews that could cause emotional or psychological distress to them. Nevertheless, I advised them to contact their Employee Assistance Programme providers if they felt the need to do so as a result of insights gleaned from the interviews. I did not offer advice to participants, and I took care not to imply advice during my visits or interviews. I was aware that because of my experience as a science teacher and now, as a postgraduate student, some participants in the professional development programme thought that I could contribute positively to their discussions. Since this could also set up a power relationship between us, I kept an unobtrusive distance during non-participant observations. I avoided getting involved in their discussions. To avoid intrusiveness in participants' time, space or lives, I invited them to choose the mode, location, and time for the interviews.

### **Trustworthiness and rigour**

I took steps to ensure trustworthiness of this research by being mindful about each step in the research process. In establishing trustworthiness, I guarded against believing everything in the interviews as I assumed an open, questioning attitude, since I needed true meanings to justify

the trustworthiness of the evidence (Polkinghorne 2007). Rather than taking participants' stories at face value, I was vigilant to identify unusual stories and cross checked them against their responses to the questionnaire and my non-participant observations of events during the professional development programme. I foregrounded my previous experiences with respect to my own professional development activities and classroom practice. My reality, as a researcher, reflected how I interpreted the realities that participants described (Sandberg 2005). I forwarded transcriptions of interviews and my interpretation of each interview, to the corresponding participant whom I interviewed, to verify, and/or modify them for authentication (Hycner 1985). In this way, I ensured the trustworthiness of the evidence and findings from participants' perspectives.

I realised that it was impossible for participants to narrate exactly their experiences of the professional development programme in relation to their professional identity. I am aware that their narratives were likely to be distorted since they, like everyone else, were likely to represent themselves positively, albeit, not intentionally (Carpenter 2009; Polkinghorne 2007; 2005). I understood that discrepancies in narratives, compared to the evidence I obtained from the questionnaire, can arise from "a retrospective viewpoint" and "the passage of time" (Hycner 1985: 296). I was aware that the result could be one of perceived "confabulation" as participants tried to fill in "gaps in memory" to accommodate me (Hycner 1985: 296). As such, I strove to obtain evidence that was as close as possible to my non-participant observations, as I tried to uphold trustworthiness.

Another way in which I strove for trustworthiness in this study was the purposeful selection of participants from among those who participated in the professional development programme. I also obtained evidence from different sources (Polkinghorne 2007). Among those sources were: participants' narrative interviews about their experiences of the professional development programme in relation to their professional identity, a semi-structured interview, and a questionnaire. My intention was to use the non-participant observations to cross reference participants' narratives to contextualise their experiences, formulate questions for the semi-structured interview schedules, and seek further clarifications during the second interviews. My intention was not to consider the non-participant observations as evidence.

I considered four components as I set out to establish the trustworthiness of this study. I focused on credibility (internal validity), transferability (external validity), dependability (reliability), and confirmability (objectivity) (Shenton 2004), to ensure trustworthiness of my research. I took steps, common to these components, to establish a rigorous interpretive study. Among these steps were: the use of several sources of evidence, cross-checking evidence from these sources, and member checking of evidence. I established credibility in my research by taking several measures. Firstly, I selected participants purposefully, as I targeted those who were in the best position to describe their experiences of the professional development programme. Secondly, I chose participants from among those who participated in the professional development programme. Thirdly, I assured participants of their rights to withdraw from the study, and of confidentiality and anonymity, to encourage them to be as candid as possible about their experiences. Fourthly, I developed a researcher/participant relationship with the participants, based on my history as a science teacher within the school board. Fifthly, I established trust with them based on my assurances during the research process. Sixthly, I gained understanding through questioning, and I withheld judgements during the interviews. Finally, I questioned the evidence iteratively, to identify contradictions (Shenton 2004; Morse et al. 2002).

I followed similar procedures in establishing transferability and dependability of my research. I documented in detail, the procedure I employed in the research process to establish transferability. As such, the professional identity of participants can be studied by other school boards, providers of professional development programmes, or others who may be interested in conducting a similar research. Then, I indicated the location of the study, described the sample selection process, and reported the number of participants in the study. I proceeded to discuss, in detail, the: research methods I utilised, number of narrative interviews I conducted to obtain evidence, length of these interviews, time period during which I obtained evidence, and steps I took to analyse them (Shenton 2004). Details of the research process also enhanced the dependability of my study so that others can successfully repeat the process. I established the reliability of the evidence I obtained as I focused on the research question and the type of evidence I obtained.

As I strove for confirmability, I bore in mind that participants controlled the narrative interviews. They decided what to omit or include in the sequence of events, the extent of the

details, and the weight and significance of points which gave meaning to their stories. I was aware that a number of factors would have influenced the stories they told during the narrative interviews. These factors were the wider situated context within their milieu, their narrative competence, and the framework within which I conducted the interviews. I was careful to define the framework of the context and culture within which participants told their stories, as well as the manner in which I conducted the interviews. As I assumed an open mind, I remembered my interest in the research topic, and my inherent biases during the interviews.

### **Researcher bias**

I reduced researcher bias by making sure that my experiences did not influence my interpretation of the evidence. I verified participants' stories through non-participant observations, the questionnaire, and further clarifications during the second interviews as I administered semi-structured interviews. Member checks of transcriptions of participants' narrative interviews, and my interpretations of these interviews which some participants checked, provided the assurance that my interpretation of the interviews aligned with their accounts of their experiences. My decisions and methods, by which I established trustworthiness of the evidence, might have influenced my interpretations. Furthermore, I rechecked the evidence throughout the study to ensure they represented participants' experiences and ideas, rather than my own, and I reflected on their stories during my search for anomalies in the evidence. Finally, I described the analysis in detail to show how my findings emerged from the evidence.

I engaged in the following activities to take further steps to avoid bias in my research. I remembered my historicity in the interpretive hermeneutic process and also my role in obtaining the evidence. I became more aware of the researcher/participant relationship and its effect on the research process through reflection. I was aware of both my verbal and non-verbal responses and reactions to participants' accounts of their experiences of the professional development programme during the interviews. Consequently, I strove to monitor those responses throughout the interviews to avoid bias. I brought to the foreground my history as a science teacher, and I questioned my stance throughout the period in which I obtained evidence, and when I analysed the narrative interviews. During interviews I ensured that I did not offer advice or comments on the participants' narratives so as not to influence their stories.

My presuppositions and prior interpretations facilitated my understanding of participants' experiences. My experiences as a science teacher situated me within the inquiry (Holroyd 2007), but I ensured that I did not superimpose my experiences on those of the participants (Denscombe 2010) through interpretive phenomenological analysis of the evidence. I questioned my presuppositions constantly during the research process. I focused on the common thread that connected participants' experiences and reduced their individual experiences to a universal concept (Cohen et al. 2007; Creswell 2007; van Manen 1997).

### **Research methods**

The research methods I utilised fitted the purpose of the study and provided evidence required to address the supporting research questions (Denzin and Lincoln 2011). Participants expressed and described their experiences because of their consciousness of those experiences (Heidegger [1962] 2008). As such, I obtained evidence through collaboration and engagement in dialogue (Carpenter 2009; Finlay 2009; Hermans 2001). I maintained methodological coherence to ensure rigour (Morse et al. 2002), by establishing congruence between the supporting research questions and the research methods. In this study, I utilised multiple research methods as reflected in the tools I selected to obtain evidence (Creswell 2009; van Manen 1997). The non-participant observations that I made, provided greater understanding for me as it served as a backdrop for participants' experiences. I observed each session of the professional development programme for the purposes of developing questions for the semi-structured interviews, seeking clarifications, and contextualising and relating to participants' narratives. Consequently, I did not consider non-participant observations as part of the evidence I required to address the supporting research questions. Such observations afforded a means of verifying and contextualising participants' experiences. Responses to the questionnaire contributed to further understanding and cross-checking participants' stories. In order to justify my choice of research methods, I aligned each supporting research question with the appropriate research tool as seen in Table 3.1: 87.

I realised that there was no specific way to obtain evidence for a hermeneutic phenomenological study (van Manen 1997). Clandinin and Murphy (2009: 598) argue that narrative interviews, as a methodological tool, captures experiences that are "lived, told, retold, and relived in storied ways on storied landscapes". On the other hand, Smith and Osborn (2008) recommend semi-structured interviews in phenomenological studies, while

Creswell (2006) considers both narrative interviews and semi-structured interviews appropriate for a phenomenological approach. I utilised written narratives, narrative interviews, semi-structured interviews (Creswell 2006), and a questionnaire, which I selected from a range of methods identified by Crotty (1998).

The focus and purpose of each supporting research question together with the appropriate research method utilised are identified in Table 3.1 below. In this table, I demonstrate congruence between supporting research questions, the research methods and the tools I utilised, and the purpose of each question. I modified the original research tools identified in the table below after I conducted the pilot study.

**Table 3.1: Congruence between Supporting Research Questions and Research Methods**

<b>Supporting Research Question</b>	<b>Research Methods and Tools utilised</b>	<b>Purpose of questions</b>
What were the science teachers' professional identities prior to commencing their professional development programme?	Written narratives- biography	Focus is on pre-teaching identity and biography, initial teacher training, and practice in early years (Luehmann 2007; Flores and Day 2006)
What did the science teachers experience during the professional development programme in relation to their professional identity?	Narrative interviews, semi-structured interviews, Questionnaire	Focus is on lived experiences to provide "depth of richness" (van Manen 1997:11) and allows layers of interpretations from the individual's perspective to be revealed
To what extent did science teachers apply any new ideas they learnt in their classrooms?	Narrative interviews, semi-structured interviews, Questionnaire	
Have science teachers perceived any changes in beliefs and classroom practice because of their experiences?	Narrative interviews, semi-structured interviews, Questionnaire	
Were science teachers' professional identities influenced by their experiences of their professional development programme?	Induction from evidence obtained	Focus on themes identified

## Research process

I conducted the research process in a succession of stages within specific time lines so that one stage led to another. An overview of the succession of events in my research is presented in Table 3.2 below.

**Table 3.2: Succession of Events in Research Process**

<b>Research Events</b>	<b>Date</b>	<b>Reasons for Sequence of Events</b>
Development of instruments	November – December 2011	To register research, apply for ethics clearance from the University of Derby, and for pilot study
Application for ethics clearance and obtaining permission from University of Derby	November 2011 – January 2012	Permission to conduct research
Application for permission to conduct pilot study from the school board	September 2012	Researchers require permission to conduct research within the school board for each academic year
Pilot study	February 2013 – May 2013	The professional development programme was conducted during this time. Pilot study was conducted to test instruments and research design
Analysis of evidence obtained from pilot study	February 2013 – May 2013	Practice analysis of evidence using IPA, evaluate research method
Amendment of research conditions and instruments	May 2013 – July 2013	To prepare for main study
Application for permission to conduct main study within the school board	September 2013	Permission to conduct research within the school board for academic year 2013 – 2014
Main research	October 2013 – May 2014	Professional development programme was conducted during this time
Transcription of interviews	October 2013 – May 2014	To manage transcription process and to manage the evidence obtained
Analysis of interviews and questionnaire	April 2014 – July 2014	To facilitate analysis while memory of interviews could be easily recalled

### **Rationale for research methods**

The research methodology informed my research methods which had the potential to yield rich evidence of participants' experiences in relation to their professional identities. Participants controlled the story-telling process in narrative interviews, while the semi-structured interviews clarified parts of the narratives and added to the richness of the evidence. I included a questionnaire (Crotty 1998) among the set of tools to authenticate participants' stories to uphold the rigour and trustworthiness of the research and, in the process, it provided additional evidence. The research methods used provided a holistic approach to understand and corroborate evidence.

Narrative interviews and written narratives imply stories being told (Clandinin, Downey, and Huber 2009; Bauer 1996) in this study. Clandinin et al. (2009) argue that narratives in identity formation describe who teachers were and would become. They argue further, that written narratives form the "nexus" of teachers' professional "knowledge", which also represents "the landscapes, past and present, on which" teachers "live and work" (Clandinin et al. 2009: 141). Teachers' narratives of their life histories described the influences on their decisions to become teachers, the course of actions they took, and the milestones they passed along the way. Those factors contributed to teachers having identities to which Luehmann (2007) and Gee (2001) refer as their core professional identities.

I sought meaning and understanding of the participants' experiences through the overarching research question and the supporting research questions. Both types of questions have informed the means by which I obtained the relevant evidence. The "dynamic role played by cultural meanings, values and identities", and all social contexts that could enrich the evidence of participants' experiences, would have been overlooked (Henwood, Pidgeon, Parkhill, and Simmons 2010: 4), if I had obtained evidence using a questionnaire alone. In contrast, a questionnaire, which is the traditional approach to obtain evidence, would have identified meanings, albeit with less abundance. As such, participants' stories expressed contextually embedded meanings, and provided in-depth understandings of their experiences (Henwood et al. 2010). In the process, such stories led to insight into teachers' professional identities since their "knowledge is entwined with identity" (Clandinin et al. 2009: 141).

The several ways in which I obtained evidence added to the robustness of this study. Narratives, both written and oral, as research methods, established the descriptive validity of my study (Pinnegar and Daynes 2007). Narrative interviews are a viable means of representing qualitative studies such as phenomenology, and they are fit for the purpose of obtaining stories of experiences (Creswell 2007; Moen 2006). I organised participants' experiences in relation to their professional identities into narratives (Moen 2006) since the "richness of narrative data" provided me "with different understandings" of their experiences (Wiklund-Gustin 2010: 35). Participants' professional biographies, through written narratives, highlighted their professional identities up to the point at which I began the research process. Evidence of participants' experiences, obtained from tools such as narrative interviews and a questionnaire, added rigour and upheld the trustworthiness of the study, while it contributed to comparison of experiences to address the research question.

### **Written narratives**

I utilised written narrative, in the form of biographical interviews, to glean participants' professional identities prior to this study. The written narrative approach situated participants within "the wider social, cultural and historical contexts" they inhabited prior to the commencement of the professional development programme (Sikes 2007: 2; Larsen 2003; Stroobants 2002). Such an approach focused on participants' perceptions of their life histories prior to the start of the research (Sikes 2007). The depth and richness of the evidence I obtained through the "narrative act" (Larsen 2003: 1), contributed significantly to the evidence, compared to the evidence other methods, such as semi-structured interviews, would have contributed (Sikes 2007; Stroobants 2002). Written narratives are stories told of one's past to portray their professional identity within a specific context of space and time. Critical reflection on past practices, beliefs, and values at each stage of one's career, foregrounds context and the changes one experiences. The written narratives represented primary evidence in this inquiry, which produced meanings while it separated the participants from me, the researcher (Polkinghorne 2007; Moen 2006). Such narratives act as a frame of reference (Moen 2006) and, concurrently, situate participants within their professional landscapes, and their professional development landscapes (Goodson and Choi 2008). As I developed the original written interview schedule (Appendix B1: XXII), I relied on literature to inform me in terms of the evidence I needed to find out participants' professional identity prior to the

main study. A few of the literature that informed this aspect of my research are Bukor (2014), Hughes (2013), Wrench and Garrett (2012), Jephcote and Salisbury (2009), Flores and Day (2006), and Kelchtermans (2005).

### **Narrative interviews**

Generally, narrative interviews minimise researcher influence on “informant’s perspective”, have no structure, and they link events to context (Bauer 1996: 2). Narrative interviews in this study, yielded a wealth of information about participants’ actions, opinions, circumstances, and events all of which facilitate interpretation of experiences as the narrator controls the interview process (Bauer 1996). Furthermore, narrative interviews provided the “personal gestalts” that would have been lost if I were to question participants by “overlying” my “agenda upon” their “own meaning frames” (Henwood et al. 2010: 5). I considered the stories that the narratives revealed to be true, since people are inherently honest (Bauer 1996). The narrative interview process involved a technique of “story-telling and listening” (Bauer 1996: 3), which consisted of ways in which the participant initiated the stories and continued to tell the story as narratives (Bauer 1996). During narrative interviews, participants can reveal hidden meanings through further explanations, which provides rich evidence for analysis (Polkinghorne 2005). Participants acquire the agency to relate their experiences contextually, either by comparison or sequentially from their perspectives as a result of the narrative interviews (Henwood et al. 2010). As with the written interview schedule, literature informed me as I developed the original narrative interview schedule (Appendix B2: XXIII), not to control the interview process, but to guide participants to stay the course and direction of the interview, so that they told stories of their experiences of their professional development programme. Among the publications in the literature that informed my decision to conduct narrative interviews are Shapiro (2010), Beauchamp and Thomas (2009), Galindo (2007), and Soreide (2006). Notably, the research tool in the form of narrative interviews was the principal means by which I obtained evidence and as such it was the focus of my analysis.

### **Questionnaire**

Evidence from the questionnaire established clear meanings of participants’ experiences. The questionnaire drew on the theoretical framework of this study (Cohen et al. 2008) and focused on cognitive development, social interactions, and emotional changes. While I appreciate that use of a questionnaire reflects an imposition of my part to guide the participants’ responses

with respect to their experiences, I utilised it to cross-match their responses to their narrative interviews. The questionnaire was not a ‘quantitative’ segment of the multi-method research design nor was it considered as a main source of evidence. It was another qualitative means (Jansen 2010) of providing evidence that focused on participants’ experiences of knowledge gained, their social interactions, and their emotional changes during the professional development programme in relation to their professional identity. As a result, it added another dimension to the evidence, which described participants’ experiences (Hendry 2010; Sikes 2007), and which reflected the theoretical framework of the study. Of note is that, I did not follow any specific method when I developed the original questionnaire (Appendix B3: XXIV), but literature (as cited for the written narratives and narrative interview questions) and my theoretical framework informed me in terms of the items that I included in it.

### **Semi-structured interviews**

Semi-structured interviews provided further insights into participants’ narratives of their first interviews and clarified my observations of each of their activities during the professional development programme. Semi-structured interviews were not utilised in the pilot study because I planned to develop bespoke semi-structured interview questions for each participant based on my observations and participants’ first narrative interviews. As such, these questions were unique for each participant since my intention was to seek further clarification for each of their experiences. The nature of the semi-structured interview questions was such that it was not possible to evaluate them in the pilot study. Compared to the use of the narrative interviews, the semi-structured interviews I utilised, had a minor role in the evidence-obtaining process.

I drew attention to the semi-structured interviews, to situate its importance in the evidence-obtaining process. The main evidence obtaining tool was the narrative interviews which was in keeping with exploring professional identities (Clandinin et al. 2009) and in conducting a study with a phenomenological approach (Creswell 2007). Of note is that I developed and utilised a rubric (Appendix B4: XXVIII) in the pilot study to record my non-participant observations. However, it was impractical to document my observations in this way, and so I discarded it. I present an overview of and justification for the process by which I obtained evidence for this research in Table 3.3: 93.

**Table 3.3: Process of Obtaining Evidence**

<b>Evidence Obtaining Process</b>	<b>Evidence Obtained</b>	<b>Justification</b>
Written Narratives	Professional biographies prior to research	Science teachers tell stories of their past (personal life, educational paths, and professional experiences) through the ‘narrative act’ (Larsen2003: 1) to portray their professional identity specific to the context and time of their past.
Narrative interviews	Experiences of professional development programme	To minimise my influence on science teachers’ “perspectives” of their experiences (Bauer 1996:2) where I could easily superimpose my ideas on theirs. This type of interview involves story-telling and listening.
Bespoke Semi-structured Questions	Clarifications of grey areas from narrative interview, explanations from observations of actions during professional development programme, and to contextualise science teachers’ narratives during analysis of interviews	To clarify meanings of expressions from first interviews and my observations of each science teacher during non-participant observations. Such questions also provide rich evidence (Polkinghorne 2005).
Questionnaire	To obtain clear indications of experiences of professional development programme unique for each science teacher.	To establish rigour and trustworthiness of research by cross-matching.

### **Access to research site**

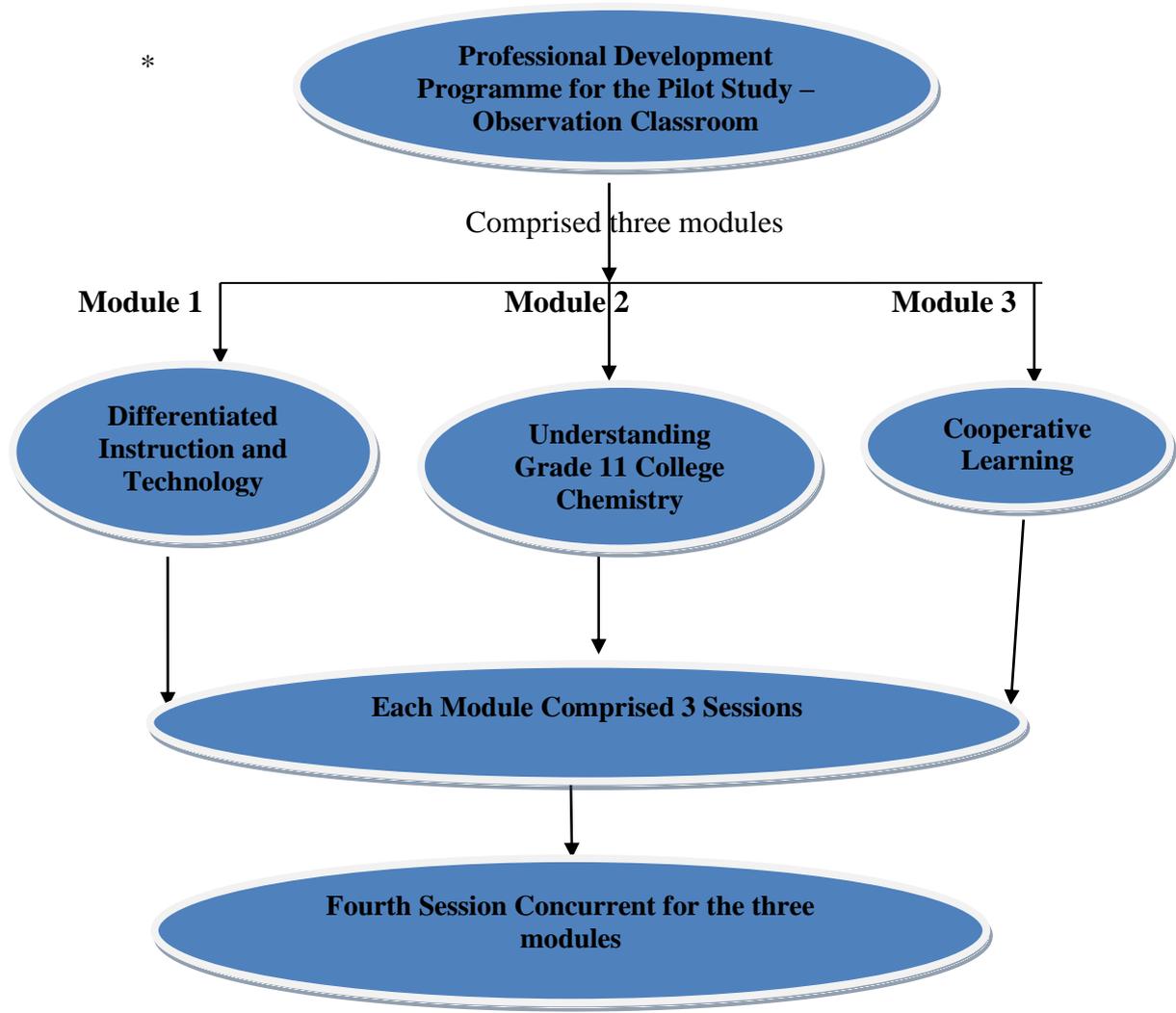
Having obtained ethical clearance from the University of Derby in 2011/2012 to conduct this research, I applied for and secured permission from the school board. As a researcher, I needed to secure permission to conduct research on the school board premises for each academic year. As such, I applied for and secured permission to conduct the pilot study in academic year (2012/2013) and then I repeated the process for permission to conduct my main study in the following year (2013/2014). In order to gain access to research sites, I informed the coordinator of the professional development programme for Science and Technology at the school board of my permission to conduct non-participant observations in the specified professional development programme. I followed this protocol for the pilot study and the formal study whereby he made arrangements with the instructional leaders for my visits to the research sites during the pilot and main studies. I met the coordinator and the instructional leaders on the first day of each professional development programme at the research sites for both studies.

### **Pilot study**

The pilot study, conducted to test the research design, occurred between February and May 2013. It comprised a different set of participants who participated in a similar type of professional development programme as the main study. I utilised a hermeneutic phenomenological approach involving research tools such as written narratives, narrative interviews, a non-participation observation rubric, and a questionnaire (Polkinghorne 2005). During the pilot study, I assessed the: sample selection process, methodological strategies, research tools, ethical considerations, logistics of location and time for the interviews, my subjectivity, trustworthiness of evidence, research protocol, and feasibility of the study. In the process, I gained experience in conducting narrative interviews and analysing the interviews by interpretive phenomenological analysis.

Participants in the pilot study represented teachers from the school board who volunteered to attend the Observation Classroom programme which comprised three modules. The three modules were: Differentiated Instruction and Technology, Understanding grade 11 College Chemistry, and Cooperative Learning. Figure 3.2: 95 represents a schema of the structure of the professional development programme in the pilot study. 11 of the 40 participants who

attended the professional development programme, volunteered to participate in the pilot study.



**Figure 3.2: Diagram of the Professional Development Programme in Pilot Study**

\* The source of this diagram is original and entirely my own

I attended all of the sessions in the three modules. The following routine was common to all modules:

- Session 1: Participants with common goals from each module planned a course of action and they had to apply it in their classroom practice.
- Session 2: Participants from each module visited one teacher's classroom to observe a lesson in action. They then went to their own schools, taught the concept to their students, test the students, and report their experiences to the group in the next session.
- Session 3: All participants then returned with samples of their students' work for moderated marking and discussion of results.
- Session 4: Participants from the three modules met at the same time and place for debriefing with the Instructional Leader and discussions among themselves.

Participants were recruited from among those who participated in the professional development programme through purposeful sampling. I invited participants in the professional development programme to participate in the pilot study after the instructional leader introduced me at the start of each module. I distributed 40 letters of invitation to participants in the professional development programme: 18 to the science teachers enrolled in the Differentiated Instruction and Technology module, 12 to those enrolled in Understanding grade 11 College Chemistry, and 10 to those in the Cooperative Learning module. I took the opportunity between sessions to approach each science teacher to invite him or her to participate in my study. By the end of the day, those science teachers, who were willing to participate in the study, signed letters of consent forms. 11 science teachers volunteered to participate in this study. 5 of them provided all of the evidence I required. Despite this, I used all the evidence I obtained from the 11 science teachers to test the rigour and robustness of the research tools.

After science teachers volunteered to participate in the study, I assigned their pseudonyms and negotiated the date, time, place, and mode for the interview. I distributed written narrative schedules to each participating science teacher, and advised them to return their professional biographies to me before the end of each module. I conducted a face-to-face interview in one science teacher's home, one in a coffee shop, 2 in professional development centres, and seven in the science teachers' home schools. A history of the date, time, and location for the

interviews that I conducted is provided in Table 3.4 below. I administered the questionnaire after each interview.

**Table 3.4: Date, Time, and Locations for Interviews in Pilot Study**

<b>Science Teachers</b>	<b>Interviews</b>		<b>Location</b>
	<b>Date</b>	<b>Time</b>	
<b>Module: A</b>	<b>Cooperative Learning</b>		
Leah	March 3, 2013	11:00 am	Her home
Veronica	March 18, 2013	9:00 am	Her school
<b>Module: B</b>	<b>Grade 11 College Chemistry</b>		
Adam	April 7, 2013	3:30 pm	School Board
Sofia	March 21, 2013	9:30 am	Her school
<b>Module: C</b>	<b>Differentiated Instruction and Technology</b>		
Alexa	March 26, 2013	2:30 pm	Her school
Brian	March 25, 2013	2:00 pm	His school
Charles	March 2, 2013	9:00 am	His school
Hannah	March 27, 2013	3:30 pm	School Board
Hailey	March 25, 2013	11:00 am	Her school
Ruth	March 25, 2013	1:00 pm	Her school
Savannah	March 21, 2013	12:00 noon	Coffee shop

I tested the original research tools in the pilot study to assess their suitability to obtain the relevant evidence for this study and found flaws in the tools. As such, I amended them before I used them in the main study. I analysed every step of the research process to identify and change aspects of it to enhance the main research design. I forwarded verbatim transcriptions of each interview, and my interpretation of the interview to each science teacher for member-checking, amendments, and anecdotes to enhance their narratives. I then cross-checked

science teachers' responses in the questionnaire with their interview transcriptions to determine the trustworthiness and rigour of the evidence I obtained from the narrative interviews. I took steps to ensure credibility, transferability, dependability, and confirmability in the pilot study. Through interpretive phenomenological analysis and qualitative survey analysis, I practiced coding and categorising the codes, before I assigned them to themes. During the pilot study, I paid attention to ethical issues, logistics of location, time commitments, research protocol, and feasibility of the study.

Several ethical issues arose from the pilot study, which stemmed from concerns of confidentiality, anonymity, and pseudonyms. Two science teachers required further explanation and reassurances regarding their rights to confidentiality and anonymity. To address this issue, I decided to explain rights to confidentiality and anonymity verbally, at the start of each interview, to all science teachers who participated in the main study. This was in addition to the stipulated measures of confidentiality and anonymity to science teachers that I included in the letters of invitation and contract, as well as in interview schedules. I recognised their vulnerability in the study since both the professional development programme and the science teachers could be identified easily.

The pseudonym I assigned for each science teacher started with letter corresponding to that of the science teacher's first name. Unwittingly, these pseudonyms reflected the science teacher's ethnicity. I soon realised how easy it would be to identify them. I realised I did not assign the pseudonyms with awareness of the implications or in an informed manner. Subsequently, I reassigned pseudonyms to protect the identity of science teachers in the pilot study. As such, for the main study, I invited science teachers to choose their own pseudonyms. I did not participate in the process by which the science teachers in the main study chose their pseudonyms since I felt that it was their choice and I respected that. However, most of them chose a first name, but a few of them chose first and last names. While I tried to honour those names, eventually, I persuaded them to use only their first names to maintain uniformity in the pseudonyms.

Other issues arose regarding the location and time for the interviews. I conducted 7 of the 11 interviews in science teachers' school environment as they requested. For the other four science teachers, I conducted one interview in a cafe as suggested by one teacher, one at a teacher's home as she suggested, and the other two on the school board premises as requested

by the teachers. Surprisingly, the interruptions, intrusions and noise level appeared to be greater in the school environment than in the cafe or the science teacher's home. The traffic of people in and out of the interview areas in the schools, and the background conversations or announcements from the public address system, distracted the interview process more than in the coffee shop or in the science teacher's home. Apart from the interruptions, several members of staff moved in and out of the interview area in the school environment. While the intrusion did not seem to affect the interviewees, I was concerned about the lack of privacy for the interviewees. As I replayed the audio recordings of the interviews, I appreciated the importance of location for the interviews since conversations of the members of staff were recorded along with my participants' narratives.

Ethically, I was reluctant to conduct interviews in the coffee shop, or the science teacher's home. However, the coffee shop was about 30 kilometres from the science teacher's school and so the chance of colleagues or students stumbling upon the interview seemed remote. I agreed to conduct the interview in the other science teacher's home to accommodate her. She made every effort to ensure that the interview process was conducted in a professional manner. Her home proved to be the best environment for interviews since she took steps to minimise interruptions. I decided to stipulate to potential volunteers for the main study to identify locations more ideal for privacy, and with minimum interruptions for the interviews, especially if they choose their school environment.

I was flexible with respect to time of arrival for interviews and duration of interviews which influenced the quality and quantity of evidence I obtained. 10 of the 11 science teachers in the pilot study arrived on time for the narrative interviews. I kept the interview sessions within the allocated time of 20 minutes so as not to inconvenience the science teachers. However, I accommodated those science teachers who wanted to continue with the interview beyond the twenty minutes. I transcribed each interview from the pilot study and found that 20 minutes of a narrative interview yielded, on average, about six pages of narrative. From a management of evidence and analysis perspective, the time line seemed adequate for interviews and so I did not make any changes for the main study. However, it appeared that the science teachers were committed to participate in the narrative interviews and answer the questionnaire but not the written narratives or in the checking of the transcriptions and my interpretation of their interviews.

The outcome of the pilot study provided valuable insight regarding the research protocol. I found the protocols of conducting written narratives, narrative interviews, and the questionnaire to obtain evidence, to be appropriate although it was a challenge to persuade science teachers to write narratives of their professional biographies in a timely manner. The most rewarding evidence with rich descriptions came from the narrative interviews. I checked science teachers' responses to the questionnaire, against their interviews for alignment of their responses. I found the study to be feasible. The support and encouragement of the school board, the professional development co-ordinator, and the instructional leader of the professional development programme, helped me to conduct my pilot study without any undue problems.

### **Amendment of research tools**

One function of the pilot study was to test the: written narrative schedule, narrative interview schedule, and questionnaire for their validity in the main study. I conducted the pilot study in the same manner in which I intended to conduct the main study. Prior to conducting the narrative interviews, I distributed written narrative schedules to science teachers, and I advised them to use the schedules as guides to provide a written narrative of their professional biographies. I collected these at the end of the professional development programme. Concurrently, I practised the narrative interviewing process. During the narrative interviews, I invited science teachers to relate their stories of their experiences as I listened without interrupting them. At the end of their narrations I asked additional questions for clarification. I administered the questionnaire at the end of the narrative interviews.

Feedback obtained from science teachers informed how I modified the research tools before I used them in the main study. I obtained varied responses to my request to write narratives of their professional biographies from the science teachers. These responses varied in terms of time, length, and content. Some science teachers answered the guided questions while others wrote extensively. I modified the written narrative tool (Appendix C1: XXXI) to offer science teachers the choice of answering the questions in the schedule or writing their professional biographies as a narrative essay for the main study. Some of them found it difficult to write about 500 words for the biographical narrative so I removed that phrase from the instructions.

The purpose of the narrative interviews was to foreground evidence of specific experiences in relation to professional identities as described by science teachers. I conducted one narrative interview with each teacher instead of two as in the main study, since I was testing the narrative interview process and the narrative interview tool rather than seeking information about their experiences. I modified the narrative interview schedule (Appendix C2: XXXII) based on their feedback about descriptions of their experiences of their professional development programme. In response to the questionnaire, science teachers identified questions that they considered ambiguous or difficult to answer. I invited them to suggest ways in which the questionnaire could be modified to be more user-friendly. The specificity of the modules, which I did not take into account when I designed the questionnaire, did not allow some science teachers to complete all of the questions. Three of them suggested I include the response keys at the top of each page. Others suggested that I should clarify specific statements in sections B and C. I made these changes and modified the instructions subsequently as I refined the questionnaire for the main study (Appendix C3: XXXIII). I inserted a clause in the instructions at the start of each section informing participants to answer the sections relevant to their experience of the module in which they participated.

### **Non-participant observations**

During the planning stage of my research, I decided to be a non-participant observer to contextualise experiences that participants would narrate to me during interviews. As such, I engaged in non-participant observations in the form of a rubric (Appendix B4: XXVIII) of the activities of the science teachers who participated in my study. However, use of the rubric proved to be impractical and so I abandoned the idea. I informed the professional development coordinator, the instructional leader, and all of the science teachers in the professional development programme of my presence during the sessions to observe the interactions and activities of the science teachers who volunteered to participate in my study (pilot and main). However, I did not address my non-participation observation in an ethical research manner befitting a doctoral research. Also, I did not use a rigorous observation grid to validate my findings. As such, I did not consider such observations as evidence collected for analysis as part of my field work. My observations contextualised participants' narratives and they also allowed me to seek further clarifications of participants' actions to understand their experiences during the semi-structured interviews (Appendix C 4: XXXVII).

## **Selection and sample of participants in the main study**

I selected science teachers for my study purposefully from among those who participated in the professional development programme described in chapter one. My intention was to focus on the experiences of in-service secondary school science teachers during their professional development programme in relation to their professional identities. As such, variables such as gender, age, educational level, years of experience, and grade levels taught were not part of the inclusion criteria for my study. The number of science teachers who participated in the professional development programme was not large enough for me to categorise them according to those criteria. Instead, I focused on those science teachers who were willing to participate in my study. I selected this professional development programme because it was the current programme offered by the school board that was appropriate for my research. I chose those science teachers because they were in a position to describe their experiences clearly to address the research question (Wiklund-Gustin 2010; Bogdan and Biklen 1998) since they were the ones who participated in the professional development programme.

The educational background of the science teachers facilitated their use of language to yield ‘rich narratives’ as they described their experiences in clear and structured ways since they were trained to express themselves (Wiklund-Gustin 2010: 34). I regarded the science teachers’ experiences as valid evidence (Morse et al. 2002) to address the research question. This was a criterion for inclusion for the sample set (Wiklund-Gustin 2010; Carpenter 2009; Polkinghorne 2005). Such an approach contributed to a rigorous study since the trustworthiness and validity of my study depended on targeting a set of science teachers who had the potential to provide a comprehensive description of their experiences of the professional development programme in relation to their professional identity (Polkinghorne 2005).

I invited science teachers to participate in the main study after the Instructional Leader introduced me to them in each module. As I introduced my research to the science teachers, I informed them that I was guided by the ethical guidelines of The University of Derby (2011), the British Educational Research Association (2011), and the Canadian Ethics Federation (2010) in conducting this study. I assured them that throughout the research process, which included the period of obtaining evidence, analysis and the write up of my thesis, I would

protect their confidentiality and anonymity. I ensured that I informed the science teachers fully about the research process as I distributed to each of them, my letter of invitation in which I included the information stipulated in the ethics section above on informed consent. I then secured signed consent letters from each science teacher who was interested in participating in the study. I advised the science teachers of their rights to withdraw from the study at any point before April 1, 2014 should they wish to do so because I intended to analyse the evidence after that date. Lastly, I provided my e-mail address and I advised the science teachers to contact me if they needed further clarification.

The demographics of the science teachers from among whom I purposively selected my participants for this study is displayed in Table 3.5 below.

**Table 3.5 Demographics of Science Teachers in Main Research**

Professional Development Module*	Number of science teachers/Module	# of Men	# of Women	Number of Science Teachers in Study	
				Men	Women
CAI	10	2	8	1	3
MU	12	2	10	1	3
ELL	16	2	14	1	4
<b>Total</b>	38	6	32	3	10

\*CAI – Culminating Activity for an Inquiry Unit

MU – Motivating the Unmotivated in Grade 10

ELL – Communicating with the English Language Learners

Of the 38 science teachers who participated in the professional development programme, 6 were men and 32 were women. 18 science teachers volunteered to participate in my study at the onset. However, due to pregnancy (1), illness (1), and timetable changes whereby some teachers no longer taught science (3), the actual number of volunteers was 13, 3 of whom were men.

The profiles of the science teachers are set out in Table 3.6: 105. It must be noted that the proportion of women to men was significantly high. This ratio by no means reflect the gender distribution of secondary school teachers in the school board where I conducted my study. While the difference in proportion of women to men is not a factor in this study, it does warrant consideration in future studies. Their ages ranged between 25 and 60 years. 8 of the science teachers have specialist qualifications in biology (4), chemistry (1), physics (2), or computer science (1) and their experience in teaching science ranged between 5 and 21 years. 2 of the science teachers (women), held positions of responsibilities and 4 of them, 3 women and 1 man, have earned postgraduate degrees in either Education (2) or Physics (2). 5 of these teachers, 3 women and 2 men, were second career teachers. Second career teachers have “hybridised identities” due to their prior professional identities, which influenced their teacher professional identities (Farnsworth and Higham 2012: 494).

**Table 3.6: Profile of Science Teachers in Main Research**

Names (Pseudonyms)	Module	Sex	Age Range	Years of Teaching Experience	Grade/ Subject	Subject Specialism	Position of Responsibility	Postgraduate Education
Ashna	ELL	F	30 – 35	7	9 -12 science, biology, chemistry	Biology	Yes	MEd
(S) Darius	CAI	M	45 – 50	10	9 – 12 mathematics, science, physics	Physics	No	MSc
(S) Felix	ELL	M	45 – 50	16	8 -12 science, biology, mathematics	-	No	None
(S) Hailey	ELL	F	30 – 35	4 (in 4 schools)	8, 9 science	-	No	None
Jean	MU	F	30 – 35	8	9, 10 science, 11, 12 biology	-	No	None
Jen	ELL	F	25 – 30	4 (in 5 schools)	9, 10 science, geography	-	No	None
Linda	ELL	F	45 - 50	21	9 – 12 chemistry/math	Chemistry	No	None
Maria	CAI	F	40 – 45	10	9 – 12 science/math	Biology	No	None
Mary	CAI	F	45 – 50	21	9 – 12 science, biology and chemistry	Biology	No	None
(S) Maya	MU	F	40 – 45	14	10, 11 enriched science, chemistry	Biology	Yes	MEd
Sage	CAI	F	35 – 40	11	7 – 12 science	-	No	None
(S) Sam	MU	F	55 – 60	11	9 – 12 mathematics, science, physics,	Physics	No	PhD
Steve	MU	M	35 – 40	13	kindergarten – 13 science, technology	Computer science	No	None

CAI – Culminating activity for inquiry unit

MU – Motivating the unmotivated grade 10

ELL – Communicating with English Language Learners

F – Female

M – Male

S – Second career

### **My role in the research process**

I assumed the role of a non-participant observer in the research process to view the science teachers' interactions and activities during their professional development sessions. My intention was to relate to, understand, appreciate, and contextualise their experiences as they narrated them to me. In the process, I formulated relevant questions to explore their stories further, during supplemental semi-structured interviews. My privilege as an observer also afforded me the opportunity to cross-check the science teachers' account of their experiences with my interpretation of events, augment audit trail, and justify my findings. The observations that I made were not considered as evidence at any time during the research process. I attended every session of each module to understand the science teachers' narratives of their experiences of the professional development programme in relation to their professional identity. My intention was not to evaluate either the professional development programme or anyone participating in it. During each session of each module, I focused on and observed the activities, behaviours, and interactions of those science teachers who volunteered for my study.

I conducted the first interview after the second session of each module and the last interview about two weeks after the end of the professional development programme. My rationale for conducting the last interview at that time was to find out whether science teachers applied their new learning in their classroom so that they could relate the outcomes of their efforts during the interview. Not all of the interviews, which I conducted, were face-to-face. The science teachers chose times and locations for their interviews that were convenient for them. As such, eight of the science teachers opted for interviews conducted by telephone, while four of them opted for face-to-face interviews, and one of them suggested that I interviewed her via Skype.

My history and presuppositions as a science teacher situated me centrally in this study. I focused on meanings as the science teachers and I co-interpreted their narratives (Laverty 2003). Interpretive hermeneutic phenomenology is regarded as "a dynamic process" and we, the actors, had "an active role" (Smith and Osborn 2008: 53). My role permitted me to focus on the lived experiences of science teachers to gain understanding from their perspectives (Cohen et al. 2007), which resulted in triple understandings (Carpenter 2009; Smith and Osborn 2008; Conroy 2003), as I discussed earlier in this chapter. I did not bracket my

experiences during the research process since my presuppositions were integral to my understanding aspects of the science teachers' experiences (Carpenter 2009; Heidegger [1962] 2008; Conroy 2003). I strove to: "uncover and describe structures ... of lived experiences" systematically (van Manen 1997: 10), gain insight into the "personal and social world" of the science teachers (Smith and Osborn 2008: 53), focus on their experiences as they described them (Kafle 2013), and on their norms and values to understand their experiences (Denscombe 2010; Cohen et al. 2007; Creswell 2007; van Manen 1997).

### **Obtaining evidence in the main study**

After science teachers volunteered to participate in the research, I included them in the planning process of the main study. I invited them to select their pseudonyms and identified the date, time, place, and mode for the first interview. I distributed written narrative schedules to each participating science teacher, and advised them to return their professional biographies to me before the second session of each module. I considered the two narrative interviews as primary evidence in this study. While the first narrative interviews involved face-to-face, telephone, and Skype modes, no second interview involved the Skype mode. I conducted the face-to-face interviews in 2 science teachers' homes and in 2 of their home schools for the first interview. I conducted all face-to-face interviews in the second interview in science teachers' home schools. A history of the date, time, and location for interviews 1 and 2 that I conducted is provided in Table 3.7: 108. I administered the questionnaire electronically or face-to-face after each second interview.

I distributed the amended narrative interview schedule to each science teacher at the start of the interview or sent them out electronically before the telephone and Skype interviews. I advised science teachers that the interview schedule was a guide, and they did not need to follow it. After reassuring them once more about their rights to confidentiality and anonymity, I informed them that I was recording the interviews in my computer. I observed that the science teachers did not need prompting to relate their experiences during the interviews. I supplemented the second interview with semi-structured interview questions that I formulated for each science teacher, after the first interview, and as a result of non-participant observations of those science teachers during professional development sessions.

**Table 3.7: Date, Time, and Locations for Interviews in Main Study**

Science Teachers	Interview 1		Interview 2		Location
	Date	Time	Date	Time	
<b>Module: Culminating Activity for Inquiry Unit</b>					
Darius	February 11/2014	1:00 pm	April 15/2014	1:00 pm	His school
Maria	February 20/2014	5:30 pm	April 10/2014	10:00 am	Telephone
Mary	February 19/2014	9:30 am	April 22/2014	10:00 am	Telephone
Sage	February 12/2014	3:30 pm	April 16/2014	3:30 pm	Her school
<b>Module: English Language Learners</b>					
Ashna	March 10/2014	2:00 pm	April 26/2014	2:00 pm	Her home for 1 <sup>st</sup> and telephone for 2 <sup>nd</sup>
Felix	March 13/2014	1:00 pm	April 21/2014	5:30 pm	Telephone
Hailey	March 13/2014	10:00 am	April 17/2014	5:30 pm	Skype for 1 <sup>st</sup> interview, telephone for 2 <sup>nd</sup>
Jen	March 6/2014	4:00 pm	April 14/2014	3:45 pm	Telephone
Linda	March 7/2014	10:00 am	April 23/2014	7:00 pm	Telephone
<b>Module: Motivating the Unmotivated Grade 10's</b>					
Jean	April 2/2014	4:00 pm	-	-	Telephone
Maya	March 14/2014	12:00 pm	May 2/2014	4:00 pm	Her home for 1 <sup>st</sup> and school for 2 <sup>nd</sup>
Sam	March 14/2014	9:30 am	May 6/2014	7:00pm	Telephone
Steve	March 11/2014	9:30 am	May 5/2014	6:00 pm	Telephone

I informed each science teacher that I would forward the transcription, and my interpretation of their interviews for them to check, verify, amend for authentication, and supplement to add to the richness of their stories. At the start of the first interview, I invited science teachers to narrate their experiences of the professional development programme in relation to their professional identity. By inviting science teachers with such an open question, I allowed them to speak freely of their experiences, thereby providing rich narratives (Wiklund-Gustin 2010). As I was recording the narratives, I listened without interrupting the science teachers as they narrated their experiences of the professional development programme in relation to their professional identity. They controlled the duration of each interview which was between 20 and 30 minutes. In the interest of obtaining 'rich data' I followed the tenets of the narrative method in which I allowed science teachers to tell their stories uninterrupted while I made notes until they signalled that they had nothing else to add. Consequently, I obtained unprompted narratives that were important to the science teachers.

Science teachers determined the direction of the interview process within the boundaries set by the objectives of the study. However, during some interviews, it appeared that the conversation was moving "away from the agreed domain" of experiences of the professional development programme (Smith and Osborn 2008: 64). At this point, I directed the science teachers to follow the narrative interview schedule, to subtly keep their narratives within my areas of interest to "monitor the coverage of the scheduled topics" (Smith and Osborn 2008: 63), not to control the contents of their narratives. Science teachers controlled the sequence of their stories so that they had control of the interviewing process. At the end of the narratives in the second interviews, I conducted the semi-structured interview for each teacher to clarify either my observations during the previous professional development session, or to further understand their first narratives. I did not ask all the questions nor in "exactly the same way" as they appeared in the semi-structured interview schedule (Smith and Osborn 2008: 64). These tailored, individual semi-structured interviews for each teacher focused on their experiences, because of the subjective nature of my study. At the end of the second interview, most of which I conducted by telephone, I administered the modified questionnaire electronically or in person for the science teachers' convenience.

### **3.5 Principles of analysis**

The model of analysis of the evidence I utilised, reflected Smith and Osborn's (2008) interpretive phenomenological analysis for the narrative interviews. Because of the relationship my model has with Heidegger's ([1962] 2008) hermeneutic phenomenology and the hermeneutic circle, I considered three concepts. These were: Smith and Osborn's (2008) interpretive phenomenological analysis, hermeneutic phenomenology, and the hermeneutic circle which my model of analysis subsumed.

#### **Model of Analysis**

Interpretive phenomenological analysis (IPA) delves deeply (Smith and Osborn 2008) into evidence that emerges from Heidegger's ([1962] 2008) hermeneutic phenomenology. Interpretive phenomenological analysis (Smith and Osborn 2008), hermeneutical principles for phenomenological research (Heidegger [1962] 2008), and the hermeneutic circle (Conroy 2003) are interrelated. Together, they contributed to understand science teachers' experiences of their professional development programme in relation to their professional identity, and in identifying themes. Interpretive phenomenological analysis also informed the manner in which I compared findings as I focused on Wenger's (1998) community of practice. In this study, understanding of science teachers' experiences occurred as they and I became engrossed in social and discursive relationships as a result of our histories as science teachers (Finlay 2012). My analysis of evidence, which was by induction, stemmed from my immersion in the evidence, and my history as a science teacher.

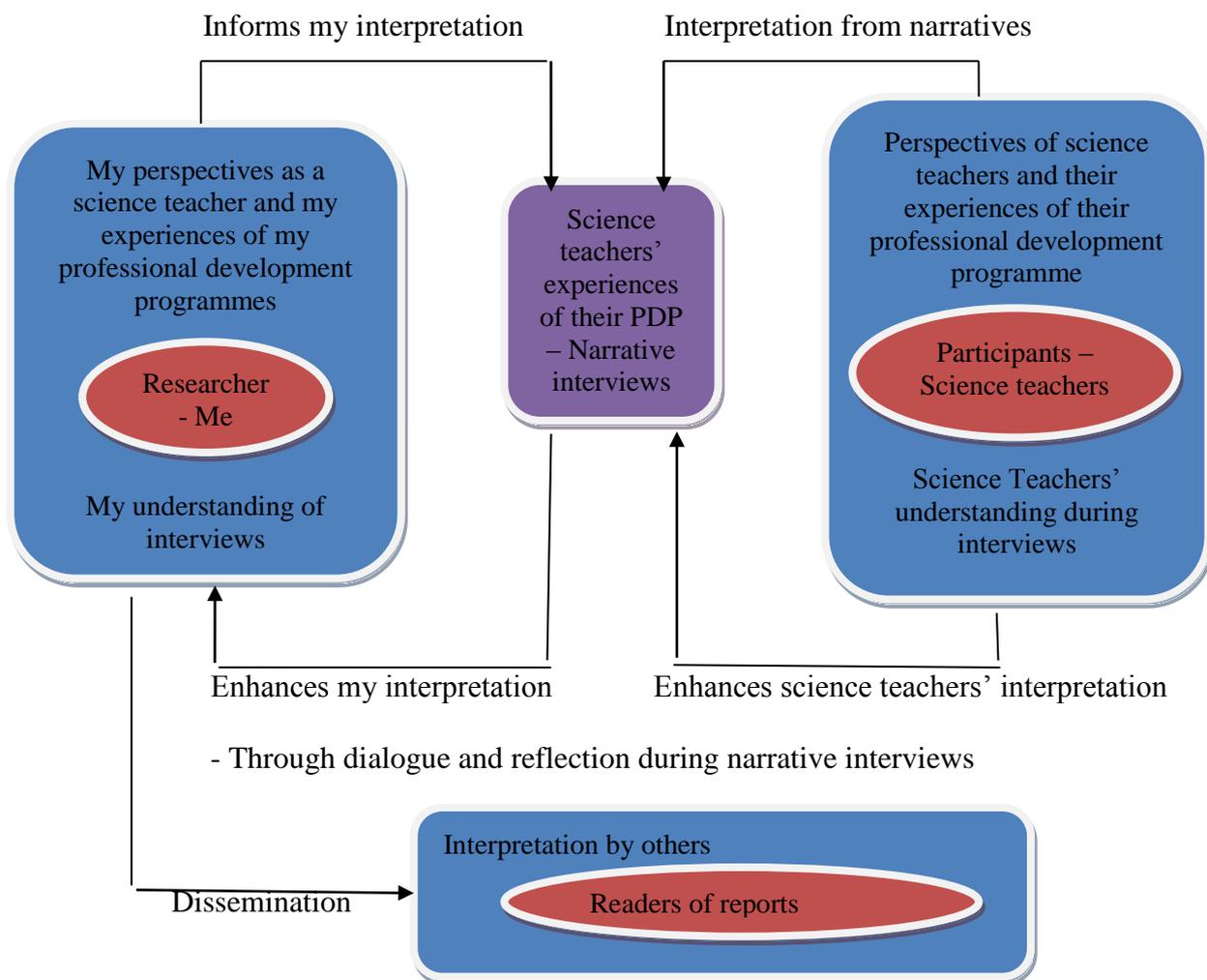
Knowledge results from social constructivism according to Heideggerian phenomenology. My historicity (past, present, and future) informed me as I interpreted and re-interpreted the narrative interviews (Conroy 2003), since "meaning of phenomenological description as a method lies in interpretation" (Heidegger [1962] 2008: 61/37). Concurrently, science teachers gleaned meanings of their experiences during their narrations (Conroy 2003; Hermans 2001). In my model, I opened the hermeneutic circle into a spiral (Conroy 2003), as in Figure 3.3: 111 to illustrate how the science teachers, I, and others may interpret the science teachers' experiences. The hermeneutic circle would have provided a circular form of interpretation between the science teachers and me, whereby interpretation of the text would have been circular and iterative (Conroy 2003). Opening the hermeneutic circle into a spiral afforded

enhanced interpretation between the science teachers and me, and it allowed interpretation by others (Conroy 2003). Figure 3.3 illustrates how, as the hermeneutic circle opens into a spiral, it promotes shared understanding between the science teachers, me, and others. My interpretation formed part of the hermeneutic spiral.

**\* Intersection of the Interpretive Perspectives between Science Teachers and Me - Concurrently**

My interpretations of science teachers' experiences as they narrated their experiences - influenced by my experiences as a science teacher

Science teachers' interpretations of their experiences of their professional development programme as they narrated their experiences



**Figure 3.3: Model of Hermeneutic Circle as a Spiral**

\* The source of this diagram is original and entirely my own-

The result of my interpretations was triple hermeneutics. Understanding occurred at three levels. Firstly, science teachers not only interpret my questions (Carpenter 2009), but they gleaned insights of their experiences as they narrated their stories (Hermans 2001). Secondly, I strove to understand science teachers' life world as I connected my understanding of science teachers' descriptions of their experiences to the theoretical framework of my study (Carpenter 2009). Thirdly, I infer meanings of science teachers' experiences (Carpenter 2009) and relate them to readers of this report so that they would understand science teachers' experiences (Conroy 2003). These processes ensured interpretation, trustworthiness, rigour, and validity of the study. I focused iteratively on the teachers' narratives to understand their experiences (van Manen 1997). Although I might not have understood fully the science teachers' experiences in all cases, I came close, as I focused on their narratives, rather than on my "preconceptions and theoretical notions" (van Manen 1997: 184).

Interpretive hermeneutic phenomenology has the potential to reveal the emergence of theories through interpretive phenomenological analysis of the evidence. Themes, which flowed through multiple sources, revealed the thoughts and actions of the science teachers as they narrated their experiences. Such themes informed my understanding of how science teachers thought and related to their professional development programme. The process was no longer about obtaining evidence, but it was about interpretation of the experiences by each science teacher and by me. From an epistemological perspective, I accepted the evidence I obtained as true, but after interpretation of the evidence, I gained insight into the truth of the evidence.

### **3.6 Analysis of evidence**

I set up a system to manage the evidence before I commenced my analysis. Firstly, I transcribed and summarised each of the recorded interviews and forwarded them to the respective science teacher for member-checking. Secondly, I analysed the evidence I obtained in 3 stages. I analysed the written narratives by utilising thematic analysis, and by identifying broad themes (Creswell 2006). Then, I analysed narrative interviews and semi-structured interviews guided by Miles, Huberman, and Saldana (2014) and Smith and Osborn (2008). Finally, I analysed the questionnaire by qualitative survey analysis (Jansen 2010).

#### **Management of evidence**

Management of the evidence commenced after the first narrative interview. I transcribed, interpreted, and summarised the first narrative interview verbatim, on the day of the first interview. I then invited the science teacher to verify and edit the interview and my interpretation for accuracy and authenticity (the transcription), and my interpretation of it. I encouraged him to include any additional anecdotes that could enhance the richness of his narrative. Such an activity served as member-checking, and for co-construction of the evidence. I repeated the procedure for the evidence I obtained from the other 12 science teachers during their first narrative interviews. 7 science teachers checked and verified the texts I sent to them, although I advised them of a timeline of two weeks for a response. Each of the science teachers, who responded, found the transcriptions and interpretations of their interviews accurate, and they had nothing new to add to the transcriptions. At the risk of appearing to coerce other science teachers who did not respond to my request to check the transcriptions, I proceeded to analyse their interview transcripts without further input from them. I assigned their chosen pseudonyms to identify each science teacher's interview, and then assigned line numbers to each interview transcript. All recordings of interviews, transcriptions, and my interpretation of interviews, saved in files in my password protected computer, were copied onto an external memory drive and these devices were either kept closely to me when in use, or stored in a closed cabinet drawer when not in use.

Of note is that because of the common mode of delivery of the professional development programme in each module, I analysed all interview transcripts in the same manner without separating them into the three modules. I focused on the sequence of coding, clustering, and categorising the themes as I analysed the narrative and semi-structured interviews. This

method of conducting the analysis, in which the professional development programme comprised the three modules, facilitated an analysis that afforded comparison among the science teachers' experiences in this study.

### **Preparation of transcripts**

In the process of modifying transcripts, I have removed expressions such as “um”, ‘you know’, ‘gonna’ and other filler words. This was to facilitate reading of the transcripts and to protect the anonymity and confidentiality of science teachers. Significantly, it is beyond the scope of this study to consider or assign meanings to such words. Lastly, I assigned codes for each science teacher and me, the researcher, for each module, and identified the interview number as seen in Table 3.8: 115.

**Table 3.8: Codes Assigned to Science Teachers to Report Findings**

Module	Symbol	Science Teacher	Symbol	Codes for Interview Transcripts	
				Interview 1	Interview 2
Culminating Activity	C	Darius	D	CD1	CD2
		Maria	M	CM1	CM2
		Mary	MA	CMA1	CMA2
		Sage	S	CS1	CS2
English Language Learners	E	Ashna	A	EA1	EA2
		Felix	F	EF1	EF2
		Hailey	H	EH1	EH2
		Jen	J	EJ1	EJ2
		Linda	L	EL1	EL2
Motivating the Unmotivated	M	Jean	J	MJ1	MJ2
		Maya	M	MM1	MM2
		Sam	S	MS1	MS2
		Steve	ST	MST1	MST2
		Researcher	SS	SS1	SS2

References to excerpts from interviews are found in Appendix D: L.

### **Analysis of written narratives**

I analysed science teachers' written narratives to address the first supporting research question regarding their professional identities prior to the study. In chapter 2, I argued that teachers' professional identities are influenced by the knowledge they acquire, their social connections during learning, and their emotions which may result from the stories they tell of themselves, the labels bestowed on them by others and themselves, and their actions. To address the first supporting research question, I focused on science teachers' stories and the labels they bestowed on themselves based on their professional identities prior to the study, and which their written narratives reflected. The questions in the modified written narrative schedule framed the narratives which revealed career choices (institution identities), social interactions (discourse identities), and group affiliations (affinity identities) (Gee 2001) which can be compared to Day et al.'s (2009) professional, situated, and personal identities. Together, these identities constituted science teachers' core professional identity (Luehmann 2007; Gee 2001).

I thought of analysing the written narratives provided by the science teachers by looking for themes through thematic analysis. However, not all science teachers provided written narratives of their professional lives. Some of them submitted their resumes or curriculum vitae which were non-narratives. I analysed the science teachers' written narratives and their resumes to select and organise evidence from these sources to produce stories of their professional lives. As such, my analysis was subjective, based on my interpretation of the science teachers' descriptions. I was "restorying" (explained on page 24) science teachers' stories of their prior professional identities within a specific framework of time, space, and people (Creswell 2006: 56) according to my interpretation. As a consequence, I conducted both a thematic analysis of science teachers' narratives and a narrative analysis of the non-narrative evidence. I narrated their stories based on the information they submitted in the form of textural descriptions (Creswell 2006) rather than in terms of emergent themes.

The questions in the written narrative interview schedule guided science teachers' responses so that each of them told stories that described defining moments in their lives. I constructed the narratives from the evidence which incorporated science teachers' words and mine so that their accounts were interspersed in my narrations. I co-contributed to the stories by introducing myself as a former science teacher within the school board thereby building

rapport between each science teacher and me in order to have a better understanding of their life histories. I selected what, to my thinking, represented the most significant parts of their stories. In presenting my findings of the science teachers' prior identities, I followed the tenets of a narrative inquiry. I included the teachers' own words in their voices by analysing the stories rather than simply reporting them. Concurrently, I focused on their positions in the stories. I did not consider the hidden meanings of the stories which is beyond the scope of this study.

### **Analysis of narrative interviews and questionnaire**

I set out a step-by-step analysis of the science teachers' narrative and semi-structured interview transcripts for the purposes of facilitating transferability of the research process. I focused on the science teachers' narrative interview transcripts as I explored their experiences to address the following supporting research questions:

- What did science teachers experience during the professional development programme in relation to their professional identity?
- To what extent did science teachers apply any new ideas they learnt in their classrooms?
- Have science teachers perceived any changes in beliefs and classroom practice because of their experiences?
- Were science teachers' professional identities influenced by their experiences of their professional development programme?

The modified narrative interview schedule guided science teachers in terms of prompting them to continue with their narratives, and helped to provide rich stories of their experiences. I analysed the transcripts of each science teacher's interviews individually by interpretive phenomenological analysis as reviewed below. Guided by Miles et al. (2014) and Smith and Osborn (2008), I initiated line by line coding in the first cycle coding of each interview transcript. In the second cycle coding process, I clustered the codes as I identified trends, patterns, and relationships. In this way I related the codes to themes, categorised the themes, and related categories of themes to theory. Lastly, I analysed the science teachers' responses to the questionnaire through qualitative survey analysis (Jansen 2010) and compared their responses to their experiences as described during the narrative/semi-structured interviews.

### **Interpretive Phenomenological Analysis**

Three significant concepts feature in interpretive phenomenological analysis. These are: phenomenology which focuses on perceptions of objects and events; hermeneutics, the philosophy of understanding; and idiography which is a detailed analysis of each science teacher's experiences (Smith and Osborn 2008). Interpretive phenomenological analysis provided the means to understand narratives through "interpretive relationship with the transcript" (Smith and Osborn 2008: 66). Potentially, such an approach enhanced how I, as the researcher, came to understand science teachers' accounts of their experiences (Finlay 2009). I realised very early on in the study that the true essence of science teachers' experiences of their professional development programme would be gleaned from their accounts of their experiences (Carpenter 2009; Conroy 2003). Consequently, I chose science teachers' narratives of their experiences as the primary evidence for analysis.

As such, evidence of science teachers' experiences of the professional development programme formed the basis of my research. I acknowledged that to focus on science teachers' responses to the transcriptions and my interpretations of their interviews would have enhanced my understanding and the trustworthiness of evidence. Such a process would have provided the means by which the study might have moved from being epistemological as I recognised and gathered evidence to understand each science teacher's experiences, to being ontological as I interpreted the nature of their experiences (Heidegger [1962] 2008; Conroy 2003). In terms of being epistemological, I would have found out what it means for the science teachers to have such experiences. In terms of being ontological, I would have understood what those lived experiences of their professional development programme were. However, 6 science teachers did not respond to my invitation to check my transcriptions and my interpretation of their interviews. As a result, I conducted my analysis based on my interpretation of their interviews. I was unable to claim uncontested trustworthiness of my research since about half of the science teachers did not engage in member-checking. The absence of feedback could have reduced the richness of the evidence I sought and any claim I intended to make of gaining ontological insights.

### Stages in analysis process

Before I report on the actual process by which I analysed the evidence, I set out Table 3.9: 119 below to highlight the stages involved in such a process. As can be seen, I conducted the first and second cycle codings on the first participants' interview transcripts to gain insight into the codes I identified and to use the results as a comparison with the codes from the other participants. As I began to categorise the codes and conceptualise the categories for the first participant, I decided to work concurrently with other participants' interviews to code and categorise for comparison and clarity.

**Table 3.9: Processes Involved in Analysis of Evidence**

<b>Process of Analysis</b>	<b>Stages</b>
First cycle coding of transcriptions	Both interviews 1 and 2 for first participant before the others
Second cycle coding – organising codes into clusters and categorising clusters into themes	Both interviews 1 and 2 for first participant before the others
Conceptualising categories – relating themes to dimensions of experiences	Concurrent coding for other participants as a reiterative process
Qualitative analysis of questionnaire	Concurrently for all participants
Integrating analyses of interviews and questionnaire	As a summary of results of analyses

### First cycle coding of the transcriptions

I coded the first and second interviews for one science teacher as a guide to code the other science teachers' interview transcripts (Miles et al. 2014; Smith and Osborn 2008). An ideographic approach facilitated analysis of each science teacher's interview transcript separately to identify each unique experience. I listened to the audio-recording of each interview, read the transcriptions and my interpretations three times and made initial notes before I began to code the passages in the text. I maintained an audit trail as I annotated the codes in the transcriptions in a column on the right side of each page. The first cycle coding

occurred concurrently as I conducted other interviews. I reflected on the meanings of the narratives and, in some cases, I sought further clarifications in the subsequent interviews as a means of “generating strategies for new data” (Miles et al. 2014: 70).

I coded the transcriptions of the science teachers’ narratives (Appendix D: L) inductively. From an epistemological perspective, I utilised descriptive codes, whereas, from an ontological perspective, I utilised in vivo codes and emotional codes. I did not utilise predetermined codes based on my theoretical framework. Firstly, I coded using descriptive codes whereby I assigned descriptions to reflect the science teachers’ words. I then recoded the text using in vivo codes and emotional codes. In vivo codes were direct quotations found in each interview transcript while emotional codes were those that implied emotions. After I completed the three coding processes, I coded the interviews deductively using the dimensions of experiences such as cognitive development, social interactions, and emotional experiences, which I identified in chapter 2. My rationale for including this step was to check whether the inductive codes reflected my theoretical framework.

Comparing deductive and inductive codes enabled me to: seek alignment with my theoretical framework, perceive any influence science teachers’ experiences had on their professional identities, and verify the potential to address the research question. I did not impose the dimensions of experiences codes on the emergent themes. To do so would give preference to the theoretical framework in the coding process, which would not reflect the tenets of a qualitative study. I repeated the procedure for the second interviews. I did not assign abbreviations to the theoretical codes as Miles et al. (2014) and Smith and Osborn (2008) recommended.

I took other measures apart from member-checking of interview transcripts to ensure the trustworthiness of the evidence I obtained. I also sent summaries of my interpretation of each science teachers’ interview to the respective teacher for verification. I strove and succeeded, to some extent, to put my own prior experiences as a science teacher who participated in professional development programmes aside as I focused on analysing the evidence. To verify the consistency in the first cycle coding process, the codes for all interviews were rechecked by someone who holds a PhD degree and who I considered to be qualified to do so. The assigned codes were found to be appropriate.

### **Second cycle coding: codes, clusters and categories**

In the second cycle coding, I examined each set of codes from the first cycle coding process to identify trends, patterns, and relationships. The codes on which I focused were embedded in the science teachers' narratives of their experiences. I moved among the codes and the text iteratively during the second cycle coding process, as I interpreted codes which reflected the science teachers' experiences through "sustained engagement" (Smith and Osborn 2008: 66). Codes reflected teacher learning, their interactions, feelings, the changes in beliefs and classroom practice, and relevance to their professional needs as a result of their participation in the professional development programme. I clustered codes with common meanings under headings such as learning, interaction, emotions, changes in beliefs and practice, and relevance to professional needs and colour coded them for easy identification. The colours I utilised were green for learning, blue for interactions, red for emotions, purple for changes in beliefs and practice, and orange for relevance to professional needs.

I utilised the word-based and key-words-in-a-context techniques (Ryan and Bernard 2003) to identify themes. In identifying themes, I examined science teachers' narratives and tried to find expressions that reflected "theoretical connections" (Smith and Osborn 2008: 67). I mapped codes by sorting and clustering them and their descriptions into themes. These themes offered rich descriptions (Polkinghorne 2005) which helped me to conceptualise them and which I assigned to categories of themes as seen in Table 3.10:122.

### **Conceptualising categories**

I sought to conceptualise the themes by incorporating science teachers' descriptions of their contextual experiences as I categorised them. The process revealed thick descriptions and a wider picture of their experiences. As I moved among themes generated, I compared experiences by citing examples from science teachers' narratives as I examined each of their contextual experiences (Pietkiewicz and Smith 2014). I conceptualised the categories and connected my understanding of science teachers' experiences to the theoretical framework of my study through such a process (Pietkiewicz and Smith 2014). For my convenience, I set up categories of themes and corresponding quotations from each teacher, based on both interviews that I considered to have captured the true essence of each teacher's experiences. Following this, I compared the science teachers' experiences in each category.

**Table 3.10: Mapping Clusters of Codes, Themes, and Categories**

<b>Clusters of Codes – verbatim words from interview transcripts</b>	<b>Clusters of Themes</b>	<b>Categories of Themes</b>
Interest, new experience, confidence, knowledge gained, new approach, new perspectives	Learning that occurs as new ideas and knowledge are encountered – subject knowledge, pedagogical knowledge, curricular knowledge	Learning
Sharing, social learning, collaboration, exchanging ideas,	Learning from each other during discourse, exchange of ideas, and learning by social interactions within the Professional Learning Community	Interacting
Positive and negative feelings, puzzlement, surprise, sense of satisfaction, positive experience, enthusiasm, feelings of disappointment, validation of efforts excitement, regret	Emotions felt as a result of learning and interacting and expressed as words described in the codes	Emotions
Confidence, classroom practice, new approach, tried it out, applied it, did it differently, change of approach	Changes as manifested or described in words such as those in the codes. They imply a change in the way one practises one’s craft	Change in Beliefs and Classroom Practice
Relevance, use, needs, benefits, professional growth, improvement	Relevance implies appropriate for use, beneficial or other words described in the codes	Relevance to Professional Needs

**Relating clusters of codes and themes to dimensions of experiences**

I identified 3 categories of themes as the dimensions of experiences, which constituted part of my definition of science teacher professional identity. In Table 3.11:123, I mapped clusters of codes to categories of themes and related them to dimensions of experiences. The clusters of codes in the first column of the table represent the science teachers’ words as they described their experiences in the professional development sessions. Commonalities among science teachers’ experiences existed despite their individual experiences. The categories of themes,

(second column) corresponding to clusters of codes, provided insight into the nature of the science teachers' collective experiences, and 3 of them aligned with the dimensions of experiences.

**Table 3.11: Relating Clusters of Codes and Themes to Dimensions of Experiences**

<b>Cluster of Codes</b>	<b>Clusters of Themes/Categories of Themes</b>	<b>Dimensions of Experiences</b>
Interest, new experience, confidence, knowledge gained, new approach, new perspectives	Learning that occurs as new ideas and knowledge are encountered – subject knowledge, pedagogical knowledge, curricular knowledge/ learning	Cognitive Development
Sharing, social learning, collaboration, exchanging ideas, discussing	Learning from each other during discourse, exchange of ideas, and within the Professional Learning Community – learning by social interactions	Social Interactions
Positive and negative feelings, puzzlement, surprise, sense of satisfaction, positive experience, enthusiasm, feelings of disappointment, validation of efforts excitement, regret	Emotions felt as a result of learning and interacting and expressed as words described in the codes/ feelings	Emotional Changes
Confidence, classroom practice, new approach, tried it out, applied it, did it differently, change of approach	Changes as manifested or described in words such as those in the codes. They imply a change in the way one practices one's craft/ changes in beliefs and practice	Changes in beliefs and classroom practice

Notably, I identified a fourth category of themes which I termed changes in beliefs and classroom practice, and a fifth category which I termed relevance to professional needs (Table 3.10). These categories warranted consideration because the science teachers consistently described such experiences. I proceeded to categorise the theme of relevance to professional needs as emotional changes since whether “goal content” is met or not implies emotions (van Veen et al. 2005: 921). Experiences of relevance to professional needs have the potential to

result in emotions such as happiness, satisfaction, unhappiness, dissatisfaction, regrets, and even anger (van Veen et al. 2005). As such, I conflated the five categories of themes to four categories of themes which were learning, interactions, emotions, and changes in beliefs and classroom practice. Subsequent to coding of interviews, sorting codes, and categorising them, I compared science teachers' experiences in terms of their cognitive development, social interactions, emotional changes, changes in beliefs and classroom practice for each module (Table 4.3a: 161, Table 4.3b:179, Table 4.3c: 192).

In the next section, I explain how I analysed science teachers' responses to the questionnaire. It must be noted at this point that, I utilised the questionnaire as a source of evidence to triangulate science teachers' stories in their interviews, to enhance the richness of my findings, and to add another dimension to their experiences. I compared science teachers' responses in the questionnaire to the themes I identified from the interviews for triangulation purposes. I interpreted each science teacher's overall experiences (multiple realities) and related them to my theoretical framework since the items in the questionnaire reflected the dimensions of experiences. Given that changes in professional identities can be shaped by these dimensions of experiences (Mc Nally and Blake 2012; Wenger 2010; Illers 2009), I focused on them to explore whether science teachers' professional identities were influenced or reshaped by their experiences of their professional development programme. Finally, I synthesised each science teacher's experiences of the professional development programme.

### **Analysis of responses to questionnaire**

The questionnaire focused on experiences directly related to the dimensions of experiences that contributed to define science teachers' professional identity during professional development. My intention was not to provide a statistical analysis of the science teachers' responses, but to focus on the patterns and diversity that arose out of them (Jansen 2010). Qualitative survey analysis focuses on coding and identifying categories. It is an inductive process which, when applied to a phenomenological study, focuses on experiences and aims to conceptualise meanings of experiences (Jansen 2010). Such surveys, which are exploratory, search for differences and patterns rather than counting of categories, and they involve open coding, labelling, and representation in a matrix (Jansen 2010). As I synthesised the codes, I compiled them to reveal each science teachers' experience based on combining characteristics (Jansen 2010).

I analysed science teachers' responses to the questionnaire by qualitative survey analysis in 3 steps. Firstly, I analysed responses to the questionnaire independently for each teacher by using the key to responses in the questionnaire as a coding guide. Secondly, I converted each teacher's responses in the questionnaire for each section to text and arranged them in separate matrices for each section (Appendices E1: CXLII; E2: CXLIII; E3: CXLIV). Finally, I synthesised each science teacher's experiences of the professional development programme to provide analysed and interpreted combinations of dimensions of experiences which I represented in a separate matrix (Appendix E4: CXLV). I utilised the codes obtained from the questionnaire to supplement those I obtained from the narrative interviews.

I compared the responses from the interviews and questionnaires and wrote my inferences for cognitive development (Appendix F1: CXLVII), social interaction (Appendix F2: CL), and emotional changes (Appendix F3: CLIV). I will discuss findings from analysis of the written narratives, narrative interviews, and the questionnaire for each science teacher, for science teachers in each module, and across modules for comparison of experiences in chapter 4. Given the interpretative nature of this study and its methodological approach of hermeneutic phenomenology, a discussion on generalisability of findings versus transferability of the research is warranted.

### **3.7 Generalisability vs. transferability**

In this qualitative study, I set out to seek meaning of science teachers' experiences, not "how many" people had those experiences (Englander 2012: 21). My intention in this study was not to make generalisations. However, it would be remiss of me not to mention the thoughts and ideas expressed in the literature on this matter, and relate them to my study. Generalisations are associated with predictable recurring experiences within a larger population, and they apply to quantitative research. As such, generalisations cannot be achieved easily from the findings of a qualitative research such as mine through extrapolation, because the sample size is too small. Nevertheless, generalisations are important for research of any type, so that such studies can be taken seriously (Larsson 2009). Researchers should not take the stance to evade claims of generalisations in qualitative studies, since it may "reduce the interest" in such a study "to practically nothing" (Larsson 2009: 31). To avoid such an outcome, I address claims to generalisability on the basis of the nature of the professional development programme, the similarity of context among science teachers within the school board, and the patterns I gleaned in terms of the ease of transferability in my research. I argue that such a claim may not be an actual generalisation, but it can be viewed as the transferability of the study. The narrative strategy that I utilised, integrated my study of the science teachers' experiences with those of the larger population of science teachers who had participated in the professional development programme within the school board (Goodson and Choi 2008).

Interpretation underpins generalisations and I, as a researcher, tried to understand how I could apply my study elsewhere. Such interpretations are fluid in that the findings of my study may be interpreted by another researcher, who tries to understand the findings. Establishing transferability by knowing the specifics of a study, and comparing it to one's own study, provide the opportunity to generalise (Larsson 2009). I could lay claims to generalisations by "maximizing variation" (Larsson 2009: 31) of sample as in random sampling. However, the sampling strategy in my study was purposeful, not random, where the science teachers represented all science teachers within the school board who taught different science subjects and grade levels, and who participated voluntarily in the professional development programme. I ensured similarity of context as I focused on one professional development programme. I chose science teachers in my study from a pool of science teachers within the school board who will, most likely, have similar experiences in similar professional development programmes, since such programmes are usually provided by those who follow

the mandate of the school board. For these reasons, I regarded the evidence I obtained as the collective memories and experiences of science teachers within the school board (Goodson and Choi 2008).

In justifying my argument for generalisation, I sought patterns during my analysis, and looked for commonalities in each case, so that the findings appeared similar. Thus I made the case for 'external validity' and transferability, and therefore, generalisation based on commonalities (Soy 1997). While I may not claim generalisability statistically as in quantitative studies, I may claim generalisability through transferability. However, since my intention was not to generalise my findings and in keeping with the tenets of an interpretive methodology, I am therefore, not laying claims to generalisability.

### **3.8 My subjectivity and reflexivity**

I am subjectively involved in this research because of my interest and history as a science teacher. My personal experience as a science teacher, who attended professional development programmes, qualifies me for my role as a researcher in this phenomenological study (Bukor 2014). My connection with the science teachers integrated my subjectivity with phenomenology (Finlay 2009) while my experience and interpretation situated me socially and so, I cannot ignore my subjectivity (Shaw 2010). I assumed an open attitude and brought my own experience as a science teacher, as well as my “preconceived biases and presuppositions” to the foreground as I reflected concurrently on my subjectivity (Finlay 2009: 12). For this reason I summarised my interpretation of each science teacher’s narrative after I transcribed it, and forwarded both the transcription and my interpretation to the science teacher to verify and/or amend.

As I interacted with the science teachers during the study, I interpreted their stories subjectively, because of my previous experience. I, as the researcher, bore my subjectivity of experience in mind during the entire research process as I obtained and interpreted evidence (Sandberg 2005). I was aware that my experience can result in flawed interpretation. I questioned my interpretations to ensure that they were based on the science teachers’ accounts of their experiences. As a result of these interpretations, I constructed a worldview which depended on the context and culture of the professional development programme (Denscombe 2010), and of the science teachers’ experiences and actions (Crotty 1998) rather than on mine. Such reflections afforded me an understanding of meanings from a socially and a personally constructed perspective.

Having obtained, coded and analysed the evidence, I report my findings in chapter 4. I considered presenting my findings thematically, but because one of my aims was to compare science teachers’ experiences in terms of renegotiation of their professional identities, I present my findings in modular form. I bring to the foreground the science teachers’ prior professional identities based on the analysis of their written interviews, which I present as a narrative. I discuss the implications of their prior identities for my study as I conclude this section. I assumed an idiographic approach, which allowed me to describe my interpretation of each science teacher’s experiences, based on the narrative interviews in which I utilised their voices to support my interpretation as I moved among themes within each module.

Following this, I compare the science teachers' experiences within each module. I then discuss findings of science teachers' responses to the questionnaire and compare findings from narrative interviews and responses to the questionnaire for science teachers in each module. Finally, I compare themes across modules to reveal similarities and differences of science teachers' experiences among the three modules. In doing so, I focus on the categories of themes which emerged as a result of the interpretive phenomenological analysis of the evidence. I utilised these indicators to highlight influences on science teachers' professional identities as a result of experiences of their professional development programme.

## Chapter 4: Findings

Learning in a professional learning community promotes cognitive development through sharing of ideas and artefacts during discussions (social interactions). Social learning and dialogue occurred within a professional learning community which I compared to the activities in a community of practice (Wenger 2010; 1998). Such interactions represent active participation that can result in transformative learning (Wenger 1998) among science teachers. This type of learning implies “becoming a different person” (Lave and Wenger 1991: 53) in that “learning and a sense of identity are inseparable” (Lave and Wenger 1991: 115). I drew on literature to inform on the identified themes that may influence and reshape the professional identity of science teachers during their professional development.

As I have established in chapter 2, characteristics of professional identity, which are multiplicity, discontinuity, and relationality, (chapter 2, section 2: 41), result from discourse and dialogue (Akkerman and Meijer 2011; Hermans 2001). These activities reflect social learning and its influence on the reshaping of teachers’ professional identity during professional development. Similarly, collaboration and shared experiences such as these can result in situated learning (Lave and Wenger 1991). Cognitive development, social interactions, and emotional changes, which represent the dimensions of teachers’ experiences, can occur through situated learning and socialisation (Wenger 2010; 1998; Lave and Wenger 1991). As I have argued, science teachers’ dimensions of experiences and the characteristics of professional identity define their professional identity.

Changes in dimensions of experiences, then, are significant in shaping professional identity. Teachers’ perceptions, their interactions, and their negotiated professional identities contribute to such significance (Shapiro 2010) while dimensions of experiences influence how teachers negotiate their professional identities (Reio 2005). Cognitive development comprises subject and pedagogical knowledge (Beijaard et al. 2000; Shulman 1986). During cognitive development, teachers are “trusted partners”, who share knowledge, collaborate, and have access to a “repertoire of communal resources” as they learn (Wenger (2000: 229). Experiences of cognitive development and social interactions result in science teachers experiencing emotional changes. Shapiro (2010) and Wenger (2000) argue that taken together, these three dimensions of experiences can influence professional identity. I argue

that such experiences can influence and reshape science teachers' professional identities, whether they are aware of them or not.

Underpinned by the sociocultural theoretical framework of Wenger's (1998) community of practice, this study utilised a hermeneutic phenomenological approach. Research methods, employing tools such as written narratives, narrative interviews, semi-structured interviews, and a questionnaire, provided evidence that led to findings. The research provided rich evidence of science teachers' experiences of their professional development programme. While written narratives led to evidence that provided an overview of the science teachers' professional identity prior to the study, the primary tool utilised to obtain evidence, was the narrative interviews. The semi-structured interviews and questionnaire contributed to the richness of the evidence, while they added robustness to the study. These three methods of obtaining evidence enabled triangulation in this study, thereby enhancing its rigour and trustworthiness.

This was an exploratory, phenomenological study which allowed me to identify themes that emerged from the evidence. I cross matched themes with factors that can influence teacher professional identity found in literature. The factors are cognitive development, social interactions (Wenger 2010; 1998), emotions (Reio 2005; Zembylas 2005; 2003), and changes in beliefs and classroom practice (Marcelo 2009; Luehmann 2007). I did not ask the science teachers in my study whether their professional identities were reshaped by their experiences of their professional development programme. As seen in Table 3.10: 122, I interpreted expressions obtained from the science teachers' narratives and classified them as the themes which I related to the dimensions of experiences identified in the literature. I focused on these themes as I evaluated each science teachers' narratives to identify any of the categories of factors that have the potential to influence teacher professional identity.

In this chapter, I present the four themes that emerged from interpretive phenomenological analysis of the interviews and qualitative survey analysis of the questionnaire. I support these themes with excerpts of science teachers' narratives (Appendix D: L) to describe "the essence" of the phenomenon of science teachers' experiences (Creswell 2006: 58). Each identified theme has the potential to influence science teachers' professional identity leading to its multiplicity, discontinuity, and relationality. I utilised the characteristics of professional

identity and dimensions of experiences during social learning to assess my findings and to infer whether science teachers' professional identity was influenced by their experiences of their professional development programme.

### **Research participants**

13 science teachers from the three modules of the professional development programme participated in this study. They represented a cross-section of science teachers within the school board who responded voluntarily, to participate in the professional development programme in a module of their choice. Apart from years of teaching science which ranged between 4 years and 21 years, the science teachers taught various subjects such as biology, chemistry, mathematics, geography, physics, science, and technology as seen in Table 3.6: 105. Although the three modules focused on different aspects of professional development, their modes of delivery were similar. As such, I considered science teachers' interview transcriptions collectively during analysis, but I present findings for each module separately for comparison.

The roles of each science teacher in the module in which they participated in the professional development programme are identified in Table 4.1:133. The instructional leader (IL) acted as a facilitator. She stepped aside most of the time while the lead teachers conducted the sessions. Each module comprised at least one lead teacher who also participated in the learning process. All of the science teachers participated in the social learning activities as they co-constructed their knowledge. Of note is that the module on developing science skills for the English language learners had one lead teacher and although the module on motivating the unmotivated had two lead teachers, only one of them participated in my study.

**Table 4.1: Roles of Science Teachers in Modules**

<b>Module/Teachers</b>	<b>Science Teachers' Role in Module</b>
<b>Culminating Activity of an Inquiry based Unit</b>	
Maria	Lead teacher
Sage	Lead teacher
Darius	Participant
Mary	Participant
<b>Developing Science Skills for English Language Learners</b>	
Hailey	Lead teacher
Ashna	Participant
Felix	Participant
Jen	Participant
Linda	Participant
<b>Motivating the Unmotivated Grade 10 Students</b>	
Maya	Lead teacher
Jean	Participant
Sam	Participant
Steve	Participant

I provide an overview of the format and the topics discussed in each of the sessions of each module briefly in Table 4.2: 134. I contextualise the science teachers' narratives and responses to the questionnaire in this table. Although each module addressed different pedagogical topics, their modes of delivery followed the same pattern. The first session in each module involved group formations, choosing, through collaboration, a common area of interest in the curriculum for the members of each group. Group members formulated a plan of action and conducted relevant lessons for the topic of their choice. Each group then reported and discussed the outcome of their plan with the instructional leader and other group members in that module. In the morning of the second session, one lead teacher conducted a lesson with his/her students while the others from the module observed and took notes. This was followed by a debriefing session afterwards. The procedure was repeated in the afternoon with a second lead teacher conducting a lesson followed by debriefing. Interspersed among

these activities during the first and second sessions for the English language learner and Motivating the unmotivated modules were group discussions on topics associated with interpreting the curriculum, and evaluating activities. All members of each module had to teach a lesson on the topic they discussed, evaluate it, and return to the last session for moderated marking. The culminating activity module had an extra session in which teachers, working in groups, brainstormed how to develop and evaluate activities relating to inquiry in science. On the last day for all of the modules, the teachers focused on moderated marking where they discussed their students' performance on tests relating to the topic.

**Table 4.2: Context of Sessions of Modules**

<b>Module</b>	<b>Sessions</b>	<b>Activities</b>
Culminating Activity of Inquiry based Unit	1	Formation of groups, choosing area of focus, planning session, developing artefacts, sharing artefacts
	2	Demonstration of conducting lessons by each lead teacher followed by debriefing afterwards
	3	Discussion of curriculum and developing and marking an inquiry activity
Developing Science Skills for English Language Learners	1	Formation of groups, choosing area of focus, planning session, developing artefacts
	2	Demonstration of one lesson by lead teacher and debriefing. Group discussions and with instructional leader on vocabulary and examples to use with English language learners
	3	Moderated marking of teachers' samples of students' work and further discussions
Motivating the Unmotivated Grade 10 Students	1	Formation of groups, choosing area of focus, planning session, developing artefacts
	2	Demonstration lessons by lead teachers and debriefing afterwards
	3	Moderated marking of teachers' samples of students' work and further discussions
All modules	4	Moderated marking of teachers' samples of students' work and further discussions

I present the various aspects of my findings in 5 sections in this chapter. The five sections are science teachers' professional identities prior to the study, findings of science teachers' experiences from narrative and semi-structured interviews, findings from the questionnaire, summary of overall findings of science teachers' experiences based on interviews and questionnaire, and science teachers' professional identity at end of the study.

#### **4.1 Science teachers' professional identities prior to research**

In response to the first supporting research question, I restoried accounts of science teachers' professional lives (Chase 2011) gleaned from their written narratives (Creswell, 2006). The stories of the science teachers' professional biographies are textural descriptions of their professional histories in their voices which are enclosed in quotation marks, and my edited comments, rather than emerging themes. I discussed in Chapter 3, section 3.6: 116, the rigorous steps I took to analyse the science teachers' written narratives of their professional biographies. I focused on factors such as educational pathways, encouragement and support, initial teacher training, professional development initiatives, first teaching assignment, and current status to retell stories of their professional biographies (Creswell 2006). The contextual nature of professional identity is such that factors such as time, place, and actors have a crucial role in the development of professional identity. As such, I looked for childhood experiences, early learning experiences, and influences of significant others on science teachers' choice of careers, as I analysed the written narratives of their personal biographies. These factors represented the "repertoire of influences on teacher identity development" (Bukor 2014: 309) that influenced how the science teachers saw themselves at the inception of their professional development programme (Moore 2007).

As I restoried the science teachers' narratives, I included expressions in their words, to illustrate their impressions of their professional identities. My narratives represent significant parts of their stories. By the end of June 2014, I invited the science teachers to check the textural descriptions of my restories of their professional biographies, but no one responded to my invitation. I realised that they were busy with their end of year schedules since the Canadian academic year ended on June 30, 2014. Having restoried the science teachers' biographies without the benefit of member checking, I proceeded to present an overview of their professional identities prior to the study.

I invited all science teachers in this study to submit their written narratives at the start of my research. Constraints of time and a heavy work load prevented Linda and Maria from submitting written narratives of their professional biographies. While some science teachers provided full written narratives, others provided their resumes or curriculum vitae. As such, the volume of material provided, varied. My restorying resulted from my interpretation of the written narratives and analysis of their curriculum vitae. I present, below, stories of each

science teacher's professional identity prior to this study. Of note is that words enclosed in quotation marks are their own words in their written narratives while the rest of the stories are my interpretation of their written narratives.

**Ashna:**

Ashna was about 35 years old with 7 years secondary school teaching experience. She taught grades 9 to 12 biology and chemistry. She has earned BSc, B.Ed. and M.Ed. degrees and she was a curriculum leader at her school. Ashna decided to become a teacher while she was in her third year at university because her secondary school teachers, family members, and friends encouraged her to do so. Ashna's initial teacher training programme focused on mathematics, science, and technology, and she felt that techniques and strategies she learnt were "specific to those disciplines". Her first teaching assignment was "overwhelming". She felt that her training did not prepare her for teaching "high-needs at risk students", especially those enrolled in applied, essential, college, and credit recovery courses. Ashna participated in a number of professional development programmes among which were 'Equity and Diversity and Restorative Practices' to help her cope as a new teacher in the classroom. She felt isolated in her department and found it difficult to interact with her peers in the science department or other departments at her school. Most of her informal support came from contacts out of school and from university. She described her professional identity at the time of the interview as "fluid" which I interpreted to mean that her professional identity was in a state of flux.

**Darius:**

Darius, who was around 45 years old and earned an MSc in Physics, had 10 years teaching experience within this school board. He was a second career physics/mathematics teacher having worked in industry prior to immigrating to Canada. He decided to teach in Canada because of a shortage of physics and mathematics teachers, his past experiences of tutoring as a student, his strong interest in mathematics and physics, his "passion for teaching", and the "elation" he felt as he discussed science topics. He enrolled in a teacher training programme which involved core compulsory courses, optional courses and subject related courses. He participated in two in-school teacher training placements in two different secondary schools, each of which lasted for 4 weeks and which focused on his subject area. As a teacher candidate, he taught grades 11 and 12 physics. He strove to establish a "good relationship" with his students. Darius credits his "background in the sciences" for his "successful relationship" with his students. He finished his training as he undertook a five-week internship programme at an inner city school to focus on special education.

Darius started teaching as an occasional teacher. Subsequently, he was offered a long-term occasional teaching position and then a permanent position. His initiation into teaching was one fraught with “problems in dealing with the multicultural student population and different learning styles”. However, he was very comfortable in delivering lessons because of his “expertise in physics and maths”. Despite this, he credited teachers and administrators for their support in helping him to “cope with the student population which was very different from his culture and background”. Darius attended a number of professional development programmes, such as workshops, seminars, and conferences in mathematics and science which focused mainly on the curriculum, to enhance his teaching. He found these programmes to be “generic” and he had to modify them before applying them in his classroom. Nevertheless, his new learning was worthwhile since he “met other teachers and learnt about their learning environment and their teaching practices”. After several years of teaching in different environments, he was confident that he could “survive any teaching situation” and face other challenges in future. In the process he has increased his knowledge base so that he can deliver his lessons “with greater clarity” to a wide spectrum of the student population. He thought he has moved on from being an “uncertain individual” to one who was “confident, secure and established”.

**Felix:**

Felix, who was around 50 years old, has taught for 16 years. Throughout this time he taught science, mathematics, and biology to grades 8 to 12 students. Family members, who were also teachers, encouraged Felix to become a teacher. His decision to enter teachers’ college was further influenced because teaching was “a lucrative profession” which provided a “stable financial future”. He was a second career teacher. His teacher educational pathway was one which earned him a bachelor in education degree and he participated in some additional qualification courses. He found his initial teacher training process “disappointing”. He felt that he was not “properly prepared for life in the classroom” and that most of his teacher-training was by observing the associate teacher during his practicum.

His first teaching assignment as a substitute teacher was not easy. The uncertainty of not knowing whether he would be “called out for the day” plus “dealing with new students” was challenging. However, his first full time teaching position was very different from his supply teaching. Felix developed a good relationship with students and collaborated with members of

his department. He also took part in many extra-curricular activities. Felix's "tenure at the school was enjoyable, exciting, and busy". He learnt about his colleagues, the students, and the school system and he developed many tools and ideas.

Felix has participated in several professional development programmes to improve his craft. He felt most of these programmes were "similar to those at the teachers' college". Very rarely were they of use to his classroom needs. At the time of this study, Felix felt isolated in his classroom since he was "the only teacher who taught mixed science grades" in his school. However, he did have a collaborative relationship with the other members of the science department, support staff and administrators. He described himself as an "upbeat, inquisitive, entertaining, and flexible teacher who questions and reflects on his teaching methods and their effectiveness". He saw himself as a teacher who can "motivate and inspire students to excel".

**Hailey:**

Hailey was a 35 year old second career teacher who was an engineer before she turned to teaching. Although the demand for physical science teachers was high, she has had to change schools 4 times in her 4 years as a teacher because of staffing policy in dealing with surplus teachers within the school board. At the time of this study, she was teaching science to grades 8 and 9 students. Apart from her teacher training, she has attended several professional development programmes of which 'Culturally Relevant and Responsive Pedagogy' was one of them. She led a discussion on action research projects for radical mathematics student groups during one teacher professional development programme.

From the inception of her career as a teacher, Hailey was busy conducting workshops for both students and teachers. These workshops were for grades 9 and 10 science and mathematics activities for students in safe school programmes, and technology in the classroom. In addition, she found time to volunteer at an autism camp for kids in northern Ontario. Hailey was so involved in helping her students and peers, that she was awarded the "New Teacher Leadership Award by the OSSTF District 12 Status of Women's Committee". She saw her presence as a "role model" for girls.

**Jean:**

35 years old Jean has taught grades 9 and 10 science as well as grades 11 and 12 biology for the last 8 years. She decided to become a teacher in her fourth year at university. Her high

school biology teacher encouraged her to go into teaching when she volunteered with him. Her decision was also due to “the possibility of being hired soon after graduation”. Her teacher education programme involved three placements. One of them was in a primary school and the other two were in secondary schools. Her first teaching assignment was a half time position in which she had to teach three different courses in a full year. She was overwhelmed because she was not prepared for the problems she faced regarding classroom management. Also she did not have the support of her department in terms of classroom management, resources or pedagogy. However, she attended a range of professional development programmes but found “few of them useful”. She found those that “focused on a collaborative learning community” to be “most rewarding”. Professionally, Jean described herself as a “teacher” who was “neither a novice or experienced”. She felt that there were many areas of her practice that needed improving and she wished to pursue them.

### **Jen:**

Jen has taught in 5 schools in 4 years due to the school board’s policy regarding surplus teachers. She was about 30 years old and held first degrees in science, physical education, and education. She decided to go into teaching in her fourth year of university so that she could “teach secondary science and physical education”. Her initial teacher training programme included theory and three placements. The in-class component of her training programme consisted of pedagogy, philosophy and classroom management. The other component consisted of subject-specific classes which focused on strategies and technology. Of the three placement blocks in which she participated, one was in a primary school while the others were in secondary schools. She enjoyed a “positive experience” in her first placement. Nearly everyone at the school was “supportive and provided resources” for her. Her elementary placement was “disappointing because of problems with that associate teacher”. However, her last placement was better where the “associate teacher took on the role” of her mentor. Together with the rest of the department, her “mentor facilitated her first steps in the classroom, provided relevant resources and support” so that she “prepared lesson plans and controlled her classroom”.

Jen’s first teaching position was as a long term occasional teacher. Everyone was supportive and caring. Nevertheless, she experienced a steep learning curve because the real classroom was “different” from those in her placements. Jen enrolled in several professional

development programmes, such as the “new teacher induction programme”, workshops for “success, safety in the classroom”, and “implementing technology in the classroom” to enhance her teaching. Jen has enjoyed a positive relationship with her peers. Her experience in 5 schools in 4 years has helped her to form strong relationships within the school system. She found that “some schools were more supportive than others and some departments engaged more in collaboration than others”. Jen described herself as “new to the profession with a variety of experiences in different departments”. She planned to continue taking formal courses to upgrade her qualification so that eventually, she can “hold a position of responsibility”.

**Mary:**

Mary, a 45 years old biology teacher, has taught science for the past 15 years. She decided in her first year at university to be a teacher although she was a good science student who could have “potentially become a doctor”. She studied biochemistry at university but was trained as a specialist biology teacher. Her teacher education programme was not remarkable in any way although her specialist programme was “more informative” and prepared her for the reality of the classroom. Mary described her initial teacher training programme as one that prepared her for her first teaching position. She has enhanced her knowledge of teaching by attending professional development programmes in which she learned to appreciate the needs of various learners, lab safety, differentiated learning, and technology in the classroom. Through her professional development programmes she has learnt to “revise and update her lessons and use new techniques” in the classroom. Mary found working with colleagues very rewarding.

She applied her learning in the professional development sessions in her classroom and shared her knowledge with her colleagues. In this way, she has “introduced them to new ways of incorporating technology in the classroom”. Mary described her professional self as a “teacher whose peers recognise her as an innovative person, who was able to stimulate her students, and had a strong sense of confidence as a professional”. Such an outlook kept her motivated. She also saw herself as “a role model for her students” since she was “an enthusiastic, life-long learner”. She described herself as “flexible, innovative, self-confident, enthusiastic, and someone who can stimulate” her students.

**Maya:**

Maya was a 45 year old ambitious teacher who has taught for the past 14 years and specialised in biology. She was a curriculum leader in the science department. She has earned a master's degree in Education in addition to her bachelor's degree in microbiology. At the time of this study, she taught grades 10 enriched science and 11 chemistry. She was a second career teacher. Originally, Maya wanted to be either a genetics researcher or a doctor. She worked in a laboratory for a year before going to teachers' college because she felt she needed to work in the laboratory first before she went into teaching. Her desire to be a teacher was not supported by her family.

Her experience at teachers' college was enjoyable as she found a mentor there who was a "major influence" in her professional career. She had much to take to the classroom. She approached her first teaching position with her usual enthusiasm so much so that students and staff "just gravitated" towards her. Her peers supported and "doted" on her because she was the youngest in the department. She started out with a half time table but her principal arranged for her to have another half time table at another school. She remembered the kindness she experienced and tried to extend the same courtesy to new teachers who "fall under" her "wings".

Maya has engaged in a number of professional development programmes at the start of her career but has since graduated into presenting at workshops, conferences, and writing articles for professional magazines. She described herself as a "sharer". She shared her resources and ideas with her peers to such an extent that she was "well known" for her expertise. Maya felt she had a strong "sense of professional self". She considered her work important and described herself as a "life-long learner who is always trying to improve and change" her practice although she recognised that it was difficult to break out of old habits and try something new. However, she challenged herself to do that constantly. She saw herself as a "teacher-leader". She loved to help both students and staff and was "passionate about collaboration and cooperative learning". She enjoyed a good relationship with her peers and new teachers, and considered herself a "beacon of hope for new students of colour" in her school.

**Sage:**

Sage, who was about 40 years old, has taught grades 7 to 12 students mathematics and science for about 11 years. She was first inspired to go into teaching while she volunteered at a youth shelter where the youths, who had issues with “sexual identities were marginalised, and, they had no suitable school system to support them”. Sage was offered a “generous scholarship” to attend teachers’ college based on insights she offered into “what youths needed from those in authority”. She found her initial training programme “very academic” and she felt that she was not being prepared to deal with “emotional and social needs of student”. She was much happier to do the practicum part of the programme. However, she did not “feel connected to the students” at that time. She eventually connected with the students when she became a full-time teacher.

She started her teaching career as a long term occasional teacher in an alternative programme for youths. She focused on teaching youths about their sexuality and emotional support. Here, she was successful in tailoring lessons to fit the students’ needs. She soon moved to a junior school programme where she taught her speciality subjects such as science, mathematics, and social science. She explored students’ opinions and encouraged them to think outside the box with respect to science and technology. She encouraged her “students to develop their own opinions and supporting arguments in science”. During this time she also gained much experience in pedagogy.

Sage enhanced her teaching by attending professional development programmes. She attended programmes which covered curricular matters, skills for engaging students, and new ways of teaching science. The “most rewarding programme” for Sage were those that involved collaborative learning among the teachers in which they developed their “own materials relevant to their immediate classroom needs”. She loved the opportunity to network with colleagues who saw themselves as lifelong learners. She saw her “greatest asset” as one in which she “offered support to younger teachers when they first entered the profession”. She did not just provide materials for them but she “showed them how to find materials”. Sage also enjoyed collaborating with her peers although she felt that some of them were “puzzled by the unconventional way she approached her work since she did not believe in having binders of notes, but rather in developing new lessons for her students depending on their needs”. She found an opportunity to “learn something new” from her students daily and was

“focused on learning from her mistakes”. Her goal was to become an instructional leader or to teach at a more high-needs school. Her greatest satisfaction was in “connecting with students who struggled to build self-confidence”. She saw herself as a “confident, forward-thinking woman of colour” who was willing to learn from her mistakes and move on.

**Sam:**

Sam, who has earned a PhD in Physics, was around 60 years old, and was a specialist physics teacher. She has taught Grades 10 to 12 science, mathematics, and physics in Canada for 11 years. Sam came from a family of teachers but none of them taught science. They found it amusing that she was interested in, and excelled in science. She has taught in 5 different schools in 11 years. Sam was a second career teacher who worked in academia and industry in her home country and in Canada. She entered teachers’ college after being awarded a scholarship and upon completion of the programme she had her first teaching position at a denominational school but soon after went over to her current school board where she has been teaching for the last 10 years.

She has attended several professional development programmes as both a presenter and as a participant. She has volunteered in various professional development programmes within her school board, school council groups, peer tutoring and remedial teaching in science and mathematics, and has “created a mathematics test to administer to new students for admission to schools”. In addition, she was affiliated with many professional organisations. She conceded that she would always see herself as a physicist first, then as a physics teacher. She was confident in her abilities as a physicist although she believed in “lifelong learning” and would be participating in many more professional development programmes. She aimed to learn how to teach outside her subject area and to inspire her students and encourage them to study physics and other sciences.

**Steve:**

Steve, who was around 40 years old, had 13 years teaching experience from kindergarten to grade 13 in areas of science and technology. He held a bachelor of education degree to teach general science and geography and was a specialist teacher in computer science in the classroom. He has participated in a number of additional qualification courses including guidance, computers, as well as design and technology. He used his expertise in this area to “stimulate his students’ imagination by integrating technology, field trips and

teleconferencing” in his classroom. In addition he was “an extra-curricular coach for various” sports activities. At the time of this study, he taught at a junior high school. Steve saw himself as an “ingenious, determined, creative, collegial person with leadership qualities”. He has mentored student teachers and conducted workshops for his peers.

### **Findings of science teachers’ professional identities prior to research**

My restoried accounts of the science teachers’ professional identities highlighted their achievements, activities, and beliefs in terms of their professional identity prior to the study. I draw attention to indicators of professional identity below, that I found in the science teachers’ written narratives, and which are supported by literature, on which I focused to glean their prior professional identities.

- Influence of parents, peers, and mentors which Palmer (2007) describes as crucial in defining who one becomes and Day (2008) refers to as their personal identities
- Initial teacher training and teaching experiences which shape beliefs and agency (Day 2008; Moore 2007)
- Willingness to share ideas among peers which indicated collegiality (Day 2008; Wenger 1998)
- Willingness to form networks with others within the school board which implied social interactions (Wenger 1998) and to which Day (2008) refers as their situated identities
- Beliefs in lifelong learning to improve their practice which indicates a tendency to change beliefs (Bukor 2014)
- Engaging in presenting and participating in professional development programmes as in life-long learning which is indicative of “remaking occupational identities” (Billet and Pavlova 2005: 10)
- Commitment and joy in choosing teaching as a profession which revealed their emotions about teaching (Bukor 2014; Day 2008).

As science teachers participated in the professional development programme, their prior professional identity influenced the extent to which they were likely to learn, apply their new learning, and change their beliefs about themselves and science teaching (Marcelo 2009; Luehmann 2007). In illustrating who the science teachers in my study were at the start of the professional development programme, I provided insight into their values, beliefs, and commitments to teaching, which are dominant characteristics in identity development (Bukor

2014). These dominant characteristics influenced and provided meanings for science teachers' experiences of their professional development programme (Marcelo 2009; Luehmann 2007) and determined their actions during professional development.

I now assess the themes identified from the interviews to reveal whether the science teachers' professional identity was influenced or reshaped by experiences of their professional development programme. To reiterate, I did not solicit science teachers' insights into changes in their professional identities during interviews, but I considered them in cases where they volunteered such information during interviews. I adopted a modular approach to present my findings since I intended to compare science teachers' experiences within each module, and across modules.

## **4.2 Findings of science teachers' experiences from interviews**

Interpretive phenomenological analysis of the evidence from 25 interviews produced 751 codes from the first cycle of coding (page 119). During the second cycle of coding (page 121), I arranged these codes into 5 clusters of themes: learning, interacting, emotions, changes in beliefs and practice, and relevance to professional needs (Table 3.10: 122). I then categorised the 5 clusters of themes into 5 dimensions of experiences. However, I merged themes signifying relevance to professional needs with those of emotions so that the end result was 4 dimensions of experiences (Table 3.11: 123). I considered the fourth theme, changes in beliefs and classroom practice, to be significant since most science teachers reported it as part of their experiences, and it is recognised as having a direct influence on classroom practice and professional identity. I focused on science teachers' experiences, which, in my study, aligned with the categories of themes and with the dimensions of experiences. As I have established at the start of this chapter and in chapter 2, I regarded such experiences as indicators of influence on and reshaping of science teachers' professional identities. These categories of themes framed and addressed the second supporting research question regarding the nature of science teachers' experiences. As I strove to interpret science teachers' narratives, I focused on the context of their narratives.

In this section, I present each science teacher's experiences of their professional development programme in the module in which they participated. I focus on the four themes of experiences of their professional development programme. As I narrate science teachers' experiences of their professional development programme, I insert excerpts from their interview transcripts to illustrate the themes obtained from the analysis and to highlight the essence of their experiences in order to authenticate my findings. I have modified the verbatim transcripts of each interview for the science teachers so that those parts of the interviews relevant to analysis, reporting of findings, and discussion are shown (Appendix D: L).

Although I grouped the 13 science teachers together during analysis because of common modes of delivery to all modules, they did not participate in any common module. 5 science teachers participated in the English language learner module, while 4 of them participated in each of the other two modules. My modular approach in presenting the findings of science teachers' experiences allowed me to compare findings among them within each module and

across modules. I arranged science teachers alphabetically in the module in which they participated, to report findings. As such, this section of the chapter comprises three parts. Module 1: Culminating activity for an inquiry based unit; Module 2: Communicating with English language learners; and Module 3: Motivating unmotivated grade 10 students. My rationale for such a decision was to compare experiences of science teachers who participated in a specific module to highlight common experiences among them in each module. I narrate experiences relating to each theme based on my interpretations of interviews as I compare science teachers' experiences to reveal my findings. Of note is that Jean did not participate in the second interview because she missed the last session of the professional development programme and she felt that she could not contribute further to the study.

### **Module 1: Culminating activity for an inquiry based unit**

#### **Cognitive development**

3 of the 4 science teachers in this module reported that they experienced cognitive development, which resulted in enhanced pedagogical skills. While Darius, Mary, and Sage experienced cognitive development, Maria did not report such an experience because she was distracted by her role as a lead teacher. 2 of these teachers reported that they acquired artefacts to help them in their daily lessons and Darius felt he would have to modify his new knowledge to apply in his classroom. In the following excerpt of his first interview, Darius explained that while he appreciated his new learning, he “can get the knowledge from this activity...but maybe in my case I have to modify it a lot” (CD1, lines 38 – 40: LXI). However, he admitted that he was learning new ideas that may be useful in future classes. He rationalised that:

“I think all I can take from these PD's is some knowledge information and use it to create my own activity and use it for my own activity for my own class and for my students” (CD1, lines 10 – 12: LX).

He continued “it helps me to get some clues of what a culminating activity in science should look like...it was a good experience for me” (CD1, lines 14 – 16: LX).

In terms of new learning, Darius said:

“I have gained some knowledge since it is directly related to the grade 10 science curriculum...the knowledge I got is directly related to the units that they were discussing. I gained pedagogical knowledge...My yes moment was in the second session when we had on the board the different strands– knowledge,

understanding, inquiry, application, communication – how we would evaluate the students...that was my yes moment. I love that part” (CD1, lines 80 - 94: LXII).

During our second interview, Darius revealed that he “didn’t get that much out of it considering that we spent 4 days going to that school” (CD2, lines 1 – 2: LXV).

SS2: “Would you say your experience of the first two sessions was more meaningful than the last?” (SS2, lines 11-12: LXV).

He replied that he expected to have the role of “a student and learn from the experienced teachers” (CD2, lines 14 – 15: LXV). He went on to say that:

“I was hoping to get some handouts and such to use in other classes in the future. So the first two sessions were the kind in which I was listening and trying to get that knowledge and figuring out what we are supposed to do” (CD2, lines 20 – 23: LXV).

He continued to explain:

“The first two sessions were fine, I tried to learn what the complex culminating activity was so I tried to learn all about it. But in the other sessions, I felt that no this is not serving my needs” (CD2, lines 26 – 28: LXV).

Despite his experience, he conceded that “it has helped me to see the need to use different ways of teaching the same topic” (CD2, lines 52 – 53: LXVI). Yet he conveyed the impression that he would have preferred to learn from the lead teachers rather than share ideas among his peers in the professional learning community.

Maria, a lead teacher, described her experience as “different because I was actually leading the workshop” (CM1, lines 1 – 2: CI). She continued:

“I don’t think I had anything to take back to my classroom. I was just focusing on having the workshop work properly, like I said it was very stressful, I just was focusing on getting people involved. But anything to take back to my classroom? Not yet. Maybe the next session” (CM1, lines 45 – 47: CII).

Mary, on the other hand, felt that she “walked away with a whole bunch of new ideas that” she “could use” (CMA1, lines 3 – 4: CIX). She described her most meaningful experience during the professional development period as:

“There were two benefits. One was coming up with new ideas and checking up on how they were evaluated. It is hard to put a measure on which one was more valuable. I guess probably on how to evaluate it...Having the ideas without knowing how to evaluate them means they just sort of remain on the shelf. So that is why I think that having the whole package of the ideas and how to evaluate them makes it more valuable” (CMA1, lines 31 – 37: CX).

Her narrative implied that she obtained artefacts in the form of a package of ideas to take back to her classroom in the process. She not only learned how to mark the culminating activity of an inquiry assignment, but also developed the necessary technological skills to communicate with her students. She felt that she had “learnt new technology and new skills and walked away with a ton of new ideas” (CMA2, lines 83 – 84: CXIII).

Sage, the other lead teacher, found herself in the peculiar position of presenter and learner at the same time as she prepared for the presentation. She remarked that “I got some ideas ...the pedagogy which can sometimes take a back seat for me” (CS2, lines 79 – 80: CXXVII).

### **Social interactions**

To some extent all of the science teachers enjoyed working together in collaborating with each other as they discussed and shared experiences and resources. However, there was a certain degree of discord between the two lead teachers, Maria and Sage, as well as between Sage and Mary. Darius also reported feeling isolated especially during the last session. He appeared to be the only one who had difficulties interacting with the others during the last session although he reported collaborating and sharing of ideas in the first two sessions.

In the early sessions of the programme, Darius exchanged ideas and information and engaged in discussions with other teachers present. As he explained:

“We did a lot of talking during the breaks and lunch. We talk about our classrooms, our students, what we do, how I implement this unit...Participating with others is better. You get more ideas and learn from their experience” (CD1, lines 124 – 131: LXIII – LXIV)

In terms of his experience of working in groups in the first two sessions, Darius felt that:

“Working in a group in the first session, although it was just my colleague and me, that was good – working on inquiry and thinking. We worked together, exchanged information and posted it on the Wikis. In the second

session, although we did not break up into smaller groups, we worked as a large group” (CD1, lines 129 – 133: XLV).

However, he went on to say that:

“I was trying to digest what others were saying. I had some input but not much. I am not the type of person who would say things right away. I have to think about it. So when I was listening, I was just listening to them saying to myself OK how is it working? Why is it working?” (CD1, lines 140 – 144: LXIV).

Yet Darius felt that attending the professional development sessions provided:

“a very good opportunity for the teachers to meet and exchange information especially in relating what we know and you can take the experience and knowledge to your own classroom and adjust it to your own student population and the environment of your teaching” (CD1, lines 2 – 6: LX).

He mentioned several benefits of social interaction experiences to him. Among these were “You get more ideas and learn from their experience” (CD1, lines 130 – 131: LXIV), “exchange information and reaffirming what you have learned previously” (CD1, lines 137 – 138: LXIV), and “networking with others and share information” (CD1, line 122: LXIII).

Maria, who worked with Sage to deliver the programme, felt that her experience was not a rewarding one. Maria described how she “ended up doing a lot of the work on my own” (CM1, line 13: CI). That “to me it was not the unequal sharing so much as it was pretty much doing everything. I have not worked together, we did meet once” (CM1, lines 23 – 25: CI). Although she was not part of any of the collaborative groups, she explained that as she moved around amidst groups, she received feedback on her performance and shared her ideas with teachers. She summed up her collaboration with other teachers as:

“we really peeled away the layers and came to the core to what we want, why we want this, why we need to know this. For me I think it was the first time I actually had it organised in such a way. I knew it but to actually pull it together? ...that was a positive for me. It was difficult to get it out of everyone. It really was like pulling teeth” (CM1, lines 90 – 96: CIII – CIV).

Mary felt that “working with a team of people...I know that I don’t have to come up with everything on my own” (CMA1, lines 9 – 11: CIX). She felt that she had a “completely positive” (CMA1, line 17: CIX) experience and that “there was a definite degree of collaboration among the teachers” (CMA1, lines 17 – 18: CIX).

She found the collaborative part of the professional development programme to be the highlight because they all engaged in sharing ideas as professionals. In her words: “There was a definite degree of collaboration among the teachers. I didn’t feel like I had to do everything right to contribute” (CMA1, lines 17 – 19: CIX). She elaborated on that statement further by saying “Collaboration with the others was the highlight of the programme” (CMA2, line 15: CXI). She described the “plethora of ideas” she “shared among other colleagues” (CMA2, lines 7 – 8: CXI).

Sage liked “collaborating with other people...I feel best when people are interacting” (CS1, lines 19 – 21: CXXIII).

She did not describe her own experience in collaborating with other teachers.

She said:

“When people visited my classroom they were able to see my interaction with my students. I would like to think that that showed them a little bit more of who I am as a teacher” (CS2, lines 62 – 65: CXXVII).

While she did not describe her own experience directly, she did indirectly as she said:

“I feel we were working like a group like colleagues rather than professionals. That they came from similar schools, populations or they dealt with similar challenges in the classroom. This made it easier for us to communicate. It was more efficient for us to share ideas and I feel like the group really worked to collaborate” (CS2, lines 4 – 9: CXXV).

### **Emotional experiences**

Science teachers in this module experienced emotions ranging from excitement, happiness, and enthusiasm to disappointment, frustration, and regret. Relevance of their experiences to their professional needs contributed to some of these mixed emotional experiences. I combined relevance of experiences to professional needs with emotional experiences since such experiences would result in feelings of satisfaction or dissatisfaction and happiness or frustration depending on whether those needs are met or not. Maria and Sage experienced negative emotions because of their roles where Maria’s perception was that she had to do most of the work and Sage’s perception was that Mary insisted on having clarification on moderated marking.

Throughout the programme, Darius experienced moments in which he was happy with the way the programme was conducted when he declared “I feel good because the experience I get I can use it next year” (CD1, lines 40 – 41: LXI). On the other hand, he experienced moments of dissatisfaction, regret, and uncertainty as he reflected “still I can do something about it. Maybe I can use a portion of this activity. I am not saying it is totally useless for me” (CD1, lines 46 – 48: LXI). He felt that his professional needs were not met at this point. Yet his “yes moment was in the second session when we had on the board the different strands ...how we would evaluate the students...” (CD1, lines 88 – 91: LXII). At one point during the interview he felt “optimistic” and “it was good” (CD1, line 76: LXII).

SS: “Would you say your experience of the first two sessions were more meaningful than the last?” (SS2, lines 11 – 12: LXV).

CD: “Maybe I have the wrong perception but I thought in the first session I would be there as a student and learn from more experienced teachers” (CD2, lines 13 – 15) “I was hoping to get some handouts and such to use in other classes in the future. So the first two sessions were the kind in which I was listening and trying to get that knowledge and figuring out what we are supposed to do” (CD2, lines 13 – 15; 20 – 23: LXV). “I felt that no this is not serving my needs” (CD2, line 28: LXV).

I noted in my observation of Darius in the last session that he did not participate in the discussions. He explained that he did not participate in the discussions because he was disappointed since his professional needs were not met. Nevertheless, Darius thought “the best session” was the one in which he observed “a classroom in which we helped the students come up with their questions and contrasting the morning session with the afternoon session” (CD2, lines 31 – 34: LXVI).

He also enjoyed discussing and sharing ideas with other teachers despite his circumstances and feeling disconnected with them. He was hoping to get a package to apply in his situation but that did not materialise. However, he conceded that:

“I was happy meeting the other teachers, get some ideas, you know get some lessons, some assignments. I would say 50-50 satisfaction. I am not saying I was totally disappointed” (CD2, lines 42 – 45: LXVI).

Meanwhile, Maria felt that:

“instead of enjoying it, the experience, it ended up, during the first session, and the second session just being stressful, a lot stressful actually because I just had to find the time to not only do my school work and the other stuff I was involved with, I had to find time to develop the whole thing on my own, the photocopying, the reading, doing everything, the power point, the equipment, bringing the equipment, I just felt exhausted” (CM1, lines 14 – 20: CI).

While she would not say that her experience “was overwhelming” (CM1, line 75: CIII), she did not think she had “much confidence” (CM1, line 76: CIII). As she put it:

“I was very nervous, very stressed out about having it run well and have this overwhelming emotion of frustration. I would say it was a bit of frustration” (CM1, lines 76 – 78: CIII).

Maria felt a sense of relief at the end of the programme although there was a degree of regret as well. She felt “a bit like there was no real closure with the last session” (CM2, lines 8 – 9: CV). She reported that, in the last session, they conveyed the impression that they “appear a little bit disorganised” (CM2, line 10: CV). She felt “we seemed to ad lib as we went along. I am very uncomfortable with that” (CM2, lines 12 – 14: CV). She summed her feelings saying “I feel disappointed that it could have been better” (CM2, lines 24 – 25: CV).

SS: “What did you learn from the whole programme based on working with the co-presenters and feedback from participants?” (SS2, lines 29 – 31: CVI).

CM: “I think my overall feeling was one of relief that it was over” (CM2, line 32: CVI). “I am not really happy with how I did. I just don’t feel that I did a great job getting the teachers engaged” (CM2, lines 34 – 35: CVI).

Mary really enjoyed working with the group which she considered to be a positive experience and sparked her imagination. She said that “I really enjoy...working with a team of people because I can draw on everyone’s expertise” (CMA1, lines 13 – 14: CIX). She felt “It sparked my imagination. It gave me a whole bunch of new ideas” (CMA1, lines 8 – 9: CIX). She considered working with other teachers “A completely positive experience...There was a definite degree of collaboration among the teachers” (CMA1, lines 17 – 19: CIX). She was comfortable in that environment and enjoyed a fair degree of trust among her colleagues. She found the idea of seeing an activity in action and getting an opportunity to revise it and adjust it before putting it into action as “priceless” (CMA1, line 40: CX). Her “aha moments” came as she was “pulling everything together to make it happen in my course. So yes I think there was some aha moments” (CMA1, lines 49 – 51: CX).

SS: “Tell me about your collaboration with the others in the last session” (SS2, lines 13 – 14: CXI).

CMA2: “Collaboration with others was the highlight of the programme” (CMA2, line 15: CXI). At the start of the second interview, Mary pointed out that:

“I was happy when we left there because at the end of the day we did firm up how we would evaluate this type of project and so I was able to go back to my class and I came up with a rubric and I was able to effectively evaluate the class. So I was really happy that I achieved the goal that I set out to do which was to come up with ideas how to evaluate. So that was great” (CMA2, lines 1 – 6: CXI).

Sage felt that “overall, the experience has been positive” (CS1, lines 6 – 7: CXXIII). She “liked collaborating with other people” (CS1, line 19: CXXIII). She felt a sense of satisfaction and described “the best moment in this session” as:

“when people had said “oh yea I kind of thought to do that. I wanted to do that but I held myself back because I was worried about not achieving the expectations that I set out to achieve that day. But here you are telling me that it is good to go with a different approach, a different perspective”. And that validates what I sometimes want to do. I think it is important to get affirmation” (CS1, lines 23 – 28: CXXIII).

Sage experienced a degree of unhappiness with the outcome of the last session because some of the teachers expected a prepared package to take away. When that did not happen they were disappointed. She felt as though she had let the group down. She said:

“I think I was a bit disappointed that the conversation went in the direction that it took. I felt that people were allowing their emotional needs to get a hold of to run away with them on this. And I didn’t feel that people were keeping to the goals of the sessions. I think people lost sight of the whole thing of why we began this journey together” (CS2, lines 39 – 43: CXXVI).

### **Changes in beliefs and classroom practice**

Science teachers in this module did not experience changes in their beliefs of themselves as science teachers but they experienced changes in their classroom practices. They were certain that it would not be easy for them to change their beliefs about themselves. It is significant that Mary and Sage reported changing their classroom practices to some extent, while the

others intended to do so, but the opportunity did not arise. Their decision not to change their practices so early after the programme was not due to their experiences but due to professional constraints.

Darius, who felt that he would have difficulties to rethink his beliefs, could see how he could modify his approach to teaching his lessons. As he pointed out:

“I will rethink how the curriculum can be delivered, what type of activities I can use. For sure it will change my perspective, beliefs, values, but by how much to measure it actually, I am not sure. Sometimes you have your own values and thoughts already and those of PD’s help you to reassure yourself that I am on the right track. That was good. In that sense for sure. If I learn better ways of teaching my students for sure I am going to use it” (CD1, lines 106 – 113: LXIII).

He affirmed further:

“What I would take to my classroom maybe would be the topics we discussed and the way in which we discussed them...maybe I can use my colleagues’ experiences in their classroom and say OK this may work in my classroom” (CD1, lines 113 – 117: LXIII).

While he saw the merits of what he learned, he was not able to take it back to his classroom because he was teaching students of mixed abilities. As he explained:

“The reality for me is totally different. You have a variety of students with different learning styles, different levels of understanding and knowledge. So I think all I can take from these PD’s is some knowledge information and use it to create my own activity and use it for my own activity for my own class and for my students” (CD1, lines 8 – 12: LX).

However, he appreciated that he could use those ideas in another situation in which he may have a different type of class. As he explained:

“I feel good because the experience I get I can use it for next year you don’t know. I might at another school with a group of students ...what I am thinking is that given the knowledge and learning about the activity, I have my resources that I get from the PD sessions it’s a good source that I can keep it and use it later...even with one grade 10 science student I can modify it. Still I can do something about it. Maybe I can use a portion of this activity. I am not saying it is totally useless for me” (CD1, lines 39 – 48: LXI).

Speaking about his experiences and its effect on himself as a teacher, Darius said:

“I really believe that these PD’s and the exchange of information among the teachers lead to improvement of teachers. I see that in myself and especially for this PD even if I don’t use the end result the way it was meant to be used I still learn what the main components of a culminating activity should be. So I can use those components in any activity that I am going to design and implement in my classroom” (CD1, lines 49 – 55: LXI).

SS: “How has your experience helped you to change your teaching strategy?” (SS2, lines 48 – 49: LXVI).

CD2: “You need to reconsider your approach, maybe to improve it and make it better. So next time when I want to do any activity with my students I will make sure that I have revisited my actions. It has helped me to see the need to use different ways of teaching the same topic” (CD2, lines 50 – 53: LXVI).

At the end of the interview he affirmed that he “walked away with the knowledge that I must rethink how I teach my lessons” (CD2, lines 55 – 57: LXVI).

When asked if she thought that at the end of the programme she would rethink her values as a science teacher, Maria replied “I think I am in the process of changing my perception of myself” (CM1, line 79: CIII).

SS: “Do you think your overall experience has changed your classroom practice?” (SS2, lines 96 – 97: CVIII).

CM1: “Yes. I would say yes. For the better. I think I am giving them the skills to take to the next level” (CM2, lines 98 – 99: CVIII). In terms of implementing these ideas in the classroom she said “I don’t think I can really implement anything like that in that class right now. I am currently battling with just getting through to them basic English” (CM2, lines 101 – 102: CVIII). However, she felt she “can use and implement more of the skills in my teaching. That is a big positive. That’s a whole new paradigm shift” (CM2, lines 105 – 106: CVIII).

Mary was enthusiastic in describing how she would use her ideas in her classroom as she said:

“We went from the inception of the idea to seeing how it could be implemented and we saw that on three levels – we saw it in the demonstration classroom with the academic students; then we saw it in the demonstration classroom with the split class, the academic/applied level students and it was done in a different way; and then I took it home to my class and again I did it another way. Really no matter how it was done, the process was effective. So not only

were we told of the idea, we also saw it in action, and then we saw examples of the finished product. Then from that we learnt to evaluate it as well. I mean it's not only my professional development but what I have learnt I have taken back to others and then in the process of doing the inquiry activity...I am 100% sure I can share what I learnt with other people" (CMA2, lines 28 – 41: CXI–CXII).

SS2 asked Mary: "Has your experience of the programme helped you to inspire and challenge your students?" (SS2, lines 47 – 48: CXII)

CMA2: "Yes. By just learning about some of the technologies out there. I had my students submit their presentations of their research in Google Docs which I did not know about previously. This is one of the things I learnt. Learning the whole inquiry process in greater detail was good for me. I knew some things about it before but I think that through this workshop I learnt about all the steps in detail...I learned a lot" (CMA2, lines 49 – 58: CXII).

Sage focused on taking what she learnt about setting assignments and using that to help students think critically. Such an experience helped her to view her classroom performance in a different light. She did not change her beliefs of herself as a science teacher, but her beliefs were affirmed when several members of the group complimented her saying "that it is good to go with a different approach, a different perspective. And that validates what I sometimes want to do. I think it is important to get affirmation" (CS1, lines 26 – 27: CXXIII). In terms of changing her perceptions of herself, she felt that her attempts to help students make smart choices and to impart that in sessions to other teachers, have "definitely cemented my views of myself not just being a leader. Being a leader in the classroom as opposed of being a source of information" (CS1, lines 14 – 15: CXXIII). "It has given me the opportunity not only to see myself as a lead teacher but to actually execute that role. I enjoyed it" (CS1, lines 42 – 44: CXXIV).

She spoke about the manner in which her experience has changed her view of her performance by saying:

"I think my experience has shifted my view of how I am performing. I think that the strength of my beliefs is that I am on the right path. I was very flattered when several people complimented me in the way in which I did things. It is always good to get positive feedback" (CS2, lines 104 – 107: CXXVIII).

She continued:

“I don’t think my experience changed or challenged my style of teaching much. However, I have learned to scaffold, to support, to structure my lessons for students that have difficulties a little bit more” (CS2, lines 108 – 110: CXXVIII).

### **Comparison of science teachers’ experiences in module 1 based on my interpretation of their narratives**

Table 4.3a: 161 illustrates a comparison of science teachers’ experiences among the four dimensions of experiences identified in this module. Not all science teachers in module 1 reported positive experiences in cognitive development in which they gained knowledge in pedagogy and obtained artefacts. Darius acquired some pedagogical skills but he felt that he would have to modify them for his students. He also shared in the available resources and artefacts. Mary, on the other hand, was happy with the skills she acquired and artefacts she collected. Maria, however, experienced no meaningful learning because she was distracted because of the stress of having to prepare for and to conduct the first two sessions while Sage found new ideas especially in designing and implementing assignments.

Most of the science teachers in this module appeared to experience some form of positive social interaction. Darius exchanged ideas and information and engaged in discussions among other teachers present in the first two sessions. However, he did not work with anyone in the last session because his classroom situation was different from theirs. He enjoyed sharing ideas and networking with other teachers, but when he felt his needs were not met, he became aloof. As a lead teacher, Maria found it rewarding to have positive feedback from participating teachers as she interacted with them. Mary was the only one among these teachers who experienced positive social interactions. She drew on others’ expertise during professional development sessions. She collaborated, shared, interacted and brainstormed with her team members to achieve her goal of learning how to evaluate an inquiry-based project. She was satisfied with the degree of social interaction in which she engaged despite misunderstanding between her and Sage in the last session. While Sage engaged in collaboration as she shared and learned with participating teachers, she found some teachers were reluctant to participate. She has acknowledged some degree of discord between her and Mary during the last session.

**Table 4.3a: Comparison of Science Teachers' Experiences in Module 1 – Culminating Activity for Inquiry**

Names	Cognitive Development		Social Interactions		Emotional Changes		Changes in Beliefs and Classroom Practice			
	Positive	Negative	Positive	Negative	Positive	Negative	Beliefs		Classroom Practice	
							Yes	No	Yes	No
<b>Darius</b>	✓	-	✓	✓	✓	✓	-	✓	-	✓
<b>Maria</b>	-	✓	✓	✓	-	✓	-	✓	-	✓
<b>Mary</b>	✓	-	✓	-	✓	✓	-	✓	✓	-
<b>Sage</b>	✓	-	✓	✓	✓	✓	-	✓	✓	-
<b>Total experiences/ category</b>	3	1	4	3	3	4	0	4	2	2

✓ - Indicates yes  
 - - Indicates no

Similarly, the science teachers experienced mixed emotional experiences whereby negative experiences came from experiences of unmet needs. Although he enjoyed some aspects of the programme, Darius was disappointed and unhappy that he did not experience true collaboration. However, he was happy to be able to observe a lesson in action. He also felt disconnected with other teachers, but still enjoyed sharing ideas with them. While he liked the first sessions and demonstrations conducted by the IL, he did not like the last session. He was hoping to get a package to apply in his situation but that was not the case.

Maria did not experience unmet needs and she enjoyed her interaction with other teachers. She would have preferred more of such positive experiences. In her capacity as a lead teacher, Maria felt that she did most of the work for the first two sessions. So she did not enjoy her experience of these sessions. She found the whole process stressful and frustrating. In addition, she found getting the science teachers to participate was not easy. Nevertheless, she was satisfied that the first two sessions were good although there was no closure in the last session of the professional development programme. However, because her co-presenter took over the last two sessions, she was less stressed and managed to relax somewhat. She felt they could have done a better job in the last session. She was disappointed that they did not manage to get teachers more engaged in their activities. She was especially upset that Sage and she appeared unprepared in the last session and this added to her frustration and disappointment.

Mary, on the other hand, felt that her imagination was sparked. Her experience was positive and she was comfortable to share her ideas with other teachers. She experienced trust and found observing a class in action to be priceless. She had an 'aha' moment when she saw how everything in her own class would come together based on what she learnt during the sessions. That made her happy. She had achieved her goal. She welcomed working together with others since it was exciting and it gave her confidence. She was disappointed during the moderated marking session because she wanted to take that knowledge with her.

Sage reported that she had an overall positive experience. She was happy that as a co-presenter, teachers observed her classroom in action and they were very pleased with it. The positive feedback she received provided a sense of validation. Yet she found the first three sessions challenging. She felt that she could not reach other teachers and sensed that somehow

she had let them down. However, she felt she had a better time during the last session on the last day despite the discord between herself and Mary.

Science teachers in this module have reported that they intended to take their experiences back to their classrooms. However, none of them thought that their experiences would change their beliefs of their professional selves. Darius believed he would find it difficult to rethink his beliefs as a science teacher. However, he could see how easy it would be for him to change his perspectives about how he would approach teaching his lessons since he obtained some useful ideas which he applied successfully in his classroom. While Maria did not see her beliefs changing, she can see herself incorporating some of the skills they discussed during sessions. She saw this as a paradigm shift in that her students can now be given tools to move to the next level of their learning. Maria was able to peel away layers and see what she wanted from the strategies for her students. She felt she could use and implement some of those ideas in her teaching. Both Darius and Maria have clearly thought of incorporating their new learned ideas in their classrooms.

Mary and Sage also believed that their experiences would not change their beliefs as science teachers. However, unlike the other two teachers, they have applied their new learning in their practice. Mary felt that after completing the professional development programme she had more confidence to conduct an inquiry study. She had acquired new ideas to take to her students and she had applied them successfully in her classroom. She found her students were much more engaged. Although her experience would not change her views of herself as a science teacher, she can see how it would have a positive effect on other courses she would likely teach in future. She was able to walk away with ideas which she considered valuable to use in her classroom. Sage, on the other hand, felt that her experiences have cemented her views of herself as a science teacher. Her experience has led her to believe that she can guide her students to think more critically in class.

I infer from Table 4.3a: 161 that 3 science teachers in this module experienced positive cognitive development. Experiences of social interactions and emotional changes were mixed, whereas no one changed their beliefs and 2 of them changed their classroom practice.

### **Science teachers' professional identities and their experiences in module 1**

Based on Table 4.3a: 161 it appears that some science teachers' professional identities were influenced by their experiences of their professional development programme. Not all of the science teachers in this module experienced the four dimensions identified in this study. Of note here is that 3 out of 4 science teachers experienced cognitive development. Experiences of social interactions and emotional experiences were mixed. While 2 science teachers reported that their experiences resulted in a change in their classroom practice, none of them felt that their experiences led to a change in their beliefs about their professional selves about teaching science. The range of experiences among the science teachers in this module included some experiences that aligned with the dimensions of experiences. As such, I perceived that some of their professional identities appeared to be influenced by their experiences of their professional development programme.

## **Module 2: Communicating with English language learners**

### **Cognitive Development**

5 science teachers from this module participated in this research and they all reported that they experienced cognitive development in communicating with English language learners. However, only Ashna reported that she acquired skills in using technology in the classroom while no one reported that they learnt about the curriculum. 3 out of 5 of them reported that they acquired artefacts to help them in their daily lessons. Linda and Jen did not report that they obtained artefacts although they had positive experiences of cognitive development. I present excerpts of both interviews one and two for each teacher to shed light on their experiences that led to this finding.

Ashna's cognitive development was pedagogical in nature. She found that some of techniques that she acquired which can be used in her English Language Learner (ELL) class, were "interesting" (EA1, line 5: L). She became "conscious of the examples that I use in class" (EA1, line 10: L) and she viewed various pedagogical activities she learnt as "another technique that you could use" (EA1, line 15: L). However, she felt "that a lot of the techniques that have been discussed in the workshop" did not serve the needs of her students (EA1, line 15 – 16: L). Nevertheless, Ashna saw the new ways of teaching her ELL students as "diversifying" her "repertoire of teaching skills" (EA1, line 85 – 86: LII) which she thought was "the most important thing" she was "getting from" the programme (EA1, line 86 – 87: LII). Although she did not learn anything new about the curriculum, she felt that in terms of her learning, "it was nice to see" (EA1, line 91: LII) "dissecting the wording of the curriculum" (EA1, lines 90 - 91: LII) as part of the session but did not "feel like curriculum wise" she has "gained anything" (EA1, lines 92 – 93: LIII).

At the end of the professional development programme, Ashna declared that her experience of the last session was "most useful of the three sessions" that she attended (EA2, line 1: LV). She felt that she "had a chance to actually see a lesson put into practice in a classroom" (EA2, lines 2 – 3: LV). Apart from learning how to communicate with the ELL students, Ashna also experienced directions on the use of technology in the classroom. As she remarked:

“I actually took that to work with me the very next day and I tried it out and I had a department meeting the week after and I showed the members of my department how to use Skitch” (EA2, Lines 21 – 24: LV).

Ashna went on to describe several other ideas on pedagogy she picked up including one that the IL demonstrated which was how to embed critical thinking in an assignment. As Ashna pointed out:

“I took that back to my department the week after and what I am trying to encourage is that how can we embed critical thinking in these activities” (EA2, Lines 40 – 42: LVI).

SS: In what ways were your experiences of the two previous sessions beneficial to you? (SS2, lines 88 – 89: LVII).

Ashna responded:

“I liked the initial collaboration session...I also liked the ESL teaching and learning strategies that the IL shared and modelled. Those are the two most beneficial things. I think that these sessions in general just extend your repertoire of techniques that you can use with the ELL students” (EA2, lines 90 – 95: LVIII).

Like Ashna, Felix learned new ideas as well as obtained artefacts based on various ways of teaching ELL students. He reported that at “the workshop not only do I hear new ideas but they also have the good sense of providing examples of general techniques that would work for all types of learning” (EF1, lines 1 – 3: LXVII). At the end of the professional development programme Felix said that:

“I came to the workshop with hopes that I would be reminded of some good teaching practices and that essentially I was. I was also surprised in ways that I didn’t expect because I did pick up practical ideas for my classroom” (EF2, lines 93 – 96: LXXII).

Hailey, who trained as an engineer, appreciated the focus on big ideas in the curriculum and pedagogy rather than subject content. She:

“Picked up pedagogical and focused on skills that the students would need. Not necessarily the content that they need to learn. It was looking at the ways to teach the subject matter and also looking at what science skills to teach to English language learners” (EH1, lines 80 – 84: LXXV).

She explained that they:

“Did go through the curriculum talking about the big ideas in the curriculum and looking at the units like the subject matter but we did not actually go through step by step, the different expectations, and the specific expectations. This collaborative learning community did not really change my understanding of the curriculum. It just helped me to see it through different lens” (EH1, lines 85 – 90: LXXV - LXXVI).

Hailey admitted to receiving “some hard copies of some assignments” (EH2, line 67: LXXIX).

Similarly, Jen obtained beneficial strategies and new insights as she engaged in her professional development. She felt that the artefacts she collected and the clear ideas imparted to them helped her to simplify her lessons. As she said “some of the techniques that we got there were beneficial for the type of lesson plans we were supposed to develop” (EJ1, lines 10 – 12: LXXXVI) and concluded that she became “a little bit more aware of the learning for the ELL students” (EJ2, lines 58 – 59: XCII). Linda, on the other hand, felt that she learnt no new subject matter. “Pedagogy... Curriculum no, not the curriculum.” (EL1, lines 27 – 28: XCIV).

### **Social interactions**

Most of the science teachers’ experiences of social interactions stemmed from their participation in their professional learning community. Social interactions for these teachers were not mainly from more informed lead teachers but among themselves. Although all of these teachers appreciated working in groups and collaborating, not all of them had positive experiences in collaborating. Only Linda reported that she benefited from collaboration during learning. The other four science teachers felt that they did not experience true collaboration during their social interactions with others in their groups. Ashna, Hailey, and Jen felt that they had to do most of the work on their own rather than have collaborative discussions with their group members, while Felix missed the opportunity to collaborate.

Ashna thought that working collaboratively would be “the most beneficial experience” to plan, share ideas, and discuss problems without reservations (EA1, lines 28 – 29: L). However, she did not consider her experience as collaboration since she did not consider it “true group work” (EA1, line 38: LI). Although she and her group members worked in a group, they did so separately. As she elaborated, “it’s not like we are sitting there and planning together and I would have perhaps liked that” (EA1, lines 39 – 41: LI). Yet she declared “I am finding it very beneficial” (EA1, line 46: LI). She worked alone but pointed

out that “I have definitely connected with one” (EA1, lines 47 – 48: LI). However, she qualified that statement by saying “I wouldn’t say a network for now because the group is very small” (EA1, lines 57 - 58: LI).

Ashna revealed that there was more interaction among her peers in the last session in which “The teachers got a chance to share things that are working well in a classroom or sharing resources that they have developed” (EA2, lines 6 – 7: LV). She admitted that she has “learned more from other teachers than I did just from the other sessions” (EA2, lines 8 – 9: LV). Ashna felt sharing ideas with other teachers was:

“rather useful. So I wouldn’t say I was completely disappointed. I think that there were aspects of the session that were beneficial, but that group component could have worked better” (EA2, lines 49 – 51: LVI).

At the end of the professional development programme, Ashna did not think that she made any “connection with the other teachers at the workshop: except with the lead teacher” (EA2, lines 54 – 55: LVI). She has tempered her apparent disappointment of her experience of collaborative activities as she said “despite what I hoped for from the collaboration, I still took a lot of useful practices and ideas away from the workshop” (EA2, lines 60 – 61: LVII).

Felix, on the other hand, missed the second session which involved group planning and felt he had nothing to contribute to group work for the rest of the professional development programme. However, he not only presented his lesson in the last session, but he participated in the discussions following the presentations. At the end of the session he felt they “learnt from each other... We were able to engage more in learning” (EF2, lines 85; 87: LXXI).

Hailey found that her experience led her to conclude that what she:

“really liked about this session is that we do have the time to just talk about things and see what the IL has tried in her classes and what other people have tried” (EH1, lines 1 – 3: LXXIII).

From this perspective her experience of the first session “was more collaborative” (EH1, line 32: LXXIV) than the others. The group she was in for subsequent sessions:

“was not such collaboration as they saw the ideas I was working on and they said “oh those are all good”. “You just take them up and post them to the Google drive”. That’s not why I’m here” (EH1, lines 4 – 7: LXXIII).

She has admitted that quite a bit of her learning during these sessions were due to her listening in on other teachers' conversations. It was here that she found out other teachers' experiences in terms of success in the classroom and she built a repertoire of ideas to use in her class. She:

“was still able to learn a lot from the other groups and get some really good ideas by overhearing what the other teachers were saying. It is one of those things where I am still going to seek out working in collaborative learning communities” (EH1, lines 71 – 74: LXXV).

Hailey found that “it was good to hear what other people think of my teaching” (EH2, lines 18 – 19: LXXVII) during debriefing after she conducted a lesson with her students while other teachers observed her. She went on to say “Just to be talking about things that other people have done in their classes gave me some really good ideas” (EH2, lines 21 – 23: LXXVII).

Jen, like Ashna, found the first session's group work rewarding. However, she worked alone in other sessions and was unable to collaborate which she would have enjoyed doing. Jen “felt as though the group could have worked well together” (EJ1, line 4: LXXXVI). She “wasn't able to really collaborate in the second session specifically because some group members did not return for a variety of reasons” (EJ1, lines 16 – 18: LXXXVI). However, she did manage to network with Hailey and found the professional development environment to be positive and conducive to her learning although she:

“was disappointed in not having those same group members there to engage in the community learning workshop...There was no one to collaborate with” (EJ2, lines 40 – 42: XCI).

Linda found working with others to be a “positive and interesting” experience (EL1, line 10: XCIV). She went on to explain:

“whatever the other professionals are doing in the classrooms I had a chance to hear their experiences, how it works, and maybe use their approach to try it in my classroom too” (EL1, lines 21 – 23: LXXV).

She felt that collaborating with other teachers “was most beneficial for me” (EL1, lines 31 – 32: XCV). She continued:

“most of the time we do not have time for collaboration in the schools. We are too busy. The best collaboration was in designing the activities. It was sharing of ideas and designing of activities. We all bring our ideas together and we put them together and make the best of it” (EL1, lines 32 – 35: XCV).

Linda was happy she had an opportunity to share resources, ideas and experiences by interacting with other teachers present. She felt comfortable among them so much so that she was unafraid to admit to her difficulties in teaching her students. She found everyone present only too willing to offer suggestions to her.

In continuing to narrate her experience, she said that she was:

“very comfortable during the workshop: I did not have any fear of stating my experience or opinion. We were all very positive. We never judge each other. So we felt safe that way” (EL1, lines 92 – 94: XCVII).

SS2: How has your experience helped you to teach the English language learners? (SS: lines 13 – 14 XCVIII)

Linda felt that:

“We none of us have a lot of experience in teaching the ELL’s and so just to talk and exchange ideas was good. It is good to hear from other professionals what their experiences are in the classroom” (EL2, lines 15 – 18: XCVIII).

### **Emotional experiences**

Science teachers’ experiences ranged from feelings of comfort, relief, happiness, satisfaction, and excitement to discomfort, disappointment, frustration, scepticism, and dissatisfaction. It is significant that Linda reported that she had only positive emotional experiences while the other four reported mixed emotions. These feelings resulted from their cognitive development, social interactions, and relevance of their learning to their professional needs. Ashna felt “very comfortable expressing” her “struggles” in teaching the ELL students with the other teachers present in the sessions (EA1, lines 102 – 103: LIII). Although she enjoyed the sessions, she was somewhat disappointed in some aspects. Her disappointment and frustration were evident as she said:

“a lot of the techniques that have been discussed in the workshop: They’re good if the students have a baseline understanding in English...some of those techniques are even difficult for those students. So what I need is more techniques at a lower level” (EA1, lines 15 – 20: L).

Although she was disappointed she still “got great tips for maybe ESL levels” (EA1, lines 22 – 23: L). She also enjoyed the last session of the professional development programme

because her experience “was the most useful of the three session...had a chance to actually see a lesson put into practice” (EA2, lines 1 – 3: LV). In describing her experience here she repeated three times “I enjoyed that” (EA2, line 3: LV). As Ashna further described her experience of the last session she expressed disappointment that she did not “feel like it was true collaboration” (EA2, line15: LV).

Yet she “really enjoyed...talking about making embedding critical thinking into the assignment” (EA2, lines 33 – 34: LVI). Ashna would not say she was “completely disappointed” (EA2, line 49: LVI) that other members of her group were not there because “there were aspects of the CLC that were beneficial” (EA2, line 50: LVI). She was disappointed with her presentation which was “very fragmented because half of her group wasn’t even there” (EA2, lines 82 – 83: LVII) and regretted that they “didn’t even work together” (EA2, line 83: LVII).

Felix had feelings of discomfort and uncertainty when he started the professional development programme followed by satisfaction later on. He was uncomfortable that he missed the second session since he was not able to participate in that planning session. Yet he found it easy and liked to work with Hailey. He summarised his experiences as “I was satisfied (EF2, line 91: LXXII), but “I felt uncomfortable at some points especially because I was not able to contribute in a meaningful way” (EF2, lines 4 – 6: LXIX). He was able to use ideas presented in a manner that served his students’ needs. Felix described his experience as “pretty good given the stuff I have written down” (EF2, lines 18 – 19: LXIX). It appears as though Felix was satisfied with his experience since if he did not find it good enough he “would not be writing anything down” (EF2, lines 22 – 23: LXIX).

Hailey “really liked.... that we do have the time to just talk about things and to see what the IL has tried in her classes and what other people have tried” (EH1, lines 1 – 2: LXXIII). However, she experienced a certain degree of frustration and disappointment because her group members did not collaborate. She felt that:

“I am not here to put all my stuff out. I was hoping to work on stuff with people and come up with something that I would not have come up with on my own” (EH1, lines 7 – 9: LXXIII).

She did have a positive experience when teachers were pleased with her demonstration lesson. She expressed her satisfaction when she said “I was really happy that it went as well as it did” (EH2, lines 15 – 16: LXXVII). As lead teacher in her module, she had hosted other teachers who observed her conducting a lesson. Her experience of the third session was a “much more positive experience...because that was like the collaboration and sharing of ideas” with all teachers in her group (EH2, lines 45 – 46: LXXVIII). The artefacts and ideas which she obtained in these sessions were useful in her classroom. She really appreciated “resources and ideas and things” that the IL gave to them (EH1, line 38: LXXIV). She expressed satisfaction when she said “This is good” (EH1, line 42: LXXIV).

Jen was comfortable working with other teachers despite her disappointment of not collaborating with those in her group during sessions. She expressed regret that “it would have been beneficial” (EJ1, line 33: LXXXVII) if they could continue. Jen felt frustrated because she and her group could have worked together but did not. Despite her frustrations, Jen found the work environment safe and comfortable. She felt “safe sharing” her “points” (EJ1 line 68: LXXXVIII). She continued:

“I had to do some things on my own I didn’t feel discomfort but some disappointment because it would have been nice to have input from other people in the group” (EJ1, lines 76 – 78: LXXXVIII).

However, Jen conceded that her experiences of activities in which she engaged were positive:

“I think it was a positive environment. People were attentive and willing to accept others’ ideas and worked with each other so that I think we were really on task and we had a focus which was great” (EJ2, lines 25 – 27: XC).

She felt:

“pleased with the experience. It was a useful workshop in which I picked up a set of activities. However, I would have liked to connect with a group to collaborate” (EJ2, lines 84 – 86: XCII).

SS: “Describe how you felt as a result of your experiences” (SS2, line 76: XCII).

Jen felt that it was “an exciting experience. Getting to know new people and their common goals, and understanding more about the ELL students was good...I felt engaged” (EJ2, lines 92 – 94: XCIII).

Linda had a positive experience as she interacted with other teachers and she described her experience enthusiastically as:

“I feel so far it is very, very, as I said at the beginning, positive. I am very happy because in the workshop I have seen some very senior teachers like myself and I have seen some very young teachers much newer to the profession than myself” (EL1, lines 86 – 89: XCVI)

As she explained:

“I felt very safe to talk about my difficulties because the Instructional Leader is a very warm person and she makes you feel very comfortable during the workshop: I did not have any fear of stating my experience or opinion. We were all very positive. We never judge each other. So we felt safe that way” (EL1, lines 90 – 94: XCVI – XCVII).

On the whole she saw her experience as a means of removing her anxiety and she was comfortable. Linda was happy that she attended the professional development programme. Her enthusiasm was evident as she said:

“I am not afraid to air my weaknesses so that I could get help from them and be a much better teacher. We are a very nice group: I am very happy” (EL1, lines 97– 99: XCVII).

Linda found the pedagogical skills she learned in the sessions very useful and relevant to her needs to help not only her ELL students but her applied students as well. She felt that her experience helped her to overcome her feeling of doubts and “dissatisfaction I had since I was saying “am I doing enough? Is there anything else I should be doing?” (EL2, lines 59 – 61: C).

SS: “Can you tell me one thing that you can say you will be taking with you as you leave the programme?” (SS2, lines 57 – 58: C).

Linda replied that she felt “it took away the anxiety and gave me comfort” (EL2, lines 61 – 62: C).

### **Changes in beliefs and classroom practice**

2 of the 5 teachers, who participated in this module, experienced changes in their beliefs of themselves while 4 of them changed their classroom practice. Hailey and Linda experienced changes in their sense of self or beliefs of themselves, while all of them except Jen

experienced some change in their classroom practice. Ashna and Hailey appeared to have made greater strides in changing their classroom practice and saw some degree of success. While Felix made some changes, he was unable to say how successful he was in doing so. Jen and Linda have made very few changes despite Linda's reported overall positive experiences.

Ashna tried some activities from the professional development programme in her classroom and she thought that she was successful in using them with her ELL students. She introduced some activities to her colleagues in her department. She felt that she extended her repertoire of techniques so that she could try different ways of explaining concepts to her students. In this way she felt better prepared to teach her students and was "diversifying" her "repertoire of teaching skills" (EA1, lines 85 – 86: LII). In the second interview, Ashna said that she "found that a lot of what I learned I could take to other teachers and to my classroom" (EA2, lines 24 – 25: LV). She elaborated that when:

"I went back to class I tried both the linking review game and the quiz, quiz, trade game. And we also talked about lab reports and making them less formal. So I did a chemical vs physical change lab with my grade 10's and in order to get them into lab reports and not feel overwhelmed, I told them they could just explain each section in words" (EA2, lines 110 – 114: LVIII).

SS2: "In what ways were your experiences of the two previous sessions beneficial to you?" (SS2, lines 88 – 89: LVII)

Ashna's response:

"I would say to some extent it increased my confidence to teach ELL students. I don't know if I'll ever be 100% confident teaching these students but yes it did help: I feel better prepared" (EA2, lines 99 – 101: LVIII).

While Felix did not change his beliefs or his role as a teacher significantly, he changed his practice. Felix reported that:

"When I went back to my classroom I made some decisions about some of the things like classroom arrangement on grouping and on a little bit on delivery. For example we started on the use of the dictionary, they are visual ones. These are the ideas I implemented in my classroom" (EF1, lines 28 – 32: LXVII – LXVIII).

SS2: "Which strategies from the sessions worked well in your classroom?" (SS2, lines 24 – 25: LXIX)

Felix:

“I don’t know if they worked well but I definitely have tried ideas out such as using roots of words to help in building vocabulary on the side board. The students were all involved in the activity as we worked through how to figure out and use roots of words to find meanings” (EF2, lines 26 – 30 : LXIX - LXX).

Felix was unable to say how successful he was in implementing changes. He felt that it was too early to tell. He reported that “I can’t generalise and say that all of them were enthusiastic or excited about it” (EF2, lines 38 – 39: LXX). However, he felt that “based on the overall student performance on that assignment, I think it was successful” (EF2, lines 40 – 41: LXX).

While he might not change his role as a science teacher, Felix would adjust his approach to teaching science. Maybe in time, he would see himself as an ELL science teacher, but not at the moment. Nevertheless, Felix felt that his experience of the professional development programme provided him “with a little bit of knowledge and tools to help me along the way. So it would help me change some of my values. Yes it would” (EF1, lines 36 – 37: LXVIII).

Felix went further to say:

“I think it might have the potential to make me implement some of these techniques on a permanent basis. In terms of my role as a teacher, it wouldn’t change that much. I guess there is the possibility that I can see myself as an ELL teacher but at this point in time I don’t see it” (EF1, lines 48 – 52: LXVIII).

Hailey used ideas from the earlier sessions and it resulted in some small change in her students’ performance. In her narrative she said:

“I ended up using that. We did a field trip to the science centre to see the great white sharks and so for my English language learner students, their assignment was to just do that four sentence story about what they learned in the movie” (EH1, lines 26 – 29: LXXIII).

She planned to apply some of these ideas later on in other classes. Hailey felt that her experience has led to a change in her beliefs about teaching science. She thought that in becoming a better teacher she would change her view of herself. She has since tried to figure out students’ needs in her quest to become a better teacher.

SS: “How has your overall experience of these three sessions changed your classroom practice?” (SS2, lines 125 – 126: LXXXI).

Hailey replied:

“I think it is changing what I am doing in the classroom. But because I am still in the middle of it I don’t really know how it has changed. Yes. I think it is changing but at this point in time I don’t know how it is changing” (EH2, lines 127 – 130: LXXXI).

She went on to say “I am still in the middle of it, trying out new things, I can see it changing me ... because I am still trying out new things. (EH2, lines 143 – 144: LXXXI). Hailey explained that “I think in becoming a better teacher I will change my view of who I am. I can see it changing me” (EH1, lines 117 – 118: LXXVI).

Jen found her experience meaningful. As she reflected on her experiences she said “It was meaningful because I could take it in different subject areas” (EJ1, lines 41 – 42: LXXXVII). Although, she developed confidence to teach science, she did not think that she would ever identify as an ELL science teacher.

However, in terms of her confidence to teach ELL students, Jen was:

“more confident. I don’t know I would describe myself as an ELL science teacher. I would definitely need more training in that area first. I can say I have some experience teaching the ELL students science. I don’t think I will ever identify as an ELL science teacher” (EJ2, lines 70 – 73: XCII).

She concluded “My experience of teaching the ELL’s together with the workshop gives me the confidence to say I am now able to teach the ELL science” (EJ2, lines 74 – 75: XCII).

Linda has used ideas she obtained from the sessions in her class and she felt good to see her students understanding her instructions much better than before. In addition, she was able to share some of her ideas with her colleagues at her school. She felt that her learning during sessions have helped her to gain confidence to teach ELL students so much so that she sees herself as an ELL science teacher. She said:

“Now I see myself as an ESL teacher also although I do not have ESL qualification. But through this professional development workshop, I see myself as an ESL teacher too. I have learnt a lot and I think that I am more confident

about teaching ESL science in my classroom...I see myself doing a much better job” (EL1, lines 51 – 57: XCV).

She was also more confident to share her new knowledge with her colleagues at her school although she had used some of these ideas in a limited way.

SS2: “How has your overall experience changed your classroom practice?” (SS2, lines 31 – 32: XCIX).

To which she replied:

“I will not say it would be a big change. It is a limited time and we were given a lot of things and I did not have a good grasp of some of the ideas. But I still believe it is good to update ourselves from time to time so that we are not doing the same thing over and over” (EL2, lines 33 – 36: XCIX).

She explained further that “I believe I have changed to some extent” (EL2, lines 47 – 48: XCIX).

### **Comparison of science teachers' experiences in module 2 based on my interpretation of their narratives**

A comparison of science teachers' experiences in module 2 can be found in Table 4.3b: 179. All science teachers, who participated in module two, reported positive experiences in cognitive development in which they gained knowledge in pedagogy, and obtained artefacts. Ashna felt that she had extended her repertoire of techniques so that she could try different ways of explaining concepts to her students. In this way she felt better prepared to teach her students. Both Ashna and Linda wished they could have had more experiences in terms of pedagogical techniques.

Only Linda had positive experiences of social interactions. Ashna either worked alone or within a group in which each group member worked independently. She networked with Hailey. However, she and other teachers in the module shared ideas during presentations. Felix, who had missed group planning activity in session two, felt he had nothing to contribute to group work for the rest of the professional development programme and so his involvement in social interaction was not as positive as he would have liked it to be. However, he did participate in discussions following presentations, and he presented his lesson.

Hailey experienced 'negative collaboration' in that her group members relied on her to do all the work and post the outcomes for them. However, she networked with Ashna, Jen, and Linda as well as shared ideas and participated in discussions during presentations with the other teachers. She collaborated and shared ideas with all teachers but not with members of her group in the third session. Jen, like Hailey and Ashna, started out the first session doing group work. However, because her group members were not there for the second session, she worked alone and was unable to collaborate. She networked with Hailey. Linda found everyone present quite willing to offer suggestions to her. She liked exchanging ideas with other teachers in the module.

**Table 4.3b: Comparison of Science Teachers' Experiences in Module 2 – English Language Learners**

Names	Cognitive Development		Social Interactions		Emotional Changes		Changes in Beliefs and Classroom Practice			
	Positive	Negative	Positive	Negative	Positive	Negative	Beliefs		Classroom Practice	
							Yes	No	Yes	No
Ashna	✓	-	✓	✓	✓	✓	-	✓	✓	-
Felix	✓	-	✓	✓	✓	✓	-	✓	✓	-
Hailey	✓	-	✓	✓	✓	✓	✓	-	✓	-
Jen	✓	-	✓	✓	✓	✓	-	✓	-	-
Linda	✓	-	✓	-	✓	-	✓	-	✓	-
<b>Total Experiences /categories</b>	5	0	5	4	5	4	2	3	4	0

✓ - Indicates yes

- - Indicates no

Ashna, Jen, and Linda felt comfortable discussing their struggles in teaching ELL students with other teachers who participated in the module. Ashna was disappointed with her own presentation but she liked the learning strategies she picked up during her participation. Ashna, Hailey, and Jen felt frustrated and disappointed about their experiences in interacting socially with their group members. Felix liked to work with Hailey and he was satisfied with his experience of the sessions. Despite her feelings regarding group activities, Hailey appreciated the positive feedback she received at the end of the module after she had demonstrated a lesson with her students. Jen regretted she did not work in groups for all the sessions. She was also disappointed because she was away for the day on which presentations were held. On the whole, she was excited to be there. Linda felt comfortable to interact with other teachers in the module. She liked the idea of exchanging ideas with others and experienced a sense of ease since she felt her anxiety in teaching ELL students was alleviated because of her experience. All of these teachers enjoyed observing their peers conducting a lesson which they thought was enlightening.

Except Jen, the others felt that their experiences enabled them to apply activities from the module in their classrooms with varying degrees of success. While Jen can see herself using some of those ideas in later classes, she could not use them in her current classes because she had a new timetable that did not include teaching science. Jen saw that some of those strategies were transferrable to any other class. Ashna, Hailey and Linda found more success based on their observations of their students' performance than Felix, who thought it was too early to judge how successful his lessons were based on his students' performance. Science teachers have reportedly shared or intended to share their newly acquired skills with their colleagues. Science teachers felt differently about their beliefs as science teachers. While Felix might not change his role as a science teacher, perhaps in time, he would see himself as an ELL science teacher. Hailey and Linda, on the other hand, reported that they have changed their beliefs of themselves as science teachers. They saw themselves as ELL teachers. Jen, however, doubted that she would ever see herself as an ELL science teacher.

Findings from this module were similar to those in module 1 in terms of mixed experiences for social interactions and emotional changes. However, here all of the science teachers experienced cognitive development, and while no one in module 1 changed their beliefs, 2 of them in module 2 changed their beliefs and 4 changed their practice.

## **Science teachers' professional identities and their experiences in module 2**

Findings from module two appear to be similar to those in module one. As in module one, most of the science teachers' experiences aligned with the dimensions of experiences. In module two, all science teachers experienced cognitive development and whereas one teacher reported positive experiences in social interaction and emotional experiences, others reported mixed experiences. 4 of the 5 science teachers reported that their experiences led them to change some aspects of their practice. Unlike module 1, 2 science teachers in this module reported that their experiences resulted in a change in their beliefs of their professional selves where they saw themselves as science teachers who can teach ELL students. As such, the science teachers' professional identities were influenced to some extent by their experiences of their professional development programme which might have contributed to reshape their professional identities in some cases.

### **Module 3: Motivating the unmotivated grade 10 students**

#### **Cognitive development**

The 4 science teachers in this module reported that their experiences in cognitive development were pedagogical. Unlike those science teachers in modules 1 and 2, however, the teachers in module 3 also learned how to use technology in the classroom. All of the science teachers in this module have reported experiences which enhanced both their pedagogical and technological skills. Of significance was that only Jean reported learning about the curriculum whereby she also acquired skills in interpreting it.

Jean found her experiences rewarding in terms of the pedagogical ideas she picked up. She narrated her experience of the use of technology in the classroom saying:

“I found most of the technology that was presented was things that I have not heard of. Whereas I find sometimes with some of the cooperative learning techniques or other sort of more traditional techniques a lot of the time you sort of hear similar things in a lot of different ways. This was all brand new things. So I came away very energised” (MJ1, lines 4 – 6: LXXXIII).

Jean found her experience of the demonstration classroom session rewarding in terms of learning new pedagogical skills. As she said “I found that the second demo portion was done well. They were interesting... I see that it may fit into my teaching for next year” (MJ1, lines 23 – 27: LXXXIII).

Maya managed to develop her technology skills. She was a co-presenter in this module of the professional development programme. Maya saw the division of labour between her and her co-presenter as a way of enhancing her learning. As she said:

“...there were some things in which she used a different system and she would show me the system so that expands my horizons, and there are some things that I truly do not know how to use so she is helping me to learn how to use them. And she gives me a certain amount of expertise, not expertise but beginning learning” (MM1, lines 47 – 51: CXV).

Maya felt that her experience afforded her the opportunity to develop and hone her skills of using technology in the classroom as she participated in this professional development programme. She explained that:

“I would say that I know that that sounds like a small another thing, but to learn Google Docs and to learn how to use prezzi, were real steps for me” (MM1, lines 40 – 43: CXV).

She felt that she was “leaving with more knowledge and confidence in applying technology in the classroom” (MM2, lines 154 – 155: CXXII).

Sam was more interested in learning about technology and hands on activities in the professional development programme rather than experiencing a refresher course in pedagogy. She described her experience as “...mostly pedagogical not so much subject knowledge but the idea of being able to use the technology in the classroom” (MS1, lines 29 – 31: CXXX). She felt that the professional development programme “might work for me” (MS1, line 26: CXXIX).

Citing some activities that she liked, she said:

“I liked the naming of the human parts activity, then following up with a lesson and then take it up to see what knowledge was learned. I liked that activity. And then I also liked, but I don’t know if I would use the twitter in my classroom. Apart from the technology I felt that it didn’t necessarily add to my learning because we can do the same sort of things in other ways without having the twitter...The other part is where I can be in touch with other teachers and access ideas from twitter that would be useful” (MS1, lines 31 – 38: CXXX).

She was also interested in seeing “how a biology person would do a physics lesson” (MS2, line 48 – 49: CXXXIII) because “that would have shown me how I could handle the biology too” (MS1, line 50: CXXXIII). She did not have that experience. But, she “got to see different ways of teaching the same lesson” (MS2, lines 3 - 4: CXXXII).

SS2: “What can you take from the whole professional development programme?” (SS2, lines 88 – 89: CXXXV).

Sam: “I have learned to go on twitter” (MS2, line 90: CXXXV). “This is a rich and rewarding experience” (MS2, lines 100 – 101: CXXXV).

Steve “picked up some new ideas and some reminders of things to try” (MST1, line 1: CXXXVI). He felt that his experience of the use of technology in the classroom and especially twitter resulted in “engaging in it and trying to keep up with it” (MST1, Line 33: CXXXVI). Steve speculated that maybe “I can get more about pedagogy and technology”

(MST1, lines 33 – 34: CXXXVI). He found the technology part “really cool” and he “wished there were more” (MST2, lines 56 – 57: CXL).

### **Social Interactions**

All science teachers in this module reported experiences in which they benefited to some extent from interacting socially during their professional development programme. However, as in module 2, there was some degree of conflict, which, in this case, was between Maya and Steve. This conflict impacted their experiences since both of them acknowledged the tension between them. Jean and Sam reported experiences of positive social interaction during their participation in the professional development programme. Maya and Steve, on the other hand, had positive social interaction experiences with other science teachers, but unease between them contributed to some negative experiences.

Jean regretted that her group had so little time in which to do their planning. She liked to help other group members and listen to them as they related their experiences. However, she felt that she experienced collaboration but not much sharing of ideas. Jean found herself very early in the professional development programme helping others with the activities dealing with technology. She felt that the experience of sharing of ideas and classroom experiences took away the isolation she felt at her own school. “I felt like I could have spent all of my time helping people out” (MJ1, line 48: LXXXIV) declared Jean. When asked to what extent she and the other teachers shared their ideas, she replied:

“There wasn’t really a lot of sharing of ideas...The sharing came from the lead teachers not among us the other participants. They were providing the examples and opportunities. There was a degree of sharing in which people were talking about the technology” (MJ1, lines 104 – 108: LXXXVI).

However, as she said earlier:

“I really enjoyed working with the other teachers from the other schools. It was nice to share experiences. It took away some of the isolation I feel at my school” (MJ1, lines 98 – 100: LXXXVI).

As Maya conducted the sessions with her co-presenter, they exchanged ideas, consulted and collaborated which she felt expanded her horizons especially in technology. As she put it:

“Just having this other person, just having this other bright, motivated person who like me just want to share ideas with other people, I just think that the

melding of ideas was very good. I think that hopefully I push her and she pushes me” (MM1, lines 58 – 61: CXV).

She continued saying that:

“...there were some things in which she used a different system and she would show me the system so that expands my horizons, and there are some things that I truly do not know how to use so she is helping me to learn how to use them. And she gives me a certain amount of expertise” (MM1, lines 47 – 51, CXV).

In terms of her experiences of interacting with other science teachers, Maya related that she shared files and ideas with participating teachers. She described her experience of collaboration, discussion, and sharing as:

“I was happy that everybody brought something even for the moderated marking or the idea sharing activity. For me I found that this day was very powerful for me. I thought that there was a lot of good internal conversation. With sharing the pieces it wasn’t just here is how to do it, here is how it works. There were a lot of discussions...” (MM2, lines 50 – 54: CXVIII).

For Maya it was not plain sailing throughout the sessions as Steve was frustrated with his progress which resulted in a clash of opinions. As she explained:

“Steve was very frustrated about the situation and so it just became a complaining session about why he couldn’t do this, that or the other. I felt like we didn’t make any progress at all” (MM2, lines 15 – 17: CXVII).

In concluding the interview she described her interaction with the other lead teacher: “For me a lot of social learning was going on” (MM2, line 148: CXXI).

Sam described her experiences as opportunities “to meet with other people, like-minded people and I learn from their experiences” (MS1, lines 4 – 5: CX). In the process she shared knowledge with them. She found observing a class in session to be very rewarding in that she had an opportunity to see others teaching since “I could figure out what I can do in my own class with my own group of students” and identify “what would not be suitable for my class” (MS2, lines 1 – 3: CXXXII).

Sam also found sharing of artefacts to be a great experience. She thought “This is a good way of helping each other. Instead of reinventing the wheel and do something that is already done, we can share our ideas, modify it and use it in our classrooms” (MS1, lines 18 – 21: CXXIX).

She felt that “talking to other teachers and seeing what they were doing gave me so many ideas” (MS2, lines 25 – 26: CXXXII).

Earlier she said: “I did not feel I couldn’t share my experience” (MS1, lines 38 – 39: CXXX).

She described her experience of the last session as:

“...a good experience and when we debriefed we got a chance to discuss what we saw with other people and there was more input from the others about their own observations. So it was good to talk about the different things. The last session was good because of sharing of resources and also some activities which were already tried in their own classes. I had a chance to share what I had done too” (MS2, lines 4 – 10: CXXXII).

For this reason, she liked the idea of networking. She observed:

“We were given a chance to network, see what other teachers were doing, and by talking to them, I know that I can tap onto them when I have problems in, or am looking for ideas in technology, demonstrations or whatever” (MS2, lines 44 – 47: CXXXIII).

She found “Meeting people and discussing things help me to see all of that and to learn how to deal with my own classroom issues” (MS2, lines 98 – 100: CXXXV).

Steve was concerned that he “was a group of one” which “made it truly challenging because I don’t know how I am going to complete the collaborative ideas and moderated marking if I have no one to work with” (MST1, lines 8 – 11: CXXXVI). However, Steve “enjoyed talking with colleagues about their projects” (MST2, lines 3 – 4: CXXXVIII) but his “interaction with Maya was a bit challenging” (MST2, lines 6 – 7: CXXXVIII). He thought “there was some tension between her and I” (MST2, line 9: CXXXVIII) but he enjoyed “talking to the IL” (MST2, lines 11 – 12: CXXXVIII). He also shared ideas on how to go about introducing technology in the classroom with the other teachers during his presentation of an activity on using quizlet. Despite his situation of being without a group, he connected with Sam. “We have exchanged e-mail addresses. She wants to try some of the technology and we can exchange ideas. I would do whatever I can to help her out” (MST2, lines 81 – 83: CXL).

## **Emotional Experiences**

Positive and negative emotional experiences reported by the science teachers reflected the extent of their learning and their social interactions. They all experienced both positive and negative emotions although to differing degrees. For Sam, negative emotions were due to disappointment of not being able to observe a much needed demonstration, whereas negative emotions for Steve was due mainly to his not working within a group and his conflict with Maya. Maya, on the other hand, experienced negative emotions because of frustrations dealing with Steve and her unsuccessful demonstrations on the last day. Jean's negative emotions were due to lack of sharing among her peers.

In describing her experience, Jean said "I came away very energised. So I was excited about trying some of those things in my own classroom" (MJ1, lines 6 – 7: LXXXIII). However, she felt sad because the others did not respond to her sharing of ideas on Google Docs. In terms of social interactions she "was a little bit sad that not very many people responded" when online feedback from other teachers did not materialise (MJ1, line 17: LXXXIII). She expressed regret as she described her experience saying "I wish there had been more time on the second day devoted to that working together instead of the time that we had" (MJ1, lines 45 – 47: LXXXIV).

Despite her regrets, Jean "really loved the fact that the CLC has follow up" (MJ1, line 52: LXXXIV). She reiterated this feeling when she said "I really like the first day and the follow up on the second day. So I got more out of that" (MJ1, lines 60 – 61: LXXXIV). She went on to say that she "really enjoyed working with the other teachers from the other schools. It was nice to share experiences" (MJ1, lines 98 – 99: LXXXVI). She ended the interview by saying "the feeling was energised. At the end of the day, I felt energised" (MJ1, line 109: LXXXVI), and "I did like the opening activity and the idea of getting the students engaged and moving around" (MJ1, lines 110 – 111: LXXXVI) and "so the music and moving around is energising for them. I did like that activity and I would use it in my classroom" (MJ1, lines 112 – 113: LXXXVI).

In describing her experience of working with the other lead teacher, Maya said that "on the first planning day it was very exciting to work with the other lead teacher" (MM1, lines 1 – 2: CXIV). She described her experience of observing the other lead teacher's classroom by

saying “I really liked” visiting “the other lead teacher’s demonstration classroom” (MM2, lines 2 – 3: CXVII). However, her experience of the other aspects of the sessions was not so pleasant for her. At one point she said “I was really a bit disgruntled” (MM2, line 13: CXVII) about some unsuccessful demonstrations and activities. As a result she was frustrated and overwhelmed and felt as though she did not make any progress in her presentation. She experienced further frustration working with Steve because he kept:

“complaining...about why he couldn’t do this, that or the other. I felt like we didn’t make any progress at all. I think the other groups may have done a little better but I left feeling a little frustrated and I felt I wasn’t sure what day 3 was supposed to be” (MM2, lines 16 – 19: CXVII).

Sam had a “good experience” when she “got to see different ways of teaching the same lesson” (MS2, lines 3 – 4: CXXXII). Sam’s experiences were positive. She enjoyed activities and discussions despite her disappointment that she “did not get as much as I expected from this part of the programme” (MS2, line 24: CXXXII). She encountered disappointment as she:

“was looking to see how a biology person would do a physics lesson. I was expecting to do that because that would have shown me how I could handle the biology too” (MS2, lines 48 – 50: CXXXIII).

However, she did “like the idea of the whole workshop: Like the three parts in which we had an exploration classroom to see a lesson being taught” (MS2, lines 36 – 37: CXXXIII). Sam was happy that she had an opportunity to network and share ideas with Steve.

Steve described his experiences as comprising mixed emotions. Despite his situation in terms of working in groups and disagreements with Maya, Steve had some positive experiences. He “certainly enjoyed talking with colleagues about their projects” (MST2, lines 3 – 4: CXXXVII) and also “talking with the IL” (MST2, line 6: CXXXVII). Steve confided that he was “a bit annoyed” (MST2, line 17: CXXXVII) at the end of the day because “my interaction with Maya was a bit challenging” (MST2, lines 6 – 7: CXXXVII).

### **Changes in beliefs and classroom practice**

Science teachers in this module have experienced some form of change in their classroom practice as a result of their experiences during their participation in this module. However, 3 out of 4 of them felt that they would not change their beliefs of themselves as science teachers while Steve did not comment on his experience in this area. Maya, however, felt that she

could see herself as a more informed technological lead teachers not as a science teacher of grade 10 students. The experiences of changes in their beliefs of themselves as science teachers in module 3 are aligned with those of teachers in module 1.

Jean applied some of the ideas in her classroom and found “it was very successful” (MJ1, lines 14 – 15: LXXXIII). Although her experience of change helped her to improve some aspects of her practice so that she felt better she “wouldn’t say it would change me or how I would identify myself as a science teacher” (MJ1, lines 82 – 83: LXXXV). While her experience may not change how she felt about herself as a teacher, she felt that her experience would certainly improve her classroom practice so that she “can continue to be the teacher I want to be” (MJ1, lines 103 - 104: LXXXVI).

Maya felt that her experience has expanded her repertoire of artefacts to engage her students. She was able to use them more intentionally and has honed her technological skills as well. She stressed her technological development when she said “I hope that at the end of this session I can see myself as a little more technological veteran” (MM1, lines 74 - 75: CXVI). She reiterated that “I am leaving with more knowledge and confidence in applying technology in the classroom” (MM 2, lines 154 – 155: CXXII).

Maya said that “I am more knowledgeable about hands on classroom demonstration in science” (MM2, lines 151 – 152: CXXII).

She describes herself as:

“I think that me being a teacher, a learner, sharer were already there. But this experience has given me an easy way of being all of that. I think it made me a more confident lead teacher rather than a more confident teacher since that was there already” (MM2, lines 120 – 123: CXX).

Sam felt “there was a lot of ideas at the workshop that made me say oh OK this is something I can work with. This might work for me” (MS1, lines 24 – 26: CXXIX).

She felt that her experience influenced her practice because “I implement them in my classroom and then I see how the students are reacting to that” (MS1, lines 47 – 48: CXXX). She reflected on and adjusted her practices until she was happy with them. Sam was very aware of her role as a teacher and did not think she should rethink her role. However, as she thought

about whether her experience of participating in this professional development programme could change her classroom practice, she said:

“It wouldn’t change my role. It might make it better I guess. I think which one works for me I will take it. I can add some more tools to my teaching. It would not make me do anything radical but even though I like to keep up and read about new ideas, I don’t expect any radical changes” (MS1, lines 53 – 59: CXXX).

Steve felt that his experience of “attending this course helps me see that to be an agent of change, I need to figure out how to get applied kids to want to learn science” (MST1, lines 36 – 37: CXXXVII). He managed to apply some of his ideas in his classroom: “There are a few things that I have tried. I’ve done the Socratic model. I’ve done the notebook software” (MST1, lines 38 – 39: CXXXVII).

### **Comparison of science teachers' experiences in module 3 based on my interpretation of their narratives**

I present a comparison of science teachers' experiences in this module in Table 4.3c: 192. All science teachers in this module reported that their experiences resulted in enhanced cognitive development in pedagogical skills, technology, and to some extent, the curriculum. While Jean learnt about different pedagogies, use of technology, and parts of the curriculum, Maya, on the other hand, developed new confidence and enhanced her technological skills from her co-presenter. Both Sam's and Steve's experiences led to enhanced skills in pedagogy and technology in the classroom. Although all of them reported that their experiences resulted in enhanced technological skills more than their pedagogical skills, Maya appeared to have benefited the most in enhancing her technological skills.

Most science teachers in this module appeared to experience some form of positive social interaction although there was some degree of tension between Maya and Steve. Jean felt that sharing of ideas and experiences took away the isolation she felt at her own school. Maya, who enjoyed working together and sharing resources and ideas with her co-presenter, interacted well with most teachers. Despite tension between her and Steve, she found working together with other teachers as they engaged in problem-solving, discussions, and sharing of ideas, to be rewarding. Sam learnt from other teachers. She shared ideas and experiences with them as she engaged in discussions with them and observed a lesson in action. She also networked with Steve. Steve, on the other hand, did not appear to have many positive experiences in his social interactions. Apart from networking with Sam, he worked by himself because no one else was teaching at his grade level. Apart from group work, Steve experienced a degree of collaboration and sharing of ideas with other participating teachers.

Cognitive development and social interactions resulted in positive as well as negative emotional experiences among science teachers in this module. Jean left the first session energised, excited, but sad because others did not respond to her sharing of ideas on Google Docs. However, she enjoyed the afternoon sessions as they engaged in planning activities. Jean was impressed by the results she observed in her classroom. Maya, who thought her co-presenter's lesson was very pleasing, was somewhat disappointed that her own activities on the last day did not go as well as she hoped it would. As a result she was disgruntled and overwhelmed, frustrated and unproductive. However, on the whole, she was pleased.

**Table 4.3c: Comparison of Science Teachers' Experiences in Module 3 – Motivating the Unmotivated**

Names	Cognitive Development		Social Interactions		Emotional changes		Changes in Beliefs and Classroom Practice			
	Positive	Negative	Positive	Negative	Positive	Negative	Beliefs		Classroom Practice	
							Yes	No	Yes	No
<b>Jean</b>	✓	-	✓	✓	✓	✓	-	✓	✓	-
<b>Maya</b>	✓	-	✓	✓	✓	✓	-	✓	-	✓
<b>Sam</b>	✓	-	✓	-	✓	✓	-	✓	✓	-
<b>Steve</b>	✓	-	✓	✓	✓	✓	Did not comment		✓	-
<b>Total Experiences/Category</b>	4	0	4	3	4	4	0	3	3	1

✓ - Indicates yes

- - Indicates no

Sam was disappointed because she wanted to observe a biology teacher teach a physics lesson since she was a physics teacher who struggled to teach a biology lesson. It appeared that Steve had the most negative emotional experience compared to others who participated in the module. He found some parts frustrating especially because he did not belong to a group but worked alone. Yet, he found observing a lesson in progress good, and enjoyed speaking with the IL and working with Sam. He was frustrated with those aspects of the professional development programme which did not serve his or his students' needs.

While they have reported some form of changes in classroom practice, no science teacher reported changes in their beliefs about themselves as science teachers. Jean tried several ideas with her students and reported mixed results. While her experience may not change how she felt about herself as a teacher, Jean felt that her experience would certainly improve her classroom practice so that she could become the teacher she wanted to be. Jean found that although some of the ideas that she learnt did not relate to her current needs, she would be able to use them in future classes. Similarly, Maya doubted that her experience would change her core beliefs. She felt that she could teach with more awareness and become more technologically able in the classroom. She saw herself as a more confident lead science teacher rather than a more confident science teacher of grade 10 students. Maya could not say whether her experiences were relevant to her classroom needs until she has had time to try them for herself. Like Jean and Maya, Sam felt that her experience would not change her view of herself as a science teacher. However, she felt it would enhance that view. Sam has used some of her new found ideas in her classroom and shared them. While Steve did not comment on changes in his beliefs, he tried some new ideas in technology with his students. He planned to use those ideas in subsequent classes.

In comparing findings from module 3 with those of modules 1 and 2, I found that like module 2 all of the science teachers experienced cognitive development. In terms of social interactions and emotional changes, the experiences of the science teachers in the three modules were similar. However, like module 1, no science teacher in module 3 changed their beliefs. Three of the science teachers in module 3 changed their practice.

### **Science teachers' professional identities and their experiences in module 3**

The science teachers in module three have reported experiences that aligned with their dimensions of experiences. As in module 2, all science teachers in module 3 reported positive experiences in cognitive development. Except Jean who reported positive experiences in social interactions, the other three science teachers reported mixed experiences. However, they all reported mixed experiences in emotional experiences. Of significance here is that all science teachers reported that they changed their practice in one way or another as a result of their experiences in this module. However, apart from Steve who did not comment on whether his experiences led to a change in his beliefs of his professional self, the other three teachers felt that their experiences did not result in a change in their beliefs of their professional selves or about teaching science. As in modules 1 and 2, findings from interviews of science teachers in this module reveal that their experiences of their professional development programmes had some influence on their professional identities.

### **4.3 Findings from questionnaire**

11 out of the 13 science teachers responded to the questionnaire. Their responses reflected the three dimensions of experiences that constitute the definition of professional identity and the theoretical framework underpinning this study. Findings from analysis of the questionnaire are presented as matrices in Appendices E1: CXLII; E2: CXLIII; E3: CXLIV for each dimension of experiences. Table 4.4: 196 represents a synthesis of the science teachers' responses to the questionnaire with respect to questions on the three dimensions of experiences. Science teachers' responses to the questionnaire revealed that 6 of them experienced enhanced subject knowledge (although they did not indicate this in their narratives), and 10 of them reported that they experienced pedagogical knowledge. In terms of social interactions, 9 of them responded that they shared ideas and artefacts while 7 of them felt that they collaborated during learning. While all of the science teachers who responded to the questionnaire felt a sense of pride due to their learning, 8 of them experienced positive feedback during the sessions.

**Table 4.4: Synthesis of Science Teachers' Dimensions of Experiences based on Questionnaire**

Science Teachers	Cognitive Development		Social Interactions		Emotional Changes	
	Subject Knowledge	Pedagogical Knowledge	Sharing	Collaborating	Positive Feedback	Pride
<b>Ashna</b>	-	✓	✓	✓	✓	✓
<b>Darius</b>	-	✓	-	-	-	✓
<b>Felix</b>	✓	✓	✓	✓	-	✓
<b>Hailey</b>	✓	✓	✓	-	✓	✓
<b>Jen</b>	✓	✓	-	-	✓	✓
<b>Maria</b>	✓	✓	✓	✓	✓	✓
<b>Mary</b>	-	✓	✓	✓	✓	✓
<b>Maya</b>	-	✓	✓	✓	✓	✓
<b>Sage</b>	✓	✓	✓	✓	✓	✓
<b>Sam</b>	-	-	✓	✓	✓	✓
<b>Steve</b>	✓	✓	✓	-	--	✓
<b>Total Experiences</b>	<b>6</b>	<b>10</b>	<b>9</b>	<b>7</b>	<b>8</b>	<b>11</b>

✓ - Implies yes  
 - - Implies no

### **Comparison of findings from narrative interviews and questionnaire**

I compared findings from narrative interviews to responses to the questionnaire to triangulate and provide an overview of science teachers' experiences of their professional development programme (Appendices F1: CXLVII, F2: CL, and F3: CLIV). Ashna, Darius, Felix, Hailey, Jen, Mary, Maya, Sage and Steve responded in the questionnaire that they gained pedagogical knowledge as they did in their interviews. However, Sam, who reported that she gained pedagogical knowledge in her interviews, responded in the questionnaire that she did not, whereas, Maria, who reported in her interviews that she did not gain pedagogical knowledge, responded that she did. In response to other questions in the questionnaire relating to cognitive development, the science teachers (9/11) applied their new learning in their classroom practices, developed confidence to try out new ideas in class, and initiated discussions with confidence. However, fewer of them (7/11) reported that their understanding of concepts improved.

While they all interacted with each other socially, some of them appreciated their peers (9/11), networked, learned, and discussed their work (9/13), collaborated with their peers (8/13), or shared ideas (9/11). There was some degree of discrepancy between responses to the questionnaire and their reports in the interviews. Although, they were all confident to apply their new learning, 9/13 of them reported in their interviews that they did so. Similarly, Ashna and Steve responded that they collaborated during the sessions, but in their interviews, Ashna said that she did not collaborate, and Steve insisted that he could not do so because he was in a group of one.

All of the science teachers' responses to questions about emotional changes revealed that they experienced a sense of pride. However, fewer of them (8/11) experienced positive feedback, (9/11) gained recognition from their peers and engaged in self recognition, while (10/11) developed confidence to change, and (8/11) engaged in self-comparison. As in the other two dimensions of experiences, there were discrepancies in responses to the questions about their emotions in the questionnaire. This was more evident in terms of their developing confidence to change either their beliefs or their practice. In their interviews, Darius, Jen, Maria, and Maya reported that they did not have the opportunity to change their practice, whereas Steve, who reported changing his practice, responded that he did not in the questionnaire.

#### **4.4 Synthesis of findings from interviews and questionnaire**

In chapter 3, I described processes by which I analysed inductively, science teachers' narratives of their experiences, interpreted their responses to the questionnaire, and arrived at my findings. The analyses of science teacher's experiences within each module, revealed common patterns of experiences individually, and among them as a whole. Cross module analysis, which compared science teachers' experiences across the three modules, confirmed that the pattern of experiences was consistent across the three modules. However, upon analysis of science teachers' responses to the questionnaire, I noted discrepancies in some of their responses compared to their reports in the interviews. In synthesising my overall findings in this study, I focused more on science teachers' reports of their experiences of the professional development programme in the interviews, than on their responses to the questionnaire. My rationale was that the interviews were conducted soon after they experienced the professional development programme, rather than some time later, as when I administered the questionnaire. With the passage of time, comes distorted memories which could account for the discrepancies.

I summarised my findings of science teachers' overall experiences of their professional development programme in terms of their dimensions of experiences in Table 4.5: 199. I interpreted science teachers' overall experiences as positive experiences (P), negative experiences (N), and a mix of positive and negative experiences (M). In representing overall experiences in Table 4.5 below, I retained my interpretivist perspective while I presented a brief overview of these findings.

Positive experiences indicate:

- Cognitive development (knowledge, pedagogy, curriculum, technology)
- Social interactions (collaboration and sharing ideas) that promote learning and networking
- Emotional changes (satisfaction, happiness, met needs)
- Changes in beliefs and or classroom practice that enhance professional performance.

**Table 4.5: Science Teachers' Overall Experiences of Professional Development Programme based on Interviews and Responses to the Questionnaire**

Science Teachers	Cognitive Development	Social Interaction	Emotional Experiences	Changes in Beliefs and Classroom Practice	
				Beliefs	Practice
Ashna	P	M	M	N	P
Darius	P	M	M	N	N
Felix	P	M	M	N	P
Hailey	P	M	M	P	P
Jean	P	P	M	N	P
Jen	P	M	M	N	N
Linda	P	P	P	P	P
Maria	N	M	N	N	N
Mary	P	M	M	N	P
Maya	P	M	M	N	N
Sage	P	M	M	N	P
Sam	P	P	M	N	P
Steve	P	M	M	No response	P
<b>Total positive experiences</b>	12	3	1	2	9
<b>Total negative experiences</b>	1	0	1	10	4
<b>Total mixed experiences</b>	0	10	11	0	N/A

**P – Positive experiences**

**N – negative experiences**

**M – mixed experiences**

On the other hand, negative experiences indicate:

- No new or relevant learning (no cognitive development)
- Social interactions that are either limited or confrontational (no collaboration or sharing)
- Emotional changes (regret, dissatisfaction, disappointment, and unhappiness)
- No change in beliefs and or classroom practice.

Mixed experiences indicate experiences that are a combination of both positive and negative. Science teachers' experiences were mostly, a combination of both for mixed positive and negative experiences.

12 of the 13 science teachers reported positive experiences in terms of cognitive development while one reported negative experiences and no one reported mixed experiences. While 3 teachers reported positive experiences of social interactions, no one reported solely negative experiences, and 10 of them reported mixed experiences. One teacher experienced only positive emotions, one of them experienced only negative emotions, and 11 of them experienced a mix of both positive and negative experiences. 2 teachers reported changes in beliefs of their professional selves as science teachers and science teaching while 9 of them reported changes in their classroom practice. 10 science teachers reported no change in their beliefs (Steve did not comment), while 4 of them reported no change in classroom practice, not because of their experiences of the professional development programme, but because of professional constraints. Overall, it appears as though most science teachers had positive experiences in cognitive development while most of them had mixed experiences in social interactions and emotional changes. Notably, Linda (ELL) was the only teacher who had positive experiences in all of the dimensions of experiences.

All of the science teachers experienced the dimensions of experiences associated with learning, albeit either positively, negatively or a combination of both. It appears that, on the basis of this finding, the science teachers' professional identities were influenced by their experiences of their professional development programme. However, I found that Hailey and Linda (both from the CAI module), have changed their beliefs of their professional selves as science teachers and science teaching. The other 11 of them, regardless of the module in which they participated, have not indicated that they changed their beliefs of their

professional selves or about science teaching. In this study, such an observation can be treated as an anomaly since it represents a small number of science teachers who experienced a change in their beliefs. Significantly, Linda (CAI) reported positive experiences in all of the dimensions of experiences whereas the other 12 of them reported mixed experiences. Also, 9 of them, including Linda (CAI), changed their practice. As such, I can say that the professional identities of all of the science teachers were influenced to some extent by their experiences of their professional development programme. However, I cannot make such a claim in terms of their professional identities being reshaped by their experiences of their professional development programme.

#### **4.5 Science teachers' professional identity at end of the research: Comparison of science teachers' experiences across modules based on interviews and questionnaire**

In this section, I compare science teachers' experiences across modules for each dimension of experiences. I have presented accounts of science teachers' experiences within their modules in which they participated and in the process, I compared their experiences for each module. As I have stated earlier, coding and categorising revealed that most science teachers, regardless of module in which they participated, reported similar experiences. I synthesised science teachers' experiences based on the themes I identified and their responses to the questionnaire and I arranged them in tables for easy access. These tables are represented as experiences of cognitive development (Appendix G1: CLIX), social interactions (Appendix G2: CLX), emotional changes (Appendix G3: CLXI), and changes in beliefs and practice (Appendix G4: CLXIII)

##### **Science teachers' experiences of cognitive development across the three modules**

Table 4.6a: 203 illustrates comparisons of science teachers' experiences of cognitive development in modules 1, 2, and 3. Except Maria, all other science teachers have undergone some form of cognitive development. Some science teachers have reported experiences that reflect combinations of pedagogical, technological, and/or curricular knowledge. Darius, Mary, and Sage (CAI), Ashna, Felix, Hailey, Jen, and Linda (ELL) secured artefacts to use in their classrooms and gained pedagogical knowledge. Jean, Maya, Sam, and Steve (MU) learnt about use of technology in the classroom as well as gained pedagogical skills. Jean reported that she gained curricular and pedagogical knowledge and obtained artefacts. While she was willing to share her new knowledge on pedagogy with her department, Linda felt that she needed more training in this area. Darius and Steve felt they needed to modify their new pedagogical knowledge or defer using them at the moment. It appears that no teacher experienced enhanced subject knowledge.

**Table 4.6a: Science Teachers' Experiences of Cognitive Development across Modules**

Module	Science Teachers	Experiences of Cognitive Development				
		Pedagogy	Artefacts	Curriculum	Technology	None
<b>1.Culminating Activity for an Inquiry Unit (CAI)</b>	<b>Darius</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>No</b>
	<b>Maria</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>Yes</b>
	<b>Mary</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>No</b>
	<b>Sage</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>No</b>
<b>2.Developing Science Skills for English Language Learners (ELL)</b>	<b>Ashna</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>No</b>
	<b>Felix</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>No</b>
	<b>Hailey</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>No</b>
	<b>Jen</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>No</b>
	<b>Linda</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>No</b>
<b>3.Motivating Unmotivated Grade 10 Students (MU)</b>	<b>Jean</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>No</b>
	<b>Maya</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>No</b>
	<b>Sam</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>No</b>
	<b>Steve</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>No</b>

### **Science Teachers' Experiences of Social Interactions**

As seen in Table 4.6b: 205, although all teachers enjoyed working together, not all of them collaborated in activities. However, most of them (10) shared ideas, experiences and resources which contributed to their learning process. 5 teachers: Mary (CAI), Linda (ELL), and Jean, Maya, and Sam (MU) experienced collaboration to a greater extent than the other 8 teachers who reported that they experienced collaboration to some extent. 6 of them: Ashna, Hailey, Jen, and Linda (ELL) and Sam and Steve (MU) formed networks among themselves within their modules. Darius, Maria, Mary, Sage (CAI), Ashna, Felix, Hailey, Jen, and Linda (ELL), and Jean, Maya, and Sam (MU) shared artefacts, ideas, and experiences. Finally, Maria, Sage, and Mary (CAI) and Maya and Steve (MU) experienced a certain degree of discord among themselves within their respective modules. No teacher reported having no experiences of social interaction.

**Table 4.4b: Science Teachers' Experiences of Social Interactions across Modules**

Module	Science Teachers	Experiences of Social Interactions				
		Collaboration	Group work	Network	Share	Discord
<b>Culminating Activity for an Inquiry Unit (CAI)</b>	<b>Darius</b>	<b>Some</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>No</b>
	<b>Maria</b>	<b>Some</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>
	<b>Mary</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>
	<b>Sage</b>	<b>Some</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>
<b>Developing Science Skills for English Language Learners (ELL)</b>	<b>Ashna</b>	<b>Some</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>
	<b>Felix</b>	<b>Some</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>No</b>
	<b>Hailey</b>	<b>Some</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>
	<b>Jen</b>	<b>Some</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>
	<b>Linda</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>
<b>Motivating Un-motivated Grade 10 Students (MU)</b>	<b>Jean</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>No</b>
	<b>Maya</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>
	<b>Sam</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>
	<b>Steve</b>	<b>Some</b>	<b>No</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>

### **Science teachers' emotional changes**

Experiences of emotional changes that science teachers experienced are displayed in Table 4.6c: 207. Such emotions ranged from excitement, happiness, and appreciation at one end of the emotional spectrum to disappointment, sadness, regret, and frustration at the other end of the spectrum. The varied emotions appear to occur within and across modules and are dependent on interactions among themselves as well as with their learning experiences. 4 of these teachers: Ashna, Jen, Linda (ELL module), and Mary (CAI module) reported experiencing feelings of trust and comfort. With the exception of Maria, other teachers experienced positive emotions such as happiness, pleasure, excitement, and enjoyment. Apart from Linda (ELL module) other science teachers experienced some form of negative emotions ranging from disappointment, frustration, and regret. Teachers within and across the modules felt both positive and negative emotions.

**Table 4.6c: Science Teachers' Experiences of Emotional Changes across Modules**

Module	Science Teachers	Experiences of Emotional Changes	
		Positive Emotions	Negative Emotions
<b>Culminating Activity for an Inquiry Unit (CAI)</b>	<b>Darius</b>	<b>Enjoyment, happiness,</b>	<b>Disappointment, unhappiness</b>
	<b>Maria</b>	<b>No positive emotions</b>	<b>No enjoyment, stress, frustration, disappointment</b>
	<b>Mary</b>	<b>Comfort, trust, happiness, excitement</b>	<b>Concern, disappointment</b>
	<b>Sage</b>	<b>Positive experience, happiness, pleasure</b>	<b>Frustration</b>
<b>Developing Science Skills for English Language Learners (ELL)</b>	<b>Ashna</b>	<b>Comfort, trust, enjoyment, happiness</b>	<b>Disappointment,</b>
	<b>Felix</b>	<b>Satisfaction</b>	<b>Sceptical, discomfort</b>
	<b>Hailey</b>	<b>Pleasure, appreciation</b>	<b>Disappointment, frustration</b>
	<b>Jen</b>	<b>Safety, comfort, trust, excitement</b>	<b>Frustration, disappointment, regret</b>
	<b>Linda</b>	<b>Positive experience, relief, comfort, trust</b>	<b>No negative emotions</b>
<b>Motivating Unmotivated Grade 10 Students (MU)</b>	<b>Jean</b>	<b>Excitement, enjoyment</b>	<b>Sadness</b>
	<b>Maya</b>	<b>Pleasure</b>	<b>Disappointment, frustration</b>
	<b>Sam</b>	<b>Pleasure</b>	<b>Disappointment</b>
	<b>Steve</b>	<b>Enjoyment</b>	<b>Annoyance, frustration</b>

### **Changes in Beliefs, and Classroom Practice**

Observations of change in beliefs and classroom practice among the science teachers are summarised in Table 4.6d: 209. Linda and Hailey (ELL module) reported changes in their beliefs of their roles as science teachers. 11 science teachers, regardless of the module in which they participated, reported that they did not experience any change in their beliefs. Mary and Sage (CAI module), Ashna, Felix, Hailey, and Linda (ELL module), together with Jean, Sam and Steve (MU module) reported changing some aspect of their classroom practice. Darius and Maria (CAI module), Jen (ELL module), and Maya (MU module) indicated that they have not changed their practice because of professional constraints and not due to their experiences. Of significance here is that while some teachers found the experience of change more meaningful than others, two of them felt it was profound enough to change their beliefs about their professional selves or science teaching.

**Table 4.6d: Science Teachers' Experiences of Changes in Beliefs and Classroom Practice across Modules**

Module	Science Teachers	Experiences of Changes in Beliefs and Classroom Practice	
		Changes in Beliefs	Changes in Classroom Practice
<b>Culminating Activity for an Inquiry Unit (CAI)</b>	<b>Darius</b>	<b>No</b>	<b>Not as yet</b>
	<b>Maria</b>	<b>No</b>	<b>Not as yet</b>
	<b>Mary</b>	<b>No</b>	<b>Yes</b>
	<b>Sage</b>	<b>No</b>	<b>Yes</b>
<b>Developing Science Skills for English Language Learners (ELL)</b>	<b>Ashna</b>	<b>No</b>	<b>Yes</b>
	<b>Felix</b>	<b>No</b>	<b>Yes</b>
	<b>Hailey</b>	<b>Yes</b>	<b>Yes</b>
	<b>Jen</b>	<b>No</b>	<b>Not as yet</b>
	<b>Linda</b>	<b>Yes</b>	<b>Yes</b>
<b>Motivating Unmotivated Grade 10 Students (MU)</b>	<b>Jean</b>	<b>No</b>	<b>Yes</b>
	<b>Maya</b>	<b>No</b>	<b>Not as yet</b>
	<b>Sam</b>	<b>No</b>	<b>Yes</b>
	<b>Steve</b>	<b>No response</b>	<b>Yes</b>

To some extent, the professional identity of the science teachers in this study was influenced by their experiences of their professional development programme. As I have established earlier, the 13 science teachers entered the professional development programme with sub-identities defined by their professional identity, their relationships, their environment, and their past experiences. These sub-identities formed their prior professional identities which, Day et al. (2009), Marcelo (2009), and Luehmann (2007) argue, determined the extent to which the science teachers learned as they participated in the professional development programme. These sub-identities, which are regarded as professional, situated, and personal by Day et al. (2009), resonated with each other and kept changing as the science teachers' experiences changed during their participation in the professional development programme.

My findings have shown that the science teachers have enhanced their knowledge about teaching science, interacted socially, underwent emotional changes, and most of them have changed their practice. Such actions have led two science teachers to report that they changed their beliefs about themselves as science teachers who can teach science to ELL students. I synthesised the professional identity of each science teacher at the end of the professional development programme to reveal whether they have renegotiated their professional identity as a result of their experiences of the professional development programme.

To conclude this chapter, I portray each science teacher's professional identity at the end of this study. I address his/her prior identity, professional background and experiences, and experiences of the professional development programme, to reveal each teacher's professional identity at the end of the programme. The knowledge claims in this study focused on the influence of the experiences of the 13 science teachers on their professional identities. Notably, each science teacher's personal and professional characteristics represent their status at the time that I conducted this study. I draw on my summary of findings from the narrative interviews and responses to the questionnaire, in Appendices F1: CXLVII; F2: CL; and F3: CLIV, as I present my synthesis below.

## **Ashna**

Ashna was a 35 year old woman of colour who participated in the professional development programme, assured of her status as a science teacher. She was encouraged to become a teacher by her family and teachers. At the time of this study she was a curriculum leader who held a postgraduate degree in education and subject specialism in biology. She felt that her teacher training did not prepare her for the realities of the classroom and as such she attended several professional development programmes to enhance her practice which is an indication of her beliefs in lifelong learning to succeed. She was a science teacher for about 7 years and has taught junior science and senior biology during this time.

Ashna has revealed during the narrative interviews that she acquired pedagogical skills and artefacts relevant to teach English language learners. Although she admitted to taking ownership for her learning in her response to the questionnaire, she felt that she did not have the confidence to understand the concepts or to initiate discussions. This response is in contrast to part of her narrative in which she explained that as curriculum leader, she returned to her school and introduced the ideas she acquired to other science teachers in her department. Ashna revealed during both interviews and in the questionnaire that she collaborated and networked with other members of the professional learning community. Her emotional experiences in both her interviews and response to the questionnaire revealed a range of emotions from disappointment, pride in recognition, and positive feedback. Despite these experiences Ashna changed some of her classroom practice although she did not change her beliefs of her professional self.

## **Darius**

Darius, who was about 45 years old and held a postgraduate degree in physics, was a second career teacher who was originally an engineer. He was inspired to teach because of his passion as a tutor when he was a student and the need to secure an assured profession in his new country. After his initial teacher training, he found that although his knowledge of physics and mathematics was solid, he needed guidance with his classroom management. As such, he attended several professional development programmes. Based on his interviews and his response to the questionnaire, he felt that cognitively, he acquired new pedagogical skills to conduct a culminating inquiry activity. Darius felt that his participation in the discussions

was limited since his professional needs were not met. He felt disappointed and unhappy yet he enjoyed some aspects of the sessions when he engaged in one-to-one discussions with some members of the learning community. He also felt that he did not receive any positive feedback although he appreciated his peers. In terms of changing his practice, Darius felt that his circumstances were such that he would have to modify his new knowledge to apply it in his classroom. However, up to the time of the interviews, he did not have an opportunity to apply his new ideas in class due to professional constraints. Darius felt that it would be difficult for him to rethink his beliefs about his professional self.

### **Felix**

Felix, who was 45 years old, taught for 16 years and was a second career teacher. He entered teaching because he was encouraged by his family some of whom were teachers and also, because it was a lucrative profession. He participated in several professional development programmes to cope with the realities of the classroom as a new teacher. Based on his narratives during the interviews and his response to the questionnaire, he learnt of new pedagogical skills and obtained artefacts. Although he did not take ownership of his learning, he understood the concepts. Felix engaged in social interactions as much as possible which allowed him to change and grow and share ideas. Emotionally, Felix felt a certain degree of unease because he missed a session, but he was satisfied with his experiences. Although he did not receive positive feedback, he gained confidence and recognition according to his response to the questionnaire. Felix appreciated his peers, learnt from them, and collaborated with them. Although Felix's experiences led him to change his classroom practice to some extent, he did not think that he would change his beliefs of his professional self.

### **Hailey**

Hailey was a 35 year old second career teacher who taught in 4 schools in 4 years. Switching from a career in engineering to science teaching has placed her in a unique position of being a role model for her female students and as an advisor in the physical sciences for other teachers who needed help with the subject knowledge. As such, she conducted professional development programmes initiated by the school board to enhance middle school science teachers' knowledge. Although Hailey gained artefacts and learnt of new pedagogical skills, she did not develop any new confidence or understood the concepts. She described her

experience of social interaction as no collaboration in which her peers wanted her to do all of the group work. However, she did network with others outside her group, she grew socially, and she appreciated her peers. In describing her emotional experiences, she narrated that she liked meeting others, but was disappointed and frustrated because her group members left all of the work for her to do. Yet in her response to the questionnaire, she revealed that she gained recognition, positive feedback, and she engaged in self-reflection. Hailey revealed that her experience not only allowed her to change her classroom practice, but she also changed her beliefs about her abilities as a science teacher.

### **Jean**

At 35 years, Jean, who taught for 8 years after choosing a career as a science teacher out of expediency, had neither a postgraduate degree nor subject specialism. Her initial teaching position was overwhelming because she was not prepared for the reality of the classroom. She received no support from her colleagues and so she attended several professional development programmes to cope, but she found few of them useful. She reported that, in this study, she learnt new pedagogical skills and technology, she interacted and helped other teachers in the professional learning community, and she shared ideas all of which eased the isolation she felt at her home school. This experience made all the difference for her emotionally. Although Jean did not think that her experience would change her beliefs of her professional self, she did change aspects of her practice.

### **Jen**

30-year old Jen who taught for 5 years in 4 schools had no specialism or postgraduate degrees. She decided to become a science/physical education teacher in her fourth year at university but found her initial teacher training experience disappointing. However, she did enjoy the support of her peers in her early years as a teacher. She has also enrolled in several professional development programmes to enhance her teaching. She told of gaining pedagogical skills and new strategies in this study, limited interactions with other teachers, and experiencing emotions of frustration and disappointment due to lack of collaboration but, at the same time, she reported feeling safe and comfortable. She did not receive any recognition, positive feedback, and felt no confidence. Jen did not report a change in her beliefs or her classroom practice.

## **Linda**

Linda, who has taught for 21 years and had no postgraduate qualifications, was about 50 years old, and specialised as a chemistry teacher. In her interview she told of her enhanced cognitive development, collaboration among her peers and sharing of ideas, and positive emotions. She changed aspects of her classroom practice and can see herself as an English language learner teacher having completed the professional development programme. She was enthusiastic that she had changed her beliefs of her professional self although she reported changing her classroom practice to a lesser extent.

## **Maria**

Maria, a woman of colour who was 45, has taught for 10 years and although she did not hold postgraduate qualifications, she was a specialist biology teacher. She was one of the lead teachers in the professional development programme. She has revealed that she did not experience cognitive development, although she understood the concepts. In terms of her social interactions, she shared ideas and collaborated with her peers. She found her role as a lead teacher to be very stressful and she was anxious that their presentation might have been flawed. She explained that she was frustrated because Sage, the other lead teacher, and she had different work habits. Due to professional constraints, she was unable to use the new ideas she presented to the group in her classroom and felt that maybe she could change her beliefs but not at this point in time.

## **Mary**

Mary, a 45 year-old biology teacher, taught for 15 years and although she did not have a postgraduate degree, she was a specialist chemistry teacher. She found her teacher-training programme informative and it has prepared her for her first teaching position. However, like other new teachers, Mary had to attend other professional development programmes to enhance her practice. In this study she gained pedagogical knowledge and artefacts. She collaborated with her peers, shared ideas, and interacted with everyone. Such experiences, according to Mary, led to positive feelings, happiness, and fun. However, she did experience some disappointment during the moderated marking activity. Mary has told of her enthusiasm in trying the new ideas in her classroom but she was sure that her experiences could not change her beliefs of herself as a science teacher.

## **Maya**

Maya was a 45 year-old woman of colour and an ambitious teacher of 15 years. She was a curriculum leader, with a postgraduate degree in education and was also a specialist biology teacher. She was a second career teacher having worked as a biochemist. Despite no encouragement from her family to become a teacher, she had a good teacher training experience because of her mentor. Maya was enthusiastic about teaching and her first year as a teacher was a positive experience. She not only attended professional development programmes to improve her practice, but she conducted workshops at such programmes and conferences especially in areas of cooperative learning. Maya loved to share her ideas with other teachers.

Maya was a lead teacher in this professional development programme. She gained new confidence to use technology in her classroom, shared ideas and collaborated with the other teachers. Although she was pleased with most of her presentation, she was disappointed and frustrated with some aspects of it, and was concerned about the discord between Steve and herself. Her response to the questionnaire substantiated her narratives in terms of her cognitive development, social interactions, and emotional experiences. While Maya was not able to apply her new learning in her classroom because of professional constraints, she did not believe that her experience would change her beliefs of herself as a science teacher but she described herself as a more informed lead teacher.

## **Sage**

40 year-old Sage, with no postgraduate degrees or subject specialism, has taught for 11 years and was one of the presenters of this professional development programme. She decided to become a teacher after she worked as a volunteer with youths who had issues with their sexuality. Her work in this area earned her a scholarship to return to university to become a teacher. She held several teaching positions all of which required her to attend professional development programmes to improve her practice. She described her experiences of the professional development programme in this study as one in which she obtained new ideas and skills, collaborated, shared ideas, and experienced positive feedback and was happy although she found the first session challenging. Sage took the opportunity to apply her new learning in her classroom, but she was sure that her experiences would not change her beliefs

of who she was professionally. However, she saw herself as a lead teacher which was not the same as a science teacher.

### **Sam**

Sam, a woman of colour, was a 60 year-old lifelong learner who has taught physics for 11 years. She held a PhD in physics and was a second career science teacher. She was also a specialist physics teacher. She earned a scholarship to attend university in Canada to become a secondary school teacher. She has had to follow up her teacher training with additional professional development programmes to enhance her classroom practice. In addition, she has conducted workshops on physics education at the school board and saw herself first as a physicist first and then as a science teacher. She reported that she gained knowledge in pedagogy and technology, shared ideas, networked, and collaborated with her peers, and experienced both disappointment and satisfaction due to her learning and interactions. Her response to the questionnaire in terms of her cognitive development contradicted her narrative that she learnt new skills. According to her response, she did not learn any new skills but she developed confidence, understood the concepts, and claimed ownership for her learning and practice. Her responses in terms of social interactions and emotional experiences were aligned with her narratives. While Sam applied her new learning in her classroom, she was sure she would not change her beliefs of her professional self.

### **Steve**

40 year old Steve was a specialist computer science teacher who taught 11 to 14 years old students for 13 years. He has participated in several professional development programmes to improve his practice and also coached sports. He revealed that he gained cognitive knowledge, did not participate in group work but networked with his peers in the professional learning community. He reported feeling frustrated and annoyed partly because of his interaction with Maya but enjoyed working with others and observing a lesson. His response to the questionnaire substantiated his narratives. While Steve applied his learning in his classroom practice, he did not think that his experiences would change his beliefs of his professional identity.

### **Inference from my research**

This was an exploratory study and I did not arrive at any definite conclusions regarding science teachers renegotiating their professional identities. However, I perceived a degree of influence on their professional identity. Most of them changed some aspects of their professional practice. In the process, I gleaned two significant points. Firstly, the 13 science teachers in this study entered the professional development programme with such prior professional identities that, as lifelong learners and enthusiastic teachers, they engaged in professional development throughout their careers to improve their practice. As such, regardless of their initial academic and professional qualifications, they believed that they could enhance their practice as science teachers through professional development and so they engaged in such programmes throughout their teaching careers. The science teachers' prior professional identities influenced the extent of the influence of their experiences in this study.

Secondly, 12/13 of the science teachers experienced cognitive development, all of them (13/13) experienced social interactions and emotional changes positively and negatively. 9/13 science teachers have changed some aspects of their professional practice while the others intended to do so. There was no case where any teacher had solely negative experiences. Although 2/13 of them reported that their experiences have led them to change their beliefs about their professional selves as science teachers, one of them, Linda, appears to be an outlier in that she did not change much of her practice but saw herself as a science teacher who emerged from the programme, with the confidence to teach science to ESL students. It appears as though Hailey was the only teacher whose professional identity was influenced because she experienced all the dimensions of experiences, albeit, some of them positively and others negatively. Given that the focus of this study was on science teachers' professional identity as science teachers, I did not consider that either Maya or Sage, both of whom are lead teachers, renegotiated their professional identities as science teachers. They reported that they saw themselves as more informed lead teacher (Maya) and lead teacher (Sage).

In exploring whether science teachers' professional identity was influenced by their experiences, it appears as though there was a significant degree of influence. Such an influence was more evident in the cases of Ashna, Felix, Hailey, Jean, Linda, Mary, Sage, Sam, and Steve all of whom changed some aspect of their practice. I was not able to infer that

the professional identities of Darius, Jen, Maria, and Maya were influenced to the same extent only because they were not able to change their practice in any appreciable way because of professional constraints. Notably, the professional identity of the science teachers who experienced the dimensions of experiences more fully were not influenced to the same extent since only two of them reported a change in their beliefs of their professional selves as science teachers. As such, I did not perceive that the reshaping of all of the science teachers' professional identities followed as a result of their experiences of their professional development programme.

In advancing to chapter 5, I engage in theoretically informed discussions of my findings. Firstly, I discuss science teachers' response to each supporting research question with the support of theoretical and empirical insights from the literature on teacher learning and their professional identity. In the process, I hope to draw attention to the connection among the responses of the supporting research questions to address the main research question. These responses contribute to discussions in the second section of the chapter in which I situate my research in literature. Finally, I synthesise the four themes to illustrate my conception of science teachers' professional identity that I gleaned from this research.

## Chapter 5: Discussion of Findings

Analysis of the evidence yielded four themes: cognitive development, social interactions, emotional changes, and changes in their beliefs and classroom practice. My results suggest that twelve out of thirteen science teachers experienced cognitive development. However, they all experienced social interactions, and emotional changes as a result of their participation in a professional development programme. Experiences such as these are considered as the dimensions of experiences which I discussed as I formulated a definition of science teachers' professional identity (Chapter 2: 38). These experiences reflect those identified within Wenger's (1998) community of practice in which learning occurs, and which is the theoretical framework that underpinned this study. Another equally important finding from the results was that nine out of the science teachers applied their new learning or changed their practice as a result of their experiences of the professional development programme. Change in beliefs and practice was one of the themes I identified and categorised as a dimension of experience on analysis of the evidence, and which Marcelo (2009) and Luehmann (2007) consider to be indicative of change in professional identity. Significantly, two of the science teachers felt that their experiences caused them to change their beliefs about themselves as science teachers and about science teaching.

I first discuss my reasons for conducting this research and the research process before I proceeding to my findings. My reasons were concerns of stakeholders in Canada, the UK, and the USA about losing their positions as world leaders in science and technology, a gap in the literature on science teachers' professional identities and their professional development, and my interest as a science teacher. A methodological approach of hermeneutic phenomenology was justified by my research question and theoretical framework of Wenger's (1998) community of practice. This approach afforded me the use of narrative interviews, semi-structured interviews, and a questionnaire to obtain and understand the evidence for my research. I analysed the evidence I obtained through interviews mainly by interpretive phenomenological analysis, and those through the questionnaire by qualitative survey analysis. The four themes listed above emerged from my analysis.

I engage in theoretically informed discussions of my findings in this chapter. As such, I base my arguments on assumptions regarding development of professional identities as a result of

teacher learning, which I have argued in chapter 2: 32. I argued there, that teacher learning can result in cognitive development, social interactions, and emotional changes, which are the dimensions of experiences identified by McNally and Blake (2012), Day and Gu (2010), Illers (2009), and McNally et al. (2008), and which can influence teacher professional identity. I proceed to explain the meaning and importance of my findings, offer alternate explanations where necessary, and relate my findings to literature in the first two sections of this chapter.

My major findings reflect themes I identified from science teachers' responses to the supporting research questions. In the first section of this chapter, I address each supporting research question as I discuss my findings within the framework of meanings and their importance while I situate them in the literature. In the second section, I connect the themes I identified to my theoretical framework and the literature. I end this chapter with a conceptual model of science teachers' professional identity based on my interpretation of their experiences of their professional development programme specific to this research.

## **5.1 Findings and supporting research questions**

In reporting science teachers' responses to the five supporting research questions, I express each question as a statement to identify subheadings for this section. Responses to the first supporting research question provided a backdrop of the science teachers' professional identity prior to the study and it informed who the science teachers were at the start of this study. Informed by theoretical and empirical arguments in the literature, I address the other supporting research questions and explain my findings. My aim here is to address the main research question through the findings of the supporting research questions. By discussing findings for each supporting research question, I reveal how each theme contributed to the outcome of this research.

### **Science teachers' professional identities prior to the study**

My narrative account of each science teacher (Chapter 4) portrayed their professional identities prior to this research. Science teachers' written narratives revealed experiences specific to the context of each of their professional lives. My aim was to portray the professional identity of each science teacher since:

a narrative way of thinking about teacher identity speaks to the nexus of teachers' personal practical knowledge and the landscapes, past and present, on which teachers live and work (Clandinin et al. 2009: 141).

Narrative interviews, whether written or spoken, can be a meaning making process in which teachers become aware of their professional identities. By inviting science teachers to write their professional life histories as a narrative in this study, I provided them with the vehicle to make sense and become aware of their professional identities (Wrench and Garrett 2012; Clandinin et al. 2009; Rodgers and Scott 2008; Sfard and Prusak 2005). I gained insight into their professional identities in the process.

Written narratives of science teachers' professional biographies represented discourses which I related to Gee's (2001) discourse identity. Gee (2001: 112) describes discourses, which are historical and social, as "core identity" which is a "unique trajectory" that he refers to as "discourse space". This unique trajectory represented experiences specific to science teachers' professional life histories prior to this study (contexts). Science teachers' professional identities reflected their personal histories and, as they wrote and interpreted their life history

and experiences, they engaged in discourse (Hermans 2001) in certain ways in order to be recognised as “certain” kinds of science teachers (Gee, 2001: 99). These discourses embraced aspects of a community of practice (Lave and Wenger 1991) or practices (Heidegger [1962] 2008) which, in my study, represented the community of secondary school science teachers, in which they interacted with each other, learned from each other, and behaved as science teachers.

I argue that science teachers’ core identities influenced how they renegotiated their professional identities as a result of their learning. Personal, situated, and professional contexts, Day et al. (2009) argue, can influence science teachers’ prior (core) professional identities. Experiences from these contexts influenced the ways in which science teachers viewed themselves (Bukor 2014; Day et al. 2009; Marcelo 2009; Luehmann 2007). Furthermore, science teachers’ prior professional identities determined how they participated in the professional development programme and, this in turn, determined how they interpreted their experiences and whether or not they renegotiated their identities (Bukor 2014; Day and Kington 2008; Luehmann 2007). As such, the science teachers’ prior professional identity influenced the ideas and skills on which they focused during their professional development programme and the decisions they made in terms of changes to their classroom practice (Wenger 1998).

Knowledge of science teachers’ professional identities prior to this study provide several insights. Such insights represented science teachers’ agencies to: interpret their contexts, be selective in terms of what they chose to learn, act accordingly by changing their beliefs and practice, and to renegotiate their professional identities (Beauchamp and Thomas 2009; Marcelo 2009; Rodgers and Scott 2008; Moore 2007; Jurasite-Harbison 2005; Beijaard et al. 2004 ). There is convincing evidence in the literature that teachers’ prior professional identity has a significant effect on how they renegotiate their professional identities (Bukor 2014; Beauchamp and Thomas 2009; Rodgers and Scott 2008; Vähäsantanen et al. 2008; Marcelo 2009; Luehmann 2007; Moore 2007; Jurasite-Harbison 2005; Beijaard et al. 2004).

Awareness of professional identities and change in beliefs and practice are reciprocal. Teachers’ awareness of their professional identities informs them of their professional beliefs, abilities, academic and professional qualifications, and they may gain agency to change their

practice (Marcelo 2009). Conversely, change in their beliefs and practice may change professional identities. Both cases are indicative of changing professional identities (Beauchamp and Thomas 2009; Rodgers and Scott 2008; Beijaard et al. 2004). Factors that are “personal, social, and cognitive” in nature (Marcelo 2009: 10) determined how science teachers interpreted their experiences of their professional development programme and renegotiated their professional identity. As such, knowledge of science teachers’ professional identity prior to this study was necessary to glean whether their resulting professional identities were influenced or reshaped by their experiences of their professional development programme. It was crucial, then, to glean science teachers’ professional identities prior to the study to understand their experiences, decisions, and actions during and after the professional development programme.

The science teachers in this study reported several factors that converged to depict their professional identities prior to this study. Among these factors were: the influences that encouraged them to become science teachers, the context and location of their educational studies, their experiences during their initial teacher education programmes, their subsequent professional development initiatives, and their early teaching experiences. My interpretation of science teachers’ written narratives revealed certain commonalities as well as differences among their core identities. The science teachers were lifelong learners (professional identity) who, regardless of their age, gender, nationality or experiences as students (personal identity), and education or career stage (situated identity), were interested in inspiring their students to excel in science. These qualities, as lifelong learners and interest in promoting student learning, identify such teachers as those who have professional integrity (Palmer 2007). Other factors revealed from science teachers’ core identities were: reasons to enter the profession such as influences of teachers, friends, and family; ease of finding a profession at the end of their formal learning; and economic expediencies. Such findings align with those of Flores and Day (2006) whose teachers cited similar reasons for choosing teaching as a career.

### **Science teachers’ experiences in relation to their professional identities**

I analysed science teachers’ narratives and their responses to the questionnaire in this study to address the second supporting research question. Four themes were identified which were cognitive development, social interactions, emotional changes, and changes in science teachers’ professional beliefs and classroom practice. Cognitive development, social

interactions, and emotional changes can influence and reshape science teachers' professional identity during professional development. Concurrently, the fourth theme, changes in beliefs and classroom practice, is also known to influence, and result in, the renegotiation of teacher professional identity (Beauchamp and Thomas 2009; Marcelo 2009; Rodgers and Scott 2008; Luehmann 2007). A summary of the number of science teachers who experienced each dimension of experiences, including the outliers, is presented in Table 5.1 below.

**TABLE 5.1: Science Teachers' Experiences of Professional Development Programme**

<b>Dimensions of Experiences</b>		<b># of Science Teachers (/13)</b>	<b>Outliers</b>
<b>Cognitive Development</b>		<b>12</b>	<b>Maria (CAI)</b>
<b>Positive Social Interaction</b>		<b>13</b>	-
<b>Negative Social Interactions</b>		<b>13</b>	-
<b>Positive Emotional Changes</b>		<b>12</b>	<b>Maria (CAI) – no positive emotional changes</b>
<b>Negative Emotional Changes</b>		<b>11</b>	<b>Jean (MU), Linda (ELL) – no negative emotional changes</b>
<b>Changes in Professional Beliefs and Classroom Practice</b>	<b>Changes in Professional Beliefs</b>	<b>2</b>	<b>Hailey and Linda (ELL) – experienced a change in beliefs of their professional selves</b>
	<b>Changes in Classroom Practice</b>	<b>9</b>	<b>4 – due to professional constraints</b>

It can be seen in Table 5.1 that twelve science teachers experienced cognitive development. While all of the science teachers reported both positive and negative experiences of social interactions, one of them reported no positive emotional changes and two of them reported no negative emotional changes. Two science teachers changed their beliefs about their professional selves and nine of them changed their classroom practice. I identified three outliers, one of whom experienced no cognitive development or positive emotional changes

(Maria), and the other two who did not experience any negative emotions (Jean and Linda) for the dimensions of experiences. Two science teachers who experienced changes in their beliefs of their professional selves are also considered as outliers.

The enhanced cognitive development (learning) experienced by science teachers can be compared to “transformative learning” within a community of practice (Wenger, 1998:10). Transformative learning has the potential to influence development of professional identity (Wenger 2010; 2000). Considered by itself, it appears that the science teachers in this study, who experienced cognitive development as a result of participation in their professional development programme, had the potential to renegotiate their professional identity (Wenger 2012; Marcelo 2009; Luehmann 2007). Transformative learning, experienced by science teachers, then, should have informed them of who they were and their acquired abilities as science teachers.

The science teachers in my study interacted positively and negatively among themselves in their professional learning community. While some of the science teachers collaborated fully, others did so some of the time because they found themselves working alone for various reasons. The lead teachers experienced social interactions that reflected social constructivism in which they were the more informed others (Vygotsky 1978). All of the science teachers learned from each other by exchanging ideas and producing artefacts (Wenger 2009). As they engaged in dialogue (Hermans 2001), they collaborated as they discussed and interacted with each other during learning within their professional learning community (Wenger 2009; 1998). These experiences reflected the tenets of social learning which are foremost in a community of practice (Wenger 1998). Clearly, participation (social interaction) shaped science teachers’ actions, their identities, and how they interpreted their actions. As such, social interactions among the science teachers should have influenced their professional identity.

Science teachers’ social interactions included experiences of collaboration, discussions, sharing of ideas, and networking. However, a certain degree of discord existed among three of them in the culminating activity module, and between two of them in the motivating the unmotivated grade 10 students module. Science teachers’ positions (lead teachers or participants) and their expectations (leading or learning) within each module, determined their

“negotiated meaning(s)” (Stets and Burke 2005:10), which constituted the shared component of their professional identities. The degree of social interaction experienced, which enhanced learning among the science teachers, influenced their professional identities (Jones et al. 2013) to some extent. It was through social interactions that science teachers recognised each other as specific types of teachers (Rodgers and Scott 2008; Gee 2001; Wenger 1998). Science teachers’ social interactions, together with their new learning and professional needs, resulted in emotional changes specific to their professional development (Shapiro 2010).

In my study, the science teachers have experienced emotional changes (positive and negative) as a result of their cognitive development, social interactions, and met/unmet professional needs. Such changes in emotions, can have significant influences on teacher professional identity (Shapiro 2010; Rodgers and Scott 2008; Zembylas 2003). Emotional changes of science teachers ranged from enjoyment, happiness, liking, and excitement to disappointment, frustration, and regret. Three science teachers reported that they felt dissatisfied although they experienced positive emotions of enjoyment, happiness, and satisfaction. The others, reported negative emotions of dissatisfaction, frustration, and regret as a result of their learning, interactions, and unmet needs, although they experienced at least one positive emotion. Of significance is that two science teachers, one from the English language learner module, and the other from the motivating the unmotivated grade 10 students module, reported that they experienced no negative emotions although they did not experience the three positive emotions. Emotions, whether positive or negative, can influence, inform, and define professional identities (Shapiro 2010; Day et al. 2009; Zembylas 2003). Emotions, then, are important for professional identity and they influence renegotiation of teacher professional identity (Day et al. 2009) during professional development. In my study, science teachers’ emotional changes, influenced by their learning and their social interactions, should have had a significant influence on their professional identities (Shapiro 2010).

Nine of the science teachers, who changed their classroom practice, were in a position to renegotiate their professional identities as a result of their enhanced cognitive development. Wenger (1998: 215) describes such learning as “an experience of identity” while Etelapelto et al. (2014: 2) consider professional learning that changes “work practices essentially as a process in which professional identities are renegotiated”. As such, it would appear that these science teachers’ professional identities should have been influenced and reshaped by their

experiences of learning as they participated in their professional development programme. However, despite this inference based on the literature, only two science teachers reported changes in their beliefs of their professional selves as a result of their participation in the professional development programme.

Results from this study indicated that science teachers experienced cognitive development, social interactions, and emotional changes, albeit, positively and negatively (the three dimensions of experiences). I inferred that science teachers' experiences influenced their professional identities, by either providing a positive sense of agency or a negative one. In theory, then, positive experiences from the three themes, implied a positive influence on science teachers' professional identity. Analysis of experiences, which was informed by theory, indicated that to some extent, all of the science teachers had experiences that influenced their professional identity and which should have led them to renegotiate their professional identities. Yet, the fourth theme, changes in beliefs and classroom practice, appears to challenge this finding. This fourth theme is addressed in response to the third and fourth supporting research questions below.

#### **Application of knowledge and skills in classroom in relation to professional identities**

I have argued that science teachers' cognitive development provided them with the agency to change their classroom practices. Change in knowledge is identified by Marcelo (2009) as one of the factors that can reflect science teachers' growth as professionals, and it can change their classroom practice. Professional growth can lead to new identities within a community of practice (Wenger 1998). In this study, science teachers' experiences of their professional development programme have resulted in a certain degree of change in their classroom practices. Nine science teachers have changed some aspect of their practice as a result of their experiences. Science teachers reported that their experiences of the professional development programme were meaningful to them and this inspired them to change their classroom practice and their approach to teaching science. Science teachers' reported change in classroom practice, although met with mixed results, transcended the modules in which they participated.

The science teachers in the English language learner module took some of the activities from the professional development programme to their classroom. Felix used some ideas in his

class but was unable to say how successful he was in implementing them. Ashna and Hailey tried some of the activities in their classrooms and used them to plan for the rest of the school year. On the other hand, Linda, who report no negative emotional experiences, applied some ideas in a limited way. Mary and Sage, who participated in the culminating activity module, took their new ideas to their students and they succeeded in implementing their ideas in class. In the motivating the unmotivated module, Steve tried several of the ideas with his students and obtained mixed results, while two others, Jean and Sam, reported better results when they applied their learning in their classrooms.

Four science teachers did not report a change in practice because of professional constraints and not their experiences of the professional development programme. Darius, who participated in the culminating activity module, was not able to apply his new ideas because, his class comprised one student and that student was away for some time. Maria, a lead teacher in this module, did not experience enhanced cognitive development or positive emotions, and she reported that she did not apply new ideas because the opportunity did not arise. Jen, who participated in the English language learner module, had a new timetable which prevented her from trying out her new learning. Lastly, Maya, a lead teacher in the motivating the unmotivated grade 10 module, was not able to apply her new ideas in class but she intended to do so. Findings from my study contrast that reported by Lew (2016) who conducted his multiple case study of science teachers who participated in an English to Speakers of Other Languages programme. He found that none of the four science teachers in his study changed their classroom practice but they changed their beliefs whereas two of the five science teachers in the English language learner module in my study, changed their beliefs and four of them changed their practice.

Long-term observations of practices by these science teachers might provide clearer insights in terms of changing practice. Results from this study show that the science teachers experienced professional growth in that they either changed aspects of their practice or intended to do so (Marcelo 2009). Professional growth such as these can cause science teachers to renegotiate their professional identities (Wenger 1998) although these changes have occurred during the professional development programme and not afterwards (Guskey 2009). It appears, then, that for some science teachers, their experiences of their professional development programme resulted in professional growth and change in practice and this

should have influenced the renegotiation of their professional identities. Yet, this does not appear to be the case since two of them reported a change in their professional beliefs about themselves as science teachers and science teaching.

### **Changes in beliefs and classroom practice due to experiences**

The science teachers in this study participated in the professional development programme to enhance their professional knowledge and student learning. The beliefs that they took to their professional development programme, determined the importance of their experiences, and their interpretations of those experiences (Marcelo 2009; Luehmann 2007). Changes in beliefs are slow processes (Beauchamp and Thomas 2009) and they take a while to materialise. Teachers' beliefs, which influence how they learn, what they chose to learn, and their change processes, have the potential to influence professional identities (Marcelo 2009). Two teachers, both of whom participated in the English language learner module, reported changes in their beliefs as a result of their experiences of the professional development programme. Both of them felt that their experiences have changed how they thought about teaching science to English language learner students. Guskey (2002) as well as Guskey and Sparks (2002) argue that change in beliefs can only occur after teachers change their practices. However, the science teachers changed their beliefs while still participating in the professional development programme. Such a finding does not align with Guskey's (2002) and Guskey and Sparks' (2002) arguments who maintain that teachers need to be convinced that the changes they make are sustainable before they can change their beliefs. It was soon after these science teachers changed their practice, that they reported a change in their beliefs. Maybe it was premature for the science teachers in my study to report such changes in beliefs. Notably, the other three science teachers in this module did not change their beliefs although they changed their classroom practice.

Most of the science teachers used the terms beliefs and identity interchangeably in their narratives. Significantly, eleven science teachers in this study, who did not report a change in their beliefs, reported that they felt strongly about their prior professional identities to change their beliefs. They reported that they could not foresee how their new experiences could influence a change in their beliefs and therefore could cause them to renegotiate their professional identities as seen in Table 5.2: 230.

**Table 5.2: Science Teachers’ Experiences, Change in Beliefs, and Influence on their Professional Identity**

<b>Science Teachers</b>	<b>Experiences of Professional Development Programme (as Indicated in Interviews and Responses to Questionnaire)</b>	<b>Change in Beliefs about Professional Self and Science Teaching (Change in Professional Identity)</b>
<b>Ashna</b>	Pedagogical skills. Collaboration and sharing. Positive and negative emotions.	No – did not change belief but “I felt better prepared” as a science teacher (EA2, line 100: LVIII)
<b>Darius</b>	Pedagogical skills. Discussions and sharing. Positive and negative emotions – disappointment, frustrations.	No – “It is difficult to rethink my beliefs and values as a science teacher” (CD1, line 100: LXIII)
<b>Felix</b>	Pedagogy and artefacts. Social interaction. Mixed emotions.	No – “In terms of my role as a teacher, it wouldn’t change that much” (EF1, lines 49 – 50: LXVIII)
<b>Hailey</b>	Pedagogical skills. Some collaboration, discussions and sharing. Networked. Mixed emotions, positive feedback.	Yes – “I can see it changing me” (EH2, lines 143 – 144: LXXXI)
<b>Jean</b>	Pedagogical skills, technology, curriculum. Sharing, and collaborating. Mixed emotions.	No – “I wouldn’t say it would change how . . .I would identify myself as a science teacher” (MJ1, lines 82 – 83: LXXXIV)
<b>Jen</b>	Pedagogical skills. Some collaboration. Mixed emotions. Did not apply ideas. Current needs not met.	No – “I don’t think I will ever identify as an ELL science teacher” (EJ2, line 73: XCII)
<b>Linda</b>	Pedagogical skills. Collaborated. Happy, shared ideas, positive feelings, felt more able to teach afterwards.	Yes – “I believe I have changed to some extent” (EL2, lines 47 – 48: XCIX)
<b>Maria</b>	No learning. Positive feedback. Interactions. Positive and negative emotions.	No – “I don’t think the session itself was the reason for the change” ( CM2, Lines 79 – 80: CIII)
<b>Mary</b>	Pedagogical skills. Collaboration and sharing, positive and negative feelings, needs met.	No – “walked with a ton of new ideas” but did not change beliefs of professional self (CMA2, line 84: CXIII)
<b>Maya</b>	Pedagogical skills. Collaboration and sharing, positive and negative emotions.	No – “ I think it made me a more confident lead teacher rather than a more confident teacher since that was there already” (MM2, lines 121 – 123: CXX – CXXI)
<b>Sage</b>	New ideas. Collaboration and sharing, positive and negative emotions. Validation by participating teachers.	No – “I don’t think my experience has changed my style of teaching much’ (CS2, lines 108 – 109: CXXVIII)
<b>Sam</b>	Pedagogical skills. Collaboration and Sharing. Mixed emotions. Needs not met.	No – “it would not make me do anything radical. . .I don’t expect changes (MS1, lines 57 – 59: CXXX)
<b>Steve</b>	Pedagogical skills. No group work. Collaboration. Positive and negative emotions. Conflict with lead teacher. Needs not met.	No – “I can use it for future classes” but did not indicate change in professional self ( MST1, lines 65 – 66: CXL)

There is a disparity between science teachers' experiences of their professional development programme and changes in their beliefs. While most of the science teachers experienced three of the dimensions of experiences and changed their classroom practice, eleven of them did not change their beliefs. Some science teachers' perceptions are not aligned with the criteria for renegotiating professional identity found in the literature. Maria did not satisfy the criteria for change in identity. She did not experience cognitive development, positive emotional experiences, or change in classroom practice. Hailey and Linda, who reported changes in their beliefs and practice, had experiences that aligned with the criteria for change in identity, but Linda was the only one whose experiences in all of the categories were positive.

In contrast, studies by Lew (2016), Woolhouse and Cochrane (2014; 2010), and Battey and Franke (2008) revealed that teachers adopted new professional identities. Teachers in these studies saw themselves as teachers who can teach science to those who are not fluent in English (Lew 2016), non-science teachers who can teach science (Woolhouse and Cochrane 2014; 2010), and as teachers of mathematics to middle school students respectively (Battey and Franke 2008). However, Lew's (2016) and Battey and Franke's (2008) teachers did not change their practice, although Woolhouse and Cochrane's (2014; 2010) teachers did. This disparity between dimensions of experiences and changes in practice, and changes in beliefs indicates a degree of uncertainty regarding the influence of experiences in renegotiating professional identities. Perhaps, in my study, those changes in practice did not convince the science teachers to change their beliefs and renegotiate their professional identities as argued by Guskey (2002) and Guskey and Sparks (2002). Or, the science teachers were secure in their prior beliefs which were not easily shaken. It appears that such convictions were strong despite experiences reported by the science teachers. Among these are: increased confidence to teach, but not to change her beliefs (Ashna); difficulties in rethinking original beliefs about his professional identity (Darius); role would not change that much (Felix); her experience did not change her perception of herself (Jean); she doubted whether she would ever see herself as an ELL science teacher (Jen); sessions were reasons to change practice but not beliefs (Maria); despite tons of ideas beliefs did not change (Mary); her core beliefs were constant but the experience led to her being a more confident lead science teacher rather than a confident science teacher (Maya); did not change her style of teaching (Sage); did not expect changes (Sam); saw future uses but not changes in his professional identity (Steve).

Teachers' decisions in the classroom and their change in practice are not due to their experiences of their professional development programme alone. Their decisions are also influenced by their experiences before and during their initial teacher training programme (Beijaard et al 2004). This line of thinking points to the importance of prior professional identities (biographies, culture, and initial professional training) in determining the outcome of science teachers' professional development as supported in the Day et al.'s (2009) study. Marcelo (2009: 12) cites three types of experiences that can influence "the beliefs and knowledge teachers have regarding their teaching activity". These types of experiences are classified as personal, professional, and situated dimensions respectively, and they reflect teachers' professional identities. Day et al. (2009), who synthesised these factors from their VITAE study, concluded that the relationship between professional, situated, and personal identities contributes to teachers' professional identity.

I align my thinking about science teachers' professional identity with Day and Kington (2008) who describe teacher professional identity as a "composite" of their professional, situated, and personal sub-identities (2008: 11). I concur that these sub-identities can influence teachers' "commitment, job satisfaction, well-being, self-efficacy and vulnerability, agency and resilience, and perceptions of effectiveness" (Day and Kington 2008: 11). If these sub-identities are in harmony or in equilibrium, then teachers would be committed, have agency and resilience, and be aware of their efficacy in the classroom (Day et al. 2009). An imbalance of equilibrium among any of these sub-identities, whereby one or more of them may be more dominant than the others, would challenge existing stabilities of teachers' identities (Day et al. 2009). The result may be emotional changes that "may affect their sense of commitment, job satisfaction, well-being, agency and effectiveness" (Day and Kington 2008: 11) and I argue, changes in teachers' beliefs about their professional selves and science teaching.

### **Shaping of professional identities and changes in dimensions of experiences.**

I set out in Table 5.3: 234 my findings compared to the factors that indicate influences on professional identity, as informed by literature. Each set of indicators reflects science teachers' experiences in my research to which I mapped some studies in the literature to support or challenge my findings that I identified to address my research question. Experiences in cognitive development, social interactions, and emotional changes, and enhanced classroom practice can cause teachers to renegotiate their professional identity (Mc Nally and Blake 2012; Wenger 2010; 2000; and Illers 2009). Such an argument implies that science teachers' professional identity can be influenced by these dimensions of experiences. Similarly, Marcelo (2009) and Luehmann (2007) argue that changing classroom practice and changes in beliefs have the potential to influence professional identity. The number of science teachers who reported changing their practice (9), outnumbered those who reported a change in their professional beliefs (2) which had the potential to influence or reshape their professional identity. Although the science teachers might not have recognised their experiences as influences on their professional identity, evidence in the literature indicate that the science teachers' experiences of their professional development programme had some influence on their professional identities.

Learning and identity development are closely linked as teachers work together to achieve their common goal. This is especially so in the case of appropriating tools as in the case of those teachers who acquired artefacts, argue Waitoller and Kozleski (2013) and Wenger (2010). In this way, teachers are recognised within a given context of time and place due to their learning activities (Gee 2001). Nine of the thirteen science teachers described themselves as different or certain types of teachers (Gee, 2001; Lave and Wenger, 1991) in that they have changed their practice, or acquired tools to enhance their students' learning, and they were teaching science in specific ways. It appears that despite the positive influences of experiences on the professional identity of the science teachers, eleven of them did not change their beliefs. Here again, findings from my study contrast findings of studies such as those conducted by Lew (2016), Woolhouse and Cochrane (2014; 2010), and Battey and Franke (2008) as I have forefronted when I discussed changes in beliefs and classroom practice above. It was not a foregone conclusion in my study that the science teachers' professional identities were influenced or reshaped by their experiences of cognitive development, social

interactions, emotional changes, and, in some cases, changes in beliefs and classroom practice.

**Table 5.3: My Findings Compared to Indicators of Changes in Professional Identity in Literature**

<b>Findings from this Study (# of Experiences)</b>	<b>Indicators of Change in Professional Identity in literature</b>	<b>Sources in Literature</b>
Cognitive development (12) Social Interaction (13) Emotional Changes (13)	Cognitive development, social interactions, and emotional changes – Dimensions of Experiences	McNally and Blake (2012); Day and Gu (2010); Wenger (2010); Illers (2009); McNally et al. (2008); Day et al. (2006a)
Positive and negative social interactions and emotions by all science teachers which can contribute to multiple identities	Multiplicity of identity – context, social interactions, relationships, and emotions	Akkerman and Meijer (2011); Jenkins (2008); Rodgers and Scott (2008)
Science teachers learned from the instructional leader and their lead teachers in their professional learning community	Learning from more informed others	Vygotsky (1978)
Science teachers engaged in learning activities consistent with social theory of learning in a community of practice (context of learning)	Social theory of learning from others in a community of practice – professional learning community	Wenger (2010; 2009; 2000; 1998)
Collaboration (9) Sharing ideas, artefacts, and experiences (13)	Collaborating, sharing of experiences, ideas, and artefacts, common behaviour	Scott and Palincsar (2013); McNally and Blake (2012); Wenger (2010; 2000)
Positive emotional experiences (12) Negative emotional experiences (12)	Positive and negative emotional experiences	McNally and Blake (2012); Shapiro (2010); Reio (2005); Zembylas (2005; 2003)
Change in beliefs (2) Change in practice (9)	Change in beliefs and practice	Lew (2016); Marcello (2009); Luehmann (2007)

In introducing chapter 4, on page 120, I explained how I analysed science teachers' experiences as described in their narratives. I identified the four themes from the narratives and compared them with indicators of change in professional identity found in literature. I also stipulated at that time that I did not solicit science teachers' opinions on whether their experiences had any influence on their professional identity. However, I clarified that, should the science teachers volunteer information that indicated any influence on their professional identity, I would use such information in my analysis. Eleven of science teachers in this study have opined about their professional identities as seen in Table 5.2: 230.

The 11 science teachers were confident in their responses. Such responses challenge and do not align with arguments that changes in the dimensions of experiences that I identified in the literature can influence change in beliefs and reshape professional identity through:

- Enhanced knowledge (Wenger 2010)
- Appropriation of tools or artefacts (Waitoller and Kozleski 2013) during social interactions
- Learning within a community of practice (Wenger 2010; Lave and Wenger 1991)
- Emotional changes due to learning and social interactions (Shapiro 2010)
- Learning within a specific context of place and time (Gee 2001)
- Change in beliefs and classroom practice (Marcelo 2009; Luehmann 2007).

I argue that other factors, such as prior professional identities, might have influenced these science teachers' interpretation of their experiences and their negotiation of their professional identities, as Marcelo (2009) and Luehmann (2007) propose.

However, based on evidence in the literature, it appears as though the science teachers' professional identities were influenced by their experiences of their professional development programme. Two science teachers reported that they experienced all of the indicators of change in professional identity. They are the science teachers who reported a change in their beliefs. Of the other eleven science teachers, seven of them experienced cognitive development, social interactions, emotional changes and change in classroom practices but

not changes in beliefs. The other four science teachers did not experience either change in beliefs or in classroom practice.

Two possibilities present themselves as a result of this finding. The shaping of science teachers' professional identities can depend on either the collective influences of the four themes, or on a combination of themes. In the first possibility, it would appear that two of the science teachers have had cause to renegotiate their professional identities because they experienced the four themes. However, the second possibility maybe that any combination of themes can influence the science teachers' professional identities. I argue, then, that all of the science teachers have had cause to renegotiate their professional identities as a result of the influence of their experiences (Day et al. 2009). According to them, any combination of themes can influence teacher professional identity. Further research within the context of my study is warranted in this area to compare with the findings of the Day et al.'s (2009) study. The nature of this interpretive, exploratory study was such that I cannot conclude with certainty that the science teachers' professional identities were influenced and reshaped by their experiences of their professional development programme.

### **Relationship between reshaping science teachers' professional identities and their experiences of the professional development programme**

I interpreted findings based on my understanding of events and science teachers' narratives of their experiences during their professional development programme. I discussed my interpretation of findings in supporting research questions 2 to 5 as seen in the preceding pages, guided by science teachers' narratives and responses to the questionnaire and the criteria on identity negotiation found in literature. In response to the supporting research question 5, I found that the science teachers were in a position to renegotiate their professional identity as a result of their experiences of cognitive development, social interactions, and emotional changes. However, I cannot say definitively that experiences relating to change in beliefs and classroom practice influenced science teachers' professional identities to the same extent. As such, I acknowledge that a relationship existed between science teachers' professional identity and their experiences of their professional development programme.

I return to the influence of science teachers' prior professional identities on their professional lives to discuss my findings from this perspective. I locate prior professional identity, which shapes teachers' beliefs, at the nexus of their contextual (situational factors), their professional (teacher initial and professional development), and their personal lives (influences from early years) prior to this study (Day et al. 2009; Day and Kington 2008; Day et al. 2006a; 2006b; 2006c; Flores and Day 2006). These dimensions of identity represent teachers' prior professional identity (Day et al 2009). They argue that prior professional identity influence teacher professional identity at different stages of their careers. I consider professional development initiatives as a stage in teachers' careers. As such, teachers' prior professional identity, together with their beliefs, influences what they chose to learn, with whom they interact, their agency, the changes they make in their practice, and the subsequent reshaping of their professional identity (Marcelo 2009; Luehmann 2007).

Based on my findings and literature, I realised that science teachers' prior professional identity had a pivotal role in influencing their professional identity. Day et al.'s (2009) findings for their supporting research question: What are the roles of biography and identity? alerted me to the role of prior identities in education reform. In their VITAE study to promote education reform, they explored factors that contributed to teacher effectiveness at various career phases and found that the three dimensions of identity: situational, professional, and personal, have the potential to influence teacher effectiveness, depending on the degree of equilibrium that exists among these dimensions of identity. Informed by literature, I interpreted these dimensions of identity as prior professional identity (Marcelo 2009; Luehmann 2007). My study builds on Day et al.'s (2009) study by focusing on their question that explored the role of biography and identity in determining teacher effectiveness. My study has shown that there appears to be a direct relationship between science teachers' prior professional identity and their experiences of their professional development programme.

## 5.2 Theoretically informed discussion of findings

In this section, I draw on literature to compare my findings from not only a conceptual perspective but also an empirical one. I set out to compare similarities and differences between my findings and those in the literature and to evaluate the meanings of these findings for science teachers, their professional development providers, and stakeholders who call for science education reform. Given that science teachers' learning is contextual, social, and steeped in dialogue, I compare my findings with studies underpinned by sociocultural theoretical frameworks. In addressing my main research question, I identified the four themes from the science teachers' narratives of their experiences and organised the themes into claims about science teachers' experiences. Studies, on which I focused, explored professional development and how teachers developed their professional identities. Some of those studies were:

- Pedagogical knowledge and professional identity (Lee and Luft 2008)
- Social interaction and professional identity (Pegg et al. 2010; Fox and Wilson 2009)
- Emotions and professional identity (Timoštšuk and Ugaste 2012; Day and Kington 2008)
- Science teachers' cross-boundary professional development and their classroom changes (Lew 2016; Woolhouse and Cochrane 2014; 2010; Farnham and Higham 2012; Hobbs 2012b; Akkerman and Bakker 2011), and
- Success of an out-of-school science programme (Luehmann and Markowitz 2007).

In my discussion I focus on the three dimensions of experiences as well as the changes science teachers made in their beliefs and practice as a result of their experiences of their professional development programme in relation to their professional identity.

## **Science teachers' professional identity and their experiences of enhanced cognitive development**

I inferred from my findings that the science teachers, who experienced cognitive development, were in a position to renegotiate their professional identities. They became teachers with enhanced pedagogical knowledge. Lave and Wenger (1991:115) precipitated the study of teacher professional identity when they argued that “learning and a sense of identity are inseparable”. They predict that if learning occurs, the teacher becomes a different person. This prediction aligns with Gee’s (2001) certain type of person. In both cases ‘persons’ imply a new identity. In my study, science teachers participated in a professional learning community in which they engaged in social learning (Wenger 2009; 1998), social constructivism (Vygotsky 1978), and dialogue among themselves (Hermans 2001) as they co-constructed their knowledge. During this process, their new learning became ‘situated’ (Wenger 1998; Lave and Wenger 1991) within the context of the professional learning community. Concurrently, their learning was temporal (Wenger 2010) since the duration of the professional development programme was between October 2013 and May 2014. The close relationship between science teachers’ practices and their professional identity (Wenger 1998), due to their experiences of their professional development programme, can influence renegotiation of their professional identities (Wenger 2010).

I argue that science teachers would have acquired multiple identities (Akkerman and Meijer 2011; Wenger 2010) based on their experiences during professional development. Their multiple realities occur as a result of science teachers internalising and appropriating their learning (Jones et al. 2013; Hoffman-Kipp 2008; Billet and Pavlova 2005). The result may be changes in their abilities to teach the specific areas in science that their modules covered. The development of pedagogical knowledge is crucial to gaining expertise in the classroom (Shulman 1986) and so science teachers’ new found expertise had the potential to enhance their classroom practice, and therefore, contribute to the development of their professional identities. I align my thinking with Shulman (1986) as do Lee et al. (2013), Beauchamp and Thomas (2009), Lee and Luft (2008), and Burn (2007), on the importance of pedagogical knowledge to enhance classroom practice and in the renegotiation of teachers’ professional identities.

Two science teachers have reported a change in their beliefs of themselves as science teachers. Given that beliefs change as a result of experiences of professional development programmes (Salo, Uibu, Ugaste, and Rasku-Putonen 2015), science teachers' new learning should have contributed to a change in their beliefs of their professional selves. Yet this was not the case for most of the science teachers. Notably, a change in practice by the nine science teachers, does not necessarily imply a change in beliefs as Salo et al. (2015) and Guskey (2002) argue and which is in contrast with the arguments put forward by Marcelo (2009) and Luehmann (2007) that such an outcome is possible. The science teachers who claimed a change in their beliefs of themselves as science teachers in my study are few compared to all of the science teachers in Lew's (2016), Woolhouse and Cochrane's (2014; 2010) and Battey and Franke's (2008) studies who changed their professional identities.

A number of theories underpin studies approached from the sociocultural and other perspectives regarding cognitive development in the form of pedagogy. I situate my research among theories such as: the shift in pedagogical knowledge can occur as colleagues reflect on their classroom practice (Lee et al. 2013; Stenberg 2010); pedagogy is rooted in the classroom and involves planning and experimenting (Lee et al. 2013; Burn 2007); and the most "critical component of the professional status of teachers" stems from pedagogical knowledge (Lee and Luft 2008: 1344). Learning occurred because of social constructivism (Vygotsky 1978) and Wenger's (2009) social theory of learning in a community of practice. Essential to cognitive and social developments in both of these learning theories are interaction, collaboration, and team work (Vygotsky 1978). Analysis of evidence revealed that experiences of enhanced cognitive development, in the form of pedagogical skills, resulted from collaboration, shared experiences and ideas, and networking despite incidences of frustrations, disappointments, and regrets. However, very few science teachers reported a change in their beliefs of their professional selves which could result in a renegotiation of professional identities.

Science teachers collected artefacts to use in their classrooms along with acquiring new pedagogical skills in this study. Most of them felt that their new pedagogical skills together with the artefacts they obtained during their professional development enabled them to deliver enhanced lessons in their classrooms. These sentiments expressed by science teachers in my study align with the outcomes of studies conducted by a number of researchers. Jones et al.

(2013) found that their teachers changed their strategies, methods of assessing their students, lesson planning, and science instructions as a result of enhanced pedagogical knowledge. The teachers in Hodges and Cady's (2012) study earned the respect of their peers by their choice of pedagogical approach which aligned with their beliefs, values and goals. Katz et al. (2011: 1192) observed evidence of growth in terms of "transformative pedagogy" and identity changes, while Woolhouse and Cochrane (2014; 2010) found that their science teachers emerged from their programme with enhanced pedagogical knowledge which provided the affordance for them to share ideas, make professional decisions, and converse in science-teaching terms. As with these findings, the results of my study imply that science teachers' professional identity can be reshaped within a professional learning community through enhanced cognitive development.

Enhanced pedagogical knowledge is pivotal in influencing the professional identities of second career science teachers and those who participated in the English Language Learners module. In each case, the science teachers experienced 'boundary crossing' as identified by Lew (2016), Farnham and Higham (2012), Hobbs (2012b), and Akkerman and Bakker (2011). Five science teachers, who participated in my study, were second-career teachers whereby they had experiences as a biochemist (1), engineers (2), a physicist (1), and in various non-academic areas (1). They brought those previous experiences to their classrooms which enriched their students' learning and fired students' imaginations as they utilised their "previous experiences in work and life" to explain science concepts to students as attested by Tigchelaar, Vermunt, Bouwer (2012: 1164). They continue to argue that such actions have the potential to result in "learning-oriented and student-centred" classroom practices (Tigchelaar et al. 2012: 1164). As these second-career teachers gained pedagogical knowledge, they acquired hybridised identities (Farnham and Higham 2012). Science teachers with hybridised identities can encourage their students to "reflect" on "subject matter" (Tigchelaar et al. 2012: 1164), thereby challenging and inspiring them.

Five science teachers in my study participated in the module on communicating with the English Language Learners, to enhance teaching science to ELL students. According to Lew (2016: 34) these science teachers entered the professional development programme with "positional identity (ies)" because they were "unqualified" to teach ELL science. Like the second career science teachers, those who were not qualified to teach science to the ELL

students, experienced boundary crossing that can be found in situated learning environments such as a community of practice (Wenger 1998). Four of the five science teachers changed their practice and two of them changed their professional beliefs in terms of their abilities to teach science to ELL students. As such, my finding here is a clear indication that their new pedagogical skills have caused them to renegotiate their professional identities.

Enhanced pedagogical knowledge added another dimension to the second-career and ELL science teachers' professional identities as it did in the case of the other science teachers. The second career teachers have become science teachers with knowledge on how to teach science while the ELL science teachers have become science teachers who can teach science to ELL students. Yet apart from Hailey, none of the other second-career teachers reported any changes in their professional identities, and Linda was the only science teacher who claimed that she could teach science to ELL students at the end of the professional development programme. The other science teachers (both second-careers and ELL) were most ardent in affirming that they felt no need to change their professional identities. Hailey, however, experienced a change in her belief about her professional self because she reported experiences that enhanced her pedagogical skills. Maybe she was not as established in her first career as an engineer, as the others were in their first careers. In the same vein, Linda felt more at ease teaching science to the ELL students given the artefacts she acquired.

Science teachers' specialised knowledge of science pedagogy sets them apart from other science professionals and even teachers of other subjects. Such distinctions among professionals may result in self-categorisation (Burke and Stets 2009) as these teachers become "a certain person" with the "competence of a community" (Wenger 2010: 2). As science teachers learned during their professional development programme, they became realigned with the competence of their professional learning community, and identified with it which resulted in "the need to belong to it, and therefore to be accountable to its regime of competence" (Wenger 2010: 3). Through this process, science teachers' professional identities became a combination of their learning, their professional learning community, and their "relationship with it" (Wenger 2010: 3).

As science teachers reflected on their experiences during the narrative interviews, they might have connected their self-identities or prior identities to their current professional identities.

Self-identities, comparable to Luehmann's (2007) or Gee's (2001) core identities, can influence how science teachers relate to new subject matter and pedagogical knowledge. Such a relationship might have resulted in new professional identities as Lew (2016), Woolhouse and Cochrane (2014; 2010) and Hobbs (2012a) found in their studies. For instance, Lew (2016: 41) found that his science teachers "developed their add-on identity as ESOL/Language teacher as a result of the new knowledge and skills obtained" due to their training. On the other hand, Hobbs (2012b: 719) refers to teachers' relationship with their subject and pedagogy as having an "aesthetic dimension" of teaching. Her premise is that "knowing what and how to teach involves both the cognitive and affective dimensions" of knowledge and are contextual. These findings point to both cognitive and emotional dimensions of professional knowledge which can be applied to science teachers' professional knowledge in my study. The science teachers' aesthetic dimension of teaching due to their prior identities promoted willingness to learn and a commitment to science education. They experienced the dimension of experiences and applied their new ideas in their classrooms. Yet only 2 of them reported a change in their beliefs of their professional selves.

Findings from my study are in contrast with those from other studies with respect to the development of professional identities and experiences of professional development programmes. Social constructivism and a community of practice underpinned my study as they do in some of the studies in the literature concerning teacher cognitive development. In those studies learning occurred because teachers interacted with each other. Lew (2016) found that his four science teachers changed their professional identities. Woolhouse and Cochrane's (2014) study, which they conducted from a community of practice perspective, revealed that their participants felt an increasing sense of self as science teachers. Hobbs' (2012a) study reveals that aesthetics can form new identities from a sociocultural perspective and involve teachers' emotions. Lee and Luft's (2008) study illustrates how specialised knowledge can lead to awareness of professional identity and therefore, self-categorisation or even marginalisation of science teachers. The evidence from these studies indicate that interactions among participants have a positive impact on their cognitive development and their professional identities. Almost all of the science teachers in my study experienced cognitive development, yet 2 of them reported that their experiences changed their beliefs about themselves and their practice. Clearly, further investigations are needed to shed light on the disparity of findings between my study and those I cited.

### **Science teachers' professional identity and social interactions**

As teachers learn, they interact with their peers, collaborate, share knowledge, and negotiate as they discuss and practise within their professional learning community. Social interaction, then, enhances teacher learning (Jones et al. 2013) and influences development of professional identity (Wenger 2010; 2000; 1998). Such actions are in keeping with Wenger's (1998) community of practice in which teachers are engaged in the joint enterprise of enhancing their practice through mutual engagement of collaborative learning, and producing a repertoire of resources such as artefacts. New learning can result in new identities that have the potential to provide teachers with the confidence they require to change their classroom practice. Change in practice in itself, can change professional identities. As the science teachers interacted, they formed role identities, they self-categorised, and they experienced situated cognition (Akkerman and Meijer 2011; Wenger 2010). In the process, they acquired multiple identities defined by their manner of speaking, use of specific vocabulary, shared behaviour, expertise, and experience which situated them in social categories, and defined their role identities (Wenger 2000; 1998).

In my study, science teachers' learning was contextual, temporal, and involved membership and multidimensional identities within their professional learning community. Such active participation may lead to transformative learning among science teachers (Akkerman and Meijer 2011; Wenger 2010). "Identity serves as a pivot between social and the individual" (Wenger 1998: 145) as science teachers and their professional learning community interacted with each other. Robinson et al. (2005) concur with Wenger (1998) as they argue that a teacher's learning and the role she plays in the professional learning community reshapes her professional identity. As such, I can make the claim that the science teachers in my study have renegotiated professional identities that reflected Wenger's position on participation in a community of practice and social learning.

Findings from my study revealed that not all science teachers benefitted from working in groups. Although they enjoyed working together, situations, due to individual circumstances and the apparent discord among lead teachers and some participating teachers, contributed to such an outcome. Despite such circumstances, some science teachers formed networks with colleagues on whom they felt they could rely for further discussions. Some science teachers reported feeling safe and supported as they discussed their difficulties and new ideas they

thought would enhance their classroom practice. In this way, the science teachers did experience some degree of enhanced cognitive development despite the less than ideal situation in which some of them experienced negative social interactions.

As in some other studies, science teachers in my research interacted with their peers and with their environment as they learned during their professional development programme. Similar findings were reported whether the studies were quantitative (Friesen and Besley 2013), qualitative (Vetter and Russell 2011; Brillhart 2010; Musanti and Pence 2010; Dotger and Smith 2009; Battey and Franke 2008), or mixed methods (Fox and Wilson 2009). Similarity of findings appears to transcend theoretical frameworks such as social psychological, identity and self-categorisation theories (Friesen and Besley 2013), community of practice (Vetter and Russell 2011; Musanti and Pence 2010; Dotger and Smith 2009; Battey and Franke 2008), and social constructivism (Brilhart 2010; Fox and Wilson 2009; Dotger and Smith 2009; Battey and Franke 2008). Findings from these studies illustrate the role of social interactions which contribute to foster learning and develop teacher professional identity. Despite the various methodological and theoretical approaches of these studies and despite the extent of interaction between teachers and their environment, learning occurred. Findings from my study align with those cited in the literature in terms of the science teachers' cognitive development, their social interactions, and the change in professional practice to some extent.

My study revealed that learning and renegotiation of professional identity as a result of social interactions are not a foregone conclusion. Studies by Friesen and Besley (2013), Vetter and Russell (2011), and Musanti and Pence (2010), illustrate that social interactions may contribute to learning and development of teacher professional identity. Although 11 of the science teachers did not perceive a change in their beliefs, 2 of them did. Theoretically, membership in a community of practice (Wenger 2010; 1998) and change in beliefs (Marcelo 2009; Luehmann 2007) have the potential to influence the development of professional identity. The science teachers were part of a community of practice but most of them did not perceive a change in their beliefs.

My findings aligned with studies conducted by Dotger and Smith (2009) and Battey and Franke (2008). The novice teachers in Dotger and Smith's (2009) study could not interact with parents because of underdeveloped social identities while, although Battey and Franke's

(2008) teachers learnt from each other within a community of practice, their initial professional identities did not support social learning. They experienced difficulties in changing their classroom practice. Like some of the teachers in my research, teachers in these studies appear to have deep-seated beliefs and values (prior professional identities) which they found difficult to change (Beauchamp and Thomas, 2009) and so even though they belonged to a community of practice, they did not experience a change in their professional identity.

### **Science teachers' professional identities and emotional experiences**

Teachers experience a range of emotions as they interact socially and learn in their professional learning community during professional development activities. The science teachers in my study experienced emotional changes due to their social interactions and their learning experiences. Timoštšuk and Ugaste (2012: 430) argue that both positive and negative emotions are important “in social learning” and they “influence the development of professional identity”. Emotions such as these may influence classroom practice and teachers' emerging identities and can result in risk taking, vulnerability, and internal and external professional changes (Kelchtermans 2005) depending on whether they are positive or negative. Common emotional threads run through the science teachers' experiences in my study. Among these are trust, happiness, satisfaction, and excitement at one end of the emotional spectrum and embarrassment, frustration, disappointment, regret, and anger at the other end of the spectrum. Joy, excitement, and satisfaction are associated with positive emotions which foster professional development (Timoštšuk and Ugaste 2012). They found a “prevalence of negative experiences” among their teachers as I have among some of mine, and they posit that these negative experiences “overshadowed other emotions” (Timoštšuk and Ugaste 2012: 430). In my study disappointment and frustration were the prevalent negative emotions due to unmet needs and discord among science teachers.

Discourses, policies and social norms in the workplace regulate teachers' emotions within a professional learning community. Emotions exist as a discursive practice in which “power” plays “an integral part” of discourses on emotions (Zembylas 2005: 937). There was a certain degree of discord between lead teachers and participating teachers in two modules in my study. Science teachers' emotional behaviours reflected their personal feelings (anger, frustration, disappointment, embarrassment, and dissatisfaction). These discordant feelings

are worthy of note specifically because of a certain degree of ‘power’ imbalance between lead teachers and the participating teachers as they engaged in discussions and interactions. According to Zembylas (2005: 937), emotions are “not private”. They are “performative” and furthermore, discussions about emotions are related to the teachers’ “sense of identity”. I concur in that, in my study, whether emotions were positive or negative, they appeared to influence the science teachers’ professional identities.

### **Science teachers’ professional identity and changes in their beliefs and classroom practice**

Two science teachers have changed their beliefs of their professional selves as science teachers who can teach science to ELL students. On the other hand, nine of them have changed their classroom practice. The science teachers applied their new learning in their classrooms before the end of the professional development programme because of perceived readiness to change how they taught their students. The science teachers were armed with new ways and awareness of teaching specific science topics and an appreciation of using technology in the classroom to enhance current teaching practices. Reviewing the literature on teachers’ experiences of professional development, Vermunt and Endedijk (2011) found that teachers employed a variety of ways in which to learn and teach. Bakkenes, Vermunt, and Wubbles (2010) found that experienced teachers in an educational innovation and change study, underwent changes in knowledge and beliefs, intentions for practice, and actual teaching practices. They found that their teachers experienced changes in knowledge and beliefs more often than they experienced changes in teaching practices which were reported rarely. This phenomenon is also observed in the outcomes of studies conducted by Lew (2016) and Battey and Franke (2008) which is quite unlike the findings in my study.

The results from my study are in contrast with those of Lew’s (2016), Bakkenes et al.’s (2010), and Battey and Franke’s (2008) studies in that most of my science teachers changed their practice rather than their beliefs of themselves. My findings align with those of Opfer et al. (2011) who found that it was easier for their in-service teachers to change their practice. Guskey (2002: 384) has argued that in their model of teacher change, teachers change their practice before they change their beliefs because “change is primarily an experientially based” learning process for teachers and so significant change in beliefs can only occur after change

in practice. None of the science teachers offered reasons such as not understanding or not being motivated to change their beliefs. Perhaps it was too early for the science teachers to be convinced that change in practice led to positive student outcomes, and so, they were reluctant to change their beliefs unless they were convinced to do so as a result of the change in their classroom practice (Opfer et al. 2011; Guskey 2002).

Some science teachers in my study, who did not perceive a change in their beliefs, appeared self-assured about their beliefs of their prior professional selves. They were not only proud of their subject content knowledge in the areas of physics and biology, but also of their pedagogical skills. These perceptions can be construed as self-categorisation (Burke and Stets, 2009). Trent's (2011) study revealed that teachers' identities changed as they participated, gained knowledge, skills and strategies, and learned to imagine and align their thinking (Wenger 2000). Teachers in Trent's (2011: 627) study saw themselves as special types of teachers such as "science-language" teachers or "history-language" teachers. Teachers in Friesen and Besley's (2013) study also had a strong sense of their teacher identity, personal identity, and their student identity, which suggested some degree of self-categorisation (Burke and Stets, 2009). It appears that science teachers in my study, who did not perceive a change in their beliefs, may have entered the professional development programme with the confidence and assurance of who they were professionally, due to their prior professional identities. They entered the professional development programme with 'core identities' (Luehmann, 2007; Gee, 2001) that reflected a well-developed sense of professional self. Enhanced cognitive development, social interactions, emotional changes, and changes in beliefs and practice in this study, are dimensions of the science teachers' professional identity. These dimensions of professional identity have contributed to the development of my conceptual model of secondary school science teachers' professional identity. I proceed to address the development of my conceptual model of science teachers' professional identity based on this study, in section 5.3 of this chapter.

### 5.3 Conceptual model of science teacher professional identity

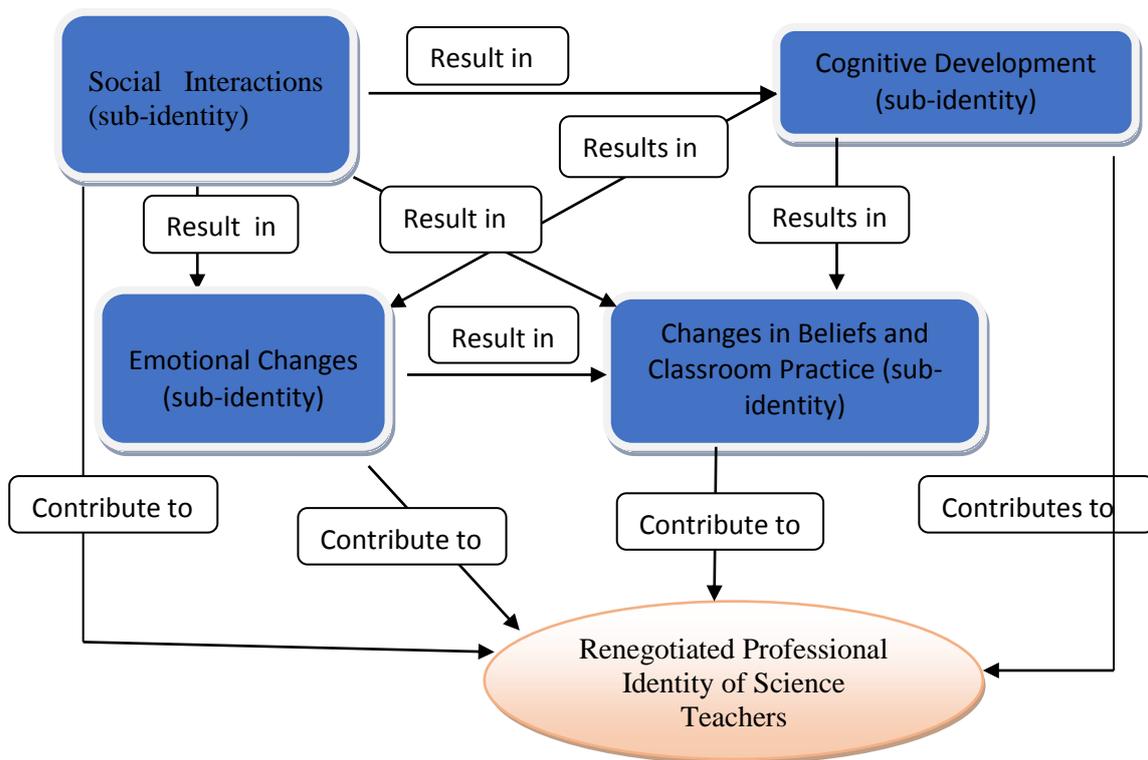
I reflected on a number of factors as I developed my conceptual model of science teachers' professional identity as a result of my study. Among these factors were the:

- Science teachers' narratives of their experiences of their professional development programme
- Insights I gleaned from my observations of the science teachers during their professional development sessions
- Findings from my analysis, and
- Answers to my research questions.

I argue that the four themes identified in this study are significant in evaluating whether science teachers' professional identity was influenced and/or reshaped by their experiences. As the science teachers became aware of these dimensions of experiences during discourse, they interpreted and reinterpreted them (Rodgers and Scott 2008; Luehmann 2007; Sfard and Prusak 2005; Hermans 2001) and in the process, they became aware of their professional identity. I, therefore, consider these dimensions of experiences as the four dimensions of the science teachers' professional identity in my study which I portray in Figure 5.1: 250. Science teachers' renegotiated professional identity sits at the nexus of the four dimensions of their professional identity.

In addition to the three dimensions of experiences identified in my definition of science teachers' professional identity, I incorporated the fourth dimension of experience, changes in beliefs and classroom practice. As can be seen in Figure 5.1: 250, the interrelationships that exist among these dimensions of experiences lead to the characteristics of professional identity such as multiplicity, discontinuity, and relationality discussed in chapter 2. Of note is that in light of my findings, experiences of cognitive development, social interactions, and emotional changes appeared more prevalent than those of changes in beliefs and in classroom practice. Social interaction during learning leads to both cognitive development and emotional changes. Similarly, cognitive development leads to emotional changes. As I have discussed in chapter 2 and elsewhere in this thesis these dimensions of experiences can influence and in some cases, result in renegotiated professional identities. Concurrently, these changes in dimensions of experiences can result in not only a change in classroom practice, but in a

change in professional beliefs as was also discussed in this thesis. In Figure 5.1 below, these four dimensions of experiences indicate not only an influence on science teachers' professional identities, but also can cause science teachers to renegotiate their professional identities in some cases. The dimensions of experiences represent the dimensions of the science teachers' professional identity in this study.



**Figure 5.1: Conceptual Model of Science Teacher Professional Identity in this Study**

**Note: The source of this diagram is original and entirely my own**

The conceptual model of the science teachers' professional identity represents the outcome of my research. My model is a construct of the science teachers' sub-identities due to cognitive development, social interactions, emotional changes, and changes in beliefs and classroom practice. The model is theoretically driven and captures the essence and stories of science teachers' experiences of their professional development programme. Such a model is fluid and dynamic in that science teachers' professional identity, which sits at the nexus of the four dimensions of experiences, is constantly being constructed and reconstructed which resulted in characteristics of multiplicity, discontinuity, and relationality due to changes in the dimensions of experiences. The four dimensions of experiences that influence science teachers' professional identity interact with each other synergistically and resonate among themselves in harmony thereby reinforcing each other (Opfer et al. 2011) both individually and collectively. The resulting changes are not linear but are influenced by culture and context. In the process they are interwoven in the stories science teachers narrated. The components of the model reflect the themes I gleaned from this study. The model is based on my reflections on these themes, and my findings in response to the research questions.

As I addressed science teachers' professional identity prior to this study, I emphasised its influence on learning, social interactions, emotions, and changes in beliefs and classroom practice. In highlighting its role in science teachers' learning, I foregrounded its importance in reshaping professional identity during teacher professional development. By synthesising my results and comparing them to theory and published evidence, I situated my study in literature with respect to my theoretical framework and findings. It was clear that, although the science teachers experienced the three dimensions of experiences that arose from my theoretical framework, it did not necessarily follow that they changed their beliefs. Yet, I opined that their experiences influenced and reshaped their professional identity, based on the findings of other researchers' work. Finally, I incorporated the four dimensions of experiences, which I later referred to as dimensions of professional identity, in my conceptual model of science teachers' professional identity. In the process, I illustrated the resonance among these dimensions of professional identity as they affect each other and their contribution to reshape the professional identity of science teachers in my study.

I begin the final chapter of my thesis as I recall my reasons to embark on this study, the questions I asked, and how I set about to address them. I identify my claims to knowledge as I

summarise my findings. In presenting my key findings and discussing the research, I address the implications of my study in terms of theory, methodology, findings, and my contribution to literature. I proceed to discuss the limitations of my study in terms of methodology, sample size, ethics, trustworthiness, and analysis, and identify areas for future research. Finally, this chapter and the thesis exit with my final thoughts.

## Chapter 6: Conclusion

In chapter one, I identified the benefits of exploring whether science teachers' professional identities can be influenced by experiences of professional development programmes. In the process, I established the importance of studying professional identity of science teachers in an era of science education reform. I conducted this research in response to the concerns about the state of science education in western countries such as Canada, the UK, and the USA. The general premise was that science teachers can have the agency to address science education reform initiatives in classrooms through professional development programmes (NMSI 2015; The Royal Society 2014; AMGEN Canada 2012).

My thesis was that learning, in a professional learning community, may influence science teachers' professional identity which, in turn, can change beliefs and classroom practice. I have argued that science teachers' commitment and effectiveness, which are crucial in science education reform, are linked to their professional identities. Furthermore, I argued that, theoretically, the connection between science teachers' reshaped professional identity and the agency they acquire as a result of their experiences in professional development programmes, may enable them to act as change agents. Such actions may lead to positive classroom changes (Moore 2007) in an era of science education reform. One of the aims of science education initiatives is to provide professional development to enhance science teachers' agency to enact positive classroom practice, which may inspire and challenge students. Such an initiative may result in science teachers renegotiating their professional identities (Marcelo 2009; Moore 2007).

Literature, which approached the subject of professional identity from different perspectives in various subject areas, informed this study. I focused mainly on studies that explored pedagogical knowledge and professional identity (Lee and Luft 2008), social interaction and professional identity (Pegg et al. 2010; Fox and Wilson 2009), emotions and professional identity (Timoštšuk and Ugaste 2012; Day and Kington 2008), science teachers' cross-

boundary professional development and their classroom changes (Lew 2016; Hobbs 2012b; Woolhouse and Cochrane 2014; 2010), and success of an out-of-school science programme (Luehmann and Markowitz 2007). In this research, I set out to achieve two goals. Firstly, I explored whether science teachers' professional identity can be influenced and reshaped by experiences of professional development programme as a step in science education reform. Secondly, I sought to bridge the gap in the literature in this area of study by focusing on science teachers in one province in Canada.

No documented, consensual definition of teacher professional identity exists. As such, I relied on literature to guide me in formulating a definition of science teacher professional identity for my study. In this study, I defined science teacher professional identity as a function of dimensions of experiences such as cognitive development, social interactions, and emotional changes that interact to promote characteristics of identity such as multiplicity, discontinuity, and relationality. I focused on dimensions of experiences in my research, since science teachers participated in a professional development programme which implied learning. Their experiences during participation in such a programme could result in multiple identities and new dimensions of experiences that can influence their professional identities (McNally and Blake 2012; Wenger 2010; and Illeris 2009). Significantly, cognitive development, social interactions, and emotional changes are some of the outcomes of participating in a community of practice (Wenger 1998). In formulating my definition of science teachers' professional identity, I foregrounded the influence on and reshaping of science teachers' professional identity by their experiences. In the process, I situated science teachers' learning within the framework of their professional learning community which can be compared with Wenger's (1998) community of practice.

My study was underpinned theoretically, by Wenger's (1998) community of practice. Professional development of the science teachers occurred within the context of an environment similar to Wenger's (1998) community of practice. However, the science teachers' learning comprised more than social learning from each other. It involved learning from more informed others (Vygotsky 1978) and through dialogue (Hermans 2001). On its own, my theoretical framework does not take into account learning from more informed

others (Vygotsky 1978) or, dialogue among teachers (Hermans 2001). Learning within a community of practice focuses mainly on Wenger's (2009) social theory of learning. Similarly, on their own, each of these three sociocultural learning theories cannot account for the learning that takes place in a community of practice. As such, they provide insight collectively, into science teachers' learning within a professional learning community. My theoretical framework, then, was Wenger's (1998) community of practice explained from the perspectives of these three learning theories. I have subsumed the three sociocultural learning theories and foregrounded Wenger's (1998) community of practice as the plinth of my theoretical framework.

The purpose of this study was to analyse science teachers' experiences of their professional development programme to reveal themes to address my research question. A methodological approach of hermeneutic phenomenology afforded the use of tools such as narrative interviews, semi-structured interviews, and a questionnaire to obtain evidence. Interpretive phenomenological analysis (Smith and Osborn 2008) of the narratives, and qualitative survey analysis (Jansen 2010) of the questionnaire yielded four themes: cognitive development, social interactions, emotional changes, and changes in beliefs and classroom practice. The first three themes reflected the dimensions of experiences identified in my definition of science teacher professional identity in this study.

I incorporated the four themes that emerged from my analysis in formulating a conceptual model of science teacher professional identity gleaned from this study as seen in Figure 5.1: 250. The theme, change in beliefs and classroom practice, like the other three, is recognised as a factor that can influence and shape teacher professional identity (Marcelo 2009; Luehmann 2007; Guskey 2002). As such, it warranted inclusion in my representation of science teachers' professional identity. I refer to those themes as dimensions of science teachers' professional identity. The four dimensions of professional identity resonate harmoniously among themselves, enhance each other, and as such, can influence or shape science teachers' professional identity (Wenger 2010; Marcello 2009; Luehmann 2007).

I inferred that science teachers' professional identities are influenced positively by their experiences of their professional development programme. The science teachers experienced

the three dimensions of experiences and most of them changed their classroom practice. Yet, two out of the thirteen science teachers, who participated in my study, reported that they changed their beliefs about their professional selves and science teaching. One possible explanation for two science teachers experiencing a change in their beliefs could be that despite their core identities, these two teachers wanted to learn new ways of teaching, and so they changed their beliefs and practices (Guskey and Spark 2002). In this way, they participated in the professional development programme to “expand their knowledge and skills... and enhance their effectiveness with students” (Guskey and Spark 2002: 383). Or, it could be that the other eleven science teachers needed evidence of success (Guskey 2002) before they could change their beliefs at that stage of their professional development.

Another reason that could explain the few science teachers changing their beliefs was because their prior professional identities could have influenced their decisions about changing their beliefs and therefore, the outcome of their renegotiated professional identities. It is prior professional identity that determined how teachers participate in a professional development programme, how they interpret their experiences, and whether they decide to renegotiate their professional identities (Bukor 2014; Day and Kington 2008; Luehmann 2007). Luehmann (2007: 828) argues that “core identities” prior to professional development, should be aligned “with the new identities being considered” in order for teachers to renegotiate their professional identities. My findings implied that some science teachers’ core identities did not align with the possible “new identities being considered” in the professional development programme, and as such, they “resisted” renegotiating their professional identities (Luehmann 2007: 828).

In concluding this thesis, I begin by discussing key findings and knowledge claims that emerged from my analysis of the science teachers’ narratives of their experiences. In the second part, I discuss the implications that arose from my study. I then proceed to recount my contribution to literature as a result of my findings, my theoretical framework, and my methodological approach in the section that follows. I address the limitations of my study and recommendations for future research in subsequent parts of this chapter. Finally, I relate my final thoughts as I exit this chapter and my thesis.

## **6.1 Key findings and knowledge claims**

My findings contrast those in the literature although almost all of the science teachers experienced the four dimensions of their professional identity. However, two of them changed their professional beliefs of themselves as science teachers and about science teaching. According to Guskey (2002), it is natural for a change in one's beliefs of one's professional self to occur after one has seen the results of a change in one's practice. However, the two science teachers in my study, reported that they changed their beliefs while still engaged in the professional development programme. As such, I consider this change in the science teachers' beliefs as an anomaly. Science teachers' prior professional identity was identified as having a pivotal role in influencing the renegotiation of their professional identity (Marcelo 2009; Luehmann 2007). In light of this view, I argue that science teachers' prior professional identity, which determines what and how teachers choose to learn, explains this anomaly.

Nevertheless, together or separately, the four dimensions of experiences are known to influence and reshape professional identities (McNally and Blake 2012; Wenger 2010; and Illers 2009). My findings are in contrast with reports in the literature on two levels. Firstly, learning within a community of practice such as the professional learning community in my study, can lead to cognitive development, social interactions, and emotional changes with the ensuing result of science teachers renegotiating their professional identities. Eleven science teachers in my study, did not change their beliefs or renegotiate their professional identities. Secondly, Marcelo (2009), Luehmann (2007), and Guskey (2002) argue that results of changes in teachers' practice due to professional development, cause changes in their beliefs, which in turn, can reshape professional identities. Although in my study, all but one of the teachers experienced the three dimensions of experiences and more than half of them changed their classroom practices, two of them changed their beliefs of their professional selves and science teaching. This finding is an outlier and contrasts those in literature. The findings from my study contribute to knowledge in the literature on science teachers' learning during professional development, the role of prior professional identity on renegotiation of professional identity, the renegotiation of secondary school science teachers' professional identity, and provide a Canadian context in the process. I now discuss these knowledge claims.

### **Science teachers' professional identities prior to the study**

One key knowledge that resulted from my study was the role of science teachers' prior professional identity in influencing and reshaping their professional identity. Analysis of science teachers' written narratives revealed that several factors contributed to their professional identities prior to their participation in the professional development programme. Researchers such as Pillen, Den Brok, and Beijaard (2013), Beauchamp and Thomas (2009), Day et al. (2009), Flores and Day (2006), and Beijaard et al. (2004) believe that development of teacher professional identity is influenced not only by their professional contexts, skills and knowledge, and colleagues, but also by their personal characteristics, learning history, prior experiences, and beliefs, which contribute to their core identity (Gee, 2001). Knowledge of science teachers' core identities revealed who they were professionally at the start of the professional development programme. It was necessary to know who the science teachers were in order to understand: whether they experienced enhanced cognitive development, the relationships they formed, the emotional changes they underwent, and their decisions to change their beliefs and practice as a result of their participation. This role of science teachers' prior professional identity, while specific to science teachers in a Canadian context, may be applicable to science teachers in other contexts and as such it a knowledge claim in this field.

### **Professional identities and experiences of professional development programme**

The second knowledge claim stemmed from science teachers' experiences of their professional development programme that reflected the theoretical framework of this study. Findings from my study revealed that science teachers experienced, to varying degrees, cognitive development, social interactions, and emotional changes, which are comparable to findings in other studies (McNally and Blake 2012; Wenger 2010). In my study, each of these dimensions of experiences interacted with the others as seen in my definition of science teachers' professional identity and in my conceptual model of science teachers' professional identity (Figure 5.1: 250). Science teachers' professional identity is at the nexus of the interacting dimensions of experiences in Figure 5.1: 250. Science teachers' experiences, then, should have influenced how they renegotiated their professional identities (McNally and

Blake 2012; Wenger 2010; Luehmann 2007), which provided the agency for them to make classroom decisions and change their practices.

None of these three dimensions of experiences was more prominent over the others in my study. Such findings are in contrast with McNally and Blake's (2012) findings in which they reported that their participants' experiences of emotional and social interaction dimensions of experiences featured more prominently than their experiences of cognitive development. Although Beauchamp and Thomas (2009) argue that cognitive development has the foremost potential to change professional identity, the evidence from my study suggests otherwise. Despite the enhanced cognitive development science teachers experienced, eleven of them did not report any change in their beliefs of their professional selves, any influence on their professional identities, nor any renegotiation of their professional identities. Two of the science teachers in my study changed their beliefs of their professional selves. It cannot be a foregone conclusion that all of them negotiated their professional identities despite their experiences.

Significantly, the science teachers did not report that they experienced the fourth dimension of professional identity to the same extent as the other three. Despite the balance of dimensions of experiences such as cognitive development, social interactions, and emotional changes, among the science teachers, my study reveals that 9 of them reported that they had changed their classroom practice and 2 of them reported a change in their professional beliefs. A change in classroom practice and professional beliefs, which is indicative of a change in professional identity to some extent (Wenger 2010; Marcelo 2009; Luehmann 2007), is featured in my conceptual model (Figure 5.1: 250). I am unable to make, with conviction, a claim to knowledge that science teachers' professional identities were influenced by their experiences of their professional development programme and that perhaps they were able to renegotiate their professional identities. Herein lies the contrast with those of other researchers' findings.

### **Changes in beliefs and classroom practices**

Two of the science teachers involved in my study felt that their experiences led to a change in their professional beliefs. Changes in professional beliefs reflect the characteristic of multiplicity of identity (Rodgers and Scott 2008). In sharing their expertise or experiences in a professional learning community, the science teachers assumed various roles which added to their sense of self (Jenkins 2008; Rodgers and Scott 2008). As the science teachers engaged in their professional development programme, they interpreted and reinterpreted their roles, beliefs, values, and experiences to cope with the contextual and institutional changes they encountered (Mockler 2011; Beauchamp and Thomas 2009; Rodgers and Scott 2008). Concurrently, they had to cope with their experiences of cognitive development, social interactions, and emotional changes. These interpretations and reinterpretations should have contributed to changes in their professional identities and classroom practice (Sutherland et al. 2010; Beijaard et al, 2004). Yet, eleven of them did not report that they renegotiated their professional beliefs or identities.

Although two science teachers experienced a change in their beliefs, nine of them (including the two) reported changes in their classroom practice. The observation that two science teachers changed their beliefs is interesting, given that all of the science teachers experienced enhanced cognitive development and gained artefacts, and most of them changed their classroom practice. Some science teachers felt that their experiences of the professional development programme were meaningful and promoted changes in their classroom practice. One explanation for such an observation could be that science teachers felt that their experiences would most probably enhance and change their classroom practice (Guskey 2002) if not immediately, then sometime in the future, but not necessarily change their beliefs about their professional selves. Or it could be that the science teachers' prior professional identities influenced their decisions to change their practice (Marcelo 2009; Luehmann 2007; Gee, 2001).

Science teachers' prior professional identities influenced how they renegotiated their professional identities during professional development. The science teachers brought their prior "experiences, beliefs, knowledge, and identities related to science and science learning"

(Luehmann 2007: 828) to the professional development programme. Such beliefs and knowledge had the potential to influence how they interpreted their learning and the importance they placed on it (Marcelo 2009; Luehmann 2007; Gee 2001). The outcome of their experiences in this study, which was a change in practice for some of them, indicated that the science teachers' experiences were aligned with their prior beliefs about their professional development and learning (Marcelo 2009; Luehmann 2007). Such an argument reinforced their experiences of their professional development programme in relation to their professional identity. This inference explains their willingness to change their practice. Yet, it was not a foregone conclusion that the science teachers renegotiated their professional identities in my study because few of them changed their beliefs of their professional selves.

My knowledge claim in the area of the influence of dimensions of experiences on teacher professional identity contrasts those in the literature. This was despite McNally and Blake's (2012) and Wenger's (2010) argument that participation in a community of practice results in changes in dimensions of experiences which can lead to a change in professional identities. Science teachers' experiences of cognitive development, social interactions, and emotional changes, were more prominent than changes in beliefs and classroom practice. Despite the imbalance of these dimensions of experiences, and my interpretation of the results as a positive influence, yet some degree of uncertainty remained in terms of reshaping of science teachers' professional identity as a result of their experiences of their professional development programme. Those science teachers who applied their new ideas in their classrooms reported that they did so because of the enthusiasm they developed as a result of their new learning, which is indicative of the positive influence of their experiences. Knowledge claims from my study, therefore, contrasts those in the literature on the influence of dimensions of experiences on teacher professional identity. The knowledge claim here adds to the literature on changing practice especially within a Canadian context.

### **Context of experiences of professional development programme, multiple realities, and science teachers' professional identity**

Science teachers' social interactions added a relational dimension to their professional identities as they participated in their professional development programme within their

community of practice. In the process, they acquired new knowledge and skills. As such, they were in a position to renegotiate their professional identities (Hodges and Cady 2012; Wenger 2010; 1998; Battey and Franke 2008). Teachers can renegotiate their professional identities through cultural practices, their history, their membership within their professional learning community, and collaboration (Wenger, 1998). In this study, the science teachers' experiences were specific to the context of their professional development programme, the social interactions in which they engaged, and their resulting learning. Although science teachers collaborated and negotiated with each other during their professional development, their prior identities might have influenced the manner in which they interpreted these experiences (Marcelo 2009; Luehmann 2007). As such, each science teacher's experiences shaped his or her professional identity in a different manner reflecting their multiple realities both individually and as a group. These social practices also influenced how the science teachers participated in the professional development programme (Lave and Wenger, 1991). Despite acquiring the same new knowledge and skills, the result of each science teachers' participation was different and so was the effect on their beliefs of their professional selves and the reshaping of their professional identities. As such, their realities, individually and as a group, were multiple.

Analysis of science teachers' learning and professional identity revealed that their experiences reflected multiple realities. Two science teachers, who participated in my study, underwent a change in professional identity as a result of changing their beliefs and classroom practice in addition to a change in their dimensions of experiences. Nine of them reported changes in their classroom practices together with changes in cognitive development, social interactions, and emotions which I have identified as conducive to changing professional identities (McNally and Blake, 2012; Wenger, 2010). Three science teachers experienced the three dimensions of experiences but did not perceive any change in their beliefs or classroom practice. One science teacher did not experience cognitive development, change in beliefs, or change in classroom practice. This finding appears to belie some science teachers' convictions that they could not change their professional identities because they were secure in the knowledge of who they were prior to the research. In such a case they would not have felt the need to change their practices. Despite their reasons, all of the science teachers reported that

they changed or intended to change their classroom practices. This finding appears to belie further, some science teachers' convictions that they could not change their professional identities because they were secure in the knowledge of their individual, prior professional identities in which case they would not have felt the need to change their practices. Such decisions, on their part, allowed each of them to reflect their multiple realities and indicated influences of their experiences on their professional identities.

Science teachers' multiple realities and their sense of self influenced how they perceived their experiences, and how these perceptions resulted in a change in their professional identities. Such perceptions are, therefore, unique for each of them. Consequently, not all science teachers experienced the "shift in identity" that Battey and Franke (2008:130) predicted would ensue. The two science teachers, who experienced a change in beliefs, might have done so as a result of their new dimensions of experiences (theoretical framework) and they might have been more inclined to change how they saw themselves at the end of the professional development programme than the others.

Science teachers' social interactions were pivotal in influencing their professional identities (Wenger 1998; Lave and Wenger 1991) within the context of their professional learning community. In my study, not all science teachers benefited from working in groups although they enjoyed working together. Also, twelve science teachers experienced enhanced cognitive development despite instances in which social interactions were not ideal. Such findings align with studies on cognitive development, professional learning communities, and professional identities. In each of these studies, science teachers interacted socially in the learning process which fostered reshaping of professional identities (Friesen and Besley 2013; Vetter and Russell 2011; Musanti and Pence 2010), thereby illustrating that social interactions contribute to the development of professional identities. Concurrently, findings from my study also align with studies by Dotger and Smith (2009) and Battey and Franke (2008) in that although teachers experienced ideal social interactions, they had difficulties applying their new learning in their classrooms. Furthermore, my findings contrasted findings from studies such as Lew (2016) and Woolhouse and Cochrane (2014; 2010). Herein lies my inference that it is not a foregone conclusion that social interactions lead to change in professional identities.

The emotional changes science teachers in my study experienced due to their cognitive development and social interactions ranged from positive to negative. Findings from my study align with those from the study conducted by Timoštšuk and Ugaste (2010: 430) who found a “prevalence of negative experiences” which, they posited, “overshadowed other emotions”. Teachers’ emotions exist as a discursive practice in which a power imbalance exists (Zembylas 2005) which was observed in the discord between pairs of teachers in my study. Of note is that three of those teachers were lead teachers who were in a position of power compared to those who were learning. Although negative emotions are significant in the development of identities (Shapiro 2010), none of the teachers in my study indicated that they perceived that their negative experiences of social interactions and emotional changes prevented a change in their professional identities. Emotional changes, then, can lead to a multiplicity of identities.

It was not surprising to find that science teachers experienced changes in beliefs and classroom practice. This is because, as Opfer et al. (2011) argue, such changes are more feasible among in-service teachers, rather than among pre-service teachers. It is difficult for new knowledge to change beliefs if the learning activity does not connect with the learning beliefs which are determined by prior identities (Opfer et al. 2011). Nine science teachers reported that they changed their classroom practice, yet they did not change their beliefs. My findings do not reflect Lew’s (2016), Woolhouse and Cochrane (2014; 2010), Bakkenes et al’s. (2010), and Battey and Franke’s (2008) findings in which they found that their teachers acquired knowledge and changed their beliefs more often than they changed their practices which they rarely reported. The claim to knowledge here is in terms of science teachers’ multiple realities of changing classroom practice and its effect on their professional identities.

The knowledge claims I make as a result of the foregoing discussion of my key findings are significant. Firstly, the significance of my findings on whether science teachers’ professional identity can be influenced by their experiences of their professional development programme is that, in most cases, they are not aligned with published reports in the literature. I do not claim that the outcome of my study is unique in terms of science teachers’ professional identity and their experiences. Secondly, science teachers’ professional identity prior to the

study was foregrounded as the common factor running through my discussions of the findings for each supporting research question. As such, the effect of such findings in influencing and reshaping their professional identities, contribute to the growing literature on science teachers' prior professional identities. Thirdly, I claim contrasting knowledge in the literature on multiplicity of identity, relationality of identity, and the influence of the dimensions of experiences on teacher learning, changes in beliefs, practice, and professional identity.

My study bridges the gap in the literature on inservice science teachers' renegotiated professional identities as well as my claim to knowledge on science teachers' professional identity. Such knowledge would be specifically relevant to the school board, the province of Ontario, and the wider science education community. However, from a contextual perspective, my findings could be of interest to stakeholders, providers of professional development programmes, and researchers not only within the Canadian context in which my study was conducted, but also in other contexts.

## **6.2 Implications of findings**

The importance of science teachers' professional identity in educational practice, educational research, theory development, and science education reform is underscored by its role in educational processes. Professional identity of teachers is developed between the teacher and his or her context, and so education cannot ignore the development of teachers' professional identity (Flum and Kaplan 2012). Beauchamp and Thomas (2009: 186) recommend that knowledge about context and communities and how they influence "the shaping of teacher identities" should be considered in science education programmes for beginning teachers, but I argue that such considerations are equally important for experienced teachers. Teacher professional identity evolves constantly due to changing contexts in terms of relationships, knowledge, emotions, ideas, and policies. As such it is important to take into account the reshaping of teachers' professional identities at every stage of their careers.

The development of science teachers' professional identity as a result of the influence of their experiences of their professional development programme has far-reaching implications. The providers of professional development programmes within the context of a school board and others who may be interested in promoting science education reform, would benefit from the findings from my study. My interpretation of the evidence led me to two conclusions. Firstly, science teachers' experiences of their professional development programme have some influence in shaping their professional identity. The implication for science teacher professional development is that awareness of their professional identity may provide them with the agency to enhance their classroom practice. As such, incorporating a professional identity component in their professional development programmes would benefit science teachers. Secondly, science teachers' prior professional identity had a crucial role in influencing the manner in which they negotiated their professional identities. As such, professional development providers should bear prior professional identities in mind as they design professional development programmes.

I have argued throughout this thesis that the potential for professional development programmes to foster development of professional identities cannot be ignored. In this study,

science teachers' learning as an experience of a professional development programme within a professional learning community, resulted, in new knowledge, social interactions, emotional changes and change in their practice. In the process, science teachers learned how to behave as certain types of science teachers (Wenger 2010; Gee 2001). The implications are for teacher educators and professional development programme providers to consider teacher identity development in planning such programmes. They need to indicate clearly their intentions of doing so in order for teachers to see themselves as teachers who can contribute to the science education reform process. Such programmes should include professional teaching communities that promote collaboration and sharing of ideas for professional growth. These efforts should clearly encourage teachers to reflect on their pedagogical choice, their practice, and their professional growth. Of course one cannot ignore the importance of teachers' prior professional identities in their learning, their decisions to change their practice, and their resulting professional identities and take them into consideration as they plan such programmes.

Generally, teachers are likely to have positive experiences during their professional development programmes. Such experiences can result in renegotiated professional identities and can provide new confidence in teachers' approach to teaching (Lumpe et al. 2012; Tymms et al. 2011; Senge 1990). The result may be that teachers, including science teachers in my study, might develop the agency to challenge and inspire their students. Furthermore, others in the science education community would likely pursue further research and initiatives in such areas that are likely to affect science teacher development or that of teachers of other subject areas and their classroom practice. One way in which these strategies can be applied is in situations where (science) teachers' professional development and their classroom practices are at issue. By focusing on teacher professional identity, professional development programme providers can tailor such programmes to ensure change in classroom practice.

The conceptual model of science teachers' professional identity that I developed in this thesis (Figure 5.1: 250) can be a theoretical guide to provide insight into the effect of attitudes, beliefs, roles, and context on professional identity. These factors can impact the reshaping of (science) teacher professional identity to change (science) teachers' knowledge and practice

as they participate in (science) education reform processes. The last supporting research question of whether science teachers' experiences influenced their professional identities can be addressed using my conceptual model since it reflects experiences that can potentially contribute to the renegotiation of professional identities. This conceptual model has implications for professional development providers and researchers in planning such programmes with the development of professional identities in mind.

### **6.3 Limitations of the research**

In exploring whether science teachers' professional identity can be influenced by experiences of their professional development programme, I focused on evidence provided by thirteen science teachers. This qualitative study was exploratory and designed to obtain as much evidence as possible from three different sources. The research design was based on methodological coherence by utilising tools that produced the appropriate evidence to address the research question. Some possible limitations of the research design and the ways in which they were addressed are discussed in this section. Possible limitations are researcher's subjectivity and theoretical framework, short time-span for the study, small sample size, and the methodological approach. Every effort was made to mitigate these limitations to ensure a rigorous and robust study.

I interpreted science teachers' narratives as I explored whether their professional identities were influenced by their experiences of their professional development programme. The science teachers' narratives revealed how they saw themselves as persons due to interactions (internal influences) and how other science teachers viewed them (external influences) (Pilen et al. 2013). In this study, I viewed science teachers' professional identities through the lens of the theoretical framework which focused on Wenger's (1998) community of practice. Such a view might have affected the manner in which I explicated science teachers' experiences despite my intention to do so by induction, as I identified themes. I neither asked science teachers directly whether their experiences influenced their professional identities, nor how they came by such knowledge. I did not establish their understandings of what constituted their professional identities. I sought this knowledge from narratives of their experiences based on my interpretation and understanding of the evidence. My understanding could have been influenced by my subjectivity during the research process, of which I was aware, the manner by which I identified themes, and how I reported the findings.

A longitudinal study might have provided more comprehensive evidence rather than the short, one-time cross-sectional study I conducted. I obtained evidence for a period of 8 months and during this time, I conducted 2 sets of narrative interviews, and administered a questionnaire. I met or spoke to participating science teachers for a total of 35 times. The evidence I

obtained proved to be enough to produce my findings. Given the nature of the professional development programme, it was not possible to conduct a longitudinal study unless there was the opportunity to arrange for the sample of science teachers to continue on with similar professional development programmes for over a longer period of time.

The small sample size of thirteen science teachers was appropriate for interpretive phenomenological analysis (Smith and Osborn 2008). I gleaned worthwhile insights regarding science teachers' experiences of their professional development programme in relation to their professional identity, from this sample of science teachers across the three modules. Different tools, such as narrative interviews, semi-structured interviews, and a questionnaire, made such an outcome possible. I analysed the evidence, which I obtained, individually for each science teacher within each module and then compared them modularly among science teachers in each module as well as across modules. I observed similar evidence across the modules which implied that the different tools produced comparable evidence. Because the evidence could represent the collective memories of the science teachers who participated in the professional development programme (Goodson and Choi 2008) such findings could apply to everyone who participated in the programme.

A phenomenological study can fit the criterion for generalisations if “representativeness and generalisability” can be achieved from a “small number of research participants” (Englander 2012: 20). As such, claims of generalisability can be made for all of the science teachers in the professional development programme, despite the small sample size. In this sense, I do not consider the small sample size as a limitation. The limitations of this study exist from the perspective of generalisability. I cannot conclude that the outcome of science teachers' professional identities due to their professional development programme, can be applied to all of the science teachers who participated in the professional development programme within the school board or in the wider science education field. However, the relatively small sample size facilitates transferability of this study to other contexts.

The methodological approach of hermeneutic phenomenology was fit for the purpose to explore science teachers' experiences of their professional development programme in relation to their professional identity. I utilised narrative interviews (Clandinin et al. 2009),

semi-structured interviews (Smith and Osborn 2008) and a questionnaire (Crotty 1998) to obtain evidence. However, my focus was on understanding the science teachers' narratives of their experiences of their professional development programme in relation to their professional identity. As such, the main methodological tool was narrative interviews which had the potential to reveal the lived experiences of the science teachers (Clandinin et al. 2009; Creswell 2013; 2006; van Manen 1997). This decision placed science teachers in control of the evidence that they provided, despite the schedule of the narrative interview which was used to focus the direction of the narratives and for clarification. If the direction of the science teachers' narratives via the narrative interview schedule was ignored, the evidence produced might have been richer in other areas, but less relevant to this study. I sought further understanding of the science teachers' experiences by utilising bespoke semi-structured interview schedules, which I developed for each science teacher. I prepared these schedules to elicit further clarifications from the first interviews and from my observations of the science teachers' activities during the professional development programme. I cannot say that I struck a balance between obtaining relevant evidence and allowing the science teachers to narrate their experiences as befitting a phenomenological study.

Perhaps the evidence could have been supplemented by science teachers' diaries which logged their thoughts about their experiences and might have yielded more rich and unexpected insights. Nevertheless, the research methods I utilised were advocated by researchers such as Creswell (2013; 2006) and Moen (2006) who found them suitable for a methodological approach such as hermeneutic phenomenology. A limitation might also exist in the questions I formulated for the questionnaire. I developed these questions based on my understanding of the dimensions of experiences found in the literature. External auditing of these questions might have contributed to the construction of more sound questions. Perhaps open-ended questions might have resulted in more insightful evidence.

#### **6.4 Contributions from findings, theory, and methodology**

I am unaware of any Canadian study that explored whether secondary school science teachers' professional identities can be influenced by experiences of their professional development programme. Studies on vocational teachers and their identities (Farnsworth and Higham 2012), science teachers' education and their identities (Pedretti et al. 2008), and on elementary pre-service science teacher identity (Yoon et al. 2006) within Canada exist. However, these do not address whether professional identities are influenced or reshaped by experiences of professional development programmes for secondary school inservice science teachers at various stages of their careers.

Contributions of findings resulting from this study are on science teachers' professional identities, the role of prior professional identities in reshaping professional identity, science teachers' learning, their professional development, learning within a community of practice, and science education reform. The influence of prior professional identities, and the four dimensions of experiences that I identified in this study, would be worthy of consideration by professional development providers and other researchers as they conduct studies on science teachers' professional development. Stakeholders within the school board, the province, and other researchers can explore any of these findings to enhance science education in a climate of science education reform. Finally, science teachers would benefit from knowledge of the influence of experiences of professional development programmes and the four dimensions of experiences on their professional identities. Knowledge of the effect of their experiences in enhancing their classroom practice can be a valuable tool in a climate of science education reform. Science teachers can be informed of the effect of their renegotiated professional identities on their agencies, and on their abilities to act as change agents in their classrooms.

I considered three sociocultural theories in constructing the theoretical framework that underpinned my study. They are the: Wenger's social theory of learning (Wenger 2009) which focused on community of practice (Wenger, 1998), social development theory (Vygotsky 1978), and the dialogical self theory (Hermans 2001). While a community of practice takes into consideration Wenger's (2009) social theory of learning, it does not consider Vygotsky's (1978) social development theory or Hermans' (2001) dialogical self

theory both of which are equally important. In view that science teachers' professional development was conducted in a professional learning community in which part of their learning was from more informed others and they engaged in dialogue, these theories warranted consideration although I subsumed them as I developed the theoretical framework.

Wenger's (2009) social theory of learning and Vygotsky's (1978) social development theory formed the framework for understanding and evaluating science teachers' learning in shaping their professional identities. The dialogical self theory (Hermans, 2001) highlights an area of learning easily neglected when considering and evaluating how learning occurs in relation to professional identity. The science teachers gleaned insights into their professional identities through dialogue among themselves within the community of practice and between them and me during the research process (Akkerman and Meijer 2011; Hermans 2001). Learning occurs as a result of dialogue. Adding such a dimension to the theoretical framework of studies on teacher education and their professional identities has the potential to enhance the research process. However, it must be noted that the focus of the theoretical framework was Wenger's (1998) community of practice since science teachers' experiences of their professional development programme in relation to their professional identity occurred within a professional learning community. I brought elements of the definition of science teachers' professional identity such as cognitive development, social interactions, and emotional changes into the framework that combined learning and community of practice. The design of the questionnaire was also informed by the theoretical framework and focused on cognitive development, social interactions, and emotional experiences.

Analysis of the evidence could have been conducted under the lens of the theoretical framework rather than by allowing themes to emerge. However, this was an interpretive study, and so, I was not guided by the theoretical framework as I tried to explicate the evidence. I allowed the evidence to speak to me in order to form themes. The categories of themes identified, reflected the dimensions of experiences. In such a case, use of this framework, including the three sociocultural learning theories, has situated my findings and my study among variations of theoretical frameworks that reflect Wenger's (1998) community of practice that underpin studies on teacher professional identity. My research is

transferable in that the method I utilised can be applied in different situations. As such, any study, underpinned by similar theories, can be applied to situations involving (science) teachers in different professional development programmes within the school board or in other contexts.

An interpretive hermeneutic phenomenological approach provided a clear understanding of science teachers' experiences. Such a methodological approach afforded me the use of narrative interview as a primary tool to obtain evidence. As such, science teachers had substantial input in the interview process since I was interested in their stories and made a conscious effort not to superimpose my ideas and influence their stories. Admittedly, I guided the research process when I informed science teachers of the focus of my study. I obtained rich and relevant evidence which I explicated. Such a methodological approach contributed to a different way of obtaining more authentic evidence based on science teachers' experiences than the semi-structured interviews alone, questionnaire alone, or both would have yielded. Such a methodological approach can be replicated in future studies as well.

## 6.5 Future studies

My findings have deepened understandings of the nature of professional identity and its connections to learning and professional growth. The evidence obtained have provided insights into the impact of science teachers' experiences, in relation to their professional identity, on their attitudes, beliefs, and values as well as on their tendencies to shape their practice. This study has shown that, to some extent, enhanced cognitive development, social interactions, emotional changes, and changes in beliefs and classroom practice can influence the shaping of science teachers' professional identities. I identified changes in beliefs and classroom practice as one of the category of themes during analysis, and as such, this category of theme warranted inclusion in my conceptual model of science teachers' professional identity. Such a conceptual model may be regarded as conjectural and further research in this area is needed to support or challenge my decision.

I inferred that the influence of science teachers' experiences of their professional development programme may be extrapolated to all of the science teachers who attended the professional development programme, but did not participate in my research. By extension it could be applied to all science teachers within the school board in which I conducted my study (Englander 2012). Such an inference is based on the collective memories of science teachers (Goodson and Choi 2008). The influence on science teachers' professional identity by experiences of their professional development programme depended on their roles within the professional learning community. These roles can determine the experiences and the negotiated professional identities of science teachers. More empirical studies with a larger sample of science teachers are needed to investigate further, the knowledge claims I made in this area of my study based on such an inference.

Many questions arose from various aspects of my research to understand the science teachers' experiences which suggested the need for further research. These questions arose from the methodological approach, the theoretical framework that underpinned my study, and the findings. Possible areas for further research could include:

- Conducting a longitudinal study to explore the sustainability of changes in professional identities as a result of experiences of professional development programmes.
- Conducting a similar study in different contexts.
- Exploring the role of gender in the outcomes of negotiated professional identities due to experiences of professional development programmes. The high ratio of women to men in my study prompted speculations whether the outcomes were gender related.
- Exploring the extent to which the professional identity of those science teachers, who cross borders as in second careers, or the unqualified science teachers who teach science to students whose first language is not English, become hybridised as a result of their experiences.
- Exploring science teachers' professional identity in terms of the balance of their sub-identities in education reform initiatives.
- Exploring whether science teachers became change agents as a result of science education reform initiatives.

## 6.6 Final thoughts

In exploring whether science teachers' professional identities can be influenced by their experiences of their professional development programme, I focused on narratives of their lived experiences. Analysis of their narratives revealed that most of them learned pedagogically, interacted socially, experienced different emotions, and improved their immediate practices as they applied their new learning in their classrooms. My findings concur, to some extent, with the literature on teacher learning and their perceptions of change in classroom practice (Luehmann 2007). Experiences of the science teachers' professional learning enhanced the classroom practice of nine science teachers while the other four did not do so because of professional constraints and not their experiences of their professional development programme. However, those experiences did not persuade eleven of them to change their professional beliefs. As such, I cannot infer that all of the science teachers renegotiated their professional identities. Clearly, a certain degree of disparity exists between my findings and those in the literature that speak of the direct relationship between teacher learning and perceptions of change in their professional identity (Woolhouse and Cochrane 2014; McNally and Blake 2012; Wenger 2010).

Two schools of thought arose as I rationalised my findings about science teachers' learning and their renegotiation of their professional identities. Firstly, a change in professional identity does not necessarily result from enhanced learning as Geijsel and Meijers (2005) attested. Secondly, although professional identity may be resistant to change, given that change is a complex and slow process, its negotiation is due to the knowledge gained and its integration into what teachers consider relevant to teaching (Beijaard et al. 2004). The implications are that either enhanced learning was not pivotal in shaping their professional identities, or, maybe they did learn, but the science teachers were unable to detect the relevance of their new knowledge to their teaching. It was beyond the remit of this study to test either Geijsel and Meijers' (2005) or Beijaard et al's (2004) arguments about teacher learning and its effect on their professional identity.

Science teachers' professional identity prior to this study influenced how they interpreted their learning experiences and the decisions they made to change their beliefs and practice.

Day et al. (2009) and Marcelo (2009) argue, and I concur, that teacher professional identity is a composite of their personal, professional, and situated sub-identities. The professional identity (science) teachers take to a professional development programme, comprises their experiences which stemmed from interactions from personal settings such as home and schools, initial education and professional learning, and the influence of professional contexts. Day et al (2009) refer to these experiences as dimensions of professional identity, and in their VITAE study, they found that teachers' responses to changes in their learning, depend on the balance among these three dimensions of identity. An imbalance of these dimensions of identity during professional development can cause science teachers to reshape their professional identity.

Day et al.'s (2009) VITAE study influenced the manner in which I conducted this study. I explored whether science teachers' professional identity can be influenced and reshaped by their experiences of their professional development programme as a science education reform measure. My inference reflects Day et al.'s (2009) conclusions about the importance of sub-identities that comprise teacher professional identity. There is the need to adjust the balance among the sub-identities in education reform initiatives so that science teachers can reshape their professional identity in response to science education reform. The inferences drawn from this research can be pursued and explored further in subsequent studies.

My conceptual model of science teachers' professional identity reflects the four themes identified in this study. Three of these formed part of my definition of science teachers' professional identity and they featured in the theoretical framework underpinning this study. The fourth theme, about changes in beliefs and classroom practice that emerged from analysis was not part of the theoretical framework. However, it is recognised as one of the factors that can influence professional identities (Wenger 2010; Marcelo 2009; Luehmann 2007). I focused on the four dimensions of experiences science teachers reported as a result of their experiences of their professional development programme in relation to their professional identity in developing my conceptual model. Synergism exists among these dimensions of experiences because they are intertwined, they resonate harmoniously among themselves such that they reinforce each other, and in the process they define science teachers' professional

identity in this study. Such a perspective can potentially frame further research into (science) teachers' professional identities and their professional development. These outcomes can inform science teaching communities of the importance of the influence of science teachers' experiences of their professional development programmes on their professional identities.

Other factors could be equally important in the process of science teachers' renegotiating their professional identities as a result of science education reform initiatives. It appears as though that might be the case in that my findings have shown that few of the science teachers have changed their beliefs of their professional selves. My research may inform stakeholders, policy makers, and those involved in developing professional development programmes with science education reform in mind, that re-educating science teachers may or may not cause them to renegotiate their professional identities. Those concerned with the future of science education can be made aware that other factors such as science teachers' prior professional identities, their social interactions, and emotions need to be considered in planning science education reform measures. Perhaps, science teachers should be given a voice in planning such professional development programmes, a gesture which can give them a sense of ownership of their learning.

My findings have implications for the assumption that science teachers would renegotiate their professional identities as a result of their re-education through professional development. It was hoped that science teachers would renegotiate their professional identities and thereby develop the agency to act as change agents in science education reform initiatives. Enhanced professional identities, as a result of renegotiation during professional development, can lead to classroom efficiency which has a significant role in science education reform initiatives. However, it must be noted that, in some cases, reform initiatives can affect the reshaping of established professional identities and beliefs, positively or negatively, depending on the context and whether teachers have a voice in formulating such initiatives (O'Connor 2008; Laskey 2005).

Findings from this research showed that the science teachers experienced enhanced cognitive development (12), negative and positive social interactions (13), and emotional changes (13). Such experiences have caused at least nine science teachers to apply their new learning in their

classrooms which indicated that they renegotiated their professional identities. Such renegotiated professional identities can result in assumed roles (Lumpe et al. 2012) which can lead to professional agency (Day et al. 2009). Professional agency refers to the science teachers' "quality of engagement" within the context and duration of their science education reform initiatives (Priestley et al. 2012: 3). The professional agency that the science teachers acquired informed them of their self-efficacy and change in beliefs, and can empower them to become change agents in the science education reform process (Pyhalto et al. 2012; Tymms et al. 2011). Notably, the remit of this research was not to find out whether the science teachers who participated in this research became change agents in their science education reform process. It was to explore whether their professional identities were influenced and reshaped by their experiences of their professional development programme as a science education reform initiative. As such, this study responds to part of the science education reform process. There is need to pursue studies to find out the effect of science teachers' learning on the development of agency to address reform needs in the classroom.

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Zemblyas, M. (2003) Interrogating “Teacher identity”: Emotion, Resistance, and Self-Formation, *Educational Theory*, 53(1): 107-127: <http://web.ebscohost.com> (accessed on August 10 2012).

## Appendices

### Appendix A1: Request for Ethical Approval

#### Request for Ethical Approval for Individual Study / Programme of Research by University Students

Please complete this form and return it to your Independent Studies Supervisor or Co-ordinator as advised by local guidance. Feedback on your application will be via your Independent Studies Supervisor or Co-ordinator

<b>1. Your Name:</b>	Shubhashnee Subryan	<b>2. Programme name and code</b>
		PhD Full time
<b>3. Contact Info</b>	Student ID: 100061942  Unimail address: S.Subryan1@unimail.derby.ac.uk	
<b>4. Module name and code</b>		
<b>5. Name of project supervisor (Director of Studies)</b>		
Dr. Julia Ibbotson		
<b>6. Title or topic area of proposed study</b>		
Can Professional Development Programmes Influence the Development of Professional Identities? A Study of		

One Secondary School Science Teachers' Professional Development Programme and the Development of Professional Identities.

## 7. What is the aim and objectives of your study?

### **What is science teachers' professional identity?**

Wenger (2000) describes identity as “a lived experience of belonging (or not belonging)” (p. 239). Identity is seen as what we know and what we chose to know and the construction of identity is the result of participation by engaging with the world (Wenger, 2000). Beijaard et al (2000), on the other hand, describe teachers' professional identity as the “ability and willingness to cope with educational change and to implement innovations in their own teaching practice” (p.750) in addition to “...the ways they see themselves as subject matter experts, pedagogical experts, and didactical experts” (p.751). In this study, science teachers' professional identity is viewed as a combination of their cognitive and social perspectives. That is, their identities are expressed in terms of how they perceive their roles as science teachers, who they would like to emulate as a result of their cognitive development and their social interaction, and their position within their school, school board and the wider educational community.

### **Clarification: Context of the professional development study**

This professional development programme is one among the various job-embedded programmes in place at the School Board to address system needs, teachers' interests and research recommendations. This programme focuses on Demonstration Classrooms in which secondary school science teachers volunteer to participate and they are involved in shared practice of observing, discussing and analysing student learning in order to enhance instructions.

The professional development programme under study consists of at least three sessions and therefore the expression “professional development activities” will imply these sessions.

**The aim of this study** is to explore emergent professional identities as a result of the engagement in professional development activities of secondary school science teachers in one school board in Ontario, Canada. This study does not aim to evaluate the professional development programme itself. This study will be conducted by examining what constitutes these science teachers' professional identities, the nature of the professional development programme, and whether this programme has any influence on the development of these teachers' professional identities. This will be achieved by use of non-participant

observations of the professional development activities, three reflective narrative interviews to explore the science teachers' experiences in the professional development activities, written biographical narratives of the science teachers' professional life histories to be done between interview sessions 1 and 2, and a follow-up questionnaire to gain an understanding of the professional development activities. The data collection tools and analysis procedures have been built around this. The non-participant observations do not aim to evaluate either the professional development programme or the facilitators but will be used as a form of field notes.

This study will be conducted within the framework of qualitative methodology with a phenomenological approach using narrative interviews, written biographical narratives, a rubric as field notes, and a questionnaire to elicit further understanding of teachers' experiences.

As such this study will:

- Seek to understand the nature of the professional development programme in which these science teachers participate
- Seek to gain insight with respect to the extent of the science teachers' participation through their actions during these professional development activities
- Explore the secondary school science teachers' professional identities to situate their current identities
- Examine the science teachers' experiences as they participate in these professional development activities
- Seek to determine whether there is a relationship between the professional development programme in which these science teachers participate and the development of their professional identities.

**The objectives of this study are to:**

- Determine the nature of the professional development programme in which these science teachers participate in terms of the knowledge gained, their social interaction and their affective experiences
- Gauge the extent of the science teachers' participation in this programme from the point of view of their interest, actions and willingness to share their expertise
- Understand and note the science teachers' perceptions of their professional identity prior to commencing their professional development activities to situate their beliefs and values as they begin their participation in the professional development activities under study
- Trace the cognitive, social and affective experiences of these science teachers as they participate in these professional development activities based on their responses to the

interviews and questionnaire

- Determine whether there is any subsequent change in these science teachers' perceptions of their professional identity due to these professional development activities by comparing their perceptions prior to the professional development activities with their perceptions as a result of their professional development activities
- Determine whether the professional development programme in which these science teachers participate has any influence on the development of their professional identities

**8. Brief review of relevant literature and rationale for study (attach on a separate sheet references of approximately 6 key publications, it is not necessary to attach copies of the publications)**

**Context:**

Educational debates about curricular areas of science education generally include not only biology, chemistry and physics when they refer to science but also technology and mathematics. However, the focus of this study is on teachers who teach biology, chemistry, integrated science and physics. From here on, this group of teachers will be referred to as 'science teachers'.

The call is for today's youths to be prepared in areas of science and technology to cope with the global advances in these areas in a rapidly evolving society (Perks et al, 2006). As such, the onus is on all teachers but more so on science teachers, who are required to be 'specialists' in subjects such as biology, chemistry and physics, to prepare these youths for the changes they will encounter. In the last two decades, Canada, the UK, and the USA have witnessed declining enrolment and performance in senior science programmes (e.g. Perks et al, 2006). It is in understanding the science teacher's professional experiences that appropriate programmes can be developed to re-educate science teachers to inspire, challenge and attract students to study science thereby addressing the issue of declining enrolment in science (Perks et al, 2006). The premise is that this re-education of science teachers, resulting in changes in their professional identities, can provide the stimulus and challenge to inspire students to engage and excel in the areas of science (Perks et al, 2006) while promoting scientific literacy and the pursuit of careers in science.

The researcher's interest in the area of science teachers' professional development and professional identity stems from her own experience as a chemistry teacher and her observation that some science teachers are able to apply successfully what they have learnt from their professional development activities in the classroom, while others have difficulties doing so (Battey and Franke, 2008). Studying science teacher professional identity enables one to understand how they participate in professional development programmes, how they learn, and how they take what they have learnt and not only apply it in their classrooms but share their expertise with their colleagues (Battey and Franke, 2008). This can

inform educational stake holders, professional development providers and science teachers of the need for a science teacher identity component in such programmes and can contribute to the growing body of knowledge about science teachers' identity and the appropriate professional development programmes in which to invest.

The professional development programme in the study, conducted by the School Board, is the Board's response to the call to address the issue of re-educating science teachers to inspire and challenge their students. Insight into these teachers' experiences of the professional development programme can inform whether such a programme can lead to enhanced changes in the attitudes, beliefs, and values of these teachers and therefore their identities. Such insights can also inform teachers of their expertise, how they learn and how they use their learning in their classrooms (Battey and Franke, 2008; Beijaard et al, 2000). This in turn may result in enhanced classroom practice and student outcomes in science.

In exploring whether there is a relationship between the professional development programme in which science teachers participate and their evolving professional identities, one needs to address the following questions:

- Does the nature of the professional development programme provide the opportunity for the science teachers' cognitive, social and affective growth?
- Does the professional development programme address the individual needs of the science teacher?
- Are the science teachers given opportunities to reflect on their classroom experiences and engage in collegial discussions about them?
- Does the science teachers' professional development programme inspire them to not only initiate discussions and challenge their students to realise their full potential but also to be mentors to their colleagues?

This study will explore the relationship between the professional development programme in which a set of secondary school science teachers will participate and the development of their professional identities. Exploring the professional development programme in this study within the framework of reflection on the science teachers' experiences and the meanings of these experiences will provide the participating science teachers with opportunities to reflect on their past and present experiences resulting in insights into, and having implications for their professional identities.

### **Survey of key literature:**

Batthey and Franke (2008) and Beijaard et al (2000), referring to teachers in general, have posited that the study of teacher professional identity is a viable way of documenting, analysing and understanding how teachers learn and how they use that learning in the classroom through a series of interpretations and reinterpretations. The interpretations of what teachers learn, their experiences and who they encounter in their professional life result in the teachers' perceptions of who they are and who they wish to be, their expertise, their professional development and their willingness to cope with changes (Beijaard et al, 2000). This is what defines and situates the teacher's professional identity. This applies to all teachers including the secondary school science teachers in this study. As such, the study of these secondary school science teachers' professional identities is important since it has the potential to inform these science teachers professionally and provide them with the confidence and knowledge to challenge their students to realise their full potential.

The theoretical lens through which I view the construct of the science teacher identity reveals both a social and a cognitive perspective. Whether it is a construct of the science teachers' professional community (Wenger, 2000) or their professional learning and growth (Beijaard et al, 2000), these two perspectives appear evident. From a social perspective, science teachers may have opportunities to interact with their peers in professional development sessions, with their community of practice, or within their subject departments. Such interactions may have the potential to enhance classroom practice and build professional confidence. Cognitively, professional development programmes can be a source of subject and pedagogical knowledge. The premise is that both produce knowledge growth for the science teacher thereby situating her in a position of not only a specialist in her specific science subject but also in the delivery of her lessons. Professional identities can foster empowerment for the more experienced science teachers so that they have the confidence to inspire students, be identified as experts, act as mentors, and eventually opt to head departments. It is their identities that determine how comfortable these teachers are with using new practices to teach content and therefore it determines how consistently they will do so (Batthey and Franke, 2008).

The aim of this study is to determine whether these science teachers grow professionally and their professional identities evolve as a result of their professional development activities. Such growth and evolution of professional identities have the potential to inspire these science teachers to assume new roles as they move through the continuum of their teaching career phases of novice, solo science teachers and eventually the retired science teachers (Batthey and Franke, 2008; Beijaard et al, 2000; Wenger, 2000). Thomas and Beauchamp (2011), Batthey and Franke (2008), and Beijaard et al (2000) have all conducted research on teachers' perceptions of their professional identities in which they

focused on:

- New teachers and how they describe their identities (Thomas and Beauchamp, 2011)
- Secondary mathematics teachers (Battey and Franke, 2008)
- Secondary teachers in several disciplines (Beijaard et al, 2000).

The research methods used ranged from formative qualitative (Thomas and Beauchamp, 2011) to Applied qualitative (Battey and Franke, 2008) to formative mixed-methods (Beijaard et al, 2000). In each study sampling was purposeful and qualitative data collections were observations, interviews, and field notes. Quantitative data collection, on the other hand consisted of questionnaires with open-ended questions. Qualitative data were coded and subjected to thematic analysis while quantitative data underwent descriptive statistics.

The findings from these studies revealed that teachers perceived that their individual professional identities and professional knowledge have a direct bearing on their classroom performance. Thomas and Beauchamp (2011) found that new teachers lacked confidence and experienced a sense of powerlessness professionally due to lack of “opportunities and experiences to develop a strong powerful identity” (p.767). Battey and Franke (2008) observed “shifts over time in participation” which “were small and slow in coming” due to different identities (p.145). Beijaard et al (2000), on the other hand, found that “most of the teachers saw themselves as combinations of subject matter experts, didactical experts and pedagogical experts”. The implications are for providers of professional development programmes and schools to rethink the nature of their professional development programmes so that they are aligned with the teachers’ professional needs.

There is a gap in the studies mentioned above in that there is no in-depth investigation of the professional identities of secondary school science teachers and their professional development programme. Literature search to date revealed an absence of studies which focus on secondary school science teachers’ identity and their professional development programme. This study intends to bridge that gap by focusing on these secondary school science teachers’ professional identity and the professional development programme in which they participate in one school board in Ontario, Canada. The focus here will be on collecting data using a phenomenological approach which will use primarily narrative interviews and written narratives as methods of data collection. The findings from this study can give the science teachers who participate in it, new perspectives of their professional roles and the confidence to adjust their attitudes, beliefs and values so that they are aligned with their perceptions of their evolving professional identities (Battey and Franke, 2008; Beijaard et al, 2000).

## **9. Outline of study design and methods**

The interplay between personal experiences of the science teachers and their professional landscape situates this study within the realm of the interpretative research paradigm. A predominantly phenomenological approach using a range of data collection methods and thematic content analysis of data obtained from the narrative accounts and the questionnaire will focus on the personal experiences of these science teachers and will involve their storied lives and narratives.

Permission to conduct research within the School Board will provide the agency for me to invite the group of science teachers who will be engaging in the professional development programme to participate in this study. The sample selection will be purposeful and opportunistic since it will be specific to the secondary school science teachers who chose to volunteer for the study. These science teachers will make up the sample of whose biographical narratives, narrative interviews, and responses to a questionnaire I intend to study. The sample size in this study will depend on the group size and composition of the participants of the professional development programme.

### **Four data collection events will be undertaken:**

**1. Non-participant observation** of the professional development activities focusing on the nature of these activities. A rubric will be used to record alignment with cognitive, social, and affective goals. Other observations at this time will be in the form of field notes.

**2. Narrative interviews and self-reflections** of the participating science teachers. The first and second interviews will be conducted 2 – 3 weeks after each professional development session to explore the extent of the science teachers' participation and their experiences in terms of the knowledge gained (cognitive), their resulting attitude (social), and their emotional involvement (affective) as a result of the professional development sessions. The third interview will be conducted 3 – 4 months after the third professional development session to determine whether these sessions have any effect on the participants' classroom practice.

**3. Written biographical narratives** to identify the science teachers' perception of their professional identities at the commencement of their professional development activities. This will be administered between the first and second interviews.

**4. Questionnaire** to determine the extent to which the science teachers' experiences in the professional development activities contributed to their cognitive, social, and affective developments. This will be administered during the final interview.

**Conflicts** due to these science teachers' realities, experiences and expressions in their narratives can be addressed by active listening, building trust, having multiple interviews and non-participant observation of the professional development sessions (Polkinghorne, 2007).

**Data collected:** The non-participant observations will be recorded in the rubric

The narrative interviews will be audio-recorded and transcribed

The written narratives and questionnaire will be collected in written form.

**Analysis:** All narrative data and non-participant observation data will be analysed by identifying and coding themes

for content analysis using appropriate technological support.

Responses to the questionnaire will be analysed by identifying and coding themes as well as by descriptive statistics.

**Reliability:** The data collected must relate to the research question. By taking an objective research stance and using the various data collection instruments for triangulation, the reliability of the research activity will be enhanced (Polkinghorne, 2007).

**Validity:** By specifying what counts as evidence and using data collected through understanding of the experience and reflections of the participants, the validity of the research activity will be enhanced (Polkinghorne, 2007).

### References:

Battey, D. and Franke, M.L. (2008) Transforming Identities: Understanding Teachers across Professional Development and Classroom Practice. *Teacher Education Quarterly* [online] Summer 2008, pp. 127 – 149 Available from: [web.ebscohost.com](http://web.ebscohost.com) [Accessed October 16 2011].

Beijaard, D., Verloop, N. and Vermunt, J.D. (2000) Teachers' perceptions of professional identity: an exploratory study from a personal knowledge perspective. *Teaching and Teacher Education* [online] 16 pp. 749 – 764 Available from: <https://talis-list.derby.ac.uk> [Accessed October 15 2011].

Perks, D.; Sykes, R.; Reiss, M.; Singh, S.; Warnock, M.; Hunt, A.; Forster, E.; Iddon, B.; Teare, H.; Lawless, G.; Farnington, C.; Kestenbaum, J.; Mellor, I.; Hearn, S.; Sargent, M.; O'Brien, H.; and Martin, P. (2006) *What is science for?* London: Signet House.

Polkinghorne, D.E. (2007) Validity Issues in Narrative Research. *Qualitative Inquiry* [online] 13(4) May, pp. 471 – 486 Available from: [web.media.mit.edu/~kbrennan/mas790/07Polkinghorne,Validity issues in narrative research.pdf](http://web.media.mit.edu/~kbrennan/mas790/07Polkinghorne,Validity%20issues%20in%20narrative%20research.pdf) [Accessed October 12 2011].

Thomas, L. and Beauchamp, C. (2011) Understanding new teachers' professional identities through metaphor. *Teaching and teacher Education* [online] 27 2011, pp. 762-769. Available from: <http://www.talis-list.derby.ac.uk> [Accessed September 16 2012]

Wenger, E. (2000) Communities of Practice and Social Learning systems. *Organisations* [online] 7(2) May, pp. 225 – 246 Available from: [home pages.abdn.ac.uk/n.coutts/pages/Radio4/Articles/wenger2000.pdf](http://home.pages.abdn.ac.uk/n.coutts/pages/Radio4/Articles/wenger2000.pdf) [Accessed October 16 2011].

### 10. Research Ethics

#### PROPOSALS INVOLVING HUMAN PARTICIPANTS MUST ADDRESS QUESTIONS 10 - 14.

Does the proposed study entail ethical considerations Yes / No (please circle as appropriate)

If 'No' provide a statement below to support this position.

If 'Yes' move on to Question 11.

**11. Ethical Considerations: Please indicate how you intend to address each of the following in your study. Points a - i relate particularly to projects involving human participants.**

**Guidance to completing this section of the form is provided at the end of the document.**

#### **a. Consent**

In order to obtain consent from the participants, I intend to meet with the prospective participants on the first day of the professional development programme. After introducing myself in terms of who I am, I will give detailed information about why I am pursuing this study, how it will be of benefit to them, what is involved in the research process, the number of interviews, and the length of each interview session. I will also take the opportunity to assure the participants that I will follow the ethical guidelines stipulated by The British Educational Research Association (2011) and the University of Derby (2011). I will also mention to the participants that they have the right to withdraw from the study at any point should they wish to do so except after data analysis begins. This information will also be in the contract.

At this point, I will distribute a letter of invitation to them which has a cut off part at the bottom so that they can indicate to me whether they are willing to participate in the study. My name and e-mail address will also be in the letter so that the participants can contact me for further clarification about the study and their options. At that time I will distribute to each participant, a contract for consent to participate in this study should they decide to do so. The participants will be required to read and sign the contract and return it to me on their way out.

#### **b. Deception**

The data collected in this study will be all that is required and pertain to answering the research questions stated above.

#### **c. Debriefing**

A debriefing session will be only to advise the participants that data will be analysed and the findings will be included in my thesis. Again I will assure them of the confidentiality of my writings and my intent to preserve their anonymity.

**d. Withdrawal from the investigation** the participants will be advised of their right to withdraw from the investigation at any stage without repercussions. This will be stated in the letter of invitation and also on the consent forms.

**e. Confidentiality**

The participants' confidentiality and anonymity will be assured since I will be the only one who will listen to the tape recordings and have access to the interview transcripts. At the same time I will use pseudonyms to protect the confidentiality and anonymity of the professional development programme and the participants.

**f. Protection of participants**

The activities in which the participants will be required to participate will not warrant any physical protection. However, I will use pseudonyms to protect the anonymity of the professional development programme and the participants. In addition, I will ensure that I do not engage the participants in conversations that may cause emotional or psychological distress to them.

**g. Observation research [complete if applicable]**

I will engage in non-participant observations of the professional development sessions. The observations required during this study will be that of observing the participants and others engaged in the professional development activities. During this process I will be taking field notes, using a rubric and narrating my observations. Everyone participating in the professional development programme will be advised of the reason for my presence during those sessions.

**h. Giving advice**

My role as a researcher does not permit me to give advice to participants and so I will be vigilant in making sure that whatever I say to the participants does not imply advice and I will also maintain my objectivity

**i. Research undertaken in public places [complete if applicable]**

Non-participant observations will be done at the venue where the professional development programme will be held. All of the interviews will be conducted at a place specified by each participant for their convenience.

**j. Data protection**

During the time of the study, all data will be stored in my password protected computer and USB which will be closely guarded in a locked safe at all times.

**k. Animal Rights [complete if applicable]**

Not Applicable

**l. Environmental protection [complete if applicable]**

Not Applicable

**12. Sample: Please provide a detailed description of the study sample, covering selection, number, age, and if appropriate, inclusion and exclusion criteria.**

The sample selection will be purposeful and opportunistic since it will be specific to the secondary school science teachers who chose to volunteer for the study. These science teachers will be from the pool of those who volunteer to participate in the professional development programme provided by the school board. Letters of invitation to volunteer to participate in the study will be given to all of these teachers at the start of the professional development programme. As such, the sample coverage will depend on how many teachers participate in the professional development programme and how many volunteer to participate in the study. These science teachers will make up the sample of whose biographical narratives, narrative interviews, and responses to the questionnaire I intend to study. The sample size in this study will depend on the group size and the composition of the participants in the professional development programme. I anticipate the number to be between 12 and 20.

**13. Are payments or rewards/incentives going to be made to the participants? If so, please give details below.**

No

**14. What study materials will you use? (Please give full details here of validated scales, bespoke questionnaires, interview schedules, focus group schedules etc. and attach all materials to the application)**

**1. Non-participant observation** of the professional development activities focusing on the nature of these programmes using a rubric to record alignment with cognitive, social, and affective goals. Other observations at this time will be in the form of field notes.

- 2. Narrative interviews and self-reflections** of the participating science teachers. The first and second interviews will be conducted 2 – 3 weeks after each professional development session to explore the science teachers' experiences in terms of the knowledge gained (cognitive), their resulting attitude (social), and their emotional involvement (affective) as a result of the professional development sessions. The third interview will be conducted 3 – 4 months after the third professional development session to determine whether these sessions have any effect on the participants' classroom practice.

**Sample of questions:**

What are your perceptions about the professional development session in which you have just participated?

Please give as much detail as possible in terms of: your feelings about the professional development session; the benefits you perceive that you and your students will gain; whether the session helped you to rethink your approach to teaching on the whole or to teaching a specific topic; whether it has influenced you to change your teaching style; and whether you have perceived any change in yourself as a science teacher.

- 3. Written biographical narratives** to identify the science teachers' perceptions of their professional identities at the commencement of their professional development programme. This will be administered between the first and second interviews. The purpose of the written narrative is to let these science teachers tell their stories without interruptions and therefore there will be a single question to initiate the narrative.

**Question:** Can you please narrate to me your professional life history? Start from when you decided to become a science teacher, what or who influenced your decision, the circumstances surrounding this decision and continue on to your present time.

- 4. A Questionnaire** consisting of eighteen questions to determine the extent to which the science teachers' experience in the professional development activities contributed to their cognitive, social, and affective developments. This will be administered during the final interview.

**Samples of the rubric, narrative interviews and questionnaire are attached.**

**15. What resources will you require? (e.g. psychometric scales, equipment, such as video camera, specialised software, access to specialist facilities, such as microbiological containment laboratories).**

I will be using my laptop computer to audio-record all interviews and conversations during this study. This laptop will either be with me or in a locked cabinet drawer at all times. It is password protected as well.

**16. Have / Do you intend to request ethical approval from any other body/organisation ? Yes / No (please circle as appropriate)**

**If 'Yes' – please give details below.**

I will apply to the School Board for permission to conduct this study since I intend to select science teachers from their pool of science teachers and the professional development programme is their initiative. This is a formal application which can only be submitted to the external research department after I have gained approval from the Ethics Approval Committee of the University of Derby. It is only after the school board grants me permission to conduct the research will I be able to seek permission from the programme coordinator for science and technology to observe the professional development activities that constitute the professional development programme.

17. The information supplied is, to the best of my knowledge and belief, accurate. I clearly understand my obligations and the rights of the participants. I agree to act at all times in accordance with University of Derby Code of Practice on Research Ethics <http://www.derby.ac.uk/research/ethics/policy-document>

Date of submission.....November 30, 2012.....

Signature of applicant.....*[Signature]*.....

Signature of project supervisor (Director of Studies) .....

*For Committee Use*

Reference Number (Subject area initials/year/ID number).....

Date received..... Date approved ..... Signed.....

Comments

**PLEASE SUBMIT ALONG WITH THIS APPLICATION THE FOLLOWING DOCUMENTATION WHERE APPROPRIATE (please tick to indicate the material that has been included or provide information as to why it is not available):**

Questionnaires/Interview schedules

Covering letters/Information sheets

Briefing and debriefing material

Consent forms for participants

## Appendix A2: Ethics approval from University of Derby



### *Approval Letter*

**Date:** 20/12/12

**Name:** Shubhashnee Subryan

Dear Shubhashnee,

**Re: Request for ethical approval for study entitled: Can Professional Development Programmes Influence the Development of Professional Identities? A Study of One Secondary School Science Teachers' Professional Development Programme and the Development of their Professional Identities.**

Thank you for submitting your application for the above mentioned study which was considered by the Social Studies and Post Graduate Research Ethics Committee (SSPG REC) on Thursday, 8<sup>th</sup> November, 2012.

Your study has now been **approved** following resubmission on 30<sup>th</sup> November which included the required additional information.

Should you have any queries, please do not hesitate to contact the Chair of the committee, Dr Vivienne Walkup:

Yours sincerely

Vivienne Walkup

Chair of the Social Studies and Post Graduate Research Ethics Committee

## Appendix A3: Permission to conduct research from the School Board



October 2, 2013

Dear Subryan Shubhashnee,

*Can Professional Development Programmes Influence  
the Development of Professional Identities?*

On September 26<sup>th</sup>, 2013 the External Research Review Committee (ERRC) of [REDACTED] District School Board considered and accepted your new research proposal which incorporated some design modifications based on last year's pilot study.

Before proceeding however, please confirm or comment on the following items:

- What is the expiry date for the Derby ethics certificate?
- Can you confirm that the specific "Exploration Classrooms" modules are in fact being delivered again this year and that the [REDACTED] Program Coordinator of Science & Technology agrees to your involvement as before?
- Do you have an estimate of the potential number of participants in those professional learning modules or a projected/ desired number of volunteers for your research study?
- In respect of teachers' time, we questioned whether the repetition of the identical set of questions on three separate occasions was warranted. Could one round be eliminated?
- Since you are no longer using a specific observation "rubric", it is suggested you share more detail with both the PL providers and the participants in your information/ consent letters about the intended focus of your observations.

In advance of the study, please forward your follow-up responses and/or modifications to my attention so that we have those on file. Upon completion, we will also look forward to a copy of your summary findings (expected November 2015)

Sincerely,

A handwritten signature in black ink, appearing to read "D. [REDACTED]", is written above the typed name.

[REDACTED]  
External Research Review Committee [REDACTED]

E-mail: [REDACTED]

[REDACTED] Program Coordinator of Science & Technology

#2013-2014-04  
(Cross-referenced with pilot 2012-13-61)

## **Appendix A4: Invitation to science teachers to participate in pilot and main study**

Dear Secondary School Science Teacher,

Does your experience of your professional development programmes influence and change your professional identity?

I am a PhD student at the University of Derby, UK, under the supervision of Dr Julia Ibbotson. I am collecting data for a study of professional identities of secondary school science teachers in Ontario and their experiences of their professional development programme.

The aim of this study is to explore whether secondary school science teachers' experiences of their professional development programme has any influence on the development of their professional identities. It is hoped that the benefits to you will include:

- Insights regarding your expertise and attitude towards your classroom practice as you interpret your experiences
- Self-awareness of your role as a science teacher
- Knowledge of your emergent professional identity as you participate in your professional development programme

I therefore invite you to participate in this study. It will involve your commitment to:

- Two interviews, each lasting for about twenty minutes. The first interview will be conducted after the second professional development activity while the second will be conducted within two weeks after the completion of the professional development programme. The location for these interviews will be confirmed later.
- A written narrative of your professional history/biography.
- A questionnaire consisting of 3 parts each having six questions for you to respond to from a scale of 1 to 4. This will take approximately fifteen minutes of your time.

I assure you that in doing this study I will be adhering to the ethical guidelines stipulated by the British Educational Research Association (2011), the University of Derby (2011) and the Canadian Ethics Federation (2010). Your participation is entirely voluntary and I will ensure the confidentiality and anonymity of your interview, biography and survey. I assure you that I

will keep your name and the professional development programme in which you participate confidential by using pseudonyms in the ensuing report to ensure your anonymity. Your responses will be strictly confidential. I also assure you that you have the right to withdraw from the study at any point without repercussions. That is, before I inform you that I have started my data analysis.

I thank you as I express my gratitude and appreciation in anticipation that you would volunteer to engage in this study. Please fill out your contact details at the back of this page should you be interested.

Shubhashnee Subryan

PhD Candidate

University of Derby, UK

E-mail: S.Subryan1@unimail.derby.ac.uk

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I am willing to participate

I am not willing to participate

Contact details:

Name: \_\_\_\_\_

Tel# & e-mail: \_\_\_\_\_

## **Appendix A5: Letter of agreement for research in pilot and main study**

### **An exploration of whether science teachers' professional identity can be influenced by experiences of professional development programmes.**

I voluntarily agree to participate in this research study on secondary school science teachers' professional identity and the professional development programme in which they participate in Ontario, Canada. I understand that this study is being conducted by Shubhashnee Subryan to satisfy the requirement for the PhD programme at the University of Derby, UK, under the guidance of Dr Julia Ibbotson.

I am happy to participate in the following events:

- Two interviews, each lasting for twenty minutes, the first of which will be conducted after the second professional development activity and the second will follow within two weeks of the completion of the professional development activities. These interviews will be based on my experiences of the professional development programme in which I participate
- A written narrative of my professional life history
- Answering a questionnaire relating to my professional development experiences which will take approximately fifteen minutes

I grant permission for the interviews to be audio-recorded and transcribed or noted on paper and used for analysis anonymously. I understand that there will be no risks to me and that the researcher will follow the ethical guidelines stipulated by the British Educational Research Association (2011), the University of Derby (2011), and the Canadian Ethics Federation (2010). I am also assured of confidentiality and anonymity in the analysis, discussion, and dissemination of findings. I agree that the information obtained would be used solely to fulfil the requirement for the thesis for the PhD programme in which the researcher is enrolled. I am aware of my right to withdraw at any time during the study up to April 1, 2014 at which point, I am informed, data analysis and write-up will commence.

Name: \_\_\_\_\_

Signature: \_\_\_\_\_

**Date:** \_\_\_\_\_

## **Appendix B: Original tools (Pilot study)**

### **Appendix B1: Written narrative of participants' professional life history**

In my letter inviting you to participate in this study, I indicated that I am exploring whether a secondary school science teachers' professional development programme can influence the development of their professional identities. One type of data I am gathering is your professional life history as a science teacher.

As you have agreed to provide me with a written account of your professional life history, I would ask that, in about 500 words, you start wherever you wish and take your time in writing about your professional life history. As you narrate your story please use the following questions as guidelines to cover the relevant information that I need.

- When did you decide to become a secondary school science teacher?
- Who or what influenced your decision?
- What circumstances contributed to or were in conflict with your decision?
- What educational pathways did you follow to achieve your goal?
- What was your initial teacher training programme like?
- What was your first teaching assignment like?
- Describe your experience of your initiation into the teaching profession.
- Describe your experience of the subsequent professional development activities in which you engaged up to this point in time.
- Describe anything else that you think you would like to add to shed light on your professional life history to this point.

After you have finished writing your professional life history, please send it to me at [S.Subryan@unimail.derby.ac.uk](mailto:S.Subryan@unimail.derby.ac.uk) or hand it in to me personally.

**Thank you**

## **Appendix B2: Narrative interviews of current professional development programme**

In my letter inviting you to participate in this study, I indicated that I am exploring whether a secondary school science teachers' professional development programme can influence the development of their professional identities. I am focusing on your experiences of the professional development programme in relation to your professional identity to explore whether those experiences have any influence in shaping your professional identity.

As you have agreed to have this interview between us audio recorded, I would suggest that you start wherever you wish and take your time as you relate your experience of the professional development programme in which you have are participating. I will listen to you without interruption but I will take notes from time to time to remind me of those matters on which I need clarification. I will seek such clarification only after you have finished telling me your story. Additional relevant experiences would be very insightful to me. As a guide to assist in your narration, please describe as fully as you can in your narration:

- Your perspectives and emotions during the professional development activity
- The relevance of the professional development session to your professional needs
- Any subject and pedagogical knowledge you may have gained
- The experience(s) which was (were) most meaningful to you
- Any event which may have had an impact on you or your career
- Whether your participation in the professional development activity has changed your perspective of your role as a science teacher
- Whether your participation in the professional development activity has caused you to rethink your approach to teaching your subject
- Any aspect of your professional development programme that you would like to take to your classroom
- The extent to which you may have left the professional development session with enthusiasm to share what you have learnt with your peers
- Please feel free to add any other observations, comments and opinions that you feel would elaborate on your experience of the professional development session. Thank you

### **Appendix B3: Questionnaire: Influence of Professional Development Activities on the Development of Secondary School Science Teachers' Professional Identities**

“Professional development programmes are systematic efforts to bring about change in the classroom practices of teachers, their attitudes and beliefs, and the learning outcomes of students” (Guskey, 2002:381). This questionnaire is based on experiences of professional development programmes that may lead to the development of your professional identity. Your input will elicit your perceptions of the programme and identify prevalent perspectives.

This questionnaire consists of **three** parts and requires **six** responses in each part. It would take approximately fifteen minutes of your time to complete and the results will be used as part of the findings in the study.

Please be as candid as possible in your response. I guarantee the confidentiality and anonymity of your response.

**There are six statements in each part of the questionnaire. Please select your response from the choices provided for each statement.**

**The responses provided are on a scale of 1 to 4 where:**

**1. – Strongly agree**

**2. – Agree**

**3. – Disagree**

**4. – Strongly disagree**

**Section A: These questions address your cognitive development. Considering the professional development activities in which you have participated recently, indicate the degree to which you:**

1. Gained subject knowledge

**1      2      3      4**

2. Gained pedagogical knowledge

**1      2      3      4**

3. Better understood concepts to answer students' questions

**1      2      3      4**

4. Developed confidence to initiate class discussions on science related topics with confidence

**1      2      3      4**

5. Used new practices such as inquiry based methods to present your lesson

**1      2      3      4**

6. Have the confidence to take ownership of your own learning

**1      2      3      4**

**Section B: The following six statements describe the social experiences you may have had during /and as a result of your recent participation in the professional development activities.**

**1. I have learnt to cope with professional changes resulting in my professional growth**

**1      2      3      4**

**2. I have learnt to appreciate my peers' points of view**

**1      2      3      4**

**3. Sharing ideas with colleagues in these sessions has given me the opportunity to form networks that I can use professionally**

**1      2      3      4**

**4. Sharing ideas with colleagues in these sessions helped me to understand better the new concepts better**

**1      2      3      4**

**5. Embedded collaboration through mentoring and co-teaching was encouraged**

**1      2      3      4**

**6. I engaged in debriefing sessions after a lesson or presentation to the group**

**1      2      3      4**

**Section C: The six statements below relate to your emotions and describe how your professional development activities can enhance or foster your confidence as a science teacher.**

1. I was provided with positive feedback on individual and group presentations

**1      2      3      4**

2. My peers and facilitators recognised my contribution in the professional development activities

**1      2      3      4**

3. I was given time for self-reflection, self-understanding and self-revelation

**1      2      3      4**

4. I can buy-in to new methods of science teaching despite my older beliefs and values

**1      2      3      4**

5. I had opportunities for self-comparison to promote my growth and confidence

**1      2      3      4**

6. I can discern and maintain my identity within the profession and the wider community

**1      2      3      4**

**Thank you for your time.**

**Appendix B4: Non-Participant Observation of Professional Development Activity Rubric**

**Title of Activity:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Name of Participant:** \_\_\_\_\_

<b>Dynamics of Professional Development Activity -</b>	<b>Criteria</b>			
	<b>Excellent</b>	<b>Very Good</b>	<b>Satisfactory</b>	<b>Unsatisfactory</b>
Alignment with teachers' cognitive goals – subject and pedagogical knowledge	Aligned with cognitive goals. It clearly addressed all of the teachers' needs and may lead to new learning	Aligned to some extent. Teachers' needs were not fully addressed. Not all needs were addressed. New learning may result	Some evidence of alignment. Limited subject/pedagogical needs were addressed. New learning may be in one area only	Not aligned with the teacher's cognitive goals. Teachers may not learn anything new
Development of teachers' social goals – collaboration group performance interaction decision-making participation sharing respect for peers responsibility	Provided ample opportunities for teachers to experience the social goals listed. Teachers were able to contribute and share ideas, take responsibility and make decisions, and value other's ideas	Most but not all of the opportunities were provided. Some goals were absent. Teachers were able to interact with their peer to some extent. Sharing of ideas and collaboration on activities occurred to some extent	Very few opportunities were provided. Teachers' interaction with peers was very limited. There was very little activity in terms of sharing of ideas and collaboration.	None of the opportunities were provided to teachers. There was no evidence of any social interaction among teachers

**Appendix B4: Non-Participant Observation of Professional Development Activity Rubric  
(continued)**

<b>Dynamics of Professional Development Activity -</b>	<b>Criteria</b>			
	<b>Excellent</b>	<b>Very Good</b>	<b>Satisfactory</b>	<b>Unsatisfactory</b>
Components of affective outcomes – teachers’ attitudes, beliefs and perceptions regarding teaching and their professional self emotions triggered	These affective outcomes were included and addressed fully. May lead to change in how teacher sees herself professionally	Some of these outcomes were addressed. May not lead to change in teacher’s concept of professional self	Very little attention was paid to these outcomes. The teacher did not have to opportunity to reflect on their professional self	Affective outcomes were not included in the activities.
Degree of engagement in the session – punctuality contribution enthusiasm cooperation initiation of discussions collaboration with peers	Teachers were fully engaged with the activities in the session. They seem receptive to applying what they learnt in their classrooms	Some teachers were not fully engaged with all the activities in the session. Some teachers were not as attentive and not willing to participate in all the activities	Very few teachers showed any degree of engagement with the activities. Interest in and the attention to the activities were minimal	Teachers were not engaged in any of the activities. There was no evidence of enthusiasm, cooperation, initiation of discussions

**Appendix B4: Non-Participant Observation of Professional Development Activity Rubric  
(continued)**

<b>Dynamics of Professional Development Activity -</b>	<b>Criteria</b>			
	<b>Excellent</b>	<b>Very Good</b>	<b>Satisfactory</b>	<b>Unsatisfactory</b>
Reform-based strategies that may result in identity development – evidence based practice student-centeredness collaboration opportunities for feedback lack of predefined expectations, roles, routines co-teaching group work mentoring professional presentations post-teaching debriefing use of blogs and journals by teachers	All elements listed are present. The teachers are actively involved in all aspects of reform-based strategies	Most of the reform-based strategies were present and teachers participated fully	Very few of the reform-based strategies were present and teachers participated in them	Absence of any reform-based strategies.

**Notes:** \_\_\_\_\_  
 \_\_\_\_\_

## Appendix C: Amended Tools

### Appendix C1: Written narrative schedule for main research

**Research Question:** Can science teachers' professional identities be influenced and shaped by their experiences of their professional development programmes?

In my letter inviting you to participate in this study, I indicated that my study involves exploring whether your experience of the professional development programme in which you participate can influence the development of your professional identity. To this end, an account of your professional biography will provide one source of evidence I need to analyse in order to address my research question.

As you have agreed to provide me with a written account of your professional biography, I would ask that you start wherever you wish and take your time in writing about your professional biography. As you narrate your story please use the following questions as guidelines to cover the relevant information needed.

- When did you decide to become a secondary school science teacher?
- Who or what influenced your decision?
- What circumstances contributed to or were in conflict with your decision?
- What educational pathways did you follow to achieve your goal?
- What was your initial teacher training programme like?
- What was your first teaching assignment like?
- Describe your experience of your initiation into the teaching profession.
- Describe your experience of the subsequent professional development activities in which you were engaged up to this point.
  
- Describe your professional relationship with your peers, professional organisation, and the wider professional community.
  
- How would you describe your professional identity at this point in your career?
- Describe anything else that you think you would like to add to shed light on your professional biography to this point.

Please return to me at [S.Subryan1@unimail.derby.ac.uk](mailto:S.Subryan1@unimail.derby.ac.uk) or hand it in to me personally.

**Thank you**

## **Appendix C2: Narrative interview schedule for main study**

In my letter inviting you to participate in this study, I indicated that I am exploring whether a secondary school science teachers' professional development programme can influence the development of their professional identities. I am focusing on your experiences of the professional development programme in relation to your professional identity to explore whether those experiences have any influence in shaping your professional identity.

As you have agreed to have this interview between us audio recorded, I would suggest that you start wherever you wish and take your time as you relate your experience of the professional development programme in which you have are participating. I will listen to you without interruption but I will take notes from time to time to remind me of those matters on which I need clarification. I will seek such clarification only after you have finished telling me your story. Additional relevant experiences would be very insightful to me. As a guide to assist in your narration, please include and describe as fully as you can in your narration the:

- Relevance of the professional development session to your professional needs
- Emotions you experienced during the professional development programme
- Subject and pedagogical knowledge you may have gained
- Experience(s) which was (were) most meaningful to you
- Experiences which may have influenced your classroom practice
- Possibility of you changing your perspective of your role as a science teacher
- Possibility of you rethinking your beliefs and values as a science teacher
- Possibility of you changing your approach to teaching your subject
- Aspect of your experience that you would like to take to your classroom
- Enthusiasm to share your experiences with your peers at the end of the session
- Way in which your experience might have an influence on shaping your professional identity

Please feel free to add other observations, comments, and opinions that add to your experiences.

**Thank you**

## **Appendix C3: Questionnaire in main study**

**Research Question: Can science teachers' professional identities be influenced by their experiences of their professional development programmes?**

**This questionnaire is based on your experiences of the professional development programme in which you are participating. Analysis of your response will contribute to findings that may address the research question.**

**This questionnaire consists of three parts and requires six responses in each part. It would take approximately fifteen minutes of your time to complete and the results will be used in the analysis of this study. Maybe the nature of the module of the professional development programme in which you participate does not allow you to respond to all three parts. You are asked to answer the parts of the questionnaire that apply to you specifically – whether it is all three parts, two or only one of them.**

**Please be as candid as possible in your response. I guarantee the confidentiality and anonymity of your response. You have the right to withdraw from this study before the analysis of the questionnaire begins which will be one week after I have received the completed questionnaire from you.**

**Please return the questionnaire to me in person or return by e-mail**

**There are six statements in each part of the questionnaire. Please select your response from the choices provided for each statement by circling the number that corresponds to your choice.**

**The responses provided are on a scale of 1 to 4 where:**

- 1. – Strongly agree**
- 2. – Agree**
- 3. – Disagree**
- 4. – Strongly disagree**

**There are six statements in this part of the questionnaire. Please select your response from the choices provided for each statement.**

**The responses provided are on a scale of 1 to 4 where:**

- 1. – Strongly agree**
- 2. – Agree**
- 3. – Disagree**
- 4. – Strongly disagree**

**Section A: These questions address your cognitive development (Subject knowledge and/or Pedagogical knowledge). Please respond to the statements that apply to you. Based on your experiences of the professional development programme in which you have participated recently, please indicate the degree to which you:**

**1. Gained subject knowledge**

**1      2      3      4**

**2. Gained pedagogical knowledge**

**1      2      3      4**

**3. Better understood concepts to answer students' questions**

**1      2      3      4**

**4. Initiated class discussions on science related topics with confidence**

**1      2      3      4**

**5. Used new practices such as inquiry-based methods to present your lesson**

**1      2      3      4**

**6. Have the confidence to take ownership of your own learning as an individual or as a science teacher**

**1      2      3      4**

**There are six statements in this part of the questionnaire. Please select your response from the choices provided for each statement.**

**The responses provided are on a scale of 1 to 4 where:**

- 1. – Strongly agree**
- 2. – Agree**
- 3. – Disagree**
- 4. – Strongly disagree**

**Section B: The following six statements describe the social experiences you may have had during/and as a result of your recent participation in the professional development activities.**

1. I have the confidence to apply what I have learnt from the programme and my peers to make professional changes due to my professional growth

1   2   3   4

2. I have learnt to appreciate my peers' points of view

1   2   3   4

3. Sharing ideas with colleagues in these sessions has given me the opportunity to form networks that I can use professionally

1   2   3   4

4. Learning with my peers has enhanced my understanding of new concepts which the professional development programme addressed

1   2   3   4

5. I had opportunities to collaborate and share ideas with my colleagues through mentoring and co-teaching in the professional development sessions

1   2   3   4

6. I engaged in debriefing sessions after a lesson or presentation to the group so that I was able to consolidate my learning

1   2   3   4

**There are six statements in this part of the questionnaire. Please select your response from the choices provided for each statement.**

**The responses provided are on a scale of 1 to 4 where:**

- 1. – Strongly agree**
- 2. – Agree**
- 3. – Disagree**
- 4. – Strongly disagree**

**Section C: The six statements below relate to your emotional experiences during the professional development programme. They describe the extent to which the emotions you experience during your professional development programme can enhance or foster your confidence as a science teacher.**

- 1. I was provided with positive feedback during the professional development programme on individual and/or group presentations in which I participated**

**1      2      3      4**

- 2. My peers and facilitators recognised my contribution in the professional development activities**

**1      2      3      4**

- 3. I was given time for self-reflection, self-understanding and self-revelation**

**1      2      3      4**

- 4. I feel more confident to change the way in which I teach some topics in science**

**1      2      3      4**

- 5. I had opportunities for self-comparison to promote my growth and confidence**

**1      2      3      4**

- 6. I was able to feel a sense of pride to be part of the science teaching community**

**1      2      3      4**

**Thank you for your time.**

## **Appendix C4: Semi-structured interviews**

### **Ashna**

Ashna, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. In what way would you say that collaboration was your most beneficial experience in the earlier sessions?
2. What was your experience during the planning session?
3. In what ways did you find the previous sessions very beneficial?
4. In the last interview you said you were able to diversify your repertoire of skill. In what ways were you able to do this?
5. You had mentioned that you wanted to remove formal lab write up for your ELL kids and focus on students' ability to communicate. Were you able to do this?

## **Darius**

Darius, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. Were you able to engage actively in discussions to talk about your experiences? How were you able to do this?
2. Tell me how you were able to get a clear picture of the outcome of the professional development programme at the end of the programme.
3. Did you have more input in the discussions than in the initial sessions?
4. Knowing that your classroom context is different from others, do you think this programme served your needs?
5. Which ideas were you able to take to your class? In your school?
6. Describe to me how you felt as you participated in the activities by the end of the programme.
7. In the last interview, you were not sure that the programme would change your perception of yourself as a teacher, do you think it has changed or will change now that the programme is over?
8. Tell me how, if at all, this programme has helped you to change your teaching strategies.
9. Have you shared the ideas you learned with your peers at school?

## **Felix**

Felix, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. Were you able to take what you learnt in the third session to your classroom?
2. How did that go with your students?
3. Tell me about your experience working in groups in the professional development programme since we last spoke?
4. Explain to me what you meant when you said that your experience was meaningful. Is this your overall feeling during the entire programme?
5. What can you take away from the programme?

## **Hailey**

Hailey, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. In your last interview, you said how good it was to talk things over with the other teachers. How effective was this for your learning?
2. You had mentioned that during planning sessions, there was no collaboration with the other teachers, how do you feel about that?
3. Did you try out any of the ideas from the earlier sessions in your classroom?
4. How did that go with your students?
5. How has your overall experience changed your classroom practice?
6. Can you tell me how your experience of this professional development programme helped you cope with the isolation you have said that you face in teaching science at your school?
7. Did you change your belief of the type of science teacher you were before the start of the programme?

## **Jean**

Jean, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. Have you tried using anymore technology in your classroom?
2. Can you describe how those lessons went with the students?
3. How has your overall experience changed your classroom practice?
4. Are you still excited to teach new ideas because of the professional development programme?
5. Are you in contact with any of the other science teachers who participated in the programme?
6. What can you take away from the programme?

## **Jen**

Jen, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. Were you able to engage actively in discussions to talk about your experiences?
2. Tell me what were your feelings about the overall programme?
3. Can you tell me why you felt disappointed in the first sessions although it was a progressive idea?
4. What did you learn from these sessions?
5. Which ideas were you able to take to your class? In your school?
6. Were you able to overcome your challenges because of the professional development programme?

## **Linda**

Linda, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. Were you able to use what you learnt in the earlier sessions in your classroom?
2. Can you describe how those lessons went with the students?
3. How has your overall experience changed your classroom practice?
4. Can you describe some of the ways in which your approach to teaching the ELL students has changed?
5. Would you say that you are in a better position to teach the ELL students now that you have completed the programme?
6. Are you in contact with any of the other science teachers who participated in the programme?

## **Maria**

Maria, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. Tell me in what ways the conditions for presentation of the programme improve in the end.
2. Do you think your experience in socially interacting with the other teachers and your co-presenter improved?
3. Were you able to take anything new to your students as you stated you would like to in the first interview?
4. To what extent did you share what you learnt and did with your peers?
5. What did you learn from these sessions?
6. What can you take away from the programme?
7. Describe to me how you felt as you participated in the activities by the end of the programme.

## **Mary**

Mary, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. Did you get the whole package of “carving up the new ideas and evaluating them?”
2. How did it go when you put these ideas into practice?
3. Were you able to conduct a science-fair like activity with the climate activity?
4. Are you still excited to teach new ideas because of the professional development programme?
5. Are you still as excited as during your last interview?
6. What can you take away from the programme?

## **Maya**

Maya, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. Did the excitement you felt early on continue to the end of the programme?
2. Have you changed your mind about using twitter professionally?
3. At the end of the programme, has it enhanced your beliefs as a science teacher?
4. Do you still find it tough to share what you have learnt with your colleagues at your school?
5. Have you become a more “technological veteran”?
6. What can you take away from the programme?

## **Sage**

Sage, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. Were you able to engage actively in discussions to talk about your experiences?  
How were you able to do this?
2. Tell me what were your feelings about the overall programme?
3. Did you have more input in the discussions than in the initial sessions?
4. What did you learn from these sessions?
5. Which ideas were you able to take to your class? In your school?
6. Describe to me how you felt as you participated in the activities by the end of the programme.
7. In your last interview you told me in many ways what your beliefs as a science teacher is. Can you tell me if your experience of this professional development programme reinforces those beliefs or enhance them or change them?
8. Tell me how, if at all, this programme has helped you to change your teaching strategies.
9. Have you shared the ideas you learned with your peers at school?

## **Sam**

Sam, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. Did you use the hands on activity like the human body in your class?
2. How did it go?
3. Have you used twitter to get in touch with other teachers?
4. How has your overall experience changed your classroom practice?
5. Did you change your belief of the type of science teacher you were before the start of the programme?
6. What can you take from the whole professional development programme?

## **Steve**

Steve, I am now conducting the second interview of this professional development programme with you. Like the first interview, this interview is also a narrative interview. Once more I would like you to tell me about your experiences of the professional development programme since the last interview. I will listen to you and when you have finished relating what your experiences were, then I will ask for clarifications and /or ask you some specific questions based on the first interview to get a better sense of your overall experiences.

### **Follow-up questions:**

1. What results did you have with twiddla or Socrative in your classroom?
2. In the last interview you sounded bewildered, frustrated and disillusioned yet motivated and inspired. Can you explain this?
3. Were you able to make the professional development programme more relevant to your professional needs?
4. What can you take away from the programme?

## Appendix D: Coded Transcriptions of Science Teachers' Interviews 1 and 2

### Ashna's Interview 1 Transcription Coding

<p>1 <b>I like when she models how we might want to deliver a lesson. So for</b>  2 <b>example, in the first session when she brought out the different types</b>  3 <b>of fruits from the different countries, and students were supposed to</b>  4 <b>make observations about those fruits. That was a very interesting</b>  5 <b>way of delivering the curriculum.</b> Because we talk about physical and  6 chemical properties. So for physical properties, why not use like  7 culturally relative things like a mango, like breadfruit. So <b>that was</b>  8 <b>interesting.</b> Even when she brought out the different types of bread.  9 Naan bread, pita bread. I guess it is making <b>me more conscious of the</b>  10 <b>examples that I use in class.</b> I shouldn't just be using examples that are  11 relevant to this society that we live in but maybe try to tap into the  12 background of my students. Some other things that she's done so for  13 example the 'speak and listen' I have seen that technique before these  14 workshops are always a <b>good reminder that hey, this is another</b>  15 <b>technique that you could use.</b> However, I do <b>feel that a lot of the</b>  16 <b>techniques that have been discussed in the workshop are good if the</b>  17 <b>students have a baseline in understanding of English. But I mean I</b>  18 <b>had students couldn't even put a few words together to make a</b>  19 <b>sentence. So some of those techniques are even difficult for those</b>  20 <b>students. So what I need is more techniques at a lower level. Maybe</b>  21 <b>for the ESL A or the ESL B students. I don't feel like I got that from</b>  22 <b>the workshop so far. But I got great tips for maybe ESL levels C to</b>  23 <b>E.</b></p> <p>24 <b>I like working with other teachers and I think I knew that I was</b>  25 <b>working with other teachers.</b> If you look at the title of the workshop, it  26 says EEL in a collaborative learning community. So <b>I was really looking</b>  27 <b>forward to connecting with other teachers and seeing how they</b>  28 <b>address problems in the classroom.</b> So that for me was <b>the most</b>  29 <b>beneficial experience.</b> Not necessarily developing lesson plans, but</p>	<p>Emotion          "I like it when"</p> <p>Cognitive (pedagogy)          Found some parts interesting</p> <p>Awareness of alternative ways of teaching a topic</p> <p>Emotion – frustration in not being able to reach students</p> <p>Needs not met</p> <p>Likes working with other teachers</p> <p>"Connecting with other teachers"</p> <p>Social interactions          "The most beneficial experience"</p>
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30 **teachers rarely get the time to connect with other teachers. We go to**  
31 **work, we are isolated in our classroom, we do what we have to do,**  
32 **we do the extra-curriculars at the end of the day, but I rarely get a**  
33 **chance to see what other teachers are doing in other classrooms. So**  
34 **I am really looking forward to be able to do that in this workshop.**  
35 **And even just to connect with other teachers and see what they are**  
36 **doing. In terms of the actual group work,** so we are planning am a  
37 lesson around the grade 10 optics unit. **I don't know if it' true group**  
38 **work.** We said 'this is the strand that we are focusing on, this is the skill  
39 we are focusing on, and we divided up the work. **So it's not like we are**  
40 **sitting there and planning together and I would have perhaps liked**  
41 **that, but then again, we got an hour of planning time in the last**  
42 **session. And then maybe an hour or so in the previous session. And**  
43 **to come up with true authentic lessons that are very layered. It takes**  
44 **more than two hours. It takes a lot of time and time is a constraint.**  
45 **But generally I like the aspect of working in a group: I am finding it**  
46 **very beneficial.**

47 **Even though my group has three people, I have definitely connected**  
48 **with one.** And then (name withheld) I mean she was sick. I knew ( ) from  
49 before. We taught summer school together. And I know from the first  
50 session she was sharing some awesome resources with us. It was great to  
51 hear what she has been up to. So it was **great to reconnect with her.**  
52 Because I knew her from before. **Yes I have connected.** If I teach another  
53 essentials class or maybe an ESL science, I feel that **I will feel**  
54 **comfortable approaching at least one other person in the group to**  
55 **see you know what have you done. You taught this class. Do you have**  
56 **any ideas?**

57 **I wouldn't say I have formed a network for now because the group is**  
58 **very small. Just one other person.** And then I mean ( ) who is helping to  
59 run the session. But I feel that I could have connected with ( ) before

60

Group work was not what it should be  
"not like we are sitting there and planning together"  
Needed more time to plan together  
Emotions – "like the aspect of working in a group" –  
"finding it very beneficial"  
Connect with other teachers  
Emotions – feels good to ask for help if needed

61 because we have mutual friends.

62 I don't necessarily think that learning **was pedagogical**. But I would say  
63 networking, a bit of pedagogy. I don't think the workshop was to be  
64 content.

65 What was emphasised in my ESL AQ course, was valuing the first  
66 language of students. So encouraging them to use bilingual dictionaries,  
67 encouraging them to do work first in their native language, and then  
68 after having that processing time, doing the assignment in English. So  
69 I didn't see that emphasised. Which I thought was very interesting  
70 because that was the whole focus of my ESL AQ. I guess what I am  
71 taking away from this programme is well number 1, like the IL showed  
72 us **the resource books that we could use in the classroom** and I wish  
73 I had those books when I was teaching the Grade 9 essentials last  
74 semester. I didn't even know these resources were available. And then  
75 I spoke to my librarian and I asked her to order those books and she has  
76 the budget she said she can order them and that was very helpful if I  
77 had that. **I just didn't know what was out there. I guess refreshing**  
78 **skills I know I had but I haven't been using them?** Because as  
79 teachers we fall into the same comfortable pattern of teaching which is  
80 transmission. I would go in, I give a lesson, they copy notes, then they  
81 do worksheets. And if it's science sometimes we switch it and we do  
82 labs. Sometimes we switch it and do activities. But I guess the norm is  
83 that they should be doing hands on stuff, they should be doing labs. And  
84 the anomaly should be me transmitting information. So I guess am  
85 **diversifying my repertoire of teaching skills. That is the most**  
86 **important thing I am getting from this.**

87 The inquiry section of the curriculum is often the section that focuses  
88 on labs. But you don't always have to perform the lab. Sometimes you  
89 just have to plan the lab. So just **dissecting the wording of the**  
90 **curriculum** I think **was nice to see that that was brought up in this**  
91 **session.** We need not conduct the lab. We can just plan it. **I don't feel**

Pedagogical  
learning

Artefacts

Take to school

Cognitive –  
“diversifying  
repertoire of  
teaching skills”

92 **like curriculum wise I have gained anything.** Lots of people feel like  
 93 we are overwhelmed with the curriculum. There is so much to teach.  
 94 But there actually isn't. When you read the curriculum, it is very vague.  
 95 People just feel overwhelmed to deliver all this content because they  
 96 are looking at the textbook. What I appreciated with this workshop was  
 97 when I go to a lot of workshops, a lot of blame is cast on teachers.  
 98 Teachers are expected to do this, that and the other. And you know if a  
 99 certain demographic of students isn't doing well in school it is because  
 100 of the teacher. So I feel a lot of blame coming from a lot of workshops  
 101 that I attended but I did not feel that in this workshop: **I felt very**  
 102 **comfortable expressing any struggles that I was experiencing in the**  
 103 **classroom.** But I think that is also part of my personality. I am not  
 104 someone who is afraid to say that I am struggling with something. If I  
 105 am struggling, I am struggling. That is just what it is. I definitely  
 106 wanted to be at the workshop and I felt that you know, my school, my  
 107 department was supporting me being at the workshop: I definitely  
 108 wanted to be there. And I got the sense that other people did. **I wanted**  
 109 **to be there I felt that something genuine would come out of it.**

110 **My experience was definitely meaningful!**

111 **One thing I appreciated was the lab report that we did in the last**  
 112 **session.** The ELL students are struggling with language. So **why not**  
 113 **take out the formality of lab reports. Because really a lab report**  
 114 **requires students to communicate what they have learnt. Not to**  
 115 **communicate you know their findings necessarily to someone else.**  
 116 **So I think that made me a little more conscious of how I get students**  
 117 **to structure their lab reports. Taking out the formality of language.**  
 118 **That was the most useful thing I learnt.**

119 I think that **all of the worksheets that the IL showed us, I think I am**  
 120 **going to put them in our teacher-share folder so that other teachers**  
 121 **in our department can access them.** Again these are all things we have  
 122 all seen before but we've forgotten about or we just need a refresher

No skills in interpreting curriculum

Emotions - comfort

Emotions – enthusiasm to be there

Emotions – meaningful experience

Needs met in terms of catering to students' level

Artefacts

Pedagogical idea

123 **to do them on a daily basis.** When I look at the folder there are tons of  
124 things that I can take to the classroom. I| can't even remember. I think  
125 **she had an interesting way of grouping people. The one she grouped**  
126 **based on alkaline metals.** So find your group 1 partners so that then  
127 those are your alkaline metal group, and alkaline earth group: I thought  
128 this is **another way of learning.** I thought that was interesting. **I liked**  
129 **the inspirational videos that she shared. So I like that.**

Emotions – “I like  
that”

## Ashna's Interview 2 Transcription Coding

1 **Well** I thought that **this last session was the most useful of the three**  
 2 sessions because we had a **chance to actually see a lesson put into**  
 3 **practice in a classroom. So I enjoyed that.** I find that in most PD  
 4 sessions teachers share lessons that they say work well but here we  
 5 actually got to see. **I like that aspect.** I find that compared to the other  
 6 sessions **the teachers got a chance to share things that are working**  
 7 **well in a classroom or sharing resources that they have developed.** I  
 8 like that aspect. **I have learned more from other teachers than I did**  
 9 **just from the other sessions.** So I like that aspect. **One thing that I**  
 10 **think could have been improved upon is for people to take more**  
 11 **ownership of what they were responsible for.** For example, **my group**  
 12 **initially had I think four or five people but in the last session only**  
 13 **two people from my group came.** I tried to reach my group members  
 14 for like three weeks and no one responded to my e-mails. So **I don't feel**  
 15 **like it was true collaboration. That's what I was hoping for.** I don't  
 16 think teachers get a chance to come together and do this and finally we  
 17 have this opportunity and then you know a lot of teachers didn't follow  
 18 through. **I wasn't very happy with that. I was glad to see a lesson in**  
 19 **action and we had an opportunity to share. That was beneficial to**  
 20 **me.** I like that the lead teacher for example uses an Iphone app called  
 21 'Skitch' to mark students' posters. **I actually took that to work with**  
 22 **me the very next day and I tried it out and I had a department**  
 23 **meeting the week after and I showed the members of my department**  
 24 **how to use Skitch.** So I found that a lot of what I learned I could take  
 25 **to other teachers and to my classroom.** Also **one of the teachers at the**  
 26 **workshop shared his idea of using a timed power point.** Then he had  
 27 shared an example of what he had created. **I took that also to my**  
 28 **department and showed it them. Someone in the ELL session also**  
 29 **mentioned using the padlet to create posters so I also took that back**  
 30 **to my school and showed it to my department.** One of the teachers  
 31 actually liked the padlet and assigned a project based on that website so

<p>“this last session was the most useful of the three”</p> <p>Emotions-</p> <p>“I enjoyed that”</p> <p>Social interaction – sharing</p> <p>“I have learned more from other teachers”</p> <p>Emotions –</p> <p>Disappointment , “I don't feel like it was true collaboration”</p> <p>“wasn't very happy”</p> <p>Beneficial</p> <p>Took to school</p> <p>Cognitive development – pedagogy</p> <p>New knowledge</p> <p>Applied new learning in classroom</p>
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32 the students could go on that website to create their own poster. **The**  
33 **other discussion I really enjoyed was where they were talking about**  
34 **making embedding critical thinking into the assignment.** One  
35 example was the elements poster which was a straight regurgitation  
36 assignment in which they have to research certain aspects of the elements  
37 and put them on the poster. Really what thinking have they done? How  
38 have they engaged with their learning? **I like the IL's example of take**  
39 **five elements and arrange in the order that you find them to be**  
40 **useful. I took that back to my department the week after and what**  
41 **I am trying to encourage is that how can we embed critical thinking**  
42 **in these activities.**

43 **Researcher: tell me how you felt during your presentation when you**  
44 **realised you were alone.**

45 The last day we were to present as a group but it ended up being me  
46 presenting my part alone. I mean what I was really looking for was to  
47 working as a group and putting our ideas together to come up with a  
48 lesson. That being said, **I found what the other teachers there shared**  
49 **to be rather useful.** So I wouldn't say **I was completely disappointed.**  
50 I think that there were aspects of the CLC that were beneficial, but **that**  
51 **group component could have worked better.**

52 Well I think I got to know the IL a little bit more so I feel more  
53 comfortable approaching her. So **the IL and I were sharing ideas. I**  
54 **don't feel like I have made any connection with the other teachers at**  
55 **the workshops.** That is **except with the lead teacher whose class we**  
56 **observed on the last day.** I feel I can approach her just to say have you  
57 tried this? How did it go? I have accessed the Google Drive and I have  
58 downloaded some of the contents that were uploaded. So even if I don't  
59 speak with the other teachers, that Google Drive itself is useful.

Emotions – “I  
really enjoyed”

“I took that  
back to my  
department”

Emotions –  
somewhat  
disappointed

“I was  
completely  
disappointed”

Social  
interaction –  
only connected  
with the IL

60 **Despite what I hoped for from the collaboration, I still took a lot of**  
61 **useful practices and ideas away from the workshop: So I am happy**  
62 **with that.**

63 We were going to focus our lesson and then we were supposed to  
64 communicate with each other via e-mail. **That didn't happen.** It could  
65 be because people have lives to live and they are busy. **I enjoyed being**  
66 **able to share ideas in person with other teachers.**

67 All the members were present. **I found that collaboration session to be**  
68 **very beneficial.** I think that what we talked about was teaching the optics  
69 unit and how it has a lot of complex terminology that are difficult for the  
70 ESL students. **We shared our struggles teaching the optics unit** and  
71 that's why we decided that we would focus our lesson on that specific  
72 unit. We came up with a bunch of examples that we could use in a lesson.

73 So that **brain-storming session I found very useful.** I think what I  
74 struggle with in science is the science, technology, society and  
75 environment component of the curriculum. We were trying to focus on a  
76 link with the STSE aspect of the curriculum. And that's what I needed  
77 the most help with in teaching this unit. **Although I learnt a lot through**  
78 **the discussion, I would have liked to have more time to develop it a**  
79 **little more.** I wanted us to fully develop the lesson we were working on  
80 in the second session as a group so that we could present it in a realistic  
81 way in the third session. **Instead, my presentation was very**  
82 **fragmented because half the group wasn't even there.** And the two of  
83 us there **didn't even work together.** I presented my component and the  
84 other teacher presented her component which she hadn't even sent to me  
85 before. I had sent her mine. And I had typed up the overall lesson plan.  
86 But she hadn't even read it.

87 **Researcher: In what ways were your experiences of the two previous**  
88 **sessions beneficial to you?**

"I still took a lot of useful practices and ideas away from the workshop"

"I enjoyed being able to share ideas"

Social interactions

Collaboration was beneficial

Solved problems together, brain storming

Wished for more discussions

No discussions, collaboration, or sharing of ideas among group members

89 **I liked the initial collaboration session. So being able to speak with**  
90 **other teachers about what we were struggling with in certain units; I**  
91 also liked the **ESL teaching and learning strategies that the IL shared**  
92 **and modelled.** Those are the two most beneficial things. I think that these  
93 sessions in general **just extend your repertoire of techniques that you**  
94 **can use** with the ELL students because there isn't one technique which  
95 always work with certain group of students. It is always a matter of trying  
96 different things. So the more techniques they have the better equipped  
97 they feel they can serve this demographic of students. **I would say to**  
98 **some extent it increased my confidence to teach ELL students. I**  
99 **don't know if I'll ever be 100% confident teaching these students** but  
100 yes it did help: **I feel better prepared.**

101 **Researcher: which activity did you feel you could take to your school?**  
102 One thing that was mentioned in the session was '**quiz, quiz, trade game.**  
103 The IL called it where one person has a definition and he/she reads the  
104 definition, and another person who has the word would stand up and say  
105 it. I have heard of this activity and have done it before but have since  
106 forgotten all about it. I reviewed the chain-linking game with my grade  
107 10's and **used it** with them as a quick way of reviewing with them. **I used**  
108 **it for nomenclature for chemistry.** I have heard of this activity before  
109 but I had forgotten about them. So when I went back to class I tried both  
110 the linking review game and the quiz, quiz, trade game. **I did a chemical**  
111 **vs. physical change lab** with my grade 10's and in order to get them into  
112 lab reports and not feel overwhelmed, I told them they could just explain  
113 each section in words. It was OK if they didn't use formal language. They  
114 could say "I did this" "I noticed this" – this is what I wanted to change.  
115 Because really it is their thinking that is important. Not the formality of  
116 language.

117

118

"extend your repertoire of techniques"

"I don't know if I'll ever be 100% confident teaching"

"I feel better prepared"

Applied ideas In classroom

"I actually went back to class and I did them after those sessions"

119 **Those are the three things that I actually went back to class and I did**  
120 **them after those sessions. I thought it was successful.**

121 Although I observed what worked in the classroom, I also saw what  
122 didn't work for me. **I didn't like the culminating discussion from the**  
123 **lesson.** Now I know that when I do that lesson, I would need to focus  
124 more on that. It is just as **important to see what works as what doesn't**  
125 **work.** I wanted to know what ideas, what concept the students got from  
126 it.

“didn't  
like...from  
the lesson”

## Darius' Interview 1 Transcription Coding

1 I think this PD session that we had recently was about science. **It provides**  
 2 **a very good opportunity for the teachers to meet and exchange**  
 3 **information especially in relating what we know and you can take the**  
 4 **experience and knowledge to your own classroom and adjust it to your**  
 5 **own student population and the environment of your teaching.** The  
 6 end result is not something like a final product I can take to my classroom  
 7 and use it repeatedly. I have different classroom environments and  
 8 populations. **The reality for me is totally different.** You have a variety  
 9 of students with different learning styles, different levels of understanding  
 10 and knowledge. So I think what I think is **all I can take from these PD's**  
 11 **is some knowledge information and use it to create my own activity**  
 12 **for my own class and for my students.** It might not be the exact same  
 13 thing that the end result was for my students but it kind of it **helps me to**  
 14 **you know get some clues of what a culminating activity in science**  
 15 **should look like.** So in general **I would say it was a good experience for**  
 16 **me. You get something out of it** I think it is impossible. I would prefer  
 17 PD's which come up with some activities which are based on real  
 18 classroom environments – **different learning styles, you may have some**  
 19 **students with behavioural issues, some people simply won't want to**  
 20 **participate, some are so active, you know some might not be so active.**  
 21 **It is a kind of mixed classroom environment that you may have. How**  
 22 **do you deal with that? How would you implement that kind of**  
 23 **activity? Maybe just coming up with one activity and trying to use it**  
 24 **in that environment. It may not be the answer, it may not work. So**  
 25 **I'm more interested in seeing those activities. I'm more into teachers**  
 26 **discussing the difference in their classroom plans and come up with**  
 27 **solutions say ok let's have plan B. This is not working. Let's have this**  
 28 **form of activity maybe you know, we divide the activity into several**  
 29 **parts and say ok part A you can have these options based on your**  
 30 **classroom and part B these option so you can choose the different**  
 31 **options in the different parts that you have and use it for your**

Emotions –  
Good  
opportunity

Needs not  
served

Modify for  
class

Cognitive  
development

New learning

“good  
experience”

Emotions -  
Disappointment

32 classroom. In my case I don't have a group of students – grade ten  
33 science students. So those activities really involve a group of students  
34 who team up together and do the activity. So let's say I have one  
35 student in grade 10 science. Another thing is that do you have the  
36 facilities in the classroom? Do you have access to a lab? To implement  
37 that activity. That's another problem. As I said I can get the  
38 knowledge from this activity what can be done regarding that activity  
39 but maybe in my case I have to modify it a lot. I feel good because the  
40 experience I get I can use it next year you don't know. I might can use  
41 it at another school with a group of students. So for now, what I am  
42 thinking is that giving the knowledge and learning about the activity,  
43 I have my resources that I get from the PD sessions it's a good resource  
44 that I can keep it and use it later. And as I said even with one grade 10  
45 science student I can modify it. Still I can do something about it.  
46 Maybe I can use a portion of this activity. I am not saying it is totally  
47 useless for me. Let it be the kind of activity that covers most of the type  
48 of classrooms that we have. That's my point. For sure! I really believe  
49 that these PD's and the exchange of information among the teachers  
50 lead to improvement of teachers. I see that in myself and especially for  
51 this PD even if I don't use the end result the way it was meant to be used  
52 I still learn what the main components of a culminating activity should  
53 be. So I can use those components in any activity that I am going to  
54 design and implement in my classroom. You should have your own  
55 perception and say I can get this information it applies to me and I can use  
56 it in working with my students or designing my own activities and  
57 that's the great thing I think I can get from these sessions even though  
58 I may not be using it in exactly the final result, but still I learn these  
59 are the main components of the culminating activity. This happened  
60 in the second session. I loved it compared to the first session. But the  
61 second session I learned that we exchange information. We put ideas  
62 on the board about – what are the components? What should we be  
63 addressing? That was great. And I believe you know each session I am

Apply  
somewhere  
else

Emotions –  
disappointment

“not totally  
useless”

Cognitive  
development  
– “I still  
learn”

Emotions – “I  
loved it”

Social  
interactions –  
“we exchange  
information”

“my  
knowledge is  
increasing”

64 **learning more and more. It is something that my knowledge is**  
65 **increasing.** In general I am saying **I am optimistic. I love it.** But there  
66 are some cons. **It could get better you know. I am sure that by the end**  
67 **of the fourth session they are going to say ok in what ways we can**  
68 **make it better?** One thing I want to say about the PD is that I mostly in  
69 turn **I like to participate in the activities. PD's really help me in my**  
70 **curriculum delivery and working with my students. It is directly**  
71 **related to what I am teaching. This PD was good. It is not that**  
72 **abstract. It can get better but still I have seen in the second session I**  
73 **have seen some students' real work on display and I got some ideas**  
74 **from them how I can come up with some activities of my own. But I**  
75 **am optimistic. It was good. If you ask me, by the end of the second**  
76 **session if I regret going to the sessions or do I like it? I liked it. For**  
77 **sure I would say it.**

78 **I am a math and science teacher. From time to time based on your**  
79 **timetable you have some science classes which I can use it. I have**  
80 **gained some knowledge since it is directly related to the grade 10**  
81 **science curriculum.** I am qualified to teach the grade 10 science  
82 academic and applied course **and the knowledge I got is directly**  
83 **related to the units that they were discussing. I gained pedagogical**  
84 **knowledge.** We actually **used the ministry guidelines to verify our**  
85 **curriculum knowledge.** We did not learn any concepts. It was assumed  
86 that all the teachers have the subject knowledge. Maybe we had some  
87 minor discussion among the teachers privately. **My yes moment was in**  
88 **the second session when we had on the board the different strands–**  
89 **knowledge, understanding, inquiry, application, communication –**  
90 **how we would evaluate the students, what activities they should do,**  
91 **how we are going to decide which strand parts of the work fall under**  
92 **– knowledge, understanding, inquiry, application, communication –**  
93 **this was my yes moment. I love that part. As I said as you get through**  
94 **the sessions you learn more.**

“my knowledge is increasing”

Artefacts

“I got some ideas”

“I am optimistic”

“I liked it”

“I am a math and science teacher”

Cognitive development  
– “I gained pedagogical knowledge”

“My yes moment was”

“I love that part”

95 **For sure the sessions will affect my view, my perception but I don't**  
96 **know how much change. Of course it will affect my overall**  
97 **understanding of my knowledge about these things especially**  
98 **learning about other teachers' experiences and the activities they**  
99 **have in their classrooms. That would be great.**

100 **It is difficult to rethink my beliefs and values as a science teacher. I**  
101 **believe in science and how important it is in students learning but I'm not**  
102 **sure. I'm not sure. I really think it would help me to maybe emphasise**  
103 **more the importance of science.** For sure I am open to change my way  
104 of teaching a certain topic. PD's are a good way for teachers to exchange  
105 information – that will change my experience, **I will rethink how the**  
106 **curriculum can be delivered, what type of activities I can use. For**  
107 **sure it will change my perspective, beliefs, values, but by how much**  
108 **to measure it actually, I am not sure.** Sometimes you know you have  
109 your own values and thoughts already and those PDs help you to reassure  
110 yourself that I am on the right track. That was good. In that sense for sure.  
111 **If I learn better ways of teaching my students for sure I would use it.**  
112 **What I would take to my classroom maybe would be the topics we**  
113 **discussed and the way in which we discussed them. But I am not sure.**  
114 **Maybe I can use my colleagues' experiences in their classroom and**  
115 **say OK this may work in my classroom.**

116 **This PD provide that opportunity to bring something new and bring**  
117 **it back to school where we do not really learn anything new. As**  
118 **members of the same school board, we may be following the same**  
119 **curriculum but we see teachers doing things a bit differently. I like**  
120 **the idea of networking with others and share information.**

121 **Actually, I would like to see more teachers at the sessions. We would**  
122 **have more discussions among the teachers. We did a lot of talking**  
123 **during the breaks and lunch. We talk about our classrooms, our**  
124 **students, what we do, how I implement this unit. It was great but**  
125 **there were not that many teachers. I met one of my colleagues from**

“It is difficult to rethink my beliefs”

Apply in class

Social interactions – networking with others  
Share information

“we did a lot of talking”

126 another school – I would see her once in a while – we were able to  
127 exchange information and even with two newer teachers that I  
128 haven't seen before. Participating with others is better. You get more  
129 ideas and learn from their experience. Working in a group in the  
130 first session, although it was just my colleague and me, that was good  
131 – working on inquiry and thinking. We worked together, exchanged  
132 information and posted it on the WIKIs. In the second session,  
133 although we did not break up into smaller groups, we worked as a  
134 large group: I love group work because of being able to exchange  
135 information and reaffirming what you have learned previously. I can  
136 have the moment when I can say yeah! What I thought and what I have  
137 learnt is right. **But I prefer to have more people in the group: I was**  
138 **trying to digest what others were saying. I had some input but not**  
139 **much. I am not the type of person who would say things right away.**  
140 **I have to think about it. So when I was listening, I was just listening**  
141 **to them saying to myself ok how is it working? Why is it working?**  
142 Afterwards I would have some input. I believe I was more interactive in  
143 the second session within the group listening. I hope I will be more  
144 involved in the third session.

“participating  
with others is  
better”

“I had some  
input but  
not much”

## Darius' Interview 2 Transcription Coding

1 **The workshop was not what I thought it would be. I didn't get that**  
 2 **much out of it considering that we spent 4 days going to that school.**  
 3 **I am a bit sceptical to be honest. That's my feeling. Other than meeting**  
 4 **some other teachers you know, exchanging information and**  
 5 **experiences, that was great. I didn't see that we addressed the topic**  
 6 **and finally get the final product and use it. That was my feeling.**

7 **I mean when we spend time like four days on something and we**  
 8 **define a topic and we want to get to a conclusion and we don't get**  
 9 **there that is the kind of thing that I don't like.**

10 **Researcher: Would you say your experience of the first two sessions**  
 11 **was more meaningful than the last?**

12 **Maybe I have the wrong perception** but I thought in the first session  
 13 **that I would be there as a student and learn from the experienced**  
 14 **teachers that they would teach me how I can accomplish the new**  
 15 **tasks; what they should look like; these are the vocabularies. It looked**  
 16 **a little like this in the first session we had with the examples, videos,**  
 17 **other people's work, and references. I like it you know, it was kind of**  
 18 **you know initiating this discussion and you know, but soon it you know,**  
 19 **I don't know. I was hoping to get some handouts and such to use in**  
 20 **other classes in the future. So the first two sessions were the kind in**  
 21 **which I was listening and trying to get that knowledge and figuring**  
 22 **out what we are supposed to do. That is what I thought the whole**  
 23 **thing is all about. I am mostly a math and science teacher.**

24 **The first two sessions were fine, I tried to learn what the complex**  
 25 **culminating activity was so I tried to learn all about it. But in the**  
 26 **other sessions, I felt that no this is not serving my needs. This is not**  
 27 **where we go. They defined clearly what the programme was about.**  
 28 **The four categories; what should be covered in each session. The third**  
 29 **session I thought was the best session because we had an observation**

Emotions –  
disappointment

“I didn't get that  
much out of it”

Social  
interactions –  
Meeting other  
teachers was  
great, exchange  
ideas

Emotions –  
disappointment

Emotions –  
Disappointment

“I am mostly a  
math and  
science teacher”

“this is not  
serving my  
needs

30 of a classroom in which we helped the students come up with their  
 31 questions and contrasting the morning session with the afternoon  
 32 session. So I thought this is what we would be doing – students would  
 33 come up with some culminating activities of their own in which would  
 34 be the different areas – initiation. I thought they were going to bring  
 35 the completed thing to me on the table. That’s what I expected to see  
 36 in the fourth session. My classroom situation is different and so the  
 37 lesson should be modified to accommodate my student. It should be more  
 38 concrete you know. I liked the idea of letting the students feel free to  
 39 put any question on the board. I think that was the highlight. I think  
 40 that was the thing. I was happy meeting the other teachers, get some  
 41 ideas, you know get some lessons, some assignments. I would say 50-50  
 42 satisfaction. I am not saying I was totally disappointed but next time  
 43 for sure I would be very, very careful in choosing which workshop I  
 44 attend. I learned is that a well-planned activity is very, very  
 45 important.

46 **Researcher: How has your experience helped you change your**  
 47 **teaching strategy?**

48 You need to reconsider your approach, maybe to improve it and make  
 49 it better. So next when I want to do any activity with my students I will  
 50 make sure that I have revisited my actions. It has helped me to see  
 51 the need to use different ways of teaching the same topic. Use of  
 52 visuals, writing, talking, close up to students, guiding them through their  
 53 work. It was a part of my professional development. I walked away with  
 54 the knowledge that I must rethink how I teach my lessons. I would  
 55 summarise like you did of my entire experience of the four sessions, and  
 56 I would say that I got some ideas, activities and assignments in science.

57

58

Disappointment

Disappointment

Emotions -  
satisfaction

“that was the  
highlight”

“happy meeting  
the other  
teachers, get  
some ideas”

“I am not  
saying I was  
totally  
disappointed”

Change in  
teaching  
strategy

Pedagogy

“I walked away  
with the  
knowledge that  
I must rethink  
how I teach my  
lessons”

### Felix's Interview 1 Transcript Coding

1 **At the workshop not only do I hear new ideas but they also have the**  
 2 **good sense of providing examples of general techniques that work**  
 3 **for all types of learning. Particularly like some grouping**  
 4 **techniques and team-building sort of exercises. I am waiting to see**  
 5 **what would happen in the third session of the workshop which I**  
 6 **understand would deal with lesson planning and more specific**  
 7 **resources. So we will be able to take it and use it in the classroom.**

Cognitive development – new ideas, examples

8 A part of **the challenge** that I have is that I have a few students in my  
 9 classroom who need this particular focus. We have to make a  
 10 professional decision all the time about how to do one without sacrificing  
 11 the other. **That is why it is so much relevant because this particular**  
 12 **dilemma, I think I deeply analyse and at the workshop we had some,**  
 13 **I think maybe ideas that were presented to us in that first session**  
 14 **which seemed to me to be things that would be very relevant and**  
 15 **helpful to me. Some parts of what I learned in the workshop are**  
 16 **feasible in the classroom.** For example the books and I don't know how  
 17 to categorise these, but these little techniques of making a word wall, the  
 18 little tips like that seem to be very useful. I think that the development of  
 19 curriculum, the planning part, I am saying **the workshop is addressing**  
 20 **the planning part but what happens at the end? I have a few good**  
 21 **tools, a few good strategies for making the lessons that are always**  
 22 **meeting the needs of the English language learners. I was reminded**  
 23 **of a few good techniques. I think what I was trying to get was my**  
 24 **expectation of the beginning of the first workshop that I attended**  
 25 **was to be reminded and to learn more tips and tricks. I am not**  
 26 **opposed to it but I wasn't looking for necessarily some larger idea**  
 27 **about how to cover a whole unit or course. When I went back to my**  
 28 **classroom I made some decisions about some of the things like**  
 29 **classroom arrangement on grouping and on a little bit on delivery.**  
 30 **For example we started on the use of the dictionary, they are visual**

Relevant to professional needs

“very relevant and helpful to me”

Feasibility in classroom

Needs met

Applied in classroom

31 **ones. These are the ideas I implemented in my classroom.** But I know  
32 that second part of the workshop we had a different workshop on  
33 grouping with other teachers and developing a unit idea or lesson  
34 planning and that I haven't see the result of. **I haven't tried this. The**  
35 **workshop that I am taking now seem to provide me with a little bit**  
36 **of knowledge and tools to help me along the way. So it would help me**  
37 **change some of my values during my career. Yes it would. I seem to**  
38 **remember mostly the general attitude I guess that the lead teacher**  
39 **had a very positive attitude.** She had a very **inclusive attitude which**  
40 **shows she is a caring teacher.** I even complemented her on the break.  
41 **Yes I felt positive about the programme. I have approached my**  
42 **principal and vice principal about this workshop and I told them that**  
43 **I attended a pretty valuable workshop: I think that in our school we**  
44 **need this kind of workshop: I want to share with my colleagues in**  
45 **my school a little of what I learnt from this three-part workshop:**  
46 **This programme has the potential to make me think a little more**  
47 **about ah the topic at hand – the English language learner. I think it**  
48 **might have the potential to make me implement some of these**  
49 **techniques on a permanent basis. In terms of my role as a teacher, it**  
50 **wouldn't change that much. I guess there is the possibility that I can**  
51 **see myself as an ELL teacher but at this point in time I don't see it.**

“implemented  
in my  
classroom

Artefacts and  
tools –

change in  
values

“it would help  
me change”

Emotions -

“I felt positive  
about the  
programme”

Confidence to  
share  
knowledge

Reflections

Change  
practice

Not much  
change in role  
as teacher

Cannot see role  
as ELL teacher  
at the moment

## Felix's Interview 2 Transcription Coding

1 I made quite a bit of notes this time around. This is a sign that **things**  
2 **went fairly well**. I found some things of interest. Once again the  
3 problem of missing the second session was a bit of a problem because  
4 our team was not represented that day. **I felt uncomfortable** at some  
5 points especially because **I was not able to contribute in a meaningful**  
6 **way as the rest of the group**: I also felt a tiny bit out of place because  
7 I didn't know if some specific rules were established during my absence  
8 from the second session. But it wasn't that bad. At the beginning I wrote  
9 quite a few ideas and usually when I am not interested or when I go to  
10 a workshop and it is not that useful, I don't make a lot of notes.  
11 Everybody was pitching in with different strategy or different ideas –  
12 some of it was part of the materials they developed for their lesson  
13 plans. And I was writing things down just like I had mentioned in my  
14 first interview with you. The expectation that I had was to come out of  
15 the session with small ideas of strategies, generic activities that I could  
16 modify and could use in my classroom. I heard about some strategy for  
17 visualising content by teaming up students with others. On the whole **it**  
18 **was pretty good given the stuff I have written down**.

19 I am finding the materials at the moment to be **more relevant to my**  
20 **needs**. I might be very interested in a workshop but if I find it I cannot  
21 take and use it in my classroom within a week or two, then I would not  
22 be writing anything down.

23 **Researcher: Which strategies from the sessions worked well in your**  
24 **classroom?**

25 I don't know if they worked well but **I definitely have tried ideas out**  
26 **such as using roots of words to help in building vocabulary on the**  
27 **side board**. The students were all involved in the activity as we worked  
28 through how to figure out and use roots of words to find meanings.  
29 Those strategies will not only benefit the ELL students but also other

“things went fairly well”

Emotions – discomfort

“I felt uncomfortable”

“not able to contribute in a meaningful way”

Cognitive development – satisfied with learning

Relevance to needs

Tried ideas in class

30 students who use language without really understanding it. Another  
31 activity was having my students **creating a visual dictionary** so that  
32 we have a bit of a list of words and I ask the students in an activity to  
33 sort the words into categories but instead of writing meanings or  
34 definitions as in a dictionary they have to make a quick sketch or  
35 cartoon to express the idea behind that word.

36 **I think the students were enthusiastic** and I would use it again in  
37 future projects. **I can't really generalise and say that all of them were**  
38 **enthusiastic or excited about it.** Some of them were not so  
39 enthusiastic. It is hard for me to say. Based on the overall student  
40 performance on that assignment, **I think it was successful.** I think I was  
41 the one who was more excited about the whole thing than the students.  
42 Sometimes the students are surprised by my enthusiasm about a project.  
43 I have to plan a project with one of the teachers in the science  
44 department and **I hope to use some of the ideas that I picked up:** I  
45 also discussed with the vice principal, the possibility of **hosting a**  
46 **session at the "lunch and learn" session with my colleagues.** These  
47 strategies that I picked up from the workshop are suited for such  
48 situations.

49 **Researcher: Tell me about your experience of the observation**  
50 **classroom**

51 The first thing that comes to mind is that really nice display on the left  
52 side of the classroom like a dictionary pasted on the wall. It was called  
53 common instruction. On it were instructional words such as describe,  
54 explain, demonstrate, were spelled out in English, Arabic, Chinese,  
55 Korean, etc. These are important words given by teachers for students to  
56 carry out activities. They were all written in languages that the students  
57 can relate to. The other thing that I wrote in my notes was about the  
58 classroom teacher's disposition towards the students. Very clearly she  
59 was open and friendly to her students. She corrected the students'  
60 pronunciation by getting very close to them and helping them out quietly

"I hope to use  
some ideas"

61 in a non-threatening way. I think overall her demeanour was one of  
62 respect and goodwill. **I liked the idea of having** the students moving  
63 around in class as they did their activities after sitting down in class  
64 listening to instructions from the teacher. It makes absolute sense for the  
65 students to have a chance to move around and have a change of pace and  
66 be active in the classroom. She empowered the students as they were  
67 giving their answers to her questions. Overall **I was impressed** with the  
68 manner in which she responded to the students' answers to her questions.  
69 Instead of pointing out mistakes, she gave her students signs of approval  
70 that it was a good idea to think differently. I liked the first activity in  
71 which she asked the students to write down what they had learned the  
72 last time before. This is a good spring board to find out what students  
73 retained from the last lesson. In this way the teacher was able to evaluate  
74 her students from a different perspective.

75 **Researcher: What was your experience like, working with the**  
76 **group in the last session?**

77 Well what jumps to my mind was the dwindling of the numbers among  
78 the number of participants. There were so few of us there compared to  
79 the first day. For the first little while it felt like there was something  
80 missing. I kept waiting and waiting for the others to come. Actually the  
81 smaller group ended up being an advantage because we stayed on track,  
82 there were not too many divergent opinions regarding politics, social  
83 issues, the weather, the politicians. For the most part we were on track,  
84 we were discussing our goals. **I think we learnt from each other.**  
85 From a tangible point of view I was able to write quite a bit of stuff  
86 down, and my feeling was precisely because we

87 were a smaller group: **We were able to engage more in leaning.**

88 **Researcher: explain to me what you meant when you said that your**  
89 **experience was meaningful. Is this your overall feeling?**

Emotions –

“I like the idea”

“I was impressed”

Social interactions –

“we learnt from each other”

90 **I was satisfied** in ways that I was expecting to be satisfied. I am not  
91 going to say it was the most memorable workshop that I have been to.  
92 **I came to the workshop with hopes that I would be reminded of**  
93 **some good teaching practices and that essentially I was. I was also**  
94 **surprised in ways that I didn't expect because I did pick up**  
95 **practical ideas for my classroom.** I am glad that I was able to reflect  
96 on my teaching and my practice especially those ideas that I haven't  
97 been using. This programme did not only remind me of good teaching  
98 practices but **I got specific ideas to use** in my classroom.

99 Maybe I can use another example to illustrate this point. This current  
100 session was a different dynamic. It was not in the form of a lecture. **It**  
101 **challenges my teaching and gives me ideas to solve my problems** in  
102 getting all of my students to learn.

"I did pick up  
practical ideas  
for my  
classroom

Discussing,  
engage in  
learning

"I got specific  
ideas"

## Hailey's Interview 1 Transcription Coding

1 **One thing that I really liked about this session is that we do have the**  
 2 **time to just talk about things and to see like what the IL has tried in**  
 3 **her classes and what other people have tried.** The group I ended up  
 4 working with was not **such a collaboration as they saw the ideas I was**  
 5 **working on and they said oh those are all good. “you just like take**  
 6 **them up and post them to the Google drive”.** That’s not why I’m  
 7 **here. I’m not here to put all my stuff out. I was hoping to work on**  
 8 **stuff with people and come up with something that I would not have**  
 9 **come up with on my own. So I guess it’s kind of that that happens**  
 10 **everywhere. You end up with some groups where it ends up being**  
 11 **collaborative and other groups in which one person doing the work**  
 12 **(laughs) and other people being just kind of like “yeah, yeah, that’s**  
 13 **good. Let’s go with that.”**

14 I found for the most part, **the experience or the sessions has helped me.**  
 15 A lot of English language learners resources are out there and we felt that  
 16 we don’t have these resources and we are trying to track them down and  
 17 having a difficult time. And then **to come to this and find out that most**  
 18 **people are making up their own materials and there is not any one**  
 19 **resource.** There are **some good parts of some things and it’s just**  
 20 **finding materials with lower reading levels or with lots of pictures.**  
 21 **So knowing that that helps. I can stop looking for things that don’t**  
 22 **exist.** I just started working with what I have. And also just **some ideas**  
 23 **for having less assessment of students** like the one we did in the second  
 24 session where we had the four pictures that were related to a unit in grade  
 25 9 science and we had to make up that story about the pictures. **I ended**  
 26 **up using that in a field trip to the science centre we had to see the**  
 27 **great white sharks and so for my English language learner students,**  
 28 **their assignment was to just do that four sentence story about what**  
 29 **they learned in the movie.** It was very interesting reading what they had  
 30 to say when they didn’t think they were giving me the right answer.

Emotions –
“I really liked”
“time to just talk”
Emotions – dissatisfaction with group, disillusionment, disappointment
“has helped me”
Shared experiences
Artefacts available
Applied in classroom

31 The **first session I found was more collaborative**. I think that was due  
32 partly because we had in the first session we had more people. So there  
33 was more people to work with. I think also because it was December, a lot  
34 of people weren't feeling the crunch of new semester. Because the second  
35 session was in February and people were in new semester trying to get  
36 through material before the March break. I think the **IL gave us a lot of**  
37 **resources and ideas and things to share which I really appreciated. It**  
38 **was good to come into that even though it was for the teachers to**  
39 **collaborate, at least she had materials and ideas and things prepared**  
40 **for us to kind of fill the gap if we did not have anything to share. This**  
41 **is good**. It is nice to have ideas given to you by the organisers so you have  
42 a starting point to begin with.

43 **I did find them useful**. I would say wow that's a good idea. Why didn't I  
44 think of that? So I would take it back to my classroom and try those  
45 activities. I am still trying to learn and meet new people and do new things.  
46 I think it makes it easier to participate in the activity.

47 There were some teachers there especially in the second session – just a  
48 **few of us talking with some of the other teachers. One of them had**  
49 **worked in junior high environment so it was interesting to get her**  
50 **perspective on it**. I ended up talking with one teacher who has worked  
51 with my current principal and there was this other workshop where I met  
52 teachers and I am still in contact with them. **I can see myself staying in**  
53 **contact with some of the other people who are participating in this**  
54 **collaborative learning community**. Especially because I have been  
55 moved around so many times. It's nice to know other teachers so if I get  
56 moved to a school I could say "oh I met you at that workshop" and it breaks  
57 the ice at that new school.

58 I think **I was frustrated because I was trying to go through what I had**  
59 **done with my ELL science class with the other people in my group and**  
60 **they were like "oh I sure it's fine, I'm sure it's fine**. Just post it as what  
61 we come up with" and I said "well you don't even know what I did with

Collaboration

"first session  
I found was  
more  
comfortable"

Emotions –  
appreciation

Artefacts

"useful" for  
use in  
classroom

Social  
interactions

Exchange of  
ideas

Networking

Emotions – "I  
was  
frustrated"

62 my class. You might not agree with it. You might have a better way of  
63 doing things and **I think I just got the feeling that they just want to have**  
64 **it over and done with so that they can go home (laughs). I was just**  
65 **hoping to be able to actually work on something we had all put**  
66 **together and not something that I put together by myself in my class.**  
67 **I don't think it affected what I learned from that session.** I learned a lot  
68 like how to use Google drive. I didn't even realise that we had Google drive  
69 at the school board for the teachers.

70 **So I was still able to learn a lot from the other groups and get some**  
71 **really good ideas by talking with the other teachers. It is one of those**  
72 **things where I am still going to seek out working in collaborate**  
73 **learning communities. I find it really helpful especially with talking**  
74 **with people who are teaching grade 10's or who are teaching the senior**  
75 **level science classes to be able to figure out what I need to help the**  
76 **students learn when they are in grade 9 so that as they go into grade**  
77 **10 they could continue learning the things they need to know. Instead**  
78 **of trying to teach in isolation I have more of an idea of the kind of skills**  
79 **they need for grade 10 science at other schools. I picked up pedagogical**  
80 **knowledge and focused on skills that I would need. Not necessarily the**  
81 **content that I needed to learn. It was looking at the ways to teach the**  
82 **subject matter and also looking at what science skills to teach to**  
83 **English language learners.**

84 **We did go through the curriculum talking about the big ideas in the**  
85 **curriculum and looking at the units like the subject matter but we did**  
86 **not actually go through it step by step the different expectations, the**  
87 **specific expectations.** This collaborative learning community did not  
88 really change my understanding of the curriculum. It just **helped me to see**  
89 **it through different lens to understand that you didn't have to teach it**  
90 **in a certain way especially when we were talking about in the second**  
91 **session when one teacher raised the issue about safety and how she has**  
92 **a student who didn't understand the safely rules and they were using**

Regrets

Social interactions -

"learn a lot from the other groups"

"really helpful"

Exchange experiences

Cognitive development – pedagogy

No knowledge developed about curriculum

Different perspective of curriculum

Alternative choices of teaching

93 **like potentially dangerous chemicals.** And then the conversation came  
94 up that it doesn't have to be those chemicals to get the same result. That  
95 you could use other types of chemicals or you could find another way of  
96 showing the thing.

97 **I did use one of the activities that was presented. Even just thinking**  
98 **about planning for the rest of the year. It changed how I think about**  
99 **it** and I know even this whole year I have been **changing my thinking**  
100 **from just the content and going more for the science skills.**

101 I have learnt of new ways of teaching from other teachers. There was the  
102 one with **the starters to the story – “today I learnt .....” “This means ...”**  
103 **So I did that with my class after we say the movie on the great white**  
104 **shark. I am planning but I haven't done it yet one in a water quality**  
105 **lab in the ecology unit. Another idea was pictures of the different steps**  
106 **of the lab and the students have to put them in order like a jigsaw**  
107 **puzzle – first I do this, then I do this...so I wanted to do that with them.**  
108 That would really help them understand the steps of the lab. **Another one**  
109 **that I am planning on doing is one that the IL talked about where the**  
110 **whole lab is about them coming up with things they want to explore.**  
111 **Those are the things I am planning on doing but I haven't done them**  
112 **as yet. One of the reasons why I go to the collaborative learning**  
113 **communities is because I want to be a better teacher. I want to better**  
114 **reach the students. I think my identity will change. A lot of it is just**  
115 **based on figuring out the needs of my students at that time and best**  
116 **try to meet their needs.**

117 **Yes I think in becoming a better teacher I will change my view of who**  
118 **I am.**

Applied in  
class

“changing  
my thinking”

Intend to  
apply

“I think in  
becoming a  
better teacher  
I will change  
my view of  
who I am”

## Hailey's interview 2 Transcription Coding

1 For the last session we had we met at my school to see my grade 9 science  
2 class. I know that a lot of the planning I did for that lesson was the  
3 weekend before. We have been really struggling with that one in terms  
4 of the vocabulary and some of the concepts. So I kind waited until we got  
5 close to the time before planning my lesson. I was looking forward to  
6 seeing everybody and also of trying the lesson and also finding out what  
7 other people had done in their group: I guess to actually finally see some  
8 collaboration and to get some ideas with the other teachers. There are  
9 sometimes when I feel like I have fallen into a rut with what I do with the  
10 ESL students. I like to change things up and try new things. So my  
11 thinking for the ESL class because a lot of the time they stay in their seats  
12 and they are really passive about their learning, they just want me to tell  
13 them everything so that they can memorise it. So I wanted to do  
14 something that would get them out of their seats and moving about. **I was**  
15 **really happy that it went as well as it did.** Because I had visions of  
16 them refusing to participate and no I really did not know what to do as a  
17 backup: I was really happy to talk with the other science teachers who  
18 were there. **It was good to hear what other people think of my**  
19 **teaching.** Because I know what I do is one way, and sometimes I could  
20 be really hard on myself and so it is nice to find out that I am doing  
21 something that is working. Just to be **talking about things that other**  
22 **people have done in their classes gave me some really good ideas.**  
23 (Name withheld) was talking about the elements project she was doing  
24 in chemistry and instead of the straightforward way of teaching the  
25 elements, she ends up being more creative – like having stories,  
26 providing them with a choice board, and just having different ways for  
27 them to communicate their learning. Like the bit strips, I never used the  
28 bit strips and so I feel I should really start looking into that. I would like  
29 to try that out.

Emotions –

“I was really happy that it went as well as it did”

Social interactions

Collaboration, discussing

Cognitive development – good ideas

30 Maybe not for this class but definitely in the future. I really like to go to  
31 professional sessions in which people participate because by finding out  
32 what other people are doing and what is working for them and the different  
33 ways in which they are using materials is very interesting to me. I never  
34 thought of using a podcast and making our own power point.

35 **I definitely would like to do more lessons like this** one with the  
36 students moving around especially now that the weather is getting  
37 warmer and their attention span is getting shorter. I find that when I  
38 change things up a little, students tend to remember the lesson better for  
39 the first week or so afterward. However, as soon as we get into a routine,  
40 they do not remember their lesson. So it's good for me and them to  
41 change things up a little.

42 **Researcher: Are you happy with the outcome of the three sessions**  
43 **of the professional development programme that you just**  
44 **attended?**

45 I found that **I had a much more positive experience in the third**  
46 **session** because of **the collaboration and the sharing of ideas**, taking  
47 people's ideas and coming up with new things like that. I thought that  
48 in the three sessions there might be more opportunities to share what  
49 we have and build on it, make suggestions, build up new resources.  
50 **Coming out of the second session, I felt that the workshop wasn't**  
51 **what I expected. I felt that people wanted to come and take away**  
52 **resources and there was no sharing.** I know that in the **first session**  
53 **we had a really good kind of energy going on, people were sharing**  
54 **things, and they were exchanging ideas in ways to make things**  
55 **different. That really helped** especially when in my school, I find it  
56 very hard to get together with other teachers and sit down and come up  
57 with ideas for teaching the materials – ideas for projects – it is really  
58 hard to get that kind of collaboration. I am

Change way  
of teaching

Emotions –

“I had a much  
more positive  
experience”

Social  
interactions –  
sharing ideas

Emotions –  
disappointment

59 **Thinking of the optics station that the teachers had done.** I think  
60 that taking that lesson and seeing how I can use it, **how I can modify it**  
61 **for my students.** That was what I thought I would get out of the three  
62 days. I feel that the programme was offering me opportunities and I was  
63 not able to get from other people what they were going to teach in their  
64 classes.

65 **Researcher: Were you able to get any artefacts from the other**  
66 **teachers to take away?**

67 We got some **hard copies of some assignments.** They also **uploaded**  
68 **assignments on the Google Drive.** I find it very helpful to have hard  
69 copies because I tend to lose files **I downloaded onto my computer.** I  
70 usually promise to organise these files but they tend to get lost by the  
71 time I get around to doing it. All of the teachers shared their materials  
72 on the Google Drive. The one thing that I really liked about this  
73 programme was the idea that we had the opportunity to share with my  
74 students my own learning process so that they see that we are all  
75 learning together. This is especially so with that ESL class who wanted  
76 to know why I was away and what I was doing. I haven't taught the  
77 ESL science before and I am trying to find ways to improve my teaching  
78 and to make it better

79 **Researcher: Can you use the pedagogical skills you developed in**  
80 **this programme in any other classroom?**

81 **I did.** I think some of the activities would really appeal to some students  
82 who are the traditional learners - those who don't really learn well from  
83 the textbook. This would give them the opportunity to show their  
84 learning in different ways. I know from just going to the school library  
85 I see so many kids using the computer to read comics, play games, etc.  
86 They are so engaged doing this that I wish they could be this engaged  
87 in class. **I can see that I can get them to do assignments using the bit**

Cognitive  
development-

New  
pedagogy

Modify for  
classroom

**Artefacts**

Applied some  
new ideas in  
class

88 strips which are really comics would really get them engaged and  
89 interested in what they are doing.

90 **Researcher: Do you think you have come out of this programme with**  
91 **a different view of yourself than when you went in terms of your role**  
92 **as a science teacher?**

93 I think it has helped. **It has given me more confidence in my ability to**  
94 **try different things**, to try and reach my students in different ways. Also  
95 just being able to manage like teaching, the extracurricular activities that  
96 I do. **Yes it was a positive experience.**

97 I think talking with other people gave me a different perspective on what  
98 I am thinking and doing in the classroom. I know that when I was talking  
99 with the others, **sharing what works and what does not work help me**  
100 **to see my difficulties in a different light. I get to see what areas I need**  
101 **to consider that I might have missed during my teaching and also see**  
102 **what else I need to consider in making my lessons successful.** I learnt  
103 that instead of creating my resources from scratch, there is always some  
104 material online that I can use for my classes. I am now aware of that.

105 Quite a few people from the first session did not come back for the  
106 second session. There were a lot of teachers who did not come back.  
107 **This was unfortunate** because **it is really hard to collaborate when**  
108 **you are not working with the same people.** I am not really sure what  
109 contributed to people not collaborating. More than anything else **I felt**  
110 **frustrated** because I had signed up for the professional development  
111 with the understanding that there would be collaboration and I did not  
112 have that at the second session. That was really frustrating. I felt that  
113 this day would have been better spent in my classroom instead of being  
114 away from it. This feeling of frustration was temporary.

115

“It has given me confidence”

“Yes it was a positive experience”

Social interaction

“sharing what works and what does not work”

Collaboration

Emotions –

“This was unfortunate”

Regrets that some people did not collaborate

“I felt frustrated”

116 **Researcher: did you try out any ideas from the earlier sessions as**  
117 **yet?**

118 **I haven't had the time to try anything as yet.** Although for my grade  
119 8, we are doing a water unit and I think **I would really like them to**  
120 **create their own comic** about things that we are learning. I would  
121 probably **definitely use the bit strip: I am hoping I could get the**  
122 **grade 9 to use the pot lights and podcast for the astronomy class to**  
123 **project the images.**

124 **Researcher: How has your overall experience of these three sessions**  
125 **changed your classroom practice?**

126 I think **it is changing what I am doing in the classroom.** But because  
127 I am still in the middle of it I don't really know how it has changed.  
128 **Yes. I think it is changing** but at this point in time I don't know how  
129 it is changing.

130 I now know that **I can reach out to the larger teaching community**  
131 who participated in the programme so I don't just have to find people  
132 in my school to talk with about what I am doing. **I can now look to**  
133 **other schools and other teachers** and see what they are doing. For  
134 example one teacher was talking about how his school uses the  
135 astronomy unit as the main unit all year and all the other science units  
136 literally revolve around it and branch off it. In this way the whole year  
137 is spent on astronomy but you do units like ecology and so on are  
138 approached from their relationship to astronomy and the universe. I  
139 think this is amazing. I think and hope **I have formed a network with**  
140 **the other teachers** who attended the programme so that we can keep in  
141 touch and share ideas. We will see how things go when we try out  
142 different ideas.

143 **I am still in the middle of trying out new things, I can see it changing**  
144 **me but I don't know how yet.** I don't know what would work or not. **I**  
145 **am not really too sure.**

Changing  
practice  
"I think it is  
changing"

Social  
interactions  
"I have formed  
a network with  
the other  
teachers"

"I can see it  
changing me"

### Jean's Interview 1 Transcription Coding

<p>1 <b>I found the first session very useful. It deals with technology that is</b>  2 <b>being integrated in the classroom in different ways and I found it</b>  3 <b>very interesting to hear people say what they were using and what</b>  4 <b>was working.</b> And especially, <b>I found most of the technology that</b>  5 <b>was presented was things that I have not heard of.</b> This was all brand  6 new things. So <b>I came away very energised. I was excited about</b>  7 <b>trying some of those things in my own classroom.</b> I especially felt  8 that the idea of using the technology in a way that was not necessarily  9 tied to using the laptop, tied to the school, tried to using the  10 infrastructure. It is a way to communicate in the classroom. <b>I felt that</b>  11 <b>that was a good idea. That idea I found very intriguing.</b> Ah again,  12 the elements presented to us were not familiar to me. I thought they  13 were <b>interesting ideas.</b> I did the reader response and the ‘A, B, C’  14 assessments. <b>I tried both of those with my students and it was very</b>  15 <b>successful.</b> The online portion to get feedback I thought it was a good  16 idea. <b>It was a good way you know to sort of try it and see how it</b>  17 <b>goes.</b> So <b>I was a little bit sad that not very many people responded</b>  18 <b>to it. I always like going in to demonstration classrooms because it</b>  19 <b>is nice to just see, no matter how great something may sound on</b>  20 <b>paper or whatever, once you actually get to the classroom and see</b>  21 <b>it sort of breaks it all down to see how the students will respond to</b>  22 <b>it.</b> Then you kind of get a sense that everybody is universal. <b>It is</b>  23 <b>humanising. But I found that the second demo portion was done</b>  24 <b>well. They were interesting. For the most part they didn’t really</b>  25 <b>relate to what I was doing and I really couldn’t see a way of placing</b>  26 <b>them into my teaching for this year. I see that it may fit into my</b>  27 <b>teaching for next year.</b> These demos were mainly chemistry demos  28 and it is hard for me to use it in my classes. <b>I actually enjoyed the</b>  29 <b>afternoon session in which we were planning. The only down side</b>  30 <b>to that was that I don’t think we had enough time to get the</b>  31 <b>planning underway. And it felt that since I was working with (name</b></p>	<p>Useful</p> <p>Social interaction – exchange ideas</p> <p>New knowledge</p> <p>Emotions – excited, energised</p> <p>“that was a good idea”</p> <p>Applied new learning</p> <p>“I tried both of those with my students and it was very successful”</p> <p>Emotions – Sad, like</p> <p>Emotions – satisfaction</p> <p>Later use</p> <p>“it may fit into my teaching next year”</p> <p>Emotions – enjoyed, regrets</p>
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32 withheld) on the grade 11 college, I felt that we did not have enough  
33 time to fully put our ideas together and since we will have to process  
34 it from afar and it would be hard for us to come up with something  
35 that we are both happy with when we are both you know I'll be  
36 working on something instead of her and she would be working on  
37 something and sending it to me. It is just easier to work in person  
38 so that we can flush the ideas fully and not sort of committed. We  
39 are still at the building an assignment kind of stage. So at this point  
40 we haven't really got any further on it. But I think we are both  
41 working independently and then we will come back and get  
42 together. So that is be really hard to make sure we are both on the  
43 same page with one assignment that we can mark together. So I  
44 guess that was the only sort of I wish there had been more time on  
45 the second day devoted to that working together instead of the time  
46 that we had.

47 I felt like I could have spent all of my time helping people out. But I  
48 think that it doesn't take any time away from me and I think it will  
49 always make the day go better to help them quickly. I think I really  
50 like the way the CLC took charge of it. I like it that it was a sort of  
51 recap. So I really loved the fact that the CLC has follow up I am sitting  
52 there and saying I could do this in class. And I am expected to try the  
53 ideas and post them on Google Docs. I felt that this is better because you  
54 are being pushed.

55 The first day we were being presented with a number of different  
56 techniques in using technology and then posting your work on it. I  
57 think that really pushed me and I sort of really looked at where I can  
58 incorporate this right away in my teaching. It might not be in the  
59 course that I am teaching but may be in a later one. I really like the  
60 first day and the follow up on the second day. So I got more out of that.  
61 I need to see the product that I come up with.

Social interactions

collaboration

Emotions

“really loved the fact that the CLC has follow up”

“I can incorporate this right away in my teaching”

“I got more out of that”

62 My learning was **pedagogical mostly**. It was about **cooperative learning**.  
63 We engage more in cooperative learning and in using the newer  
64 technology.

65 **I find I did three different things from that first session. I did the**  
66 **activity where I paired the students and person A and person B**  
67 **reading their paragraph and asking questions and then switching**  
68 **roles.** I did that in a grade 12 science class. **I asked for feedback at the**  
69 **end of the lesson and I felt that they all felt it was a strategy to keep**  
70 **them focused and to get a summary of what the point of the article was**  
71 **about. I felt that was a plus-minus. I also felt that getting them to work**  
72 **in pairs it allows them to express their ideas and it sort of brought**  
73 **more out of them instead of individually.** The other technique that I also  
74 used with my college biology class was the Socratic technique. I put  
75 together a little multiple choice and short answer test that the students  
76 could access on their smart phones. I let them play with the materials we  
77 already covered and I let them work either individually or in pairs. It turned  
78 out that they mostly worked together on things. I found that students, who  
79 already were not working well, were really participating. **I was really**  
80 **impressed by it. I definitely had more student engagement** on using the  
81 Socratic than I would have had if I had just given a handout or ask  
82 questions. **I think I wouldn't say it would change how I feel or how I**  
83 **would identify myself as a science teacher.** Because I always felt that no  
84 matter what class you have – high or low achieving – you know there is  
85 always something you could do to incorporate it in your lesson. If it works  
86 I will try it again. It doesn't always work but I like to try different things.

87 Although **cooperative learning** has been modelled for me, I have always  
88 been hesitant to try it. **I liked it and I found that it was doable and I**  
89 **tried it and I did have success.**

90 **I have incorporated some ideas in my teaching and I am thinking**  
91 **where else can I do this?** I've tried it in one classroom, so I need to try it  
92 in another classroom or use it in another way.

Cognitive development –  
Pedagogy, cooperative learning

Applied new learning

“I was really impressed by it”

“I definitely had more student engagement”

“I wouldn't say it change how I would identify myself as a science teacher”

Emotions

“I think I wouldn't say it would change how I feel or how I would identify myself as a science teacher”

“I tried it and I did have success”

“I have incorporated some ideas”

93 **I would not hesitate to go out of my way to share what I have learnt,**  
94 **to show them what I have done, and give them help: I think there are**  
95 **a fair amount of people on staff who have been teaching for a while. I**  
96 **really enjoyed working with the other teachers from the other schools.**  
97 **It was nice to share experiences. It took away some of the isolation I**  
98 **feel at my school. I find working with other people enjoyable. I feel good**  
99 **to know that I am there to try new things and I am interested in how**  
100 **these teachers improve learning among their students. I get inspired**  
101 **this way so that I can continue to be the teacher I want to be. There**  
102 **wasn't really a lot of sharing of ideas. I mean time was really**  
103 **structured. The sharing came from the lead teachers not among us the**  
104 **other participants.** They were providing the examples and opportunities.  
105 **There was a degree of sharing in which people were talking about the**  
106 **technology. And coming up with ideas.**

107 **The feeling was energised. At the end of the day, I felt energised.**

108 **I did like the opening activity and the idea of getting the students**  
109 **engaged and moving around.** This is good for the grade 10's. **So the**  
110 **music and moving around is energising for them. I did like that activity**  
111 **and I would use it in my classroom.**

Social interactions – sharing of ideas, helping

Emotions – “I really enjoyed working with the other teachers from the other schools”,

Feel good, inspired

Emotions – “I felt energised”

“I could use it in my classroom”

## Jen's Interview 1 Transcription Coding

1 So I felt like a lot of the strategies which were presented by the person  
2 who hosted the PLC which allows her to demonstrate some of the  
3 strategies which we can **use in our classroom** which is kind of official.  
4 **I felt as though the group could have worked well together.** One thing  
5 that I notice was that the numbers did dwindle on the second session so I  
6 am not sure if that affected the second session where we had to come  
7 together as a group and develop our lesson. **That definitely affected the**  
8 **second session where we had to come together as a group:** From the  
9 first session I felt as though the materials we received were from the PLC  
10 we went to. **Some of the techniques that we got there were beneficial**  
11 **for the type of lesson plans we were supposed to develop:** I suppose  
12 we end up breaking off into groups. People had a lot of different opinion  
13 in terms of what lesson or what strand we should focus on. I think I was  
14 the only one last person standing in the last session who was skimming  
15 for main ideas out of the booklet for the grade 9 curriculum. I mean **in**  
16 **terms of collaborating I wasn't able to really collaborate in the**  
17 **second session specifically because the group members did not**  
18 **return for a variety of reasons.**

19 I do think that **it was a progressive idea in a progressive fashion to**  
20 **develop a set of lessons a variety of lessons for a variety of different**  
21 **units.** I do think that ideally there would be a maybe **working in groups**  
22 of three would be beneficial and then maybe **opening it up to a larger**  
23 **teacher base would be beneficial.** Because that way we could have a  
24 larger collection of lessons maybe increase the number of lessons to  
25 maybe 6 or 10.

26 I think there were about four of us per group: We had a solid group of fou  
27 But not everyone was there. The **collaboration aspect did not con**  
28 **through because of those individuals that weren't able to attend.**

29 The thing is that we had the stuff of where we were going. We had the  
30 framework for our next session so **it wasn't that we did not have a**

Cognitive  
development  
– new  
knowledge

“use in our  
classroom”

Emotions –  
regrets about  
group work

Benefits

Social  
interactions –  
not much  
collaborations

Artefacts

Emotions –  
regrets

Social  
interactions –  
not much  
collaboration

31 **chance to talk. It was just that we did not have a chance to continue.**  
32 **So it's not as if I felt abandoned** but I needed a little bit more input from  
33 the group members. So **I think it would have been beneficial. At least**  
34 **you walk away with something concrete. So I do see that as an**  
35 **important goal of the sessions.**

36 If we have groups of three as opposed to groups of four we can develop  
37 maybe one or two more lessons. But I mean I again if it were a group of  
38 three then for the second session we may be together.

39 Even though I'm now teaching Geography, I do believe that by  
40 September my time table would change again and I am sure these ideas  
41 would come in useful then. **It was meaningful because I could take it**  
42 **in different subject areas.**

43 **I think it just made me a little bit more aware of some of the**  
44 **challenges.** Certain groups may share. I just having an awareness of that  
45 and being able to appropriately scaffold and take shape and having an  
46 awareness or a reminder of that sometimes you forget aspects of the  
47 content and the curriculum. I think it is a reminder that's all.

48 **I think the most relevant piece is the needs of the ELL students. I**  
49 **think that the strategies were relevant. The lesson plans that come**  
50 **out of it are geared towards specific strands in the curriculum.**

51 **I don't think it has imparted confidence but it's been very**  
52 **informative in terms of the strategies.** I believe **it would help me in a**  
53 **new class but I have had such students before.** I have had students at  
54 the applied level, grade 9 science who range from ESL A to ESL C or D  
55 and ELL levels before and I have learned how to work with them. **I think**  
56 **that I have already developed many strategies and have resources**  
57 **already.** If I have experience like this prior to this would have been  
58 valuable. But I have already developed some of those techniques on my  
59 own. **I do think it helped** but my experience was that it was a good  
60 operation. It has supplemented what I knew.

Emotions –  
disappointment  
“I felt  
abandoned”  
“it would have  
been  
beneficial”  
  
Future use of  
knowledge  
  
Awareness of  
challenges  
  
Relevance to  
students’  
needs  
  
Not relevant to  
current needs

61 So I took the notes. I was the one with the lap to: I sort of took into  
62 account all of the ideas and try to find out all the learning needs,  
63 skimming for new ideas and incorporating it into a lab. So I was involved  
64 in that process.

65 I think it was a good way to do DI and you know, **to get comfortable in**  
66 **the group:** I think that it serve as you know a good opening activity.  
67 Most people were fairly involved and positive and excited to be there.

68 **I feel it was a comfortable environment. I feel safe** sharing my points.  
69 I think several individuals were sort of involved in sharing their ideas. I  
70 think it was a professional environment where you know, my **opinion**  
71 **and those of the others were shared.** I feel people were motivated to  
72 tackle their learning needs and construct a lesson that can be useful. So **I**  
73 **felt comfortable working in that whole process.** I feel that the  
74 instructor provided a **positive environment.** She **tried to support us in**  
75 **any way, shape or form. Whether we needed resources or ideas, or**  
76 **other issues in the classroom. I had to do some things on my own I**  
77 **didn't feel discomfort but some disappointment because it would**  
78 **have been nice to have input from other people in the group: Sharing**  
79 **ideas is absolutely good because sometimes you overlook things, and**  
80 **somebody else would pick up on it.**

81 For me personally, I think **the sessions help me in terms of being a**  
82 **more prepared teacher.** I think it was a **way to network and meet**  
83 **people** within the school board and in my subject area. I was able **to**  
84 **make connection. Get some ideas. I connect with one person and we**  
85 **would throw out ideas back and forth in terms of what we are**  
86 **interested in the curriculum in science.** I think **it makes for a learning**  
87 **environment in which apart from our target, we can think of other**  
88 **activities or ideas which we can share with our colleagues? It was**  
89 **beneficial for all of us. Even though part two didn't work out I do**  
90 **feel like it was beneficial in terms of being able to get my ideas on the**  
91 **curriculum in an innovative way.**

“I do think it helped” “

it has supplemented what I knew”

Social learning –

Sharing of roles

Social interactions – “to get comfortable in the group”

Emotions – comfortable, safe

“I felt comfortable working in that whole process”

Emotions – “I didn't feel discomfort but some disappointment”

“the sessions help me in terms of being a more prepared teacher”

Social interaction

“it was beneficial for all of us”

“get my ideas on the curriculum in an innovative way”

92 I suppose I would have been able to network with others but then that fell  
93 through. So it did not translate into anything concrete. **Networking is not**  
94 **necessarily among people in the same group:** My network was **with**  
95 **someone outside my group:**

Social  
interactions  
– exchange  
ideas

Social  
interactions -  
networking

## Jen's Interview 2 Transcription Coding

1 To be honest I was supposed to post some lessons regarding some  
 2 learning skills but I didn't do that. That was supposed to happen but did  
 3 not happen. I think that the main thing that is done is that **it has given**  
 4 **me some insight into the ELL learner.** I think that's the main thing. I  
 5 already have some insight but I feel like it was broken down a little bit  
 6 different in terms of the phrasing of the question to put the topic right  
 7 at the beginning so that they have some sort of idea where the questions  
 8 were leading to. So **I think that specifically some strategy even**  
 9 **simple things to do in the classroom to help the ELL succeed. I**  
 10 **would have liked to work in a group for the three days.**  
 11 Unfortunately, I wasn't there the last day. The second time we met like  
 12 I had said, I was the only one in the group and so **I didn't have that**  
 13 **collaboration.** It was **good to see how the other groups were**  
 14 **collaborating** because one group had 4 members which was great.

15 **Researcher: which ideas were you able to take to your class?**

16 Well I think **some of the strategies that we used for the ELL's could**  
 17 **be used in my classes.** I am teaching an applied class. A lot of them  
 18 need the same type of reinforcement. I think there is some overlap there  
 19 with the applied level students. So although I am not teaching the ELL's  
 20 per se, some of those same strategies do work well with other students  
 21 and I mean I will run into ELL's again. So **it's not as if it was going to**  
 22 **waste.** Interacting **was fairly productive especially that first day.**  
 23 Different people with different ideas in mind were working together to  
 24 develop an outline of a lesson that would work. We weren't fresh. **I**  
 25 **think it was a positive environment. People were attentive and**  
 26 **willing to accept others' ideas and worked with each other.** I think  
 27 **we were really on task and we had a focus which was great.**

28

Cognitive development –
Insight
“it has given me some insight into the ELL learner”
Social interactions –
Not much group work
“I didn't have that collaboration”
Emotions –
Regrets
Use in class
“some of those strategies would work well with other students”
Social interactions –
people were accepting
“Different people with different ideas in mind working together”

29 I felt like we picked a concrete topic in the curriculum and it really not  
30 so for from what we do in an academic class which is breaking it down  
31 into smaller bits and having a focus. So **I never felt as though any of**  
32 **it was irrelevant to my needs.**

33 **Researcher: why did you feel disappointed in the programme**  
34 **although it was a progressive idea as you told me in the first**  
35 **interview?**

36 The first session went really well. The **second session unfortunately I**  
37 **was the only one in my group:** So there wasn't any other representation.  
38 **I had all these ideas from the first session, because I took notes on**  
39 **my laptop:** So I was the one who sort of was writing and jotting down  
40 ideas. So **I was disappointed in not having those same group members**  
41 there to engage in the community learning workshop: So that is where  
42 the disappointment came from. **There was no one to collaborate with.**

43 I think I was referring maybe to the second session in which I was  
44 working alone. The challenge was **to come up with the lesson on my**  
45 **own.**

46 **Researcher: did you learn of any new idea that would be useful in**  
47 **class?**

48 Listening to others in the workshop, we all felt that there were **some**  
49 **useful strategies that we engaged with.** This was how to set the ELL's  
50 up for success, how to connect ideas by picturing one sentence after  
51 another. I think those ideas were definitely new. I think I thought about  
52 what to emphasise with the ELL's but I think there was a lot of emphasis  
53 on trying **to develop their learning skills** and skimming for main ideas.  
54 So I think that maybe what we take for granted as native English  
55 language speakers, was difficult for the ELL learners and so **we should**  
56 **be aware that what we find easy is not as easy for the Ell's.** So I  
57 think it is more of awareness along with those strategies that I gave.

Relevance to  
needs

Social  
interactions -

No group  
work

"There was no  
one to  
collaborate  
with"

Emotions –  
disappointment

Cognitive  
development –

Useful  
strategies

"To develop  
their learning  
skills"

58 I do think it is definitely helpful. **I think it makes me a little bit more**  
59 **aware of the learning for the ELL students. It gives me a little bit**  
60 **more confidence in the classroom and I can implement these**  
61 **strategies** right at the beginning of the year to get the students in a good  
62 team. And then hopefully continue to progress throughout the year.  
63 Like I said it is more of awareness. And I can use these strategies at any  
64 time of the year. **This would definitely be beneficial.**

65 **Researcher: Has your participation in this programme boosted you**  
66 **confidence as a science teacher?**

67 The more prepared you are the more you feel that you have a handle on  
68 things. So that you can make sure **you set the students up for a clear**  
69 **path and success.** So I think that that is something **that makes me feel**  
70 **more confident. I don't know that I would describe myself as an ELL**  
71 **science teacher. I would definitely need more training in that area**  
72 **first. I can say I have some experience teaching the ELL students**  
73 **science. I don't think I will ever identify as an ELL science teacher.**  
74 **My experience of teaching the ELL's together with the workshop**  
75 **gives me the confidence to say I am able to teach the ELL science.**

76 **Researcher: describe how you felt due to these experiences**

77 I think that even before attending the workshop, it wasn't as if I was  
78 reluctant to attend it. **I was excited.** At the time that I was asked to attend  
79 the workshop was because I was teaching the ELL's. **I was excited and**  
80 **eager to attend it.**

81 So going in with that **approach I was definitely happy to attend** and to  
82 meet the Instructional Leader who has a wealth of knowledge and  
83 resources and so this created **a positive interaction among people in the**  
84 **same subject area. I felt pleased with the experience.** It was a useful  
85 workshop in which I picked up a set of activities. However, **I would have**  
86 **liked to connect with a group to collaborate.** Unfortunately, the

“Confidence in the classroom”

Emotions –  
Confidence  
“Makes me feel more confident”

“I don't think I will ever identify as an ELL science teacher”

“I am able to teach the ELL science”

Emotions –  
excitement

“I was excited and eager to attend it”

“I was definitely happy”

“a positive interaction among people”

“I felt pleased with the experience”

87 numbers dropped from 20 people in the first session to 10 in the second  
88 especially when collaboration is involved.

89 I think that **the initial activity** itself such as the ice breaker and other  
90 group activities in getting to know each other **was a positive experience**  
91 **for me**. It was a nice way to get to know a little bit more about the other  
92 participants. Again it was **an exciting experience**. Getting to know new  
93 people and their common goals, and understanding more about the ELL  
94 student was good. During the activities **I felt engaged**. I was an observer  
95 that one who participated. So for me it was sort of getting information  
96 and observing what was happening and trying to get a feel for the  
97 different personalities and their specialities that they have. So while  
98 engaging and collaborating I felt that perhaps some people in the group  
99 were more focused than others. That was what I noticed. I think people  
100 have different comfort level. I felt I needed to understand their needs. I  
101 wasn't cynical at all I was there to be productive. I was trying to reach  
102 my end goal.

Regrets –

“I would have liked to connect with a group to collaborate”

“a positive experience for me”

“I felt engaged”

## Linda's Interview 1 Transcript Coding

1 Well **my whole experience with the two sessions that I have attended**  
 2 **so far was positive.** This is the second time I am teaching ESL science  
 3 and it was a little bit challenging for me so the fact that we don't have  
 4 any written material. We have to get or gather all the material on our own  
 5 or adjust the materials for the grade level. It was a big challenge for me.  
 6 I have found out that I am not the only one. Everybody has the same  
 7 challenge. And also maybe different approaches to maybe a variety of  
 8 different students. This was one thing that I found out. **I also think that**  
 9 **interacting with other professionals like myself is something that is**  
 10 **positive and interesting.** Because **sometimes you might think you are**  
 11 **the only one maybe having the challenge and I found out that**  
 12 **everybody is in the same boat.** And also in terms of resources I also in  
 13 our workshop found out that we use different resources from a variety of  
 14 different sources. **I think it is good.** I have a long teaching experience  
 15 about twenty years of it. I think maybe one thing in activities was new.  
 16 **In the first workshop the introduction activity of giving each student**  
 17 **an element and have them introducing each other with element**  
 18 **name. I think in terms of activities I learn from them. It is good to**  
 19 **have variety so that maybe the ESL students can speak up more. It**  
 20 **gets students to try talking.**

21 **Whatever the other professionals are doing in their classrooms I had**  
 22 **a chance to hear their experiences, how it works, and maybe use their**  
 23 **approach to try it in my classroom too. It was positive. It was**  
 24 **positive. I mean it was beneficial.** I don't think only new teachers  
 25 should attend the workshop: Experienced teachers like me maybe would  
 26 get ideas from the new teachers, the young teachers. I did not learn new  
 27 subject matter. But **Pedagogy yes.** Maybe I can say in **teaching**  
 28 **approach to ESL students. Curriculum no, not the curriculum.** I have  
 29 been teaching for so long that I am familiar with the curriculum.

Positive experience
Social interactions – positive experience in interactions
“positive and interesting”
Cognitive development –
New knowledge
Social interactions – sharing experiences
Emotions -
“it was positive. It was positive”
Cognitive development -
Pedagogical knowledge

30 **Collaboration with other teachers was good. Maybe in finding an**  
 31 **activity that might work for ESL students. This was most beneficial**  
 32 **for me.** Because most of the time we do not have time for collaboration in  
 33 the schools. We are so busy. The best collaboration was in designing the  
 34 activities. It was sharing of ideas and designing of activities. We all bring  
 35 our ideas together and we put them together and make the best of it  
 36

37 **Teaching the ELL students is still a challenge. I definitely think my**  
 38 **experience would help the applied students also. Yes definitely.** No  
 39 matter how much experience you have, you do not have the same students  
 40 to teach all the time. You always have different students. **I think it helped**  
 41 **a lot.** It helped a lot. **Every experience, every workshop, help to make**  
 42 **you more confident. Definitely. I feel so good in my ESL class this**  
 43 **semester than the first semester. This is due to attending these sessions.**  
 44 **Because I was thinking that maybe it is me that has the problem. I was**  
 45 **having the challenge because it was my first time. But I think that**  
 46 **everybody has this struggle I had.**

47 I think that **this is one of the things that I promote in my department. I**  
 48 **definitely like to share with my other colleagues. I have started talking**  
 49 **with my colleagues, and shared the work sheets I got from the**  
 50 **workshop: Definitely. I share with them and I try to air my opinion.**

51 **Now I see myself as an ESL teacher also although I do not have ESL**  
 52 **qualification. But through this professional development workshop, I**  
 53 **see myself as an ESL teacher too. Because I have learnt a lot and I**  
 54 **think that I am more confident about teaching ESL science in my**  
 55 **classroom. I know that the expectations now maybe I can teach them**  
 56 **better in my classroom. Definitely. Definitely. I see myself doing a**  
 57 **much better job.**

58 **I wish we had less maybe instructional leader giving instructions to us**  
 59 **and more interaction among the group members.** I know that she is the  
 60 facilitator, but I wish that we have less facilitation and more interactions

Social interaction  
 "collaboration with other teachers was good"  
 Sharing ideas  
 Producing artefacts  
 Relevance to needs  
 Inspired confidence  
 Emotions – "I feel so good in my ESL class this semester"  
 Confidence to share with colleagues  
 "Now I see myself as an ESL teacher although I do not have ESL qualification.  
 I am more confident about teaching ESL science"

61 among the group members. **We would be preparing the activities and**  
62 **sharing more ideas. We had to choose an activity, if I had to choose I**  
63 **would have chosen a chemistry activity. I am more comfortable with**  
64 **this section.** But as a group we decided to come up with an activity for the  
65 optics unit. And we will bring them together and share them. We would  
66 apply the lesson in the classroom and then when we meet in the third  
67 workshop we will discuss with each other our experience of whether it  
68 worked or didn't work. I mean it is not always good to work in your  
69 comfort area because as a science teacher you are always working in  
70 different units. I am glad we worked on the optics instead of chemistry unit  
71 because I am more comfortable in chemistry. **I learnt a lot from the group**  
72 **members and I was able to contribute and share ideas** as well in  
73 planning the lesson. I haven't taught the lesson as yet. I have to think  
74 about it. I will do this after the March break. Our next meeting is April 10.

75 First of all, so far **I am happy that I attend those sessions.** I did not have  
76 a chance to hear from the other groups what activities they are planning to  
77 apply in their classrooms. This is why it is a bit early for me to say I feel  
78 very good and that I am getting ideas from the other group members.

79 We would be sharing those in the last session. In my group I can tell you  
80 that the other teachers are very, very enthusiastic about coming up with  
81 new ideas to use in the classroom. They are hopeful that in the last session  
82 we would all be coming up with something and going back to our schools  
83 richer with more activities, different activities to apply in the classroom to  
84 help the students maybe learn much better. It's early for me to say. Maybe  
85 after the third session I can say for sure.

86 **I feel so far it is very, very, as I said at the beginning, positive. I am**  
87 **very happy** because in the workshop I have seen some very senior teachers  
88 like myself and I have seen some very young teachers much newer to the  
89 profession than myself. **It's good to interact with a variety of teachers**  
90 **so that we can learn from each other. I felt very safe to talk about my**  
91 **difficulties because the instructional leader is a very warm person and**

Social interactions – planning activities

“I learn a lot from group members and I was able to contribute and share ideas”

“I am happy I attend those sessions”

Emotions – positive and happy feelings

“feel very comfortable”

92 **she makes you feel very comfortable during the workshop: I did not**  
93 **have any fear of stating my experience or opinion. We were all very**  
94 **positive. We never judge each other. So we felt safe that way.** I mean  
95 people were very mature and very open to others. **We were not**  
96 **judgemental at all in the workshop:** It promotes my learning and at the  
97 same time **I am not afraid to air my weaknesses so that I could get help**  
98 **from them and be a much better teacher. We are a very nice group: I**  
99 **am very happy.**

Emotions

Feeling of  
comfort

“I did not  
have any fear  
of stating my  
experience or  
opinion”

“I could get  
help and be a  
much better  
teacher”

## Linda's Interview 2 Transcription Coding

1 **I have definitely started using some of the ideas that I picked up from**  
 2 **the first two sessions.** I used to do the vocabulary, oral discussions. I  
 3 did not use any of the activities because I haven't had the time to try any  
 4 of them as yet. **I will definitely use them.** I was in the optics group and  
 5 we were going to present our lesson, but I had a parent-teacher interview  
 6 which I could not avoid and I live a far way. There was no way I could  
 7 attend the workshop and be there on time for the interviews. I did a few  
 8 things and I asked the IL if I should send them to her but she did not reply  
 9 to me. So I was able to pull things together in a lesson but I was not there  
 10 to present it. My co-presenter sent some materials by e-mail and I was  
 11 unable to go to Google Docs where they post everything. As soon as I  
 12 can I will go to Google Docs to check the lessons out.

13 **Researcher:** How has your experience helped you to cater to the  
 14 English language learners?

15 **This programme has definitely helped me to teach the ELL's.** We  
 16 none of us have a lot of experience in teaching the ELL's and **so just to**  
 17 **talk and exchange ideas was good. It is good to hear from other**  
 18 **professionals what their experiences are in the classroom.** I mean  
 19 especially the first activity, the element activity, I liked it. By  
 20 **interacting with other colleagues, I believe we always get some new**  
 21 **ideas.** Normally we do not have much time to interact with other  
 22 teachers because we are always moving from class to class but **the**  
 23 **workshop gives us that opportunity** that is out there and done by the  
 24 professionals.

25 **Researcher:** were you able to use what you learnt in the earlier  
 26 sessions in your classroom?

27 I was not able to use any ideas because I am not at that unit as yet. When  
 28 I get to the climate section, I will be able to use the ideas as I teach the

Applied new  
ideas in  
classroom

"helped me to  
teach the ELL's"

Social  
interactions –

Talk and  
exchange ideas

"interacting with  
other  
colleagues"  
collaboration

Has not applied  
in classroom as  
yet

29 optics section. I have some of the worksheets that were sent to me and I  
30 will definitely use them in the optics section.

31 **Researcher: Has your overall experience changed your classroom**  
32 **practice?**

33 **I will not say it would be a big change.** It is a limited time and we were  
34 given a lot of things and **I did not have a good grasp of some of the**  
35 **ideas.** But I still believe it is good to update ourselves from time to time  
36 so that we are not doing the same thing over and over. There are so many  
37 changes in education that we do need to keep track of them. I believe in  
38 workshops that is why I decided to attend this one. But at the same time  
39 it brings lots of responsibility. I wish we would be able to do the activities  
40 during the workshop:

41 Even by a little bit change. My expectations were maybe more than they  
42 can benefit? Maybe **I try different ways to teach** them. My class is  
43 made up of different levels of ELL students so we do lots of reading  
44 and lots of explanation before we complete a lesson. I used to ask the  
45 students to do these by themselves but now I am thinking that they  
46 should do it together and maybe I can clarify my instructions by  
47 explaining more, elaborating more so that they can understand. **I**  
48 **believe I have changed to some extent.** I cannot say I did not benefit.  
49 **I benefited.** But I am not sure, maybe because we were all in the same  
50 boat, maybe teaching ELL kids for the first time or second time. No  
51 teacher was there with years and years of experience that they can share  
52 their experiences with us when we did things together. Not have enough  
53 books to follow, we always had to find resources by ourselves which  
54 takes up lots of time.

55

56

“I will not say it would be a big change”

“I did not have a good grasp of some of the ideas”

Intend to change practice

“I believe I have changed to some extent”

“I benefitted”

57 **Researcher: Can you tell me one thing that you can say you will be**  
58 **taking with you as you leave the programme?**

59 **Maybe I would say the anxiety I had, the dissatisfaction I had since**  
60 **was saying am I doing enough? Is there anything else I should be**  
61 **doing? Am I helping them enough? I mean I would say it took away**  
62 **the anxiety and gave me comfort.** I am in the same boat with other  
63 teachers in the same situation in which we are struggling together. A  
64 positive side of it is that **every teacher came up with ideas which we**  
65 **shared.**

66 **Researcher: are you in contact with any of the other science**  
67 **teachers who participated in the programme?**

68 **I will definitely.** I will definitely. We share e-mails. It is a good idea.  
69 We spent time working together using up two teaching days and I don't  
70 want it to go to waste. At least **I now have a line of communication**  
71 **open which I can use, can get resources.** Definitely **I will keep in**  
72 **touch with those teachers.**

Took away  
anxiety

Comfort

Shared ideas

Communication

“I will keep in  
touch with  
those  
teachers”

## Maria's Interview 1 Transcription Coding

1 Well, for me it was, a bit **different because I was actually leading the**  
2 **workshop: It has been a lot of work.** A lot of work but I think that when  
3 teachers came to the workshop they think we would give them the work  
4 and the assignments and **I don't think they realise that the whole idea of**  
5 **the PLC was to work together to develop rich culminating tasks.** I think  
6 those who show up on the second day understood what was expected and  
7 what was the value of the rich culminating tasks that focus on the skills in  
8 the curriculum.

9 As a lead teacher, before I say how I felt, I think I should say that **it wasn't**  
10 **really what I expected.** I knew what I was getting into, I knew I was going  
11 to work with another teacher and we were going to work together to come  
12 up with an outline as to how these four workshops were going to work out.  
13 **I ended up doing a lot of the work on my own.** More than a lot of work.  
14 **Probably about 95% of the work on my own. Instead of enjoying it,**  
15 **enjoying the experience, it ended up, during the first session, and the**  
16 **second session just being stressful, a lot stressful actually because I just**  
17 **had to find the time to not only do my school work and the other stuff**  
18 **I was involved with, I had to find time to develop the whole thing on**  
19 **my own, the photocopying, the reading, doing everything, the power**  
20 **point, the equipment, bringing the equipment, I just felt exhausted.** If  
21 look back on the two sessions, you know, am I enjoying it? **I think could**  
22 **have enjoyed it, but I don't think I enjoyed it.** I think that moment has  
23 passed. I wanted to it to go well, I think I had no choice but to do. **To me**  
24 **it was not the unequal sharing so much as it was pretty much doing**  
25 **everything. I have not worked together, we did meet once** – on the first  
26 day when we actually knew we were going to work together and the next  
27 time we met was the day before the first session. I think I said we needed  
28 to meet to decide how to do the power point, who would do whatever. I  
29 think we just ended up with us agreeing you do this and you do that and  
30 I'll do this and I'll do that and you can bring these handout and whatever.

“a lot of work”

Emotions – negative feelings

Emotions – disappointment

“I ended up doing a lot of work on my own”

Stressful, no joy

“I don't think I enjoyed it”

Social interaction – “pretty much doing everything”

31 But on the day of the activity whatever we had planned never happened.  
32 So the hand out we had planned never arrived. So whatever handouts I had  
33 that day was stuff that I did. I have people already coming to my classroom.  
34 I have the Superintendent coming in March or April. I have demonstration  
35 classroom within the school where people from my school are visiting my  
36 classroom. It would be too much for the kids. So that was one reason. The  
37 second reason was **I thought you know I think I have done enough for**  
38 **the two sessions. I think it's time that you run the third session. I**  
39 **offered to provide handouts and such and I offered to do part. I just**  
40 **think that I am not, it was just too much stress for me to continue.**

41 **It is not enjoyable and I find myself asking the IL on numerous**  
42 **occasions** if “this is going ok, is this going well?” I needed the feedback  
43 of whatever has been done. I needed feedback on whatever I have been  
44 doing was what she expected.

45 **I don't think I had anything to take back to my classroom. I just was**  
46 **focusing on getting people involved. But anything to take back to my**  
47 **classroom. Not yet. Maybe the next session.** Maybe the next session  
48 things would come together when people actually start to get their class  
49 to do the assignment. Maybe when the teachers work together and come  
50 up with their own ideas and implement them in their classrooms and  
51 bring it back on the last day. So maybe I would say maybe the last day  
52 when we bring back our lessons, maybe I would get something concrete.  
53 **I shouldn't say I learnt nothing. I got feedback from the teachers as**  
54 **to what they experienced, it seems they were experiencing the same**  
55 **thing with our applied kids –trying to get them involved, trying to**  
56 **get them to be turned on to science. So that was good. That was good.**  
57 **I realised there were people there who felt the same as I did and**  
58 **experienced the same things that I did.**

59 I'm hoping that at the end I would get some feedback as to how certain

Emotions –  
stressful

“It was not  
enjoyable”

Cognitive  
development –  
no new  
learning

60 activities work in other classrooms with students similar or even not so  
 61 similar to my kids. So I see it more as getting feedback from teachers so  
 62 **that I can take some of their strategies and use it in any of my classes**  
 63 **not necessarily the grade 10 class. It would be a combination of both**  
 64 **content and pedagogical knowledge**

65 **I think the reason why I was excited about the topic in the first place**  
 66 **was because it was that** the topic was a push in our school on which are  
 67 focusing right now. The applied kids – we are getting them involved, we  
 68 are looking at the whole development process and I thought and **I still hope**  
 69 **I would be able to take information back to the teachers at my school.**

70 Before I did this programme within the last two years I have been  
 71 rethinking my role as to what exactly what my job is as a science teacher  
 72 and I have been doing other activities and programmes at school. **This**  
 73 **programme is supposed to reinforce or encourage me. It gave more**  
 74 **confidence but to be honest, not this session (laughs). Maybe a little,**  
 75 **but I won't say it was overwhelming.** I think because of the situation, **I**  
 76 **don't think it gave much confidence. I was very nervous, very stressed**  
 77 **out about having it run well and have this overwhelming emotion of**  
 78 **frustration. I would say it was a bit of frustration.**

79 **I think I am in the process of changing my perception of myself. I**  
 80 **don't think the session itself was the reason for the change. The**  
 81 **change started a little before. And because the change was**  
 82 **happening, I considered that I needed to do more; when this**  
 83 **opportunity came along, I thought it would help me to want that.** It  
 84 was my way of I would say not focusing on the applied kids, not focusing  
 85 on content, but working on the overall idea of what science is about. I am  
 86 looking at the skills that you can use from grade 9 taking it to grade 10,  
 87 grade 11, grade 12 and beyond to college. I guess **I would say during**  
 88 **the second session interacting with the teachers who were there and**  
 89 **really trying to peel away all the layers to see exactly what we wanted**  
 90 **the students to take away with them. At the end we really peeled**

Social interaction – positive feedback, shared experience

Professional needs

Social interactions- learn from others

Cognitive development – pedagogy, content

Emotions– excitement

Apply to classroom

Some change in role

Emotions – frustrated, overwhelmed, lack of confidence

Change in perception of self not due to experience

Social interactions – “interacting with others”

Meaningful reflection

91 **away the layers and came to the core to what we want, why we want**  
92 **this, why we want, why we need to know this.** For me I think it was the  
93 first time that I actually had it organised in such a way. I knew it but to  
94 actually pull it together. When we typed it out on the smart board - that  
95 really put things together for me - that was a positive for me. **It was**  
96 **difficult to get it out of everyone. It really was like pulling teeth. So**  
97 **the ones that we have are the ones who would see the benefits and see**  
98 **the big picture.**

Emotions –  
frustrations  
with group  
work

## Maria's Interview 2 Transcription Coding

1 For the second half I think for me was **it was better** in the sense that I  
2 did not give myself stress and extra work. My partner pretty much  
3 handled the third session which was the exploration classroom. I thought  
4 **that was a great, great session**. The sessions in which the students were  
5 interacting with each other and actually being in the classroom was a  
6 personal experience for me. The last session I really wanted it to be  
7 wrapped up very well but we didn't get time to do everything we had  
8 planned to do. So **I feel a bit like there was no real closure with the**  
9 **last session**. At least we came up with the final rubric. I think we were  
10 seen **as a little bit disorganised** in the last session but overall I would  
11 say that **I felt better about the last two sessions**. Maybe this was  
12 because **I did not allow myself to be too stressed out as much. We**  
13 **seemed to ad lib as we went along. I am very uncomfortable with**  
14 **that**.

15 **Researcher: do you think this experience affected the delivery of**  
16 **your programme?**

17 Not really. What I did was thought of ways in which I could have tied in  
18 my interest with this programme. I tried to do this by bringing the  
19 moderated marking and the success criteria, and checklist from what I  
20 was doing in another session. It was a **little more difficult** to meld the  
21 two together. At **times it just seemed a bit too much** because instead of  
22 focusing on one thing **I was now focusing on two different things for**  
23 **my professional learning**. I guess I see myself as a little more flexible  
24 in trying to meet the challenge. **I feel disappointed that it could have**  
25 **been better**. Maybe my partner and I could have been more effective if  
26 we had chosen a topic as teachers knowing what other teachers need and  
27 what our experiences were in the classroom.

28

"it was better"

"that was a great, great session"

Emotions – regrets about earlier sessions

"I feel a bit like there was no real closure with the last session"

"I feel better about the last two sessions"

"I am very uncomfortable"

"It was a little more difficult"

Emotions – disappointment

"it could have been better"

Relief

29 **Researcher: What did you learn from the whole programme based**  
30 **on working with the co-presenter and feedback from the**  
31 **participants?**

32 I think **my overall feeling was one of relief that it was over.** If I had to  
33 grade myself, do I think I was successful? Would I give myself a level 4?  
34 No I would give myself a level 2. **I am not really happy with how I did.**  
35 **I just don't feel that I did a great job getting the teachers engaged,**  
36 **getting them to really work. I felt it was a little bit messy. I don't think**  
37 **that I did a good job. I wouldn't say it was a good job, I would say it**  
38 **was OK.** Maybe it has to do with the planning, I really can't explain it.  
39 I don't think the teachers left feeling and I haven't gotten their feedback  
40 as yet, but I don't think they left feeling that they had anything that was  
41 very, very useful to them. Maybe it was a little useful, we had some good  
42 discussions but I don't think they left feeling that this 4 part session was  
43 worth their time.

44 **We were very much disconnected. I would have interacted more with**  
45 **members of the group:** Outside of the sessions like e-mailing and  
46 finding out how it was going, whether they needed help in any areas, and  
47 really make it a community. It wasn't really a community because we  
48 just met for four sessions and we did not really meet between those  
49 sessions. I mean we did try. We used the Wiki spaces on line, um but  
50 then again because **there wasn't any interaction really between myself**  
51 **and my partner** then how can we expect the other teachers to participate  
52 in the Wiki spaces.

53 **Researcher: what was going on during the moderated marking at the**  
54 **end of the last session?**

55 The moderated marking was as I had planned supposed to be one in  
56 which people would bring in their work and we would take a sample,  
57 make copies and share it with everyone so that we would be focusing on  
58 one paper with a rubric in hand. We would have all marked it and then

“I am not really happy with how I did”

“We were very much disconnected”

59 meet to discuss why we award the mark we did. And then we would  
60 adjust the rubric so that we would have a more level playing field in  
61 marking such an assignment. **I was surprised** when there was no rubric  
62 and um no one really knew how to do the reflection and it just, that was  
63 the messy part. And um I am sitting there and thinking oh **we seem so**  
64 **unprepared**. We ended up spending I don't know I think hours just not  
65 knowing what this activity was about. How could you do moderated  
66 marking without a rubric? **I felt frustrated, very frustrated**. Some  
67 teachers did bring samples of their students' work and we could have  
68 used their work but there was no rubric as well. **I found this stressful on**  
69 **my part. I was disappointed in my partner** because if she had promised  
70 to get it done, she should have followed through with it. That was the  
71 frustrating part. I just felt badly about it.

72 **Researcher: tell me about your experience where the one teacher was**  
73 **having difficulties understanding what she had to do.**

74 She had no idea because she didn't have a rubric. You need to have a  
75 rubric, I mean if you are just marking the reflections, then you need to  
76 know what you are looking for. But when you have five different people  
77 sitting around and verbally explain to them what to look for it becomes  
78 difficult without a rubric. Each teacher was supposed to bring an  
79 assignment and a corresponding rubric. You see although the teacher had  
80 a rubric for a separate assignment, we were not using hers; we were using  
81 my partner's. However, my partner did not have a complete rubric, she  
82 was just telling us what the reflections would be and **it was very**  
83 **confusing** because like especially with reflections – what exactly are we  
84 looking for? It was bordering on the ridiculous because there was no  
85 rubric and we were doing moderated marking. It just didn't make sense  
86 and that teacher was questioning it because she herself as wondering what  
87 was she really marking. We did get something out of it. We got a rubric.  
88 It was a generic rubric that all of us could use. Eventually we did finish  
89 what we wanted to do but **it was tedious**.

Emotions –  
surprise

“we seem so  
unprepared”

“I feel  
frustrated,  
very  
frustrated”

“I was  
disappointed  
with my  
partner”

Emotions –  
confusion,  
disappointment,

“it was very  
confusing”

“it was  
tedious”

90 **Researcher: what can you take away from the programme?**

91 I think the rubric is something that I would use. I have moved back to  
92 focus on the 4 skills that the students have to learn. And I find that in  
93 incorporating those skills, not all at once, into my lesson actually does  
94 help the students get the concepts. **I am seeing things in a different way**  
95 **and my students are reacting to it positively.**

“I am seeing things in a different way”

96 **Researcher: Do you think your overall experience has changed your**  
97 **classroom practice?**

“I try to give the students a more permanent learning experience”

98 **Yes I would say yes. For the better. I think I am giving them the skills**  
99 **to take to the next level. I like it when I see that change in my way of**  
100 **thinking. Yes. I don't think I can really implement anything like that**  
101 **in that class right now. I am currently battling just getting through**  
102 **to them basic English.**

Has not used ideas in class

103 **Researcher: were you able to take away anything new to your**  
104 **students?**

105 The positive, **I can use and implement more of the skills in my**  
106 **teaching. That is a big positive. That's a whole new paradigm shift.**  
107 The bad is that **I would be hesitant to do another workshop again. I**  
108 **don't think that I personally did a good job**

“I can use and implement more skills in my teaching”

“new paradigm shift”

### Mary's Interview 1 Transcription Coding

1 **It was good to speak with the other teachers and sort of brain storm**  
2 **ideas. It opened up a possibility of how I could do new assessment. It**  
3 **did a couple of things for me. What I walked away with was a whole**  
4 **bunch of new ideas as to how I could use. I have new ideas about how**  
5 **I can cover one of the units in grade 10; I have new ideas how I could**  
6 **so some of the units I have already covered differently.** Even though  
7 we were discussing grade 10, **it gave me some ideas with the college**  
8 **grade 12 class. It sparked my imagination. It gave me a whole bunch**  
9 **of new ideas. Further than that it wasn't just ideas; working with a**  
10 **team of people, so I know that I don't have to come up with**  
11 **everything on my own.** Because I am actually good at coming up with  
12 ideas, but then not always as good at figuring out how to evaluate it  
13 effectively. **That is one of the things that I really enjoy about working**  
14 **with a team of people because I can draw on everyone's expertise. I**  
15 **felt 100% welcomed. My ideas were valid. Yea even though I had**  
16 **missed the first session, it felt like we just picked up as if I had been**  
17 **there. A completely positive experience for sure. There was a definite**  
18 **degree of collaboration among the teachers. I didn't feel like I had to**  
19 **do everything right to contribute. I didn't feel like I had to have a lot**  
20 **of experience to contribute. It was just an open plan where**  
21 **everybody's ideas were equally valid. It was just an open forum**  
22 **where everybody's ideas and opinions were equally regarded. Yes**  
23 **definitely there was a certain degree of trust.** I have been teaching for  
24 a while but I haven't taught the grade 10 course. So when. **I felt**  
25 **comfortable to share ideas;** you are doing a course for the first time,  
26 you know you spend a lot of time sort of getting the content down you  
27 don't have as much time for the creativity. So **when you can draw on**  
28 **the expertise of others then you can accomplish both at once. So we**  
29 **can have the content and the creativity working as a team rather**  
30 **than working as an individual.**

Social interaction – share ideas

Cognitive development – new ideas, apply in classroom

Emotions – enthusiasm, joy

“It sparked my imagination”

“I can draw on everyone's expertise”

Social interaction – Collaboration

“I felt 100% welcome”

“I felt comfortable to share ideas”

“draw on expertise”

Social interaction

31 There were **two benefits in attending this programme**. One was  
 32 **coming up with new ideas and checking up on how they were**  
 33 **evaluated**. It is hard to put a measure on which one was more valuable.  
 34 **I guess probably how to evaluate it because I think I had mentioned**  
 35 **before that if I needed to I would be quite fine coming up with new**  
 36 **ideas given enough time**. So that is why I think that having the whole  
 37 package of the ideas and how to evaluate them makes it more valuable.  
 38 And then what's coming next is **the opportunity to see it in action and**  
 39 **then to revise and adjust**.

40 **I put these things into practice. It is priceless**. That I really like. **So**  
 41 **that's one of the things I might do with it**. So I will use it in the grade  
 42 10 with inquiry projects and then and I had taught the grade 12 college  
 43 course for a number of years and really wanted to replace their final  
 44 written exam with a practical exam but wasn't quite sure how to go about  
 45 it. **I think that with the knowledge that I take away from this session**  
 46 **I think I can now put that in place. So that would be exciting. I really**  
 47 **want to see more inquiry-based projects going into the grades 11 and**  
 48 **12 chemistry courses as well**. In the PD session I would say there was  
 49 **some aha moments** because I had done inquiry before. **The 'aha' for**  
 50 **me was pulling everything together to make it happen in my course**.  
 51 **So yes I think there was some aha moments. I think it comes down to**  
 52 **the confidence thing** as well. When you are not afraid to share your  
 53 **ideas and people see you as someone who can be trusted I think that**  
 54 **is why my contribution was well received. It was delivered with**  
 55 **confidence**.

Benefits

Pedagogy

“the opportunity to see it in action and then to revise and adjust”

Apply in classroom

“It is priceless”

Application to higher grades

Emotions – excitement

Can “apply to pretty much every other course that I teach”

“aha moments”

## Mary's Interview 2 Transcription Coding

1 Working backwards, **I was happy when we left** there because at the end  
2 of the day we did firm up how we would evaluate this type of project and  
3 so I was able to go back to my class and I came up with a rubric and I  
4 was **able to effectively evaluate the class**. So **I was really happy that I**  
5 **achieved the goal** that I set out to do which was to come up with ideas  
6 how to evaluate. So **that was great**. What was also positive experience  
7 was the **plethora of ideas** of evaluating the students. **All of these ideas**  
8 **were shared among the other colleagues exciting to see everyone**  
9 **involved in this way**. **It was very, very rewarding**. You know, you put  
10 10 people in a room then you get 10 times the ideas. So having the  
11 opportunity to exchange ideas with the other colleagues **gives you a**  
12 **tremendous sense of confidence**.

13 **Researcher: Tell me about your collaboration with the others in the**  
14 **last session**

15 **Collaboration with the others was the highlight of the programme**.

16 **The idea that was shared** about the aeroplane building contest I think it  
17 was a fantastic and simple and effective way to introduce the whole  
18 concept of inquiry. I basically got ideas for every single unit. **We talked**  
19 about inquiry for chemistry and **we discussed** a couple inquiry activities  
20 for physics – the light tunnel idea – **that was fun**. The process of coming  
21 up with a lab design was really cool. We looked at one teacher's idea and  
22 **I found it interesting** because I had a similar idea years ago but I hadn't  
23 figured out how to implement it. **I didn't really know how it would**  
24 **come together but now seeing that example, I know exactly how I am**  
25 **going to do mine**. So **I just look forward to doing so many of these**  
26 **different activities**. It's fun. **I will absolutely use these ideas in**  
27 **subsequent classes**.

28 **We went from the inception of the idea to seeing how it could be**  
29 **implemented and we saw that on three levels** – we saw it in the

Emotions –

“I was happy when we left”

Applied in class

Achieved goal

Social interactions –

Shared ideas among colleagues

“it was very, very rewarding”

Confidence

Collaboration was highlight

Social interactions -

Shared ideas, talked, discussed,

Emotions –  
“that was fun”

30 demonstration classroom with the academic students; then we saw it in  
 31 the demonstration classroom with the split class, the academic/applied  
 32 level students and it was done in a different way; and then I took it home  
 33 to my class and again I did it another way. Really **no matter how it was**  
 34 **done, the process was effective.** So not only were **we told of the idea,**  
 35 **we also saw it in action, and then we saw examples of the finished**  
 36 **product. Then from that we learnt to evaluate it as well.** I mean it's  
 37 not only my professional development **but what I have learnt I have**  
 38 **taken back to others** and then in the process of doing the inquiry activity  
 39 I was working with the library teachers as well and I managed to teach  
 40 them as well. So the more Ideas we come up with the more people benefit  
 41 from it. **I am 100% sure I can share what I learnt with other people.**  
 42 I think my students will walk away from grade 10 science saying Oh miss  
 43 do you remember when we did that project? That was so cool. I learnt  
 44 this thing in that project and I thought it was so neat. I think these are the  
 45 type of things that they never forget. These things are important and they  
 46 **are part of my beliefs.**

47 **Researcher: Has your experience helped you to inspire and challenge**  
 48 **your students?**

49 **Yes. By just learning about some of the technologies** out there. I had  
 50 my students submit their presentation of their research in Google Docs  
 51 which I did not know about previously. This is one of the things I learnt  
 52 and which **the students were excited about.** Learning the whole **inquiry**  
 53 **process in greater detail was good for me.** I knew some things about it  
 54 before but I think that through this workshop **I learnt about all the steps**  
 55 **in detail.** I would have to say that when I compare one of the lead  
 56 teachers' knowledge of the steps, she knew all the steps. **I also learned**  
 57 **about the various processes of inquiry and how to evaluate the whole**  
 58 **process of inquiry. I learned a lot.**

59 **Researcher: Tell me about part in the moderated marking part of**  
 60 **the last session**

Cognitive development – new knowledge, pedagogy

“I will absolutely use these ideas in subsequently classes”

Cognitive development -

Different ways in which learning occurred

“what I have learnt I have taken back to others”

Beliefs

Inspire and challenge students

“the students were excited about”

Cognitive development -

“I learned about the various processes of inquiry and how to evaluate the whole process”

61 I was not sure of how to do the evaluation since I did not know what we  
62 were looking for. I don't even know how to put it. I guess **my concern**  
63 **was that we were spending a bit too much time trying to accomplish**  
64 **a task that wasn't clear when there was a greater need to accomplish**  
65 **a task that was clear.** I guess I persisted until that happened. Because  
66 we were asked to moderate mark the reflections but we didn't even know  
67 what we were trying to mark. So to me that was a futile exercise. **It**  
68 **wasn't a matter of anxiety it just seemed as a waste of time to be**  
69 **doing something that didn't even have any direction.** In some ways **I**  
70 **am a bit disappointed** because I would have really enjoyed moderated  
71 marking, but doing it without a marking guideline that was futile. I hope  
72 I did not take away from the others but our goal was for the team to come  
73 up with an inquiry activity and to be able to evaluate it. So when it was  
74 2:00 o'clock on the final day and we hadn't done that yet, I felt it was  
75 important to get that done. When you bring a lot of professionals together  
76 a lot can be done, but you have to stay on task.

77 **Researcher: what can you take away at the end of the programme?**

78 **I have become a more qualified teacher** because **I have more**  
79 **knowledge and expertise.** I have **gained confidence in taking on**  
80 **inquiry activities.** I have embraced them and have no concerns  
81 whatsoever. **I will bring inquiry activities in my classroom.** I have no  
82 trouble implementing or evaluating it. I am confident in my knowledge,  
83 training, and experience. I have **learnt new technology and new skills**  
84 **and walked away with a ton of new ideas** that I would not have  
85 otherwise have.

Emotions –  
concern

Emotions –  
“I am a bit  
disappointed”

“I have become  
a more  
qualified  
teacher”

“I have more  
knowledge and  
expertise”

“I have gained  
confidence”; “I  
will bring  
inquiry  
activities in my  
classroom”

## Maya's Interview 1 Transcription Coding

1 **On the first planning day it was very exciting to work with the other**  
 2 **lead teacher.** I wasn't sure because she is like an extreme type A person  
 3 which sometimes can be a bit much for me, I am a very much completion  
 4 oriented and what's going to be very usable for teachers' person. **I view**  
 5 **this PD as not only for the teachers that are coming but also for us**  
 6 **as well. I hope that my partner feels that way too.** Using the  
 7 technology pieces is such a challenge for me, even using something as  
 8 'Prezie' which is so common for students to use, **I tried it, it drove me**  
 9 **nuts,** I didn't know how to save it on my computer, and I just said forget  
 10 it. So even when we were planning I tried it again and using twitter and  
 11 using all these technology pieces. I don't even know how to trouble  
 12 shoot. So you feel like you have to be an expert when you are leading but  
 13 it's really the lead teacher who is the expert. So we met twice when we  
 14 did our planning and we were both **excited about what we had.** My co-  
 15 leader again was pushing me that the school board has Google Docs now,  
 16 so she set up a Google Docs account for us and created folders for all  
 17 four days. **Now I am becoming a little more proficient and now I've**  
 18 **been sharing files with other colleagues.** That's pretty cool. In terms of  
 19 how the first day went, I think it went really well. **We really thought**  
 20 **that the teachers themselves had a lot of expertise, and had a lot of**  
 21 **experiences to share and so hearing from the teachers what they**  
 22 **were saying and those exchanges of ideas, those conversations we**  
 23 **thought were really, really important.** So if the participants had looked  
 24 closely they would have found that we didn't do everything that we had  
 25 planned to do that day. And we were not at all upset about it because  
 26 those conversations were really, really important. On the other hand,  
 27 teachers always **want to have something tangible to try out when they**  
 28 **leave.** So we had to balance that as well. So we try to manage  
 29 those conversations using the cooperative learning technique so that  
 30 having those conversations but also having the techniques by being the

Emotions – excitement
“it was very exciting”
Uncertainty
Emotions – frustration
“it drove me nuts”
Social interactions – learning from more informed other
Cognitive development
New knowledge
Social interactions – conversations,
“a lot of experiences to share”
Need for artefacts

31 recipients of those techniques. I also wanted to have a good balance  
32 between technology and cooperative learning.

33 So she said to me “let’s do a prezie” and I said “oh last time I tried a  
34 prezie **things were not working out**”. And so **we gave it another try**  
35 **with me that was typing it out and she had to go elsewhere to do some**  
36 **things so I had to figure it out**. But there were a few little issues that I  
37 had but **she was there to help me so that went well**. And then also just  
38 her doing the Google Docs and setting that up like we were sitting there  
39 and her fingers would be flying she sends an e-mail to this person, then  
40 she sets up this, and she uploads that and ... I have to learn that. So **I**  
41 **would say that I know that that sounds like a small another thing,**  
42 **but to learn Google Docs and to learn how to use prezie, were real**  
43 **steps for me**. She invited us to sign on to twitter and so I signed on to  
44 twitter. It’s **neat to expand my repertoire**. So she was showing us  
45 twiddla whereas I was using wall wisher. Or she was using Google docs  
46 not Google, but Moodle or D2L which is Desire to Learn, while I used  
47 Edmodo. **So there were some things in which she used a different**  
48 **system and she would show me the system so that expands my**  
49 **horizons, and there are some things that I truly do not know how to**  
50 **use so she is helping me to learn how to use them**. And **she gives me**  
51 **a certain amount of expertise**, not expertise but beginning learning.

52 I think we had a lot of trouble with twitter. I loved how everything came  
53 up but I think this particular one is not one that I myself would use. I  
54 think that we have been using the iPad a lot. We were using it with a  
55 group of people who were either super users of twitter already or  
56 complete non-users. So I think that **I would have to really use it in the**  
57 **classroom to decide whether what the problems were with it**.

58 Well just like I said about the technology. **Just having this other person,**  
59 **just having this other bright, motivated person who like me just want**  
60 **to share ideas with other people, I just think that the melding of ideas**  
61 **was very good. I think that hopefully I push her and she pushes me**.

Social interactions  
–

“we gave it another try”

Cognitive development  
–

New learning

Social interactions  
–

“she would show me”

“that expands my horizons”

“she is helping me to learn

Apply in classroom

62 We are both biology and chemistry teachers, biology first but she is  
63 teaching more biology and I am teaching more chemistry. So even on day  
64 2 of the PD we are going to see her applied level classroom and in the  
65 second period we are going to do chemistry demonstrations.

66 **I think hopefully I would expand my tool kit so to speak in terms of**  
67 **how to engage each student.** Doing demonstrations is a major hook for  
68 me for students. **I am hoping that I can add that to my kit. I wouldn't**  
69 **say I am changing my core beliefs. I think it is just finding different**  
70 **ways of doing the same thing.** I wouldn't say that I would change any  
71 of my beliefs but I would say that **I would add** to it. I always believed in  
72 varied instructions. So I think it is just another tool in varied instructions  
73 that would help the kids to learn, that students really like.

74 **I hope that at the end of this session I can see myself as a little more**  
75 **technological veteran. Yes I can say I have used technology in the**  
76 **classroom with confidence.**

Artefacts

New pedagogy

## Maya's Interview 2 Transcription Coding

1 Day 2 was the demonstration day which I thought went fairly well in  
2 some respects. **The parts that I really liked were when we went to the**  
3 **other lead teacher's demonstration classroom.** That was very  
4 interesting. I showed the teachers some demonstrations. **I thought that**  
5 **went really well** too. We showed them some stuff in the afternoon which  
6 was also fine. But in **the last session the teachers were supposed to**  
7 **work on their plans** that they were supposed to implement in their  
8 classroom. **I felt that that part did not go very well.** It is actually a very  
9 important part of the CLC model in which the participants are not just to  
10 come in and sitting there passively and receive whatever we are giving  
11 them. They are supposed to take whatever we teach them and extend that  
12 and have group planning and collaborate to plan lessons. That is why it  
13 is called collaborative learning. So **I was really a bit disgruntled** about  
14 it, **I felt like everybody just dispersed and talked about whatever they**  
15 **wanted to. Steve was very frustrated about the situation and so it just**  
16 **became a complaining session about why he couldn't do this, that or**  
17 **the other. I felt like we didn't make any progress** at all. I think the  
18 other groups may have done a little better but **I left feeling a little**  
19 **frustrated** and I felt I wasn't sure what day 3 was supposed to be.  
20 Actually, day 3 was supposed to be very simple. We were supposed to  
21 meet in the morning, have a debriefing session, and then a share session  
22 in which each person was supposed to bring something to share with the  
23 group: In the afternoon, we were going to have a moderated marking  
24 session for about 1 to 2 hours. That the people from the group that had  
25 implemented their plan were to bring photocopied samples of their  
26 students' work with their names blacked out. So this plan was very  
27 dependent on the participants. Very dependent and **I just didn't know**  
28 **what to do about it** because we didn't feel that people were going to step  
29 up: We sent a few e-mails around to remind the participants what to  
30 bring and how to prepare the material to remind them. **I didn't feel that**

Emotions –  
pleased

“I thought  
that went  
really well”

Disappointed

“I felt that  
that part did  
not go very  
well”

Disgruntled

“a  
complaining  
session”

Frustrated

31 **we had emphasised a lot of about the sharing part**, but I did feel that  
32 that was something that people could pull out of their hats quickly in  
33 terms of thinking about what cool idea they could bring that others would  
34 like. It would just involve people to upload something, copy it from their  
35 share file and bring it.

36 So preparing for today, there were a few challenges for me. **I was a bit**  
37 **overwhelmed**. One of the participating teachers had e-mailed me  
38 panicking about her moderated marking. She had worked with me before  
39 on cooperative learning in previous CLC sessions. She has a lot of  
40 expertise but for some reason she did not have a lot of confidence. So she  
41 was panicking about her moderated marking session about getting it in,  
42 she was having difficulties but she was just really **excited and happy to**  
43 **support me**. So **that was really awesome**.

44 I brought three items to the table with a few more if I needed them. So I  
45 tried to play it loose and easy. I didn't want to be a slave to the agenda. I  
46 felt that people were very apologetic if they don't bring something. Or  
47 if they bring something that they feel is not very good. So **I tried to be**  
48 **sensitive about the whole thing. So it was actually pretty good**. The  
49 IL did one thing, I did another. And then we were starting to slot in some  
50 of the participants. **I was happy that everybody brought something**  
51 **even for the moderated marking or the idea sharing activity**. For me  
52 I found that **this day was very powerful for me**. I thought that there was  
53 a lot of good internal conversation. With sharing the pieces it wasn't just  
54 here is how to do it, here is how it works. **There were a lot of discussions**  
55 and it brought up a lot of issues about the college level students' learning.  
56 **One of the participating teachers had brought something to share**  
57 **and she realised very early on that it was not as good as other**  
58 **people's work and she was apologetic**. I felt that the conversation  
59 around her work was very valuable. **I couldn't have planned it better**.  
60 **There were some very vexing questions that educators have. But I**  
61 **felt that it was very valuable about applied level learners and they**

Emotions –

“I was a bit overwhelmed”

Social interactions –  
“support me”

“that was really awesome”

Emotions – “I was happy that everybody brought something even for the moderated marking or the idea sharing activity”

“this day was very powerful for me”

62 **really came out in this session. People were trying to problem solve,**  
63 **they were talking it through.** So whether people use or not use the  
64 actual piece, this was a sort of jumping point. So **that was really cool.**  
65 Part of what we were trying to present was cooperative learning, hands  
66 on learning, demonstrations and technology. **One teacher shared**  
67 **something about quizlet, another shared about Socrative.** Even  
68 though I had not had any technology bits for the day, **the participants**  
69 **jumped in.** This shows that the **participants actually used the ideas** we  
70 provided. One of them even brought something I had not heard of. That  
71 was new and I think there was quite a bit of discussion about that. I  
72 showed something about Bitstrips and another similar one about comic  
73 life. So when another brought her storyboarding assignment that was a  
74 nice tie-in that we hadn't even planned. She didn't mention that she was  
75 bringing this assignment in. So I think that in these workshops you just  
76 have to relax yourself and trust people would bring something and all  
77 would be well. **Overall I was very pleased.**

78 **Researcher: tell me about how you feel about teachers not**  
79 **participating**

80 **I know that there is a richer learning that happens if you as a**  
81 **participant are participating,** if you are synthesising what you learned.  
82 With this PD model on day 1 we gave them information. Day 2 involves  
83 serious planning. And day 3 was moderated marking. **So at the end of**  
84 **these days you have something concrete to use in your classroom**  
85 **using what you learnt.** So at the end of the session even if you will  
86 never use what you learnt, you would have done that. So **it is frustrating**  
87 **that at the end of the module if they haven't done that. As I become**  
88 **more experienced as a leader or teacher leader, I get tired of just**  
89 **endlessly giving. When you know that all the participants have such**  
90 **rich things to give back. I was so excited when I saw Sam's optics**  
91 **lesson.** I didn't even know what that was but it looked exciting. So that  
92 is **why I was so satisfied when people brought their materials and**

93 **ideas to the table.** Even if it wasn't for the moderated marking but  
94 certainly half of the group did pull those together. Even in our small  
95 group the activity 'the last word', one teacher was saying that she tried  
96 out one of the activities we did on the second day with her 11c's, she  
97 liked it. So she tried it again the next day with 15 questions. When she  
98 came she showed us and we did it together. So **I think that was very**  
99 **successful transference.**

100 **Researcher: would you say that despite your knowledge and**  
101 **expertise as a teacher leader you have also learnt something new in**  
102 **this programme?**

103 Well I guess I like to share and develop curriculum tasks. But I also like  
104 to develop and pick up new ideas. I guess **as a learner I am particularly**  
105 **satisfied when people are bringing their ideas to the table.** In this way  
106 **I can learn about it and take it back to my department. I can share**  
107 **this. I said 3 or 4 things that I thought are really of good quality that**  
108 **I want to follow up with the participants so that they can publish**  
109 **them in the 'Crucible'**

110 **Researcher: do you think your experience has enhanced the**  
111 **confidence you have to develop people's potential?**

112 **For sure it has helped me a lot.** I find that if I have done it often enough  
113 that so that I just take it in my stride. Even though **I was stressed out** and  
114 my tactile lesson didn't work too well, I had to realise that something  
115 really wrong happened and it was all completely mixed up: **Four years**  
116 **ago I would have been very flustered about it.** Half of the day would  
117 have been ruined. **I have so much more confidence now** and because  
118 we have become to know each other as a group, **I felt more comfortable**  
119 **about the whole situation. I also love the networking possibility.**

120 I think that **me being a teacher, a learner, sharer were already there.**  
121 **But this experience has given me an easy way of being all of that. I**  
122 **think it made me a more confident lead teacher** rather than a more

Emotions –  
frustrations

"I was so  
excited"

Satisfied

Confidence

Learn

Apply in  
classroom

"I have so  
much more  
confidence"

"I felt more  
comfortable  
about the whole  
situation"

"this experience  
has given me an  
easy way of  
being all of that.  
I think it made  
me a more  
confident lead  
teacher"

123 confident teacher since that was there already. I like my life to be very  
124 integrated. So there is a lot of levels to it. So as a classroom teacher I  
125 teach the kids they go away. I am a department head, I share with staff  
126 and they share with me, we build ideas in teacher-share. I develop things  
127 at the school level like the science outreach, the science Olympics, and  
128 at this level which is the Board level. So we have the situation where  
129 whatever I do, it trickles down to the department, across to the school and  
130 community, and up to the Board. At the same time I take other people's  
131 ideas back to my classroom, and use it to develop other people's potential  
132 to present at other workshops and even publishing their materials. **I think**  
133 **there is a lot of integration here and I like that, I find it very pleasing.**

134 **Researcher: can you summarise you experiences for the three days?**

135 **We had a very strong first day. It was really good.** However, **I cannot**  
136 **say the second day was a bit disappointing. I think we finished pretty**  
137 **strong.** I think three days were enough. **I am a little disappointed that**  
138 **some people signed up but did not follow up on attending all three**  
139 **days.** I think three days spread out a month apart is not a big commitment.

"I am a little disappointed that people signed up but did not follow up on attending

140 **Researcher: at the end of the programme, has your experience**  
141 **enhanced your beliefs about your role as a science teacher?**

142 It is really hard to change my core beliefs. I find that as I work with the  
143 other lead teacher, I have **become more knowledgeable about**  
144 **technology in the classroom** because she is very much tech savvy about  
145 technology in the classroom. I would say **my base learning in technology**  
146 **has extended.** The lead teacher and I are a good team. She excels in  
147 technology and I excel in teaching science. So we complement each other.  
148 We challenge each other. **For me a lot of social learning was going on.**  
149 Not all of us moved along with the technology. For example, Steve and the  
150 other lead teacher are more knowledgeable than the rest of us are in  
151 technology and **they help us along.** On the other hand, **I am more**

Cognitive development

152 **knowledgeable about hands on classroom demonstration in science**  
153 **and so I help them along.**  
154 **I am leaving with more knowledge and confidence in applying**  
155 **technology** in the classroom

“I am leaving  
with more  
knowledge  
and  
confidence”

### Sage's interview 1 Transcription Coding

1 So being part of the professional development session and developing  
 2 professional development of **teachers has been very collaborative.** I  
 3 think both myself and the other lead teacher have taken **on different**  
 4 **roles in the process.** I think **the other teacher has taken on the role of**  
 5 **the more theoretical providing background much more research-**  
 6 **based information. Overall, the experience has been positive. I think**  
 7 **the experience has been positive**

8 I think **I have these beliefs before** I came to this programme and I think  
 9 one of the reasons I asked my partner to steer the PD session the way that  
 10 I did is because **I wanted to flush out whether other people would**  
 11 **engage with it.**

12 **I think it gives me a fair amount of confidence when people validate**  
 13 **the ideas that I have. The first session was challenging I think this**  
 14 **definitely cemented my views of myself not just being a leader. Being**  
 15 **a leader in the classroom as opposed of being a source of information.**  
 16 **I don't think that you can take too lightly the idea of drawing on**  
 17 **people's prior experiences. We are learning from each other and**  
 18 **developing new ideas together.**

19 **I like collaborating with other people.** So on the one hand, **I really do**  
 20 **feel energetic during the sessions, and I feel best when people are**  
 21 **interacting, when they are coming up with not just ideas that are**  
 22 **expected but also new ideas. I think the best moment in this session**  
 23 **has been when people had said oh yea I kind of I thought to do that.**  
 24 **I wanted to do that but I held myself back because I was worried**  
 25 **about not achieving the expectations that I set out to achieve that**  
 26 **day. But here you are telling me that it is good to go with a different**  
 27 **approach, a different perspective. And that validates what I**  
 28 **sometimes want to do. I think it is important to get affirmation. No I**  
 29 **do not feel disappointed. I do not need the validation.**

Social interaction
Collaboration
Different roles for lead teachers
Emotions –
Positive experience
Confidence
Emotions – validation
“cemented my view of myself”
Social learning, cognitive development –
“We are learning from each other”
Social learning – collaboration
Emotions –
“the best moment of this session has been when people had said ...”

30 I think the other lead teacher had more experience in planning meaning  
31 in scaffolding and chunking the progress of the day. She had a much  
32 better picture about how much time we had to do it but also it had to do  
33 with the timeline of the day; but also this was the first time I was  
34 attempting to plan -

35 PD session so I was not really sure how much time or how long it would  
36 take for us to develop certain ideas nor was I sure how much time to  
37 spend on each item. **I was deferring to her because she seemed to have**  
38 **an idea of what we would be able to accomplish. I think it is**  
39 **important to not come in with your ideas and only hear yourself. I**  
40 **think in teaching and in learning you need to acknowledge that you**  
41 **don't know everything.**

42 I guess it **has formalised that role for me.** It has given me the  
43 opportunity not only to **see myself as a lead teacher but to actually**  
44 **execute that role. I enjoyed it. I think that one of the difficulties with**  
45 **delivering a session like this has been to realise that not everyone**  
46 **buys into it.**

47 **Despite the fact that I have enjoyed the sessions we have had so far,**  
48 **I enjoyed them because I got to make them, because I was able to**  
49 **plan, it was my idea. While you are really focused and enjoyed doing**  
50 **these PD's you will not be disappointed if you not to move forward**  
51 **in being a formal lead teacher.**

“I think it is important to get affirmation”

Emotions – “I don't feel disappointed”

Social interaction

Deferring to more informed other

“it has formalised the role for me”

“see myself as a lead teacher but to actually execute that role”

Emotions –

“I enjoyed it”

## Sage's Interview 2 Transcription Coding

1 I think that the first two sessions were mostly formative since we were  
2 getting to know each other as colleagues. Not as colleagues but as  
3 professionals. I think that people were still trying to understand where  
4 others were coming from, their background. The last two sessions **I feel**  
5 **the people we were working with were like a group like colleagues**  
6 **rather than professionals. That they came from similar schools,**  
7 **populations or they dealt with similar challenges in the classroom**  
8 **made it easier to communicate. It was more efficient for us to share**  
9 **ideas and I feel like the group really worked to collaborate.** The last  
10 two sessions were better than the first two sessions because people were  
11 still trying to understand what it was that we were trying to collaborate  
12 on, what the final product would be. That was the dynamics. **I feel like**  
13 **people were left out in the last session because I sensed that they**  
14 **expected to come and to have a product, a marking scheme.** And I  
15 think that sometimes as educators, we overlook the importance of  
16 formulating a rubric which is a marking scheme or check list while we  
17 are creating an assignment. That part of the pedagogy sometimes doesn't  
18 get the priority that it should get. I know that **towards the end of the day**  
19 **of the last session I thought some of them were deflated because they**  
20 **were insisting that we had to create a product that they could take**  
21 **with them to use with the assignment in their classroom.** I do know  
22 that moderated marking was very challenging to do because we didn't  
23 have a marking scheme which I am assuming I was supposed to be  
24 responsible for. **I felt that I let the group down because I hadn't**  
25 **created one – I hadn't fully created one.** The first session I thought was  
26 quite productive. People seemed very interested in interacting with my  
27 students. And they were very energised by the experience of being in the  
28 classroom and watching the students work. I think it is always intriguing  
29 to go into somebody else's classroom and observe the

Emotions –  
collegial

Social  
interaction

Collaboration

Emotions

Disappointed

Regrets

“I felt that I  
let the group  
down”

30 dynamics that exists between the educator and the students because  
31 everyone's classroom is so different and everyone has a different style. **I**  
32 **feel that in the fourth session people were a bit tired.** I think that came  
33 through that some people were a bit more urgent in their demands for  
34 completed materials that they could walk away with. I think the  
35 progression was good. I think the timing worked out well. I think we  
36 planned the timing well.

37 **Researcher: what were your thoughts during the moderated**  
38 **marking?**

39 I think **I was a bit disappointed that the conversation went in the**  
40 **direction that it took. I felt that people were allowing their emotional**  
41 **needs to run away with them on this.** And I didn't feel that people  
42 **were keeping to the goals of the sessions. I think people lost sight of**  
43 **the whole thing of why we began this journey together.** I was  
44 reminded of the first session when people were confused about what we  
45 were trying to produce. So when faced with so many requests where  
46 everybody seems to want something, and nobody was really clear on  
47 what they wanted, I thought well let people work through that because,  
48 in the end, if I give them an answer and they don't like it, they are not  
49 going to buy into creating this anyway. One individual in particular who  
50 really took over the conversation, she inserted herself and I felt that only  
51 she was being heard. That was unfortunate. I think it is always unhealthy  
52 and unproductive to shut out and take over the conversation. So I was to  
53 bring other people back into it. I didn't want it to be just her and me  
54 dialoging back and forth. I felt there was a lot of transference there. I felt  
55 that she was transferring her frustrations or urgency about something  
56 else. Maybe not being full time, not being in the teaching full time. But  
57 she shouldn't allow that to take over her ability to get a better perspective  
58 of the situation.

59

Emotions –  
“I was a bit  
disappointed”

Discord

60 **SS2: During the sessions, to what extent were you able to share with**  
61 **the others your own experience?**

62 In the third session **when people visited my classroom they observed**  
63 **my direct teaching style. They were able to see my interaction with**  
64 **my students. I would like to think that that showed them a little bit**  
65 **more of who I am as a teacher.** And then **the last session I think that**  
66 **definitely we shared many stories. We shared what we had done with**  
67 **our students.** I felt like everyone got an opportunity to speak about their  
68 experiences including myself. I learned that there are a lot of different  
69 types of students and every one of us in the discussion has made a  
70 concerted effort to be successful connecting with the students, you know,  
71 where they are at. This includes (teacher's name withheld) who is very  
72 liberal with his students where he allowed them to be creative, the lack  
73 of boundaries there because he wants to see what they are capable of,  
74 their passions and their interest. **I found the sample of work that he**  
75 **brought from his students was very intriguing but also extremely**  
76 **well done.** The students did a very good job of collecting the information  
77 he asked them to get. And I think that we gave him good cause to go back  
78 to his students and reconsider what the final outcome of the assignment  
79 should be. **I got some ideas from him and I am being reminded of the**  
80 **pedagogy which can sometimes take a back seat for me** because I  
81 work with such a high functioning population. **So I was reminded to**  
82 **scaffold things and to keep in mind that student need guidance to do**  
83 **a good job and to excel at it. These students would need more**  
84 **direction. I felt that having less people at the table was beneficial for**  
85 **those who really wanted to engage with the project.** The first session  
86 was not that great because **the site for the project was not ideal.**

Learned from  
others

Artefacts

Cognitive  
development

87

88

89 People had a **misunderstanding or a misconception of the goal of the**  
90 **programme. People missed out in the idea that this was to be a**  
91 **collaborative learning opportunity, meaning collaboration, meaning**  
92 **taking part, playing an active role and contributing to the final**  
93 **product.** Overall I think that the people who came took something away  
94 with them. Maybe not all of the same thing. **Some definitely took pieces**  
95 **of the experience with them to structure their work** with their students  
96 a little bit more. **I had a much more positive experience in the third**  
97 **session.**

98 **I think I am taking away that science is not a perfect subject.** It is a  
99 very diverse subject. **I am taking away an appreciation of the diverse**  
100 **individuals who enjoy taking on the responsibility of teaching**  
101 **science.** I think it is a very challenging subject. We were able to come  
102 to a consensus that the concepts are important but it is equally important  
103 to develop students' skills.

104 I think **my experience has shifted my view of how I am performing.**  
105 I think that **the strength of my beliefs is that I am on the right path.**  
106 **I was very flattered when several people complimented me in the**  
107 **way in which I did things. It is always good to get positive feedback.**

108 **I don't think my experience changed or challenged my style of**  
109 **teaching much.** However, **I have learned to scaffold, to support, to**  
110 **structure my lessons for students that have difficulties a little bit more.**

Artefacts

“I had a much more positive experience”

Appreciation of nature of science

“my experience has shifted my view of how I am performing”

“it is always good to get positive feedback”

“I don't think my experience changed or challenged my style of teaching much”

### Sam's Interview 1 Transcription Coding

<p>1 The first thing was I have never used twitter before, so <b>this was</b>  2 <b>something new and I like to go to workshops where I learn something</b>  3 <b>new about technology in the classroom.</b> That was one thing. The other  4 one was <b>it gave me a chance to meet with other people, like-minded</b>  5 <b>people and I learn from their experiences.</b> It not only help to know  6 what is going on in the workshops but also it gives an idea of what is  7 going on in other classroom, what works for other people, and what I can  8 take back to my own classes. And <b>there were some hands on activities</b>  9 <b>like the human body where we had to make an outline of a person</b>  10 <b>and then label the parts inside. I like that activity and I think that is</b>  11 <b>something I am planning to use in my classroom.</b> Then there were  12 <b>other useful things, other information I could take</b> on and there was a  13 date by which I had to do something and then report. The nice thing about  14 is that there is a follow up and we have to give an account of what we did</p> <p>15 <b>You take something from somebody, you give something in return.</b>  16 So at that worked well with a lot of teachers, there were a lot of people  17 and there were so many things going on. Even with the same kinds of  18 activity <b>different teachers have different experiences. This is a good</b>  19 <b>way of helping each other.</b> Instead of reinventing the wheel and do  20 something that is already done, we can <b>share our ideas, modify it and</b>  21 <b>use it in our classrooms.</b></p> <p>22 There were other <b>people talking about what works in their classes that</b>  23 <b>I did not try out in my own classroom.</b> Apart from the science even  24 about the behaviour like when we are doing labs and such. So <b>there was</b>  25 <b>a lot of ideas at the workshop that made me say “oh OK this is</b>  26 <b>something I can work with. This might work for me”.</b></p> <p>27</p> <p>28</p>	<p>Cognitive development –  “I am learning something new”</p> <p>Social interactions  “I learn from their experiences”</p> <p>Artefacts  Use in classroom</p> <p>Emotions  Social interaction –</p> <p>Share ideas  “good way of helping”</p> <p>Sharing of ideas</p> <p>Use in classroom  Social interactions</p> <p>Collaborating, sharing  “This might work for me”</p>
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29 This workshop was mostly **pedagogical not so much subject**

30 **knowledge** but the idea of being able to use the technology in the

31 classroom. **I liked the naming of the human parts activity, then**

32 **following up with a lesson and then take it up to see what knowledge**

33 **was learned. I liked that activity. And then I also liked, but I don't**

34 **know if I would use the twitter in my classroom.** Apart from the

35 technology, I felt that it didn't necessarily add to my learning because we

36 can do the same sort of things in other ways without having the twitter.

37 The other part is where I can be in touch with other teachers and access

38 ideas from twitter that would be useful. **I did not feel I couldn't share**

39 **my experience. Everyone who goes there go to learn. They are open**

40 **in discussing their experiences. They are like that. Mixing with**

41 **people with the same mindset, because the people who are there are**

42 **there to learn so it is easy to be open and talk to them.** Even when we

43 are there and some of us cannot log on or something, someone else may

44 know what to do and they help each other and everybody moves u: **The**

45 **same way in which I learn for myself I implement it in my classroom**

46 **and help my kids.** We work in groups and we do it the way we would

47 do it in our classrooms. **I implement them in my classroom and then I**

48 **see how the students are reacting to that.** Even with the group work in

49 some classes it does not work. I am always willing to take risks and keep

50 learning. So **I try out these things in class and I see what works and**

51 **what does not and I reflect upon it and then I know what works and**

52 **what does not.** When you have other people in the school who think

53 along the same lines, it is so good to share ideas and work together. **It**

54 **wouldn't change my role. It might make it better I guess. I think**

55 **which one works for me I will take it. I can add some more tools to**

56 **my teaching.**

57 **It would not make me do anything radical but even though I like to**

58 **keep up and read about new ideas, I don't expect any radical**

59 **changes.** But also I am not starting my teaching career at this time. If that

Cognitive development pedagogical
Emotions
Apply in classroom
Social interaction – Share experience
Apply in classroom
Change in practice
Reflections
“It wouldn't change my role”
“I can add more tools”
“I don't expect any radical changes

60 were the case it would have made a difference to me. I have learnt a lot  
61 of stuff by now. So **I think that the new things that are coming up that**  
62 **I am not aware of, I want to learn about those. What is good for me**  
63 **I will take it and what doesn't work for me I will leave. I am a lifelong**  
64 **learner, I want to be at the top of my profession and as long as I**  
65 **participate in professional development programmes, I will be the**  
66 **same person. I am a good teacher and with the training I will be a**  
67 **better teacher whether I get a chance to go to a workshop or not.**

New learning

## Sam's Interview 2 Transcription Coding

<p>1 <b>I like watching the other class in action and I could figure out what</b>  2 <b>I can do in my own class with my own group of students.</b> What would  3 not be suitable for my class. And I also got to <b>see different ways of</b>  4 <b>teaching the same lesson.</b> That was a <b>good experience</b> and when we  5 debriefed <b>we got a chance to discuss what we saw with other people</b>  6 <b>and there was more input from the others their own observations.</b> So  7 <b>it was good to talk about the different things.</b> The last session was  8 <b>good because of sharing of resources and also some activities which</b>  9 <b>were already tried in their own classes.</b> I had a chance to share what I  10 had done too. I did not get much out of the moderated marking because  11 the things people brought were based on the grade 11 biology curriculum  12 when we were supposed to bring in materials taught at the grade 10  13 science level. I am not a biology teacher so I didn't know anything about  14 that. I have done the moderated marking before. So I had a sense of what  15 they were talking about. <b>But this time the moderated marking session</b>  16 <b>did not fit very well with me because I, because this marking was not</b>  17 <b>relevant to what I do.</b> I like the amount of technology they presented in  18 the session. They were small things but some of them that I have not  19 heard about some of them. I think that based on individual interest, some  20 people are more into the technology and others are not interested as  21 much. So I found the Bitstrip was an old technology. Right now I don't  22 use Bitstrips except for the grade 9's. So these are all well established  23 and taken for granted. <b>I was looking for something new.</b> So in that sense  24 <b>I did not get as much as I expected from this part of the programme.</b>  25 <b>But talking to other teachers and seeing what they were doing gave</b>  26 <b>me so many ideas.</b> And one of the lead teachers posted something on the  27 Google Drive and before that Steve was showing us all the different  28 technology stuff he was using. But he said that it did not click with his  29 students. I shared with him that maybe the students are not hooked by</p>	<p>Social interactions  "watching the other class in action"  Cognitive development –  "I could figure out what I can do in my own class"  Social interactions –  Talk about ideas  Sharing artefacts  Not relevant to needs  Emotions –  Disappointed  "I did not get as much as I expected from this part of the programme"</p>
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30 the technology, maybe he should try taking them out to the pond or field  
31 and see what happens.

32 I told him this would work well in the section on biotic and abiotic parts  
33 of ecology. I told him that just taking them down to the park for 10  
34 minutes may do wonders for the students. The student would see what is  
35 relevant to what they are doing and they may become interested. **I did**  
36 **like the idea of the whole workshop: I like the three parts in which**  
37 **we had an exploration classroom to see a lesson being taught;** by the  
38 time we got comfortable with that **we had lessons to share and work**  
39 **from students to mark as well. So that part of it was good. I would**  
40 **have appreciated more teachers there so that we could have more**  
41 **input.** Even with the moderated marking only two teachers brought their  
42 work. Both were the same biology stuff. So that was not very useful.  
43 Other than that the whole workshop idea which was done in stages was  
44 a good one. **I learned a lot.** We were given **a chance to network, see**  
45 **what other teachers were doing, and by talking to them, I know that**  
46 **I can tap onto them when I have problems in, or am looking for ideas**  
47 **in technology, demonstrations or whatever.**

48 I think **I learned a bit of everything. I was looking to see how a biology**  
49 **person would do a physics lesson. I was expecting to do that because**  
50 **that would have shown me how I could handle the biology too.**  
51 Nobody touched the physics. I know this is a fact that most of the teachers  
52 have biology and chemistry background and they don't do justice to the  
53 physics. When I brought the physics assignment to share everybody was  
54 pleased with that.

55 **I did learn, I learned some technology to use right away in class, I**  
56 **learned some demonstrations which I may not be doing right away**  
57 **but later on I may need to, I learned about some lessons that other**  
58 **people do.**

Emotions –

“I did like the idea of the whole workshop”

Social interactions –

Share lessons

“we had lessons to share and work from students to mark as well”

Cognitive development –

“I learned a lot”

Emotions –

Disappointment

“I was looking to see how a biology person would do a physics lesson...it would have shown me how I could handle a biology too”

“I did learn”

“ I may not be doing right away but later on I may need to”

59 **Researcher: how has your overall experience changed your**  
60 **classroom practice?**

61 If I don't change immediately, still everything counts. Even **if I don't**  
62 **use it right now I have it in my head that someday I may fall back on**  
63 **it. Also I know I have the people to network with so if I need to, I can**  
64 **contact them and ask for help or ideas.**

65 What I have done, **is apply some of the ideas I picked up in my physics**  
66 **class. In optics, I would start by drawing a diagram and numbering**  
67 **where the missing parts would be and leave it there so that the**  
68 **students can go up to it and label the missing parts of the diagram.**

69 **I didn't use technology in class. No. I used it to communicate with**  
70 **others. I still need to be comfortable using it in class** and also not all  
71 of my students have cell phones. So **it is not practical** to use twitter in  
72 class at this time. Maybe at some point I can try it out in my class.

73 **Researcher: can you describe your overall experience of the entire**  
74 **three days?**

75 Like I said **it has helped me in my classroom practice.** Every time you  
76 go out you learn something new. It may not be in a big way but there is  
77 always something to learn.

78 **Researcher: has this programme helped you firmed up your beliefs**  
79 **about yourself as a science teacher?**

80 Definitely, I learn different things when I go to these workshops. I am a  
81 risk taker. I am willing to start new things, use them in my class and if  
82 they do not work out, I move on. If it works, I try to modify it, improve  
83 upon it. I believe that as long as I am teaching you have to keep up with  
84 the times, you have to keep up with the kids that are coming to your class  
85 so that you can understand them. So you have to learn new things and  
86 you have to keep your mind alert. So every time you have a chance to  
87 learn something you had better take it.

Network for help

Applied in classroom

“apply some of the ideas I picked up in my physics class”

“it has helped me in my classroom practice”

New learning

“definitely, I learn different thing

Cognitive development

88 **Researcher: What can you take from the whole professional**  
89 **development programme?**

90 **I have learnt to go on twitter. I have learnt to use different technology**  
91 **in my classroom. These are things that I have not tried before.** And I  
92 know that some people are still not doing what I had stopped doing. So I  
93 see that different people are at different places. I see different schools and  
94 different classrooms where they have more resources or less resources  
95 than I have; **teachers teaching in so many different ways using**  
96 **different strategies and resources.** Overall people seem to have the  
97 same sort of issues with classroom management and how to teach their  
98 students and so on. Everybody has a different talent. **Meeting people**  
99 **and discussing things** help me to see all of that and to **learn how to deal**  
100 **with my own classroom issues. This is a rich and rewarding**  
101 **experience.**

“use different technology in my classroom”

New strategies learned from other teachers

Learning from others how to deal with classroom issues

## Steve's interview 1 Transcription Coding

<p>1 <b>I picked up some new ideas and some reminders of things to try.</b> So  2 <b>I found that very helpful.</b> I am liking the technology side of things. I  3 wish we were doing more of that. I wish it would be the focus of the ideas  4 and resources. My students really like using their phones in class. So far  5 <b>I have tried Socratic, I've tried twiddla and twitter. These are</b>  6 <b>interesting ideas. I am not really sure how to put them into practice,</b>  7 <b>how I would use this or that today in my class.</b> I think that the break  8 up into smaller groups was interesting because <b>I was a group of one. So</b>  9 <b>it made it truly challenging because I don't know how I am going to</b>  10 <b>complete the collaborative ideas and moderated marking if I have no</b>  11 <b>one to work with.</b> The instructional leader or one of the lead teachers,  12 she tries but she is genuinely uninterested, she gave me a book, patted  13 me on the head and sent me on my way. I teach grade 9 and this is geared  14 for the grade 10 applied and even that is debateable. <b>I don't feel like the</b>  15 <b>presenters are really committed to the ideas they are pushing. There</b>  16 <b>were some problems. Nobody had posted theirs by the time I posted</b>  17 <b>mine. I was not sure what to do. I thought we had to try something</b>  18 <b>and post it on the internet. I could not work with anyone.</b> So I went  19 with one of the lead teachers to the office for materials. We came back  20 with ancient books. Resources that were 20 – 30 years old. <b>Actually I</b>  21 <b>was inspired. Even trying out stuff you know in my classroom,</b> I took  22 ah I took the Socratic app about technology and basically <b>led a</b>  23 <b>discussion about technology with the kids asking them if they would</b>  24 <b>be interested in using their cell phone for this.</b> But a week and a half  25 later I haven't really done anything else on it. I try to see what I can  26 apply and you know being a lifelong learner helps. It's amazing. <b>Even if</b>  27 <b>it doesn't work in your classroom now, it might work in another one.</b>  28 <b>The twitter feed was annoying</b> to have to go on twitter and so on. You  29 know they said you got to get on you have to make the connections. It  30 forced me to follow 5 people. <b>I really got some good tips on you know</b>  31 <b>about tech ideas in class.</b> So I never would have come across if I have  32 to go on to it. I said OK. I know I am part of twitter. But <b>at least I am</b>  33 <b>engaging in it and trying to keep up with it. Maybe I can get more</b>  34 <b>about pedagogy and technology.</b> We did the twitter bit. But we never  35 came back to it. <b>That was frustrating.</b></p>	<p>Cognitive development – Pedagogy Cognitive development –“I picked up some new ideas” Apply new learning in class Social interactions - negative experience “I was a group of 1 Challenging Emotions - Concerns “I could not work with anyone” Emotions – “Actually I was inspired” “I really got some good tips on you know about tech ideas in cl Social interaction - Challenging , no one to work with “The twitter feed was annoying “I really got some good ideas” Emotions – “ that was frustrating”</p>
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36 Attending this course helps me see that **to be an agent of change, I need**  
37 **to figure out how to get applied kids to want to learn Science.**

38 **There are a few things that I have tried. I've done the Socratic**  
39 **model, I done the notebook software**

“a few things I  
have tried”

## Steve' Interview 2 Transcription Coding

1 I think the last session was **pretty good**. The Veritech activity  
2 introduced by Maya was a little bit lower level and I am not sure why  
3 she used it. **I certainly enjoyed talking with colleagues** about their  
4 projects. It would have been interesting to do the moderated marking  
5 but nothing came of that. I think **it was a good session**. I think **I got**  
6 **more out of it. I enjoyed talking with the IL. My interaction with**  
7 **Maya was a bit challenging**. I think we are similar personalities and  
8 she seems to be doing and knowing everything and I think I just rubbed  
9 her the wrong way. I think there was some tension between her and I.  
10 It was sort of interesting. I felt like whatever I said she had to say  
11 something after I said it. I had this funny feeling. **I mean I enjoyed**  
12 **taking to the IL** and the other teachers about the technology and how  
13 to use it. But in terms of engaging the applied level learners? No. **It**  
14 **didn't help me**. I realised that what I am doing doesn't work for them  
15 and that I should be doing it differently.

16 At the end of the day, **it was teachers trying to help**: I am not angry in  
17 that. I guess **I am a bit annoyed** by. My own experience of these sessions  
18 was that I was in a **group of 1**. By then I was very frustrated because  
19 **none of that helped the kids in my own school**.

20 I don't think that what I presented was what they were looking for. I tried  
21 to identify what my kids needed to know. That was my concern at the  
22 end of the day. I just want to get them to show up in class. These kids are  
23 self-deprecating saying things like 'Sir, I am too dumb to do this'. I think  
24 **I should have done more than I did** in the presentation.

25 **Researcher: what can you take away from the programme?**

26 Part of what I have taken away was the IL's idea of looking at how we  
27 teach these applied level kids differently. That certainly rang true with

Emotions –  
enjoy

“I certainly  
enjoyed  
talking with  
colleagues”

“it was a  
good  
session”

“I enjoyed  
talking to the  
IL”

Constraints:

“My  
interaction  
with Maya  
was a bit  
challenging”

Needs not  
met:

“It didn't  
help me”

Emotions –“I  
am a bit  
annoyed”

Frustrated

No group  
interaction

Emotions –

Happy with  
IL

28 me. There was what she said at the end about **not lowering our**  
29 **expectations. It was great to hear that** from the IL. **I love that idea.** I  
30 felt that finally somebody understands that about the kids. It is not about  
31 the marks or how it looks on paper. That was great. **I did like the twitter**  
32 **idea** at the beginning although we didn't do anything about it later on. **I**  
33 **love it.** I checked it out and I use it all the time. I have connected with all  
34 sorts of educational gurus out there with great ideas to use in the  
35 classroom.

36 **Researcher: tell me about your experience during the moderated**  
37 **marking activity**

38 I appreciate it was a good idea to do the moderated marking I didn't  
39 find the assignment have a lot of substance to it. **It was well written**  
40 **and all that but** There was a rubric but it **was very simple.** It was just  
41 sort of a title of what the mark was about and a scale of 1 through 5 with  
42 no explanation of those scales. **I am not sure how useful that rubric**  
43 **was. So that was frustrating I have no interaction with the others in**  
44 the group so I can't get any clarification as well. **I was very frustrated.**  
45 I found a way to make the most of it so that it does not seem as a waste  
46 of my time.

47 **I think I aligned with the IL's way of thinking.** She is trying to solve  
48 the problem of teaching the college level learners. I certainly felt that  
49 my presentation was good and I am trying to get a position as a lead  
50 teacher as well. Also by talking with other people, I realised that it  
51 was not just me, **everybody was having the same experiences in the**  
52 **classroom.** I guess it was an eye-opener. It's not just me not knowing  
53 what to do, how to teach these students. Also the twitter things. Also  
54 some of the technology stuff like twiddla, Socrative, and

55

"I love that idea"

Emotions – "I love it"

Frustration

"I have no interaction with the others"

"I was very frustrated"

Social interactions – "everyone was having the same experiences in the classroom"

56 so on. These were really cool technology and I wished there were more.  
57 **I wished we could have done more**, or get the other lead teacher to push  
58 more of the tech stuff.

59 **I got pretty good results** using some of these ideas in my classroom with  
60 the kids using their cell phones during these activities. It was a great idea  
61 but not practical for the students in my school. I appreciate that in another  
62 school environment I can use all of these ideas, but it is unfortunate that  
63 I cannot use them here at my current school. I can see **me using those**  
64 **ideas again in another situation**. I tried to get as much as I can from  
65 this course so that even if it is a year or so later **I can use it for future**  
66 **classes**.

67 **Researcher: were you able to make the professional development**  
68 **programme more relevant to your professional needs?**

69 It was just **one idea. The one with the comic strips**. It wasn't as  
70 organised as I would have liked but it was worth a try. I don't know if  
71 I was expecting to see cutting edge ideas, but this was around for about  
72 10 years. But I could see where it can be useful. The other idea was to  
73 produce the avatars.

74 **I didn't find any** of the science demonstrations relevant to my students'  
75 needs. There were some great chemistry demonstrations but not  
76 relevant to my student's needs.

77 **Researcher: Did you network with the other teachers there?**

78 The only person that I would want to keep in contact with is the IL. I  
79 think she has an idea of how to reach the applied level kids; she aware of  
80 their problems and she is looking for solutions. Another person is **Sam**.  
81 **We have exchanged e-mail addresses**. She wants to try some of the  
82 technology and we can exchange ideas. **I would do whatever I can to**  
83 **help her out**.

Regrets – “I  
wished we  
could have  
done more”

“I got pretty  
good results”

Not relevant  
to current  
position

Used ideas in  
classroom

“I can use it  
for future  
classes”

Relevance to  
classroom  
needs –

“I didn't find  
any”

Social  
interactions –  
network

“We  
exchanged  
email  
addresses”



## Appendix E: Converting Responses for Questionnaire into Text

### Appendix E1: Matrix of Science Teachers' Experiences of Cognitive Development

<b>Science Teachers</b>	<b>Enhanced Subject Knowledge</b>	<b>Enhanced Pedagogical Knowledge</b>	<b>Understand Concepts</b>	<b>Initiate discussions with confidence</b>	<b>Apply new Knowledge in Classroom</b>	<b>Confidence to take Ownership</b>
<b>Ashna</b>	<b>No</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>
<b>Darius</b>	<b>No</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Felix</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>
<b>Hailey</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>
<b>Jen</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>
<b>Maria</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Mary</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Maya</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Sage</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Sam</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Steve</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>No</b>	<b>-</b>

## Appendix E2: Matrix of Science Teachers' Experiences of Social Interactions

<b>Science Teachers</b>	<b>Confident to Apply Learning</b>	<b>Appreciate Peers</b>	<b>Share ideas</b>	<b>Learn from Peers/Network</b>	<b>Collaborate</b>	<b>Engaged in Debriefing</b>
<b>Ashna</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>
<b>Darius</b>	<b>Yes</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>
<b>Felix</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Hailey</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>
<b>Jen</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>No</b>	<b>No</b>
<b>Maria</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Mary</b>	<b>Yes</b>	<b>-</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Maya</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Sage</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Sam</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
<b>Steve</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>

### Appendix E3: Matrix of Science Teachers' Experiences of Emotional Changes

Science Teachers	Positive Feedback	Recognition for Contribution	Self-recognition and Self-revelation	Confidence to Change	Self-comparison to Promote Growth	Pride
Ashna	Yes	Yes	Yes	Yes	Yes	Yes
Darius	No	No	Yes	Yes	Yes	Yes
Felix	No	Yes	No	Yes	No	Yes
Hailey	Yes	Yes	Yes	Yes	Yes	Yes
Jen	Yes	No	No	Yes	No	Yes
Maria	Yes	Yes	Yes	Yes	Yes	Yes
Mary	Yes	Yes	Yes	Yes	Yes	Yes
Maya	Yes	Yes	Yes	Yes	Yes	Yes
Sage	Yes	Yes	Yes	Yes	Yes	Yes
Sam	Yes	Yes	Yes	Yes	Yes	Yes
Steve	No	Yes	Yes	No	No	Yes

### Appendix E4: Synthesis of Science Teachers' Experiences from Questionnaire

Science Teachers	Cognitive Development	Social Interactions	Emotional Changes
<b>Ashna</b>	Gained pedagogical knowledge, Applied ideas in classroom, Took ownership of learning	Applied ideas with confidence, Appreciated peers, Shared ideas, Learnt from others, Collaborated, Engaged in debriefings	Received positive feedback, Gained recognition, Engaged in self-reflection, was confident to change practice, felt a sense of pride
<b>Darius</b>	Gained pedagogical knowledge, initiated discussions, applied ideas in classroom, claimed ownership of learning	Applied ideas with confidence, did not appreciate peers, did not share ideas, did not learn from others, did not collaborate, did not engage in debriefing	Did not receive positive feedback nor recognition, engaged in self-recognition, was confident to change practice, felt a sense of pride
<b>Felix</b>	Gained subject and pedagogical knowledge, understood concepts, initiated discussions, applied ideas in classroom, did not claim ownership of learning	Applied ideas with confidence, appreciated peers, shared ideas, learnt from others, collaborated, engaged in debriefing	Received no positive feedback, engaged in self-reflection, experienced growth, felt a sense of pride
<b>Hailey</b>	Gained subject and pedagogical knowledge, did not understand concepts, initiated discussions, applied ideas in classroom, claimed ownership for learning	Applied ideas with confidence, appreciated peers, shared ideas, learnt from others, did not collaborate, engaged in debriefings	Received positive feedback, engaged in self-reflection, changed practice with confidence, experienced growth, sense of pride
<b>Jen</b>	Gained subject and pedagogical knowledge, understood concepts, initiated discussions, did not apply ideas in classroom, claimed ownership for learning	Experienced confidence, appreciated peers, did not share ideas, learnt from others, did not collaborate, engaged in debriefings	Received positive feedback, felt confidence and pride
<b>Maria</b>	Gained subject and pedagogical knowledge, understood concepts, initiated discussions, applied ideas in classroom, claimed ownership of learning	Applied ideas with confidence, appreciated peers, shared ideas, learnt from others, collaborated, engaged in debriefings	Received positive feedback, recognised by others, engaged in self-reflections, changed practice with confidence, experienced growth and a sense of pride

#### Appendix E4: Synthesis of Science Teachers' Experiences from Questionnaire (continued)

Science Teacher	Cognitive Development	Social Interactions	Emotional changes
Mary	Gained pedagogical knowledge, understood concepts, initiated discussions, applied ideas, claimed ownership of learning	Applied ideas with confidence, did not appreciate peers, shared ideas, learnt from others, collaborated, engaged in debriefings	Received positive feedback, recognised by others, engaged in self-reflections, changed practice with confidence, experienced growth and a sense of pride
Maya	Gained pedagogical knowledge, understood concepts, initiated discussions, applied ideas in classroom, claimed ownership of learning	Applied ideas with confidence, appreciated peers, shared ideas, learnt from others, collaborated, engaged in debriefings	Received positive feedback, recognised by others, engaged in self-recognition, changed practice with confidence, experienced growth and pride
Sage	Gained subject and pedagogical knowledge, understood concepts, initiated discussions, applied ideas in classroom, claimed ownership of learning	Applied ideas with confidence, appreciated peers, shared ideas, learnt from others, collaborated, engaged in debriefings	Received positive feedback, recognised by others, engaged in self-recognition, changed practice with confidence, experienced growth and pride
Sam	Gained no subject nor pedagogical knowledge, understood concepts, initiated discussions, applied ideas in classroom, claimed ownership of learning	Applied ideas with confidence, appreciated peers, shared ideas, learnt from others, collaborated, engaged in debriefings	Received positive feedback, recognised by others, engaged in self-recognition, changed practice with confidence, experienced growth and pride
Steve	Gained subject and pedagogical knowledge, understood concepts, initiated discussions, did not apply ideas in classroom	Applied ideas with confidence, appreciated peers, shared ideas, learnt from others, collaborated, engaged in debriefings	Received no positive feedback, recognised by others, engaged in self-reflections, did not change practice with confidence, experienced no growth but felt sense of pride

## Appendix F: Experiences of Science Teachers based on Interviews and Questionnaire

### Appendix F1: Comparison of Experiences of Cognitive Development Based on Interviews and Questionnaire

Science Teachers	Experiences of Cognitive Development Based on Interviews	Experiences of Cognitive Development Based on Questionnaire	Inference
<b>Ashna</b>	Ashna felt that she added to her pedagogical skills during this programme. She also learnt of new ways of teaching her ELL students, and shared in the available resources and artefacts available to them	Ashna strongly agreed that she took ownership of her learning, but she agreed that she learned some pedagogy, and new practice. She did not have confidence or understood the concepts to initiate discussions	Ashna's experience has developed her pedagogical skills, allowed her to take ownership of her learning but she did not have the confidence nor did she understand the concepts to initiate discussions and share ideas. <b>Discrepancy</b>
<b>Darius</b>	Darius acquired new pedagogical skills but found that for his current students, he would have to modify them. However, he appreciated that he was learning of ideas that may be useful in future classes. He also shared in the available resources and artefacts	Was confident, claimed ownership, used pedagogical knowledge for new practice	Darius has developed pedagogical skills and was confident in claiming ownership of his learning to the extent that he could modify the ideas to suit his students' needs. He could see uses for these ideas in future classes.
<b>Felix</b>	Felix described his experience as one in which he learnt new ideas and collected artefacts	Felix strongly agreed that he learned new pedagogy and engaged in new practice. He did not take ownership of his learning but had confidence and understood concepts	Although Felix learned of new pedagogical ideas, he did not take ownership of his learning but had confidence and understood the concepts
<b>Hailey</b>	Hailey found good ideas in pedagogy and picked up artefacts from the others in the process	Hailey felt she did not have the confidence or understood the concepts, but she agreed to the other experiences	Hailey learned new pedagogies but did not have confidence or understood the concepts
<b>Jean</b>	Jean learnt about different pedagogies, use of technology, and parts of the curriculum		Jean learned of new pedagogies and technology- <b>no questionnaire responses</b>
<b>Jen</b>	Jen obtained beneficial strategies and new insights as she engaged in the programme	While Jen disagreed that she engaged in new practice she agreed that she gained in pedagogy and all the other areas	Although Jen learned new ideas and strategies, she did not apply them in her classroom
<b>Linda</b>	Linda obtained a variety of ideas and pedagogical knowledge but felt that she could have learned more		Linda picked up ideas in pedagogy but didn't say whether she used them. <b>no questionnaire responses</b>
<b>Maria</b>	Maria experienced no meaningful learning because she was distracted due to her role as a lead teacher	Maria strongly agreed that she understood concepts and claimed ownership in learning as she agreed to learn, and changed practice	Although Maria understood the concepts and claimed ownership for her learning, she did not learn anything new. She changed practice.

**Appendix F1: Comparison of Experiences of Cognitive Development Based on Interviews and Questionnaire (Continued)**

<b>Science Teachers</b>	<b>Experiences of Cognitive Development Based on Interviews</b>	<b>Experiences of Cognitive Development Based on Questionnaire</b>	<b>Inference</b>
<b>Mary</b>	Mary learnt of new ideas and pedagogical skills and collected a number of artefacts	With the exception of agreeing that she understood the concepts, Mary strongly agreed to all the other questions.	Mary felt that she benefited from the study in that she not only learned new pedagogies, but also gained in all other cognitive ways
<b>Maya</b>	Maya developed new confidence, obtained more pedagogical skills and hands-on techniques and picked up a few technological tips from her co-presenter	Maya strongly agreed that she gained in pedagogy and owned her learning. However, she disagreed that she had new subject matter but understood the concepts.	Maya was able to strengthen her technological skills and picked up new pedagogies, she owned her learning and understand the concepts to initiate class discussions
<b>Sage</b>	Sage found new ideas especially in designing and implementing assignments	Sage strongly agreed that she gained skills in pedagogy, confidence, new strategies and ownership while she agreed that she understood concepts	Sage learned of new ideas, gained skills and was confident to initiate discussions with her students since she understood the concepts.
<b>Sam</b>	Sam learnt of skills in pedagogy and technology in the classroom	Sam disagreed that she learned any pedagogy or new ideas, but she agreed that she had confidence, understood concepts, ownership of her learning & practice	Although on the one hand Sam learned of new ways of teaching, she felt she did not in the interviews. However, she did have the confidence and understood the concepts to initiate discussion.
<b>Steve</b>	Steve's learning was pedagogical	While Steve did not understand the concepts, he agreed that he gained in the other areas.	Although Steve learned of new ways to teach his students, he did not understand the concepts enough to initiate discussions

**Based on the Interviews:**

Other than Maria, all of the other science teachers have undergone some form of cognitive development to some extent. It must be noted that the science teachers' cognitive development did not include subject matter knowledge. Although these teachers have reported an increase in the development of their pedagogical, technological, and curricular knowledge to some extent, the increase was not to the same extent for all of them. In addition these teachers have all obtained artefacts relating to their professional development.

### **Based on their Responses to the Questionnaire:**

Again, as with the interviews, except Maria, all of the other teachers have added to their pedagogical content knowledge not subject matter knowledge. To varying extent some have strongly agreed or simply agreed that they understood the concepts and were confident to initiate discussions among their students. Linda and Jean did not participate in answering the questionnaire so there was no way of cross checking their responses from these sources. Ashna's response to some questions in the questionnaire did not align with her interview narrative in terms of understanding the concepts and having the confidence to initiate discussions with her students. In her interview she told of how she was able to take the ideas back and use them successfully with her students.

## Appendix F2: Comparison of Experiences of Social Interaction Based on Interviews and Questionnaire

Science Teachers	Experiences of Social Interaction Based on Interviews	Experiences of Social Interactions Based on Questionnaire	Inference
<b>Ashna</b>	Ashna likes the idea of collaborating and appreciates the benefits of it, but did not consider her experience as collaboration since although she and her group members worked in a group they did so separately. She worked alone but did network with Hailey and during the presentations there was a certain degree of sharing among the teachers present.	While she disagreed that she learned from her peers, she agreed to making changes and growing, appreciating her peers, shared ideas with colleagues and engaged in debriefing. However, she strongly agrees that she had opportunities to collaborate.	Ashna interacted socially with her peers to the extent that she was engaged in the learning process. She has formed connections with at least one other person but regretted she was not able to work in a group situation.
<b>Darius</b>	Darius exchanged ideas and information and engaged in discussions among the other teachers present but did not work with anyone because his classroom situation was different from that of the other teachers.	There does not seem to be any evidence of social interaction	Although in the earlier sessions of the programme, Darius engaged in discussions with the other teachers despite that his classroom context was different from the others, he did not participate in the last session because he felt that it did was not relevant to his needs.
<b>Felix</b>	Felix, who was away for one session, missed the group planning session and felt he had nothing to contribute to the group work for the rest of the programme. However, he did participate in the discussions following the presentations	He agreed that he had changed and grown, appreciated his peers, shared ideas with colleagues, learnt from peers, collaborated and engaged in debriefings after presentations.	Unfortunately for Felix, he missed the second session and could not collaborate to the extent he wanted to with his colleagues. However, he did change and grew from the experience
<b>Hailey</b>	Hailey experienced no collaboration in that her group members relied on her to do all the work and post the material for them. However, she did network with Ashna and Jen and shared ideas and participated in the discussions during presentations	She strongly agreed that she grew and changed and appreciated her peers. However, she agreed that she shared ideas, learned with others, engaged in debriefings, but strongly disagreed that she collaborated	Hailey experienced no collaboration. Her group members were reluctant to share ideas. She did network with Ashna and Jen, shared ideas, grew, changed and learned from others, and engaged in debriefings.

**Appendix F2: Comparison of Experiences of Social Interaction among Science Teachers Based on Interviews and Questionnaire (Continued)**

<b>Science Teachers</b>	<b>Experiences of Social Interaction Based on Interviews</b>	<b>Experiences of Social Interaction Based on Questionnaire</b>	<b>Inference</b>
<b>Jean</b>	Jean found herself very early into the programme helping others with the technology activities. She felt the sharing of ideas and experiences eased the isolation at her school		Although Jean did not participate in answering the questionnaire, she did speak at length of her interaction with and helping others
<b>Jen</b>	Jen started out on the first session doing group work which she found rewarding. However, her group members were not there for the second session. So she worked alone and was unable to collaborate which she would have enjoyed doing. However, she did manage to network with Hailey and found the professional development environment to be positive and conducive to her learning	Jen was confident to apply her new knowledge, she appreciated her peers, and learnt from others. However, she did not share ideas, collaborate, nor engage in debriefing sessions	Jen's experience of social interaction was not to the same extent as those of other teachers who worked in a group: As a result she did not collaborate, share ideas or engage in debriefings. However, she managed to network with Hailey.
<b>Linda</b>	Linda was happy she had an opportunity to share resources, ideas and experiences by interacting with the other teachers present. She felt comfortable among the others there that she was unafraid to admit to difficulties in teaching her students. She found everyone present only too willing to offer suggestions to her		While Linda did not participate in responding to the questionnaire, she did say she was happy to share resources, ideas and experiences with her colleagues. She felt comfortable enough to state her fears and shortcomings without fear of repercussions.
<b>Maria</b>	As a lead teacher, Maria found it rewarding to have positive feedback from the participating teachers. She enjoyed her interaction with the other teachers although she would have preferred to do more of this.	She agreed that she grew, shared, learned and collaborated but strongly agreed that she engaged in debriefing, appreciated her peers	Maria found it rewarding to receive the positive feedback she received from her peers. She found a great deal of satisfaction as she interacted and collaborated during the sessions. She grew and changed parts of her practice

**Appendix F2: Comparison of Experiences of Social Interaction among Science Teachers  
Based on Interviews and Questionnaire (Continued)**

<b>Science Teachers</b>	<b>Experiences of Social Interaction Based on Interviews</b>	<b>Experiences of Social Interaction Based on Questionnaire</b>	<b>Inference</b>
<b>Mary</b>	Mary drew on others' expertise during the professional development sessions. She collaborated, shared, interacted and brainstormed with both her team members to achieve her goal of learning how to evaluate an inquiry-based project.	She strongly agreed that she had the confidence to apply what she learnt from her peers, share ideas with her colleagues, collaborate and engaged in debriefing sessions but agreed that there was some learning from her peers.	Mary enjoyed interacting with the others as she learned. She collaborated, shared and brainstormed with others and engaged in the debriefing session to learn how to evaluate an inquiry study
<b>Maya</b>	Maya enjoyed working together, sharing resources and ideas with her co-presenter. Although she interacted well with most of the teachers, she was frustrated with Steve's 'complaining'. She found working together with the teachers as they engaged in problem-solving, discussions, and sharing of ideas to be rewarding.	She strongly agreed to everything except the debriefing.	Maya engaged in quite a bit of collaboration as she led the programme but had difficulties interacting with Steve during the sessions. She did not participate in the debriefing session.
<b>Sage</b>	Sage engaged in collaboration, sharing and learning with the participating teachers. However, she found some of the teachers were reluctant to participate. There was a certain degree of discord between her and a participating teacher during the last session. She was not happy about that.	She agreed that she has grown, but strongly agreed that she appreciated her peers, shared ideas, learnt from peers, collaborated, and engaged in debriefing sessions to consolidate learning.	Sage collaborated with the teachers as she led the programme. She has grown in the process and has come to appreciate her peers especially during the debriefing session after her classroom observation
<b>Sam</b>	Sam learnt from the other teachers. She shared, mixed, and exchanged ideas and experiences with the other teachers. She engaged in discussion with everyone and observed a classroom in action. She also networked with Steve.	She agreed that she experienced growth and change, appreciated her peers, shared ideas with colleagues, learnt from them, collaborated and engaged in debriefing sessions.	Sam collaborated, learnt and shared ideas with other teachers and in the process she grew, changed some of her practice and engaged in the debriefing session

**Appendix F2: Comparison of Experiences of Social Interaction among Science Teachers  
Based on Interviews and Questionnaire (Continued)**

Science Teachers	Experiences of Social Interaction Based on Interviews	Experiences of Social Interaction Based on Questionnaire	Inference
Steve	Steve worked all by himself because no one else was teaching at his grade level. However, he did network with Sam. Although Steve was able to interact in a collegial way with the participating teachers present, he had difficulties communicating with Maya who was one of the presenting teachers. He was not happy about that interaction.	He agreed that he changed and grew, appreciated his peers, shared ideas with colleagues, learnt from them, collaborated, debriefed after a presentation.	The extent of Steve's social interaction was limited because he did not belong to a group: However, he did form a network with Sam but he had difficulties relating to Maya one of the lead teachers. Despite this, he did collaborate with other teachers present and was able to change and grow. He did participate in the presentation.

**Based on the Interviews:**

To some extent, all of these teachers enjoyed working together, collaborating on, discussing, and sharing of ideas, experiences and resources which contributed to their learning process. However, not all of them benefitted from working in a group situation as described by Hailey, Felix, Jen and Steve. Also there was a certain degree of discord among lead teachers and participating teachers such as Sage and Mary as well as Maya and Steve.

**Based on the Questionnaire:**

The teachers more or less reported the same outcome of their interactions as they did in the interviews.

### Appendix F3: Comparison of Emotional Changes Based on Interviews and Questionnaire

Science Teachers	Experiences of Emotional Experiences Based on Interviews	Experiences of Emotional Experiences Based on Questionnaire	Inference
<b>Ashna</b>	Ashna felt comfortable discussing her struggles in teaching the ELL students with the other teachers present in the sessions. Although she enjoyed the sessions, she was somewhat disappointed in some aspects. She would have welcomed extra time to develop ideas on teaching her students. She was also disappointed with her presentation but she liked the learning strategies she learnt about from the sessions.	She agrees that she had positive feedback, recognition, confidence to change and a sense of pride while she self-reflected and self-compared.	It appears that Ashna had an overall positive experience in which she felt good about herself as a science teacher and now she has the confidence to make changes in her classroom practice.
<b>Darius</b>	Although Darius enjoyed some aspects of the session, he was disappointed and unhappy that he did not experience true collaboration. However, he was happy to be able to observe a lesson in action. He also enjoyed the discussions on the examples. Because of his circumstances, he felt disconnected with the other teachers, but still enjoyed sharing ideas with them. While he liked the first sessions and demonstrations conducted by the IL, he did not like the last session. He was hoping to get a package to apply in his situation.	There was no positive feedback or recognition, but he did reflect on his practice, had the confidence to change, compared his present status with his past and has a sense of pride	Darius was disappointed and unhappy with the manner in which the sessions were conducted. He enjoyed some aspects of the sessions but he felt that he did not collaborate really. He felt disconnected. He was not recognised or received positive feedback but he did reflect on his practice.
<b>Felix</b>	Felix was sceptical about the end result of the programme. He was uncomfortable that he missed the second session and so was not able to participate in the planning session. He found it easy to work with the lead teacher. So while he was satisfied with his experience of the sessions, he did not find any part of it memorable.	He disagreed that he had positive feedback, self-reflected or self-compared. However, he agreed that he gained recognition, confidence and a sense of pride	Apart from his discomfort due to missing a session, Felix felt he had a positive experience although he did not receive feedback or engaged in self-reflection but he gained confidence, recognition and a sense of pride.
<b>Hailey</b>	Hailey felt it was good to form network with other teachers. She liked the idea of meeting and speaking with the other teachers. Unfortunately although she looked forward to engage in group work, she was disappointed and frustrated because the other members of her group decided to let her do all the work while they waited for her to give them the end product. As the lead teacher,	She strongly agreed that she gained recognition and a sense of pride but agreed that she received positive feedback, confidence and engaged in self-reflection and self-comparison	Hailey liked the idea of forming network which she did. However, she was disappointed with other members of her group who did not contribute to the lesson planning activities. She really appreciated the positive feedback she

**Appendix F3: Comparison of Emotional Changes Based on Interviews and Questionnaire  
(Continued)**

<b>Science Teachers</b>	<b>Experiences of Emotional Experience Based on Interviews</b>	<b>Experiences of Emotional Experience Based on Questionnaire</b>	<b>Inference</b>
<b>Hailey</b>	She hosted the other teachers who observed her conducting a lesson. She appreciated the positive feedback she received at the end. She found that third session to be a more positive experience. In this session she was able to collaborate and share ideas with all the teachers and not members of her group alone		received as a result of her classroom lesson and had a sense of pride as she reflected and compared her progress to the start of the programme
<b>Jean</b>	Jean left the first session energised, excited but sad because the others did not respond to her sharing of ideas on Google Docs. However, she enjoyed the afternoon session doing group work planning.		There was no way to compare experiences based on interviews and questionnaire
<b>Jen</b>	Jen was frustrated because she felt her group could have worked together but did not. However, she found the work environment safe and comfortable and she wished that they could have worked as group for all the sessions. She was also disappointed because she was away for the day on which the presentation was held. On the whole, she was excited to be there but regretted that they did not have as much collaboration as she wanted.	She strongly disagreed that she received recognition, but disagreed that she self-reflects and self-compared. However, she agreed that she had positive feedback, confidence and a sense of pride	Jen was frustrated that she was not able to collaborate in a group situation. She felt comfortable and safe in the learning environment and was excited to attend the sessions. She regretted the lack of collaboration. She had positive feedback, confidence, and a sense of pride, but no recognition
<b>Linda</b>	Linda had a positive experience as she interacted with the other teachers. She liked the idea of exchanging ideas with the others. She was relieved that others have the same problems teaching the ELL students as she had. On the whole she saw the experience of the session as a means of removing her anxiety and bestowing comfort to her.		There was no way of comparing Linda's experiences based on her interviews and her response to the questionnaire.

**Appendix F3: Comparison of Emotional Changes among Science Teachers Based on Interviews and Questionnaire (Continued)**

Science Teachers	Experiences of Emotions	Experiences of Emotional Experiences Based on Questionnaire	Inference
<b>Maria</b>	As a lead teacher, Maria felt the burden of the work for the first two sessions fell squarely on her shoulders. So she did not enjoy the experience of the sessions as much as she wanted to. She found the whole process stressful and frustrating. In addition, she found getting the science teachers to participate was not easy. Despite this she felt the sessions were good. She felt that there was no closure at the end of the programme. However, because her co-presenter picked up the baton for the last two sessions, she was less stressed and relaxed a little. She felt they could have done a better job and for this she was disappointed that they did not manage to get the teachers more engaged in the activities. She was especially upset that they appeared so unprepared in the last session and this added to her frustration and disappointment.	Maria experienced positive feedback and recognition from her peers. She was confident to change her practice, and had a sense of pride in her achievements as a result of the professional development programme. Additionally, she engaged in self-reflection and self-comparison.	On the one, hand Maria experienced disappointments, frustrations, and stress but according to her responses to the questionnaire, she felt positive about the feedback and recognition she received, was proud of her achievements, and engaged in self-reflection and self-comparison to improve her practice.
<b>Mary</b>	Mary felt that the sessions sparked her imagination. Her experience was indeed positive and she was comfortable to share her ideas with the other teachers. She experienced trust and found observing a class in action to be priceless. She had an ‘aha’ moment when she saw how everything in her own class would come together based on what she learnt during the sessions. That made her happy. She had achieved her goal. She also found the idea of everyone working together to be an exciting and fun event and it gave her confidence. Her only concern was the lack of clarity she saw in the task of the moderated marking. She was disappointed with that because that was the most important idea she wanted to take away.	While she strongly agreed that she received positive feedback, with a sense of pride, and was confident to change, she agreed that she self-reflected and self-compared and gained recognition.	Mary felt enthusiasm, happiness and confidence as she participated in the programme. However, she did feel disappointed and expressed concern that the last session was not as clear as it should have been. She loved the idea of working with others. She received positive feedback, was confident to change and gained recognition. She felt a sense of pride.

**Appendix F3: Comparison of Emotional Changes Based on Interviews and Questionnaire  
(Continued)**

<b>Science Teachers</b>	<b>Experiences of Emotional Experiences Based on Interviews</b>	<b>Experiences of Emotional Experiences Based on Questionnaire</b>	<b>Inference</b>
<b>Maya</b>	Maya found observing her co-presenter's lesson very pleasing. She was a bit disappointed that her own activities on the last day did not go as well. As a result she was disgruntled apart from feeling overwhelmed, frustrated and unproductive. However, she was pleased with the ending	While she agreed on self-reflecting and having confidence to change, she strongly agreed to have positive feedback, recognition, confidence, and pride.	As a co-presenter, Maya was pleased with her partner's lesson and not happy with the outcome of her own activities. However, the ending was OK. Favourable response in questionnaire
<b>Sage</b>	Sage had an overall positive experience. She was happy that as a co-presenter, the teachers observed her classroom in action and they were very pleased with it. The positive feedback she received provided a sense of validation. She found the first sessions challenging. She felt that she could not reach the other teachers and had the sense that somehow she had let them down. However, she felt she had a better time on the last day.	Sage strongly agreed that she had positive feedback, recognition, had confidence, self-compared and a sense of pride while agreed that she self-reflecting	Sage had an overall positive experience especially as the teachers observed a lesson in her class. Their positive response validated her efforts. Challenging moments were diffused as she had positive feedback, recognition and a sense of pride in her work
<b>Sam</b>	Sam liked the activities especially observing a lesson in progress. She liked the idea of sharing ideas and experiences with the other teachers. However, she was disappointed that no one who was not a physics teacher shared how they would teach a physics lesson since she is a physics teacher who struggled to teach a biology lesson.	She disagreed that she had positive feedback, confidence to change and self-compared. However, she agreed that she received recognition, she self-reflecting and had a sense of pride	Sam found observing a lesson very rewarding and she liked to share ideas and experiences. She had some disappointment as her professional needs were not met. She did not receive positive feedback. She had recognition, self – reflected and felt a sense of pride

**Appendix F3: Comparison of Emotional Changes among Science Teachers Based on Interviews and Questionnaire (Continued)**

<b>Science Teachers</b>	<b>Experiences of Emotional Experiences Based on Interviews</b>	<b>Experiences of Emotional Experiences Based on Questionnaire</b>	<b>Inference</b>
<b>Steve</b>	Steve did not think that the presenters were committed to the programme they were presenting. Nevertheless, he was inspired to participate in the sessions. He found some parts frustrating especially because he did not belong to a group but worked alone. He found observing a lesson in progress good and enjoyed speaking with the IL. However, he found it challenging to interact with Maya. He was a bit annoyed about that. He was frustrated with those aspects of the programme which did not serve his or his students' needs.	He disagreed that he had positive feedback, confidence to change and self-compared. However, he agreed that he had recognition, self-reflected and had a sense of pride	Steve felt disillusioned about the sessions. He felt that the leaders were not committed to the programme and was challenged by the tension between himself and Maya. He received no positive feedback, or confidence. He was recognised and as he self-reflected he felt a sense of pride.

**Based on Interviews:**

It appears that the emotional experiences of the science teachers in this study ranged from excitement, happiness, enthusiasm and appreciation to disappointment, sadness, regret, frustration and uncertainty. These emotional 'swings' appear to occur within and among sessions and are dependent on interactions among teachers as well as with the learning experiences.

**Based on the Questionnaire:**

Teachers' responses reflect their narratives.

**Appendix G: Comparison of Science Teachers' Dimensions of Experiences across Modules**

**Appendix G1: Comparison of Experiences of Cognitive Development among Science Teachers across Modules**

<b>Science Teachers</b>	<b>Experiences of Cognitive Development</b>
<b>Ashna</b>	Ashna felt that she added to her pedagogical skills during this programme. She also learnt of new ways of teaching her ELL students, and shared in the available resources and artefacts available to them
<b>Darius</b>	Darius acquired new pedagogical skills but found that for his current students, he would have to modify them. However, he appreciated that he was learning of ideas that may be useful in future classes. He also shared in the available resources and artefacts
<b>Felix</b>	Felix described his experience as one in which he learnt new ideas and collected artefacts
<b>Hailey</b>	Hailey found good ideas in pedagogy and picked up artefacts from the others in the process
<b>Jean</b>	Jane learnt about different pedagogies, use of technology, and parts of the curriculum
<b>Jen</b>	Jen obtained beneficial strategies and new insights as she engaged in the programme
<b>Linda</b>	Linda obtained a variety of ideas and pedagogical knowledge but felt that she could have learned more
<b>Maria</b>	Maria experienced no meaningful learning because she was distracted due to her role as a lead teacher
<b>Mary</b>	Mary learnt of new ideas and pedagogical skills and collected a number of artefacts
<b>Maya</b>	Maya developed new confidence, obtained more pedagogical skills and hands-on techniques and picked up a few technological from her co-presenter
<b>Sage</b>	Sage found new ideas especially in designing and implementing assignments
<b>Sam</b>	Sam learnt of skills in pedagogy and technology in the classroom
<b>Steve</b>	Steve's learning was pedagogical

**Appendix G2: Comparison of Experiences of Social Interaction among Science Teachers  
across Modules**

<b>Science Teachers</b>	<b>Experiences of Social Interaction</b>
<b>Ashna</b>	Ashna likes the idea of collaborating and appreciates the benefits of it, but did not consider her experience as collaboration since although she and her group members worked in a group they did so separately. She worked alone but did network with one Hailey Lewis and during the presentations there was a certain degree of sharing among the teachers present.
<b>Darius</b>	Darius exchanged ideas and information and engaged in discussions among the other teachers present but did not work with anyone because his classroom situation was different from that of the other teachers.
<b>Felix</b>	Felix, who was away for one session, missed the group planning session and felt he had nothing to contribute to the group work for the rest of the programme. However, he did participate in the discussions following the presentations
<b>Hailey</b>	Hailey experienced ‘negative collaboration’ in that her group members relied on her to do all the work and post the material for them. However, she did network with Ashna and Jen and shared ideas and participated in the discussions during presentations
<b>Jean</b>	Jean found herself very early into the programme helping others with the technology activities. She felt the sharing of ideas and experiences took away the isolation she felt at her own school
<b>Jen</b>	Jen started out on the first session doing group work which she found rewarding. However, her group members were not there for the second session. So she worked alone and was unable to collaborate which she would have enjoyed doing. However, she did manage to network with Hailey Lewis and found the professional development environment to be positive and conducive to her learning
<b>Linda</b>	Linda was happy she had an opportunity to share resources, ideas and experiences by interacting with the other teachers present. She felt comfortable among the others there that she was unafraid to admit to difficulties in teaching her students. She found everyone present only too willing to offer suggestions to her
<b>Maria</b>	As a lead teacher, Maria found it rewarding to have positive feedback from the participating teachers. She enjoyed her interaction with the other teachers although she would have preferred to do more of this.
<b>Mary</b>	Mary drew on others’ expertise during the professional development sessions. She collaborated, shared, interacted and brainstormed with both her team members to achieve her goal of learning how to evaluate an inquiry-based project.
<b>Maya</b>	Maya enjoyed working together, sharing resources and ideas with her co-presenter. Although she interacted well with most of the teachers, she was frustrated with Steve’s ‘complaining’. She found working together with the teachers as they engaged in problem-solving, discussions, and sharing of ideas to be rewarding.
<b>Sage</b>	Sage engaged in collaboration, sharing and learning with the participating teachers. However, she found some of the teachers reluctant to participate. There was a certain degree of discord between her and a participating teacher during the last session. She was not happy about that.
<b>Sam</b>	Sam learnt from the other teachers. She shared, mixed, and exchanged ideas and experiences with the other teachers. She engaged in discussion with everyone and observed a classroom in action. She also networked with Steve.
<b>Steve</b>	Steve worked all by himself because no one else was teaching in his grade level. However, he did network with Sam. Although Steve was able to interact in a collegial way with the participating teachers present, he had difficulties communicating with Maya who was one of the presenting teachers.

### Appendix G3: Comparison of Emotional Changes among Science Teachers across Modules

Science Teachers	Experiences of Emotions
<b>Ashna</b>	Ashna felt comfortable discussing her struggles in teaching the ELL students with the other teachers present in the sessions. Although she enjoyed the sessions, she was somewhat disappointed in some aspects. She would have welcomed extra time to develop ideas on teaching her students. She was also disappointed with her presentation but she liked the learning strategies she learnt about from the sessions.
<b>Darius</b>	Although Darius enjoyed some aspects of the session, he was disappointed and unhappy that he did not experience true collaboration. However, he was happy to be able to observe a lesson in action. He also enjoyed the discussions on the examples. Because of his circumstances, he felt disconnected with the other teachers, but still enjoyed sharing ideas with them. While he liked the first sessions and demonstrations conducted by the IL, he did not like the last session. He was hoping to get a package to apply in his situation.
<b>Felix</b>	Felix was sceptical about the end result of the programme. He was uncomfortable that he missed the second session and so was not able to participate in the planning session. He found it easy to work with the lead teacher. So while he was satisfied with his experience of the sessions, he did not find any part of it memorable.
<b>Hailey</b>	Hailey felt it was good to form network with other teachers. She liked the idea of meeting and speaking with the other teachers. Unfortunately although she looked forward to engage in group work, she was disappointed and frustrated because the other members of her group decided to let her do all the work while they waited for her to give them the end product. As the lead teacher, she hosted the other teachers who observed her conducting a lesson. She appreciated the positive feedback she received at the end. She found that third session to be a more positive experience. In this session she was able to collaborate and share ideas with all the teachers and not members of her group alone.
<b>Jean</b>	Jean left the first session energised, excited but sad because the others did not respond to her sharing of ideas on Google Docs. However, she enjoyed the afternoon session doing group work planning.
<b>Jen</b>	Jen was frustrated because she felt her group could have worked together but did not. However, she found the work environment safe and comfortable and she wished that they could have worked as group for all the sessions. She was also disappointed because she was away for the day on which the presentation was held. On the whole, she was excited to be there but regretted that they did not have as much collaboration as she wanted.
<b>Linda</b>	Linda had a positive experience as she interacted with the other teachers. She liked the idea of exchanging ideas with the others. She was relieved that others have the same problems teaching the ELL students as she had. On the whole she saw the experience of the session as a means of removing her anxiety and bestowing comfort to her.

### Appendix G3: Comparison of Emotional Changes among Science Teachers (continued)

Science Teachers	Experiences of Emotions
<b>Maria</b>	As a lead teacher, Maria felt the burden of the work for the first two sessions fell squarely on her shoulders. She did not enjoy the experience of the sessions as much as she wanted to. She found the whole process stressful and frustrating. In addition, she found getting the science teachers to participate was not easy. Despite this she felt the sessions were good. She felt that there was no closure at the end of the programme. However, because her co-presenter picked up the baton for the last two sessions, she was less stressed and relaxed a little. She felt they could have done a better job and for this she was disappointed that they did not manage to get the teachers more engaged in the activities. She was upset that they appeared so unprepared in the last session and this added to her frustration and disappointment.
<b>Mary</b>	Mary felt that the sessions sparked her imagination. Her experience was indeed positive and she was comfortable to share her ideas with the other teachers. She experienced trust and found observing a class in action to be priceless. She had an ‘aha’ moment when she saw how everything in her own class would come together based on what she learnt during the sessions. That made her happy. She had achieved her goal. She also found the idea of everyone working together to be an exciting and fun event and it gave her confidence. Her only concern was the lack of clarity she saw in the task of the moderated marking. She was disappointed with that because that was the most important idea she wanted to take away
<b>Maya</b>	Maya found observing her co-presenter’s lesson very pleasing. She was a bit disappointed that her own activities on the last day did not go as well. As a result she was disgruntled apart from feeling overwhelmed, frustrated and unproductive. However, she was pleased with the ending.
<b>Sage</b>	Sage had an overall positive experience. She was happy that as a co-presenter, the teachers observed her classroom in action and they were very pleased with it. The positive feedback she received provided a sense of validation. She found the first sessions challenging. She felt that she could not reach the other teachers and had the sense that somehow she had let them down. However, she felt she had a better time on the last day.
<b>Sam</b>	Sam liked the activities especially observing a lesson in progress. She liked idea of sharing ideas and experiences with the other teachers. However, she was disappointed that no one who was not a physics teacher shared how they would teach a physics lesson since she is a physics teacher who struggled to teach a biology lesson.
<b>Steve</b>	Steve did not think that the presenters were committed to the programme they were presenting. Nevertheless, he was inspired to participate in the sessions. He found some parts frustrating especially because he did not belong to a group but worked alone. He found observing a lesson in progress good and enjoyed speaking with the IL. However, he found it challenging to interact with Maya. He was a bit annoyed about that. He was frustrated with those aspects of the programme which did not serve his or his students’ needs.

**Appendix G4: Comparison of Changes Experienced among Science Teachers across Modules**

<b>Science Teachers</b>	<b>Experiences of Changes in Beliefs and Practice</b>
<b>Ashna</b>	Ashna took some of the activities from the programme to her classroom and she thought that she was successful in using them with her ELL students. She also took some other activities and introduced them to her colleagues in the department. She felt that she extended her repertoire of techniques so that she could try different ways of explaining concepts to her students. In this way she felt better prepared to teach these students.
<b>Darius</b>	Darius believed it would be difficult for him to rethink his beliefs as a science teacher. However, he could see how easy it would be for him to change his perspectives about how he would approach lessons in future.
<b>Felix</b>	Felix found some ideas that he felt he could use in his class but was unable to say how successful he was in implementing them. He felt that it was too early to tell. He did take these ideas to his colleagues and did a presentation during a ‘lunch and chat’ session at his school. While he might not change his role as a science teacher, he would adjust his approach to teaching science. Maybe in time, he would see himself as an ELL science teacher, but not at the moment.
<b>Hailey</b>	Hailey tried some of the activities in her class and used them to plan for the rest of the school year. Her experience has changed how she thinks about teaching science. She has since tried to figure out students’ needs in her quest to become a better teacher. In the process, she has changed her views about herself. She now has more confidence to modify and change her approach to suit her students’ needs. However, she was not sure what form the change would eventually take.
<b>Jean</b>	Jean has tried several of the ideas with her students and got mixed results. However, she was impressed by that. Her students were definitely more engaged. While her experience may not change how she felt about herself as a teacher. She felt that her experience would certainly improve her classroom practice so that she could become the teacher she wanted to be. At the end of the sessions she attended she couldn’t wait to try the new ideas in class.
<b>Jen</b>	Jen found the lessons meaningful. She could see how she would be able to use some of the ideas in her classroom. However, she doubted she would ever see herself as an ELL science teacher.
<b>Linda</b>	Linda felt better to teach her ELL students after attending the sessions. She can see herself as an ELL science teacher. She is also confident to share her new knowledge with her colleagues at her school although she had used some of these ideas in a limited way.
<b>Maria</b>	Maria can see herself incorporating some of the skills they discussed during the sessions. She saw this as a paradigm shift in that her students can now be given tools to move to the next level of their learning.
<b>Mary</b>	Mary said that after the programmes she had more confidence to teach an inquiry study. She had acquired new ideas to take to her students and she had used them. She was successful in implementing such ideas in her classroom. She doubted that her experience would change her views of herself as a science teacher. However, she can see how it would keep the process going and have a positive effect on the other courses she was likely to teach in future.

**Appendix G4: Comparison of Changes Experienced among Science Teachers across Modules (continued)**

<b>Science Teachers</b>	<b>Experiences of Emotions</b>
<b>Maya</b>	Maya has added to her repertoire of ideas to engage her students. However, she doubted that the experience would change her core beliefs. She felt that she could teach with more awareness and become more technologically able in the classroom. She saw herself as a more confident lead science teacher rather than a more confident science teacher.
<b>Sage</b>	Sage felt that her experience cemented her views of herself as a science teacher. Her experience has led her to believe that she can guide her students to think more critically in class.
<b>Sam</b>	Sam has used some of the ideas she picked up in her classroom and shared them with her colleagues on staff as well. Although her experience may not change her view of herself as a science teacher, it would enhance that view.
<b>Steve</b>	Steve's experience helped him to realise that he had to try some of those activities in order to help his students learn science. This was because he had tried some of those ideas and obtained some pretty good results. In addition, he could see how he would be able to use some of those ideas in future classes.