

**AN EXPLORATION OF THE ROLE OF THE ADVANCED
CERTIFICATE IN EDUCATION ON THE PROFESSIONAL
DEVELOPMENT OF MATHEMATICAL LITERACY
TEACHERS.**

by

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**A Dissertation submitted to the Faculty of Education, University of
KwaZulu-Natal, in partial fulfilment of the requirements for the degree of
Master of Education (Mathematics Education).**

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2012

DECLARATION

I, Thandimfundo Eugene Thembela, declare that the research reported in this dissertation is my original work submitted in partial fulfillment of the requirements for the degree of Master of Education (Mathematics Education).

This dissertation has not been submitted for any degree or examination at any other tertiary institution / university.

Where use has been made of the work of other people, such work has been duly acknowledged in the text and referenced.

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Dear Mr Thembela

Protocol reference number: HSS/0827/012M

Project title: The role of the Advanced Certificate in Education in the professional development of Mathematical Literacy educators.

EXPEDITED APPROVAL

I wish to inform you that your application has been granted Full Approval through an expedited review process.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully



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INSPIRING GREATNESS



DEDICATION

This dissertation is dedicated to both my late parents,

Prof. Alexander Jabulani Thembela (1932 - 2003), and my mother,

Mrs. Theodora Thembela, uMaNgcobo (1931 - 2009),

who, sadly and unfortunately, did not live long enough to see the fruit of their teachings and influences being borne through this study. They were and still are my source of inspiration and my pillar of strength throughout my life.

Mom, Dad, this is for you!

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ABSTRACT

Mathematical Literacy (ML) was introduced as a new subject in 2006, as an alternative to Mathematics for learners in Grade 10 to 12 in South African schools. The challenge of the shortage of Mathematics teachers (and hence Mathematical Literacy teachers), was exacerbated. Hence the KwaZulu Natal Department of Education (KZNDoE) jointly with the University of KwaZulu-Natal (UKZN) initiated a programme designed to re-skill teachers to teach this new subject.

This study explores the professional development of such teachers as a result of their participation in the Advanced Certificate in Education (ACEML) course at UKZN. Their professional development is explored in terms of their content knowledge, a content specific pedagogy and their professional identity and beliefs.

The study was informed by a naturalistic, interpretivist orientation. Two versions of semi-structured questionnaires were completed by a total of twenty-three teachers. The first version, called Questionnaire A, was completed by fifteen teachers while the second version, Questionnaire B, by eight teachers respectively. Later, semi-structured interviews with four of the teachers were conducted. Their previous academic records were also used as data sources.

The key findings of the study revealed that all teachers interviewed perceived improvement in their content knowledge as a result of their participation in the programme. Examples of improvements in their content-specific pedagogies were their increased repertoire of teaching strategies, their increased confidence, their focus on learners' prior understanding and their ability to link their teaching to real life applications. Findings also indicate that many teachers developed strong identities as Mathematical literacy teachers. A shift in identity was also evident with some teachers switching over from previous specialisations to teaching only Mathematical Literacy. Many teachers also felt that the generic modules helped them gain a broader understanding of their role. Claims that Mathematics teachers who have not studied the ACEML cannot teach ML as successfully as those who have, were made by most teachers.

ACRONYMS

ACEML	- Advanced Certificate in Education in Mathematical Literacy
ACE	- Advanced Certificate in Education
ML	- Mathematical Literacy
UKZN	- University of KwaZulu-Natal
KZNDoE	- KwaZulu-Natal Department of Education
NMMU	- Nelson Mandela Metropolitan University
DoE	- Department of Education
GET	- General Education and Training phase
FET	- Further Education and Training phase
KZN	- Province of KwaZulu-Natal
C2005	- Curriculum 2005
HOD	- Head of the Department (in schools)
SG	- Standard Grade Mathematics
HG	- Higher Grade Mathematics
LPG	- Learning Programme Guidelines
LO	- Learning Outcome
PCK	- Pedagogic Content Knowledge
CCK	- Common Content Knowledge
SCK	- Specific Content Knowledge
SMK	- Subject Matter Knowledge
KCS	- Knowledge of Content and Students
KCT	- Knowledge of Content and Teaching
EMS	- Economic and Management Sciences

List of Tables

- 3.1. Criteria for Qualitative Research
- 4.1. Number of teachers who taught different subjects
- 4.2. Current Post-Level of Participants
- 4.3. Teacher qualifications on entering the ACEML programme
- 4.4. Rating of Learning Outcomes
- 4.5. Responses to Section D of Questionnaire A
- 4.6. Subjects taught and teaching experience of Participants in Questionnaire B
- 4.7. Responses to Question 6 of Questionnaire B
- 4.8. Topics identified by Questionnaire B participants as making huge difference in their teaching of ML - (School Content related modules}
- 4.9. Comments by Questionnaire B Participants on the Generic modules
- 4.10. Ranking of Modules in terms of Usefulness to Participants in Questionnaire B
- 4.11. Reasons for studying in ACEML programme (Questionnaire B)

TABLE OF CONTENTS

A	DECLARATION	i
B	ETHICAL CLEARANCE CERTIFICATE	ii
C	DEDICATION	iii
D	ACKNOWLEDGEMENTS	iv
E	ABSTRACT	v
F	ACRONYMS	vi
G	LIST OF TABLES	vii
	TABLE OF CONTENTS	viii
1.	CHAPTER 1: Overview and Focus of the Study	1
1.1.	Introduction	1
1.1.1.	Mathematical Literacy as a School Subject	1
1.1.2.	Background to the Context of the Study	4
1.1.3.	The Outline of the Curriculum in the ACEML	5
1.2.	Rationale and purpose of the Study	6
1.3.	Personal Motivation for the Study	7
1.4.	Objectives of the Study	10
1.5.	Significance of the Study	11
1.6.	Organisation of the Study	12
2.	CHAPTER 2: Literature Review and Theoretical Framework	13
2.1.	Introduction	13
2.2.	Literature Review	13
2.2.1.	Changing Curriculum	13
2.2.2.	General Issues of Professional Development	15
2.2.3.	The Mathematical Literacy Purpose and Philosophy	21
2.2.4.	Mathematical Literacy Teachers and the Subject ML	24
2.3.	Theoretical Framework	27
2.3.1.	Content Knowledge	31
2.3.2.	Pedagogic Content Knowledge	32
2.3.3.	Identity and Beliefs as ML Teachers	35

3.	CHAPTER 3: Methodology and Research Design	38
3.1.	Introduction	38
3.2.	Methodology Chosen	38
3.3.	Data Sources and Data Collection	39
3.3.1.	Why was data collected?	39
3.3.2.	Data Sources	39
3.3.3.	The Participants of the Study	42
3.3.3.1.	Participants in the Questionnaires	42
3.3.3.2.	Participants in the Interview	43
3.3.3.3.	Participants in the Second Questionnaire [Questionnaire B]	44
3.4.	Data Analysis	44
3.5.	Validity and Trustworthiness	46
3.6.	Ethical Considerations	49
3.7.	Challenges of the Study	49
3.7.1.	Identifying Suitable Participants for the Questionnaire	49
3.7.2.	Identifying Suitable Participants for the Interviews	50
3.7.3.	Avoiding Researcher Bias	50
4.	CHAPTER 4: Results	51
4.1.	Report Based on Questionnaires	51
4.1.1.	The Report on the First Group of Questionnaires [Questionnaire A]	51
4.1.2.	The Report on the Second Group of Questionnaires [Questionnaire B] ..	60
4.2.	The Report on the Interviews with Participants	65
4.2.1.	Teacher A: Miss ZN - Biography	66
On Subject Matter Knowledge	66	
On Content Specific Pedagogy	69	
On Beliefs and Development of an Identity	71	
4.2.2.	Teacher B: Mrs PSK - Biography.....	73
On Subject Matter Knowledge	74	
On Content Specific Pedagogy	76	
On Beliefs and Development of an Identity	77	

4.2.3.	Teacher C: Mr. PN - Biography	79
	On Subject Matter Knowledge	80
	On Content Specific Pedagogy	81
	On Beliefs and Development of an Identity	82
4.2.4.	Teacher D: Mrs. SP - Biography	83
	On Subject Matter Knowledge	84
	On Content Specific Pedagogy	85
	On Beliefs and Development of an Identity	86
5.	CHAPTER 5: Discussion and Conclusion	89
5.1.	Introduction	89
5.2.	Discussion of Professional Development in the Three Areas of the Study.	89
5.2.1.	Influences on Content Knowledge	90
	5.2.1(a) Improvement of Existing Content Knowledge	90
	5.2.1(b) Acquisition of New Content Knowledge	91
	5.2.1(c) The Different Content Needs of Teachers.....	93
	5.2.1(d) The Link between Content and real-Life Situations	94
	5.2.1(e) Importance of Foundational Knowledge from GET	96
5.2.2.	On the Knowledge of Content Specific Pedagogy	97
	5.2.2(a) Designing Tasks in ML	98
	5.2.2(b) Identifying Misconceptions in Teaching ML	99
	5.2.2(c) Ways in which Studies in Generic Modules contributed to Teachers' PCK.....	100
	5.2.2(d) Understanding the Difference between Mathematics and ML.....	102
	5.2.2(e) Changing and Improving Teaching Strategies	103
	5.2.2(f) Endorsement of the Value of the Programme in Developing PCK	105
5.2.3.	On Beliefs and Development of an Identity as ML Professionals	106
	5.2.3(a) Development of Self-Confidence	106
	5.2.3(b) Emergent Categories of Identity	107
	5.2.3(c) Identity and Enhancement of the Will for Further Academic Progression	108

5.3.	Limitations of the Study	111
5.3.1.	Sampling	111
5.3.2.	Observations	111
5.3.3.	Self-Reported Data	112
5.3.4.	Inability to Locate Drop-outs and those who Returned to Previous Specialisations after Studying the ACEML	112
5.3.5.	Avoiding the Hawthorne Effect	112
5.4.	Recommendations	113
5.5.	Final Conclusions	116
	References	118
Appendix A	Transcript of Interview with Miss ZN	124
Appendix B	Transcript of Interview with Mr. PN.....	136
Appendix C	Transcript of Interview with Mrs PSK.....	145
Appendix D	Transcript of Interview with Mrs.SP	149
Appendix E	Teacher Questionnaire A	159
Appendix F	Teacher Questionnaire B	166
Appendix G	Interview Schedule with Participants.....	170
Appendix H	Informed Consent Letter	172
Appendix I	Certificate of Editing	173
Appendix J	Turnitin Originality Report	174

CHAPTER 1

OVERVIEW AND FOCUS OF THE STUDY

1.1. INTRODUCTION

In this chapter an overview of the subject Mathematical Literacy is explored as an introductory way to reveal the main focus of the study. This is done by looking at the background to the context of the study as well as the outline of the curriculum of the Advanced Certificate in Education in Mathematical Literacy. Shortly thereafter a discussion of the rationale and purpose of the study ensues, followed by an account of the personal motivation for this study, the objectives of the study, the significance and the organisation of the study.

1.1.1. Mathematical Literacy as a School Subject

Globally there have been widespread concerns about the low levels of mathematical literacy amongst adults globally. (DoE, 2008, p. 8). Some of this numerical illiteracy has come to affect the workplace. Most adults in South Africa end their study of Mathematics in Grade 9 whereas the workplace requires “the use of fundamental numerical and spatial skills with understanding” (DoE, 2008, p. 7). The introduction of Mathematical Literacy as a school subject was to ensure that all learners from Grade 10 to 12 would receive mathematical education beyond Grade 9. It was hoped that ML would be able to “reach the 200 000 grade 12 school leavers without Mathematics and the 200 000 additional learners who fail the subject each year” (Christiansen, 2006, p. 10). Adding to this concern, Clark (2012) states that between 2000 and 2005 as many as 40% of grade 12 learners in the country were not taking any Mathematics at all, and half of those who did, took the subject at Standard Grade level. ML is meant to provide some necessary skills to learners who otherwise would not have had any opportunity of becoming more mathematically literate according to the previous system of education in South African schools. The subject ML was offered as an alternative to Mathematics in Grade 10 to 12, to those learners who did not wish to pursue a career in mathematics, but who would have terminated their formal study of mathematics at the end of the General Education and Training phase (GET) in Grade 9.

The Learning Programme Guideline (LPG) of Mathematical Literacy (2008) describes the subject ML as:

“..a subject driven by life-related applications of mathematics. It enables learners to develop the ability to think numerically and spatially in order to interpret and critically analyse everyday situations and solve problems” (DoE, 2008, p. 7).

Mathematical Literacy was then introduced with a number of purposes, one of which was to produce learners who are *self-managing* individuals. These were individuals able to handle their financial issues properly along with a number of other daily issues related to mathematical demands. In that way each learner would become a *contributing worker* in the workplace, possessing the basic numerical and spatial skills as mentioned above. As a contributing worker, learners would become *participating citizens* able to take a “critical stance to mathematical arguments presented in the media or other platforms” (DoE, 2008, p. 7). Such participation in society requires an awareness that statistics can be manipulated to suit the needs of the person who produces them.

The change in the curriculum which was introduced in South African schools in 2006, where learners were expected to take either Mathematics or Mathematical Literacy (ML) as a subject in the Further Education and Training (FET) band, had its own challenges. The shortage of qualified Mathematics teachers had always been, and still is a challenge in South Africa and elsewhere (Parker, 2004). This challenge of the shortage of Mathematics teachers was further exacerbated when Mathematical Literacy was introduced as an alternative subject for those learners who did not continue studying Mathematics in the Further Education and Training band (FET). It is worth noting that there were no trained ML teachers who would teach this new subject at the time of its’ introduction (Goba, James, Bansilal, Webb & Khuzwayo, 2011). The next paragraph illustrates the enormity of the shortage of teachers by making use of some rudimentary calculations.

According to Goba et al., (2011) the learner -teacher ratio in South African schools is 30,6 : 1. Using the above learner to teacher ratio and considering that there were 61 591 learners in KZN who wrote grade 12 ML in 2011 (DoE, 2011, p.58), approximately 2013 teachers were required to teach grade 12 ML in KZN alone. Furthermore, if the Grade 10 and 11 learners were taken into consideration, then the demand could be closer to 6039 teachers. This shows that most of the learners taking ML may still be taught by teachers who do not have the necessary qualification to teach ML. A glance at the national figures as far as ML teaching and learning is concerned, reveals that 263 464 learners wrote ML in 2008, 277 677 in 2009 and 280 836 in 2010 (DoE, 2011, p.58). If 61 591 learners required 2013 teachers, then

263 464 would need approximately 8610 teachers. These 8610 teachers would be for Grade 12 only, and assuming the same numbers or more for Grades 10 and 11 in all institutions; roughly 25 830 ML teachers were required nationally in 2008. Something had to be done to provide such large numbers of teachers if ML was to be endured. An urgent need had arisen for the Department of Education (DoE) to provide more teachers at this time.

In attempting to address this challenge, the University of KwaZulu-Natal (UKZN) together with the KwaZulu Natal Department of Education (KZNDoE), as well as Nelson Mandela Metropolitan University (NMMU), and many other universities, initiated a programme designed to reskill and retrain teachers to teach this new subject. A new formal teacher qualification, the Advanced Certificate in Education in Mathematical Literacy (ACEML), was introduced in 2006, at the time that the subject was introduced in schools. The decision to explore the possibility of training teachers to deliver the new curriculum, through a formal qualification was influenced by criticisms and recommendations made in the report by Chisholm, Volmink, Ndhlovu, Potenza, Mahomed, Lubisi, Vinjevold, Ngozi, Malan & Mphahlele (2000). The report (Chisholm et al.) strongly criticised the use of workshops and cascading models. In the *Cascade Model*, which was seen as a “top-down approach” (Shezi, 2008) - personnel at National level were located at the top of the model in order to train the personnel at provincial level. Those at provincial level would further train other officials at district level, who in turn would eventually train personnel at the circuit and school-based teachers. The trained teachers were further expected to train their colleagues in schools to implement Curriculum 2005 (Shezi, 2008). According to Chisholm et al., (2000), the cascading model “failed to prepare either officials or school-based educators for the complexity of C2005 implementation. In the first instance it resulted in the ‘watering down’ and/or misinterpretation of crucial information” (Chisholm et al., 2000, p.1). Secondly, the Cascade model had “trainers that lacked confidence, knowledge and understanding to manage the training process” (Chisholm et al., 2000, chapter 4, p.1). Therefore alternatives to the cascading model were sought, one of which was the option of formal qualifications. The formal qualification route offered a further benefit of upgrading underqualified teachers. A joint initiative by UKZN and KZNDoE was put in place in the province, marking the start of a number of large scale teacher training and upgrading programmes offered by UKZN for various subjects, one of which was the Advanced Certificate in Education in Mathematical Literacy (ACEML). It is this programme which is the subject of this study.

1.1.2. Background to the Context of the Study

The first cohort of prospective ML teachers enrolled at the University of KwaZulu-Natal in 2006 and was followed by other cohorts in the subsequent years of 2007, 2008, 2009 and 2010. Because ML was a new subject with a philosophy different from mathematics, teachers had to rely on textbooks at their disposal to develop an understanding of the subject and its purpose. However, there were in fact various textbooks, each of which was published by people with their own perceptions of what they thought should be taught in ML; which sometimes conflicted with the policy documents. Hechter (2011) states that “teachers received mixed messages from policy documents, guidelines and textbook writers as to what is expected from them in the Mathematical Literacy classroom” (Hechter, 2011, p.8). It was therefore important for teachers to be guided in the development of teaching practices and assessment tasks that were consistent with the aims and vision of ML. One of the purposes of the ACEML was to help develop teachers’ understanding of the philosophy behind the introduction of ML.

There were many misconceptions about ML. Several stakeholders within the learning situation, such as principals, HOD’s, teachers of other subjects, parents and the community at large were less knowledgeable about the intentions and purpose of the subject ML, what it actually entailed and who it was intended for (Goba et al., 2011; Madongo, 2007). To some people ML was viewed as a substitute for Standard Grade Mathematics (Venkat& Graven, 2008). In emphasizing this viewpoint they say, “the structuring of Mathematics/ML choice is often interpreted as a replacement of the previous Higher Grade (HG)/Standard Grade (SG) distinction that used to exist in Mathematics” (Venkat& Graven, 2008, p.39). Others saw it as Functional Mathematics, while the majority of learners thought of ML as just an ‘easier’ form Mathematics, dumbed down for struggling learners, all of which it was not (Houston, 2006). In fact, in the school in which I teach, Grade 10 learners were told by the principal that the relationship between Mathematics and Mathematical Literacy was the same as was the relationship between Computer Studies and Computer Literacy. I was dismayed when I heard this and it illustrated to me the extent of such misunderstandings of ML. This pronouncement became one of the factors that motivated this study. The designers of the ACEML hoped that the programme could help correct such misconceptions. In the next section, I will briefly outline the curriculum of the ACEML offered at UKZN.

1.1.3. The Outline of the curriculum in the ACEML

The curriculum of the ACEML at UKZN comprises of eight modules. Four of these modules were closely related to the subject content as outlined in the LPG of the Department of Education (2008). These modules were *Number and Operations in ML*; *Functional Relationships in ML*; *Space, Shape and Measurement in ML* and *Data Handling in ML*. All these four modules were pedagogic content knowledge (PCK) modules which focused on the following:

- i. examining the curriculum of ML
- ii. exploring how the content must be taught
- iii. identifying misconceptions that arise
- iv. discussing ways of explaining concepts
- v. designing appropriate tasks
- vi. exposing teachers to assessment strategies

It was believed that through these modules, teachers would be able to produce learners who would be “highly numerate consumers of Mathematics” (Department of Education, 2008, p.7), as can be seen from their relationship to the school subject ML which is designed as follows:

Through Learning Outcome 1, and hence the module Numbers and Operations in ML, learners produced would be:

“able to use numbers and their relationships to estimate and calculate, investigate and monitor the financial aspects of personal, business and national issues and to investigate and solve problems in other contexts” (Department of Education, 2008, p.11).

Learning Outcome 2, and hence the module Functional Relationships in ML, would allow teachers to produce learners who are:

“able to recognise, analyse, interpret, describe and represent various functional relationships in order to solve problems in real and simulated contexts” (Department of Education, 2008, p.11).

In Learning Outcome 3, and hence the module Shape, Space and Measurement in ML, the learner produced would be:

“able to measure using appropriate instruments, to estimate and calculate physical quantities and to describe and represent properties of, and relationships between 2D-shapes and 3D-objects in a variety of orientations and positions” (Department of Education, 2008, p.11).

Lastly, Learning Outcome 4, and hence the module Data Handling in ML, would train teachers to produce learners who are:

“able to collect, summarise, display and analyse data and apply knowledge of statistics and probability to communicate, justify, predict and critically interrogate findings and draw conclusions” (Department of Education, 2008, p.11).

Two modules in the programme were generic modules which focused on improving teachers’ knowledge of the school; the profession; teaching; learning; context and resources etc. These two modules were *Learning and Teaching*, a module which “explores the links between the social and the individual [and] considers the cognitive development of learners to help us understand the levels of the learners whom we teach and also considers learning and behaviour” (Akhurst, Sader&Ntoi, 2005), as well as *Educational Policy and Professionalism*. The remaining two modules were devoted to the philosophy behind ML and practical applications within the subject. They were: *Teaching and Learning Mathematics in the FET*, with reference to ML and *Professional Practice in ML*. These modules were therefore considered to be necessary for the professional development of the teachers.

1.2. RATIONALE AND PURPOSE OF THE STUDY

The ACEML programme was the main training programme for ML, especially in the province of KZN, and it is therefore necessary to evaluate the effects of such a programme. Teachers enrolled on the programme for different reasons. Depending on their need, they may have needed to retrain and be reskilled to teach the new subject or to upgrade their teacher qualification to a higher level or both. For others the programme “opened access to the higher education pathway” (Goba et al., 2011, p.1). The programme offered a means of professional development where teachers would acquire more subject matter knowledge needed to teach the subject; to develop their knowledge of content-specific pedagogy; and to develop a new identity as ML teachers (Peressini, Borko, Romagnano, Knuth & Willis, 2004). Teachers may have envisaged that participation in the programme would enhance their personal belief in themselves and hence improve their confidence as ML teachers. For Graven (2004), confidence “is conceptualised as an additional component of learning and as

such, as an individual teachers' movement from the periphery of various overlapping mathematics... towards more central participation, identification and belonging within these communities" (Graven, 2004, p.179). Such confidence could thus be seen to form part of the teachers' professional development.

The purpose of this study therefore is to explore the teachers' professional development as a result of the teachers' participation in the programme. Professional development is explored in terms of their content knowledge, content specific pedagogy and their professional identity and beliefs.

1.3. PERSONAL MOTIVATION FOR THE STUDY

My interest in the subject ML was developed when I became part of the first group of teachers to enrol for the ACEML programme in 2006. I taught at a school in which there were only two of us who were teachers of Mathematics. The FET band, Grades 10, 11 and 12 had one class each and were always allocated to the other teacher, who was the Deputy Principal of the school. He was entitled to have fewer classes because of his administrative commitments. I was the Mathematics GET "specialist", teaching all classes in Grade 8 and 9. Occasionally, a Physical Science teacher offered some relief in one or two classes in Grade 8 only over the years, but this did not happen all the time.

When the opportunity to teach ML in Grades 10, 11 and 12 arose, I was the only suitable candidate in my school. It was decided that I should enrol in the ACEML programme in order to learn how to teach the new subject. On arriving at UKZN, I found that some of my classmates were teachers who had last done Mathematics as high school students themselves. Others had only done Mathematics up to Grade 9 level. The university was not strict at the time (2006) on the entry requirements into the programme. We were a group of approximately 35 students, with the majority among us coming from other subject specialisations and learning areas. These included Geography, Accounting, Natural Science, English, Afrikaans, Biology, Economics and many more. Some of the teachers were even teaching at Primary schools where there is not much subject specialisation as is the case in high school. Basic Mathematical concepts had faded for most of them and the pace at which we moved was significantly affected by this. As early as the second month, some teachers started dropping out because Mathematical Literacy turned out to be different from what they had anticipated. It appears as if some teachers did not even finalise their registration at the University because records accessed through UKZN, of students registered for the first

module, Number and Operations in ML, in 2006, show that only 24 students were registered for this module up to the end of the first semester. Others may have been scared at a very early stage and decided not to even register for the first module. There were teachers who could not even calculate simpler concepts like the percentage. A significant number of teachers in our group had never taught Mathematics before in their career. ML as a subject demanded a reasonable knowledge of mathematical concepts, not just the basics, as had been perceived by most teachers during the earlier stages of the introduction of the subject. Those who had last done Mathematics as students, ten to twenty years ago, found it difficult to come to terms with teaching the new subject. There was nevertheless, a few teachers teaching mathematics either in the GET, FET or both. This was cause for much concern, considering that we were expected to return to our schools and teach this new subject. Some of us were teaching it already in 2006. The stance that had been taken by some Mathematics teachers, principals and HOD's, who believed that a mathematics teacher would be a better qualified teacher to teach ML (Goba et al., 2011), had to be verified. I was disappointed that by the second year of our study, there were 16 of us who were still enrolled on the programme. By the time we graduated in April 2008 we were only 13 (54,2%) out of a possible 24 students who were registered at the end of the first semester. This indicated a drop out rate of 45,8% in our 2006 cohort alone.

This large dropout rate made me question the effectiveness of the programme. It became unclear whether the programme was achieving its intended outcomes. Huge groups had followed us in 2007 and 2008, although they were not recruited in the same way as our 2006 cohort. The subsequent cohorts were funded by the Department of Education and were non-paying students. Some of them completed the ACEML in subsequent years but went back to their schools to teach in the specialisations that they had been teaching before. It was likely that some teachers had only enrolled to upgrade their qualifications to a higher teaching category without any intention to teach the new subject. A report prepared for the deputy Dean at the University of KwaZulu-Natal indicated that out of a total of 691 students captured in the database, who enrolled in 2007, only 51% graduated in 2009 (Bansilal, 2010). This is a low completion rate within the minimum time. Although a further 25% completed within 4 years of study, it is a concern because the ACE is a professional qualification for practising teachers, and being a fully funded programme, one would expect completion rates closer to 100%.

One other interesting issue was that some teachers only taught ML during the time they were students in the ACEML, since it was the requirement of the university that they should teach at least one class of ML. Upon completion of the course, some teachers went back to teach in those specialisations that they had been teaching in prior to enrolling in the ACEML programme. This raises legitimate questions about the role of the ACEML programme in these teachers' lives.

Furthermore, because the decision of who should enrol was taken primarily by the school management, many teachers would have joined the programme on the instruction of their principal and not because they wanted to. The teachers in this position were most likely those who were declared in excess by their schools, teaching redundant subjects and subjects that were soon to be phased out. Coming to university for them was not a choice, it was circumstantial; a means of ensuring that they remain employed at the school.

I also noticed during the early stages of ML in 2006 that in most schools, ML was taught by teachers who had a limited understanding of the purpose of ML. This was evident in workshops conducted by the DoE for ML teachers in 2006. I also noticed that many Mathematics teachers felt that they already knew more about ML than the non-Mathematics teachers. There seemed to be a misunderstanding that ML was identical to Mathematics, but for the fact that it was an easier option. In fact, in conversations, many Mathematics teachers mentioned that they viewed ML as “lower grade mathematics”. This made me inquisitive as to who exactly should be teaching ML. These experiences made me think about whether teachers who were trained mathematics specialists would make good ML teachers, or would teachers of other subjects who identified themselves with ML, make good teachers? In other words, what needed to be considered when one wanted to become a teacher of ML? I was already enrolled at UKZN by that time, therefore I was more informed about what ML should have been, who should be teaching it and how they should be teaching it. This motivated me to ascertain from those who had completed the ACEML what their thoughts would be on this matter. I therefore embarked on this study to find out from teachers their perspective on how their professional development was enhanced as a result of participating in the ACEML programme.

There existed a strong need to identify important issues to be considered when people are to be trained to become ML teachers. The philosophy of ML should be clarified in those teachers who want to teach ML. Among the important issues one can mention the knowledge

of ML content as opposed to content learned in mathematics. Teachers who wanted to teach ML had to have a strong identity with the subject and hence be clear about the purpose of ML as opposed to mathematics. Also of importance was learning to design the assessment tasks in ML which should be based on context. In fact, teaching strategies used in ML had to be explored as opposed to those used in Mathematics. The teachers' beliefs about the subject ML that were based on their knowledge of the purpose of the subject had to be explored. No one could better explain the professional development mentioned in this section than the teachers themselves who had participated in the ACEML.

For reasons mentioned above, it became clear that the noble intentions of the KZNDoE and the University of KwaZulu-Natal, to provide professional development to teachers and help them deal with curriculum reforms and serve the curriculum needs of the province may not have been adequately achieved. Thus this study is designed to explore and establish, from the point of view of the participants in the ACEML, whether and how their professional development was enhanced by their participation in the programme. This study aims to explore the role of the ACEML, (according to the participants), on their professional development in terms of acquisition and improvement of subject matter knowledge; development of content-specific pedagogy and development of an identity and beliefs as professional ML teachers.

1.4. OBJECTIVES OF THE STUDY

The main objectives of this study were to explore the role of the ACEML in the professional development of the participants in the programme, in terms of their content knowledge, content specific pedagogy and the development of a professional identity as ML teachers as well as their beliefs about the new subject. Such an exploration, it is hoped, would be of assistance in designing future programmes for in-service teachers where they would emerge with a formal qualification in the end. As in the study by Woolhouse & Cochrane (2010), the current study gathered qualitative information that focused on individuals' perspectives. This was seen to be able to help identify "changes that teachers reported regarding how they felt about themselves" (Woolhouse & Cochrane, 2010, p.608).

In attempting to find explanations to the above, two critical questions were to be answered. These were questions were:

1) What are the ways in which participation in the Advanced Certificate in Education in Mathematical Literacy enhanced the professional development of the teachers?

2) How did participation in the ACEML programme enhance the teachers' professional development?

Answers to the two critical questions above would be sought by trying to find responses to further questions such as:

- i. Did the teachers actually improve on or gain new content knowledge as a result of their participation in the programme? In which areas specifically?
- ii. Did their teaching strategies improve or change as a result of their participation?
- iii. Did the teachers actually develop a new identity with the new subject Mathematical Literacy over and above their previous teaching specialisations?
- iv. What were the teachers' 'new' beliefs that were developed on the subject ML as a result of their participation in the ACEML programme?
- v. What were the implications of the programme as a whole on the professional development of the teachers involved?

It is hoped that the findings of the study would help in explaining the professional development of the teachers as a result of their participation in the ACEML programme.

1.5. SIGNIFICANCE OF THE STUDY

The findings of the study may be used in tailoring further professional development programmes for teachers and maybe result in the improvement of teaching and learning practices of ML within the classroom. Improvements could also be made within the existing ACEML programmes to make professional development of teachers more accessible and simple; yet remain precise and to the point. As proclaimed by Hobden (1999), "curriculum innovators should seek ways that make it possible for people to accommodate new ideas within the constraints of their personal belief system" (Hobden, 1999, p. 11). Such a study along with others would hopefully serve to evaluate existing programmes for the betterment of their value to those who are offered such programmes.

This study also strives to “contribute significantly to the identification of problem areas which require special attention, with the aim of improving the design and implementation of other in-service programmes on the teaching and learning” of ML. (Molebale, 2005, p. 9). The study further intends providing more insight into how the ACEML can be designed to suit how teachers gain new knowledge, what they need as ML teachers and what they need to learn as ML teachers.

Findings of the study may provide recommendations to the Departments of Basic and Higher Education, on issues that need to be attended to in order to ensure the sustainability of the subject ML in schools and provision of teachers of the subject ML.

1.6. ORGANISATION OF THE STUDY

This dissertation is organised into five chapters, followed by a list of references and the relevant appendices:

Chapter 1 is an introductory section, where an overview of the study is presented. The background to the context of the study; rationale and purpose of the study; motivation for the study; the objectives of the study and significance of the study are all handled in this chapter.

Chapter 2 is made up of a review of the related literature connected to teacher professional development, largely in the field of Mathematics education and hence in Mathematical Literacy as a school subject. This chapter also includes the theoretical framework of the study.

Chapter 3 gives a detailed report of the research methodology used in the study; who participated in the study and why; what type of data was used; how data was gathered; and why it was collected.

Chapter 4 entails a thick and detailed report on the findings and results of the study where an intensive report of what was found in the study is given.

Chapter 5 summarises the findings of the study and highlights the limitations and recommendations emanating from the study, which could be useful for future research.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1. INTRODUCTION

In this study about the professional development of ML teachers, it is necessary to understand the context in which the programme was developed. As Wilson & Brenner (1999) note, professional development of teachers is often seen as fundamental to various education reforms that are made by the government, which is certainly the case in South Africa.

Since the dismantling of apartheid, there have been numerous curriculum reforms, one of which was the introduction of ML. In this literature review, I will start by briefly outlining some of the existing research undertaken in South Africa with regards to the implementation of the curricula. I then broaden the outlook to examine the notion of professional development of teachers and present some results about related research that has been conducted both in South Africa and in other countries. Thereafter, I focus on the philosophy and rationale behind the introduction of ML. This discussion then leads naturally to a discussion of recent research that has focused on teachers who are teaching ML. The chapter concludes with an outline of the theoretical framework.

2.2. LITERATURE REVIEW

2.2.1. Changing Curriculum

The numerous curriculum reforms in South Africa have resulted in a strong need for teachers to be retrained. Since the introduction of Curriculum 2005 (C2005), the National Curriculum Statement (NCS), the Revised National Curriculum Statement (RNCS) and lately the Curriculum and Assessment Policy Statement (CAPS), many teachers have been left wanting and are unable to implement the changes required by these policies. Occasional in-service provisions, in the form of workshops attempt to address the challenge faced by teachers in their efforts to implement new policies. Somehow, however, these provisions are not directly addressing the problem faced by teachers. According to Johnson, Monk & Hodges (2000), these workshops attempt to change what teachers do. However, it makes sense that professional development initiatives should focus on identifying the reasons *why* teachers practice as they do *before* trying to change their teaching.

A large number of teachers in South African high schools were trained to teach in the now defunct Colleges of Education. These college diplomas initially, could not lead to higher

qualifications for further study. After completion, a teacher would need to start at the beginning with a bachelors' degree, because there was no means of transfer between the diploma and degree qualifications, if they wanted to improve their qualifications. Such teachers usually remained on the same educational level for lengthy periods. The introduction of the Further Education Diploma in the 90's, tried to partly address this problem. However, these were subsequently phased out as well. At the same time these teachers were faced with ever-changing curriculum reforms (C2005; NCS), including the change from a teacher-centred to a learner-centred style. One of the changes was the introduction of a new subject ML, among others, a subject in which no teacher had previously been trained to teach. According to Debba (2011), there were concerns "whether teachers would be able to shift from teaching mathematics to teaching Mathematical Literacy; whether the training of teachers would be successful to take on the challenges of teaching a new subject" (Debba, 2011, p. 9). The introduction of ML required a drastic change in the mindset of teachers who had to first understand its purpose and philosophy before they could teach it. In addition, they were challenged to alter their teaching strategies.

The subject ML, was introduced to address the problem of many educated adults who remain functionally innumerate even after having attended school for years. According to Hechter (2011) ML still needs to find its place - with respect to its nature, purpose and practice of teaching. This process is a huge challenge for South African teachers who are still caught up in the 'will versus capacity' dilemma that emerges when teachers are trying and willing to implement new policies, but are restricted by the environment in which they work. Hechter (2011) argues that prior to 1994, under the apartheid regime, access to education was far from equitable. Some communities ended up with very poor quality education; and in some instances there was even a complete *lack* of education in certain areas. The reform was less considerate of the masses of teachers who had been trained under the then Colleges of Education. The irony of this reform was that changes in the curriculum demanded that there should be retraining and reskilling of the very people who were expected to implement the change.

The introduction of C2005 had as its rationale that "for too long South African students have memorized content, which they then regurgitate in tests and examinations" (Rogan, 2006, p. 442). Learners needed to shift from these ideas and realise the potential that they had to implement their knowledge. Rogan further asserts that the intention of C2005 was to "usher in a new era of prosperity based on better educated citizens, who are literate, creative

problem solvers and critical thinkers” (Rogan, 2006, p. 442). However, critics such as Jansen (1998) saw the curriculum as full of unrealistic, ambitious undertakings that a significant number of teachers, especially those previously disadvantaged, would struggle to achieve. Chisholm et al., (2000) reported similarly that teachers were struggling with the implementation of C2005. The lack of understanding the philosophy behind C2005 resulted in teachers failing to adhere to the demands of C2005. This was especially true for those teachers who worked in poorly resourced schools, with overcrowded learners from poor socio-economic backgrounds. For example, simple demands like bringing an old magazine to class or buying a calculator prevented teachers who would have prepared lessons based on these learning support materials, to do so. Generally, the subsequent Policy Statements like the NCS, the RNCS and the new CAPS (which is yet to be introduced in other grades), have not shown any authentic improvement. In confirming the above, Jansen (2012) claims that “the political masters have failed to deal effectively with the legacy of education inequality” (Jansen, 2012, p.3). He further argues that there is evidence to show that “progress towards education equity has stagnated or even reversed” (Jansen, 2012, p.3). For Jansen, the slightest change in the improvement of the pass rates is rarely the government’s doing, but to the contrary, it is non-government organisations (NGO’s) and community-based groups that “drive the school change initiative...with considerable effects” (Jansen, 2012, p.3). As a result, schools find themselves under considerable pressure to improve their Grade 12 results and subsequently “hold back learners in earlier grades or “downgrade pupils into easier subjects such as Mathematical Literacy over pure Maths” (Jansen, 2012, p.2). In combating these practices, Rogan (2007) states that “schools should be empowered to set their own implementation plan, including both the scope and pace...and the role of the Department of Education should be to support these plans by building capacity both human and physical” (Rogan, 2007, p.118).

2.2.2. General Issues of Professional Development

According to Buczynski& Hansen (2009), most of the literature on professional development of teachers has provided descriptions of past failures more than it has provided achievements in a number of studies. However, in recent studies on teacher development, there has been more concern about teachers’ knowledge of content and how this has a bearing on their confidence and competence in the process of teaching (Graven, 2004). As alluded to earlier, the introduction of new learning fields like ML, emphasise learner-centred outcomes-based

curricula for schools. This places further pressure on the confidence and competencies of teachers who are daunted with the task of teaching in these learning fields (Graven, 2004).

Whilst this study focuses on the South African context only, it should be noted that this lack of confidence and competence of teachers is in fact a global phenomenon and is not only a South African challenge. Professional development of teachers which comes with a call for more research on the learning of teachers is “the only ticket to reform” (Wilson & Berne, 1999, p. 173). Wilson & Berne wanted to know more about the professional knowledge that teachers acquire in teacher learning. Their study focused on practicing teachers rather than pre-service teachers, where they wanted to understand teacher learning in terms of the curriculum and the pedagogy. The authors wanted to know what teachers learn and how they are taught. Professional development projects were selected where knowledge was investigated through the provision of :

- a) opportunities to talk about and do subject matter
- b) opportunities to talk about students and learning and
- c) opportunities to talk about teaching

In one of the projects, Wilson & Berne discovered that after teachers had been briefed about the a new curriculum, “teachers did not enact the curriculum in the ways intended” (Wilson & Berne, 1999, p. 177). It was discovered that “teachers had not changed their beliefs about science or science teaching, even though they had agreed to teach a radically different science curriculum” (Wilson & Berne, 1999, p. 177). Subsequently, in a follow-up study conducted later on, where teachers had to attend for two hours after school and two weeks during holidays, they began to discuss and critique what they learned. Through “shared meetings” (Wilson & Berne, 1999, p. 178), teachers were able to change their practices.

Knowledge of subject matter is often seen as the central component of learning that enables and supports teachers to become professionally developed. Whilst not ignoring the role of subject matter knowledge, Graven (2004) and Peressini et al., (2004), assert that professional development should also include other facets such as the development of a content-specific pedagogy as well as a professional identity. Their view is also shared by Woolhouse& Cochrane (2010), who argue that little or no attention is given to individual and personal benefits of those who undergo professional development both locally and abroad. It is for this reason, according to Woolhouse& Cochrane (2010), that studies which focus on the professional identity of teachers also need to be addressed. Studies conducted in Hong Kong,

the United States as well as locally all allude to the fact that while professional development centres around content knowledge, the teachers' professional lives and hence their identity should not be left unattended by further teacher professional development initiatives. (Goldschmidt & Phelps, 2010; Tang & Choi, 2009 and Graven, 2004).

Research about the extent to which teachers' beliefs and experience impact on their professional development should be considered when studying their professional development. According to Goldschmidt & Phelps (2010), there has always been a link between learners' performance and their teachers' background, credentials, certification and experience. For them, this link has furthermore always demonstrated positive results. The "teachers' knowledge and their beliefs interact with their historical, social and political contexts to create the situations in which learning to teach occurs" (Peressini et al., 2004, p.68). They assert that this interaction is evident when the *process of learning to teach* is studied. These teachers who were trained in colleges of education, and are seen as underqualified, would require even more training when curriculum reform is introduced. This greater need for retraining confirms the input of their historical, social and political backgrounds at the time when they were in the process of learning to teach. It is for this reason that teachers certified from colleges of education, where there were no opportunities to upgrade unless one went back to university, were eager to take up this opportunity to enrol for the ACE. Teachers saw this as an opportunity to upgrade to a higher level of teacher qualification than as an opportunity for their own professional development in terms of content knowledge, content-specific pedagogy and developing a professional identity.

Teacher professional development is equated to teacher learning. Kelly (2006) notes that whilst there are many cognitive models of learning, they all share common ground in that "individuals acquire skills, knowledge and understandings in one setting, often specifically designed for that purpose, and are subsequently able to use these skills, knowledge and understandings elsewhere" (Kelly, 2006, p.506). From this view, Kelly (2006) asserts that "teacher learning is the process by which teachers move towards expertise" (Kelly, 2006, p.514), and it is during this movement that expert teachers are distinguished from novices. An expert teacher, according to Kelly (2006) is "better able to plan ahead" whereas a novice "needs to learn the 'defined body of knowledge' which constitutes professional expertise, and then apply this in their practice" (Kelly, 2006, p.508). To be an expert teacher means having an active and productive relationship with one's knowledge base, thus being able to construct your own knowledge base, according to your own specific circumstances. In supporting the

importance of construction of knowledge, Shulman (1986) posed the following question: “Where do teacher explanations come from? How do teachers decide how to teach, what to teach, how to question students and how to deal with problems of misunderstanding?”(Shulman, 1986, p.8). He was questioning the source of teacher knowledge, which he claimed, is often ignored by research. For Shulman, teachers are sometimes expected to teach topics that they themselves have never learnt whereas such knowledge “originate from the wisdom of practice” (Shulman, 1986, p. 9).

Rogan’s (2006), concept of the Zone of Feasible Innovation (ZFI), is important in the study of teacher professional development. This concept was derived from the Zone of Proximal Development (ZPD) as formulated by Lev Vygotsky. Just as Vygotsky applied the ZPD to the learning of new concepts by learners, the ZFI prescribes the extent of change that is feasible to a teacher in the process of learning to teach and developing professionalism. Rogan (2006) maintains that “learning occurs in a social setting” and therefore stresses “the role of the social environment in the learning process” (Rogan, 2006, p. 445). In defining the ZFI, Rogan (2006) writes:

“a ZFI consists of a collection of teaching strategies that go beyond current practice, but are feasible given the existing resources available to that teacher, or group of teachers, and the prevailing environment of the school in terms of its ability to foster and sustain innovations” (Rogan, 2006, p.441).

The idea behind the concept of the ZFI is that “various members of the school community participate in drawing up a plan to implement change in a way that is appropriate and feasible for that schools’ context and culture” (Rogan, 2006, p. 443). The concern highlighted in the above quote is that when developing teachers professionally, due to an introduction of a new curriculum, authorities should consider that each teacher brings to the teaching task a “number of complex beliefs, assumptions and experiences that constitute the educational institution within which change occurs” (Vilakazi, 2010, p. 16). Therefore a ZFI is particular to work in one situation and is not guaranteed success in another situation. An implication of the work by Johnson et al (2000) is that working on extending the content knowledge and teaching strategies of teachers without considering the conditions under which they work would be counter-productive. Studies of teachers’ professional development need also to consider that the South African education system as a whole requires structural reform rather than simply the development of individuals alone.

The complexity of teacher professional development has always been a concern to research in Mathematics education. The development of the professional knowledge of teachers is a process of learning. According to Boaler (1999), “situative perspectives suggest that the behaviours and practices of students in mathematical situations are not solely mathematical, nor individual, but are emergent as part of the relationships formed between learners and the people and systems of their environment” (Boaler, 1999, p. 260). The focus of such a view is on the broader community and tends to shift away from individual attributes of those concerned.

The suggestion by situative perspectives of the importance of the people and systems of their environment in forming relationships that influence the behaviours and practices of students in mathematical situations, is reiterated in the concept of the ZFI. Teachers are part of the environment and therefore their practices are likely to influence the behaviours and practices of the mathematics students. This then renders important the need to consider the context under which teachers work, which determines their practice. The ZFI has the current practice of the teacher at one end, and the national curriculum standards of the Department of Education at the other. It is important for research to look at the current capacity to support the innovation because the ZFI compels the researcher to consider the context under which a teacher is working (Rogan, 2007). The need for teachers to develop a professional identity and to see themselves as belonging to a specific community can never be ignored. It can be claimed that “to learn a subject is now seen as becoming a member of a certain community” (Sfard, 2008, p. 33).

An important aspect of professional development is the pedagogy, which does not simply refer to strategies of teaching, arrangement of classroom, formulating questions and developing schemes of work (Leach & Moon, 2008). Professional development is an ongoing process which is situated in social, historical and cultural settings. Leach & Moon (2008) argue that the nature of a pedagogy is defined and sustained over time when interactions and practices unfold between teachers and learners. To say that professional development includes the development of a content-specific pedagogy, does not mean that teachers acquire a possession that they keep forever. Any pedagogic setting will always have a past, a present and a future. A pedagogy defines the goals and purposes, the views of the mind and learning and the views of learning and the learner. It further defines the assessment activities and lastly the roles and the relationships of both teachers and learners. In this way each subject and each teacher will engage in a specific pedagogy for a specific class at a specific time.

This pedagogy has to be studied and developed. According to Leach & Moon (2008), pedagogy acknowledges teachers as intellectuals. However, “teachers provide students with knowledge that students then react to, reject, re-interpret, analyse and put into action” (Leach & Moon, 2008, p.21). One of the expectations in the ACEML programme was that teachers would develop a content pedagogy specific to the subject ML.

Teachers are said to have many teaching strategies that they do not use in their practice (Johnson et al, 2000). According to Johnson et al, some schools in South Africa have limited access to facilities and their teachers “a moderate content mastery through limited professional training” (Johnson et al., 2000, p. 183). Hechter (2011) concurs with this statement when noting that some schools had very poor quality of education, due to the socio-political and economic legacy of the apartheid era. The results of such a trend are still visible even years after the advent of formal democracy. This limitation has resulted in a lack of agency that teachers have in their practices. In these schools the environment in which a teacher practices plays a determinant role in the strategies that are employed by teachers. Johnson et al. assert that the selection of pedagogic strategies used by teachers in poorly supported schools is more often determined by the environment than by the teachers’ pedagogic knowledge. These teaching strategies are demanded by the very nature of the subject ML, where teachers have to choose contexts that are relevant to their specific learners both in explaining certain concepts as well as in the designing of tasks.

A change in the curriculum usually impacts negatively on the confidence and competency of a teacher in teaching a subject. The situation becomes exacerbated when a change as is drastic as that of a new subject being introduced. With ML being a new subject altogether, it can be expected that no teacher would have had the necessary confidence in the subject. Another of the crucial roles of the ACEML programme would have been to develop this confidence and competency in those teachers who participated in the programme. Graven (2004) notes that around the world there exists a huge concern about teachers knowledge of and confidence in Mathematics teaching. She maintains that changes after 1994 tended to exert more pressure on the confidence of teachers. Change requires that teachers adopt new roles. The learner-centred approach to teaching and learning demanded that teachers “minimise teaching and maximise learning” Wenger (1991) as cited in Graven (2004). This minimisation of teaching had different consequences in the confidence of teachers, especially those who had been in the profession for a considerable amount of time. As teachers lose their confidence they may feel that the workshops organised for their professional

development are “dictatorial and judgemental” (Graven, 2004, p. 188). This sentiment leaves teachers with a view that they are judged without much attention being paid to what they are already doing. This practice of trying to change teachers’ ways of teaching leaves their confidence devastated. Without confidence, competency in a subject is lost. As a result the building of that confidence remains one of the expected outcomes of participation in the ACEML programme.

Graven (2004) also points out that in a study called Program for Leader Educators in Senior-phase Mathematics Education (PLESME); which was conducted to support teachers from previously disadvantaged communities in their understanding and implementation of the new curriculum, most of the Mathematics teachers present “were not Mathematics teachers by training or choice. They had not studied to become Mathematics teachers” (Graven, 2004, p. 189). The same can be said of the participants in this study, who had been teachers in other various specialisations, most of which had not even been related to Mathematics. This statement does not imply that Mathematics teachers would have been better candidates for teaching ML, however, ML is more closely related to Mathematics than to any other school subject; hence the choice between ML and Maths for students in the FET band. After careful reflection on the interviews and questionnaires responses of the teachers, new careful planning of the teacher activities in the program was undertaken. Through this new planning, teachers began to “state their confidence as “mathematics teachers, and their confidence to admit to what they (did not) know and still needed to learn” (Graven, 2004, p. 177). Hence Graven (2004) states that “the notion of confidence is pivotal in understanding and explaining mathematics teacher learning” (Graven, 2004, p. 177). One might imagine the lack of confidence of those teachers who find themselves faced with a task of implementing a change of curriculum in a subject they had assimilated not out of their own choice. The same can be said of ML, where most rural schools are still taught by teachers who have not undergone any training in ML (Goba, James, Bansilal, Webb & Khuzwayo, 2011) and have very little or no confidence or competency, which then calls for extensive professional development to be initiated. This too, was one of the expectations in designing the ACEML programme.

2.2.3. The Mathematical Literacy Purpose and Philosophy

There are several features that have been identified as creating a distinct and clear difference between ML and mathematics. This can be traced back to the very definition of ML in the subject statement document which reads as follows:

“Mathematical Literacy provides pupils with an awareness and understanding of the role that mathematics plays in the modern world. Mathematical Literacy is a subject driven by life-related applications of mathematics. It enables pupils to develop the ability and confidence to think numerically and spatially in order to interpret and critically analyse everyday situations and solve problems” (DoE, 2003, p.9).

According to Venkat (2010), “the emphasis in ML is on developing the skills needed for a range of adult life roles - becoming ‘a self-managing person, a productive worker and a contributing citizen’” (Venkat, 2010, p.54). It is with this very emphasis that critiques of the ML curriculum, which tend to compare it to mathematics, find points that they use to discredit the introduction of ML. For example, there is a cry that ML “lacks the overt mathematical progression across the three grades that comprise the FET phase (Grades 10 - 12)” (Venkat, 2010, p.54). These critiques assert that there is repetition of the same Assessment Standards (AS’s) across the three grades. However, Venkat (2010) argues that it is the very nature of ML that is the reason for this lack of overt mathematical progression. A further support of the argument is that the repetition of the same AS’s across grades requires that “emphasis is (should be) on increasing complexity of the situation” (Venkat, 2010, p. 55). ML is seen as a subject whose main aim is to prepare learners for later adult roles. Whilst its structure is purely mathematical, “attempts have been made to incorporate life preparation orientation into the structure of the curriculum” (Venkat, 2010, p. 55).

There has been tendencies to compare ML in the South African context to other conceptions of mathematical literacy internationally. Venkat (2010) reiterates the assertion by Jablonka (2003) that numeracy and quantitative literacy are different from what ML in South Africa is all about. The former, international conceptualisations of mathematical literacy focus on the ability to think mathematically. However, according to Venkat (2010) “the South African version (of ML) differs in terms of its relatively limited emphasis on mathematical development”. (Venkat, 2010, p. 56). The same sentiment is echoed by Bansilal (2012) when she says that “the subject ML is not about learning more mathematics, but about developing skills that will enable them to participate (and not be excluded) in situations which use numerically based arguments” (Bansilal, 2012, p. 2). Bansilal further notes that the intention in ML is to help learners not to feel intimidated by various presentations of data in the real world. This in turn will make them want to be informed better before they make any decision on, for example, a purchase that they intend to make.

Having highlighted the above, one of the issues of concern becomes the considerations that are to be taken into account when teachers are trained to teach ML. The role of the teacher in a ML classroom becomes central in the sense that the only form of assessment used in ML is

the writing of examinations. Being a subject that is driven by context, teachers have to be aware that familiarity with certain contexts is relative. What is familiar to one class, to one set of learners, is not/will not necessarily be familiar to the other. This brings to mind the domain discussed earlier, of Knowledge of Content and Students, as identified by Ball et al., (2008), where they stress that a Mathematics teacher should know what motivates her/his learners and always be wary of the choice of examples to be used in a Mathematics classroom. In the same manner, task design in ML becomes a crucial aspect to consider.

It is further noted by Bansilal (2012) that the nature of ML is more suitable to tasks that learners engage with over an extended period of time. She further argues that “it is likely that purposes of ML are compromised by the country’s fixation with assessments by examinations” (Bansilal, 2012, p. 19). This fixation, she argues, puts some learners at a disadvantage, as they fail to recognise important issues and information given about the context provided. Time constraints of the examinations in South Africa hampers the would be performance of some learners had these tasks been given to them as projects, assignments, investigations or even oral presentations. Venkat (2010) concurs with this idea when she states that the teacher in her study was “encouraging her pupils to make sense of the problem situation as it stood at various stages of their working” (Venkat, 2010, p. 61). Clearly, the intended outcome would not have been achieved if these pupils in the study had been made to write 2-3hours examinations in order to be assessed. Venkat (2010) proposes that between mathematics and ML there exists a “differentiated emphasis on the mathematical and situational terrains” (Venkat, 2010, p. 65). She further points out that due to its nature, ML is not concerned mainly with making sense of the mathematics but to the contrary, it (ML) is concerned with making sense of the situation presented in the problem.

ML in the South African context involves three aspects namely: content (mathematics); context (life-related applications); and the abilities and behaviours (confidence, thinking, interpreting, analyzing and solving) exercised by a mathematically literate human-being (Bowie & Frith, 2006; Brombacher, 2007; DoBE, 2011; Vilakazi, 2010). There is an emphasis on these three perspectives being interwoven, and it is this very nature of the subject that poses challenges both to those who teach it and those who learn it. This is quite distinct from the version of ML in the United Kingdom (UK), which is referred to as Numeracy. The emphasis on numeracy (in the UK) is on the ability to use mathematical knowledge and understanding, skills, intuition and experience when a need arises in life-related daily activities. However, ML in the South African context “must provide learners

with the opportunity to demonstrate both competence with Mathematical content and making sense of the world” (Debba, 2011, p. 31).

2.2.4. Mathematical Literacy Teachers and the subject ML

In discussing the ML teacher and the subject ML, it becomes unavoidable to repeat the argument that since the inception of ML, there has been some controversial debates on the issue of who should teach ML i.e. what kind of a teacher would make a successful ML teacher. One view, according to Goba et al., (2011), was that “some mathematics teachers and HOD’s or principals believe(d) that a mathematics specialist teacher was better qualified to teach ML” (Goba et al., 2011, p.8). This view arises from the fact that, at its inception, most stakeholders, including teachers themselves, saw ML as a ‘watered down’ version of the real mathematics, intended to be offered to those learners who could not cope with mathematics in the FET band (Bansilal, 2012). Jansen (2012) sees ML as an easier subject used to improve the matric pass rate where school authorities “downgrade pupils into easier subjects like mathematical literacy over pure maths”. (Jansen, 2012, p.2). Some thought of ML in terms of the traditional ‘Standard Grade’ vs. ‘Higher Grade’ dichotomy (Hechter, 2011), where ML was mistakenly assumed to be substituting the now defunct Standard Grade Mathematics. Up to this date, this confusion still exists in some areas of the country.

Various studies have since been conducted regarding the ML teacher, after various higher education institutions introduced a two-year formal qualification, the Advanced Certificate in Education in ML (ACEML); with the intention of retraining existing teachers to be able to teach this new subject. Nel’s (2009) study was set around this ACEML programme which was designed to “help teachers understand the curriculum document, which sets a platform to teach the subject, how to do assessment and how to develop classroom activities that relate to the real life contexts” (Nel, 2009, p. 36). Nel confirms that the teachers involved in her study began to “see themselves as facilitators in the learner centred classroom, became more competent in introducing new concepts and started to enjoy teaching the subject” (Nel, 2009, p. 77). Teachers had started to take context from anything interesting that they came across in the newspapers, in adverts, on TV and were able to find the mathematics in those. In that way they would develop tasks that were relevant to their classes. One participant in Nel’s study even “saw the course as able to make a participating teacher passionate about ML, confident with any context that might be presented to her and feeling free to explore the subject” (Nel, 2009, p. 38).

As was the case in one KZN university, most teachers recruited to learn to teach the subject were teachers who taught subjects that were soon to be phased out in their schools, or alternatively, teachers who were facing redeployment in their schools due to a decrease in the number of learners they taught. Some of such teachers, were teachers similar to those found in the PLESME study (Graven, 2004), who taught mathematics *not* of their own voilition. These teachers were from specialisations other than that of mathematics. It is for this reason that Pillay (2006), had raised a concern that “educators that were ‘re-cycled’ from redundant subjects or novices may (would) not have the empathy and patience to teach ML” (Pillay, 2006, p.67). He had noted that most teachers of this kind had “limited or no formal training in mathematics education”, but would suddenly be faced with “the challenging task of facilitating the study of mathematical knowledge” (Pillay, 2006, p.67). He further warned that teachers would find themselves in a position where they would have to re-teach concepts that were previously covered in lower grades because, according to him, “the ML textbooks assumed that learners have all the necessary skills and knowledge pertaining to the previous work covered” (Pillay, 2006, p. 71).

Hechter (2011) also pointed out the need for an urgent ML teacher guidance and training in order to ensure that teachers can make a coherent connection between context and the mathematical content required to solve real life situations. She also pointed out that teachers needed to add to their own knowledge, the “knowledge of the GET mathematical curriculum in order to be informed of the learners’ expected prior mathematical knowledge” (Hechter, 2011, p.149). Coupled with the knowledge of the GET curriculum is what Vilakazi (2010) calls the “difficulties faced by both the teachers as well as students, which are associated with the increased language and comprehension required by ML due to its more applied, contextualized and real-life problem-solving nature” (Vilakazi, 2012, p.18). These difficulties prescribe those things which teachers of ML need to remain cognisant, especially when designing tasks that are to be undertaken by their learners. As identified by Bansilal & Debba (2012) any ML teacher has to be aware of the following, especially when designing tasks:

- *contextual rules*, namely, “procedures that are bound to the context and need to be interpreted by the learner” (Bansilal, 2012, p.13). There is a tendency for learners to fail to understand the instruction and hence answer the question using their own wrong interpretation of the instruction.
- *contextual language*, namely, “a specific phrase or terminology that carries a meaning in the context” (Bansilal, 2012, p.15). Learners may be faced with a contextual item

that they do not know at all. It becomes difficult therefore to answer any question if this difficulty is present.

- *contextual reasoning*, where, “reasoning, arguments or assumptions are made about issues in the context (Vilakazi, 2010, p.18).

The presence of these difficulties and others, makes the duty of the teacher challenging. Having said this, there is an urgent need to guide teachers of ML as raised by Hechter (2011) which arises. Such tensions were also noted by Graven & Venkat (2008) in their study in Gauteng where teachers interpreted the same task differently (Vilakazi, 2010). This tension and difference, according to Vilakazi (2010), is attributed to a mismatch between content and context, showing an inability to marry the two.

Concerns have also been raised about teachers enrolling for the ACEML programmes in order to upgrade their qualifications to a higher teaching category, and not for purposes of their professional development as teachers of ML. Alluding to this concern, Goba et al (2011) claim that “it is disappointing that the possible effects of the ACE programmes run by two Higher Education Institutions have been ‘washed out’ because there has been such a poor take up of teaching ML after completion of the programme” (Goba et al. 2011, p.8). Even so, Nel (2009) pointed out that in her study, some “...teachers foregrounded the new ML identity and backgrounded...” their previous identities in other specialisations. This foregrounding of a new identity confirms the effectiveness of the programme to some participants of the ACEML in Nel’s study.

In a study by Graven & Venkatakrishnan (2007), teachers reported being faced with a problem of learners who move between mathematics and ML midstream, a problem which may have been overlooked in the design of the curriculum. Learners were reported “to move to Mathematical Literacy only after failing or struggling to cope with first tests or mid-year examinations in Mathematics” (Graven & Venkatakrishnan, 2007, p.7). This move poses a challenges for the ML teacher who has to devise catch-up strategies in his pedagogy for such learners. A further challenge reported by teachers is the status of ML for further studies, as they struggle to explain to parents the advantages of the subject for future career paths. The ACEML in UKZN included a module which tried to “promote transformative practice by encouraging teachers to take up ownership of their practice by recognising and managing problems of practice that they identified (Bansilal & Rosenberg, 2011, p. 1). From such development, it is hoped that teachers will cope and be able to handle problems and challenges similar to the one mentioned above.

2.3. THEORETICAL FRAMEWORK

This study on the professional development of teachers who participated in the ACEML programme has an interpretivist orientation, and will be informed by the situated learning theory. Sfard (2008) calls the situated view on learning the '*participation metaphor*' (Sfard, 2008, p.33). Elaborating, she sees learning *not* as an accumulation of possessions, but to the contrary, meant for community building, belonging and communicating (Sfard, 2008) and thus, participation enhances meaningful learning. Within the situated learning perspective focus is directed towards the broader community and away from the individual learner (Boaler, 1999). Teachers content knowledge cannot be isolated from their working environment. As teachers focus on content knowledge, they are also concerned about how learners will learn that content.

One of the prominent claims in the situated learning perspective is that what becomes successful in one situation can never be guaranteed to succeed in another situation. The emphasis therefore is on whether the lessons learned by teachers at University succeed in creating a suitable ground for learning in the classroom or not. As argued by Peressini et al., (2004), it is important that context be considered in the study of teacher learning just as learning should be studied in context. This is because the teachers' knowledge and beliefs interact with their historical, social and political contexts, thus creating situations where learning to teach will take place. Johnson et al., (2000) concurs with this argument, when they assert that the knowledge possessed by the teacher is not the starting point but it is the environment in which the teacher works that has to be considered first.

The situative learning theory stipulates that any form of learning is situated. According to Peressini et al., (2004), this implies that what is learnt by a person as a set of knowledge, and the situation in which that person learns, are the basic part of what is to be learnt. Citing the work of Adler (2000), Peressini et al., (2004) maintain that "teacher learning can be understood as a process of increasing participation in the practice of teaching, and through this participation, a process of becoming knowledgeable in and about teaching" (Adler, 2000, p.37). The situative perspective does not focus on the knowledge that individuals acquire, but to the contrary, it focuses on the practices where teachers have learnt to participate. Their acquisition and use of their knowledge is seen as a product of their participation in social processes.

The work of Greeno (2003) as cited in Peressini et al.,(2004) suggests that the mathematical knowledge and understanding of students can only grow as a result of their sustained participation in learning activities. Unlike in the cognitive perspective, where knowledge is

seen as an entity that can be transferred from one situation to another, situative learning theory emphasises that there has to be an understanding of “how practices learned in university courses can be recontextualised in elementary and secondary school classrooms” (Peressini et al., 2004, p.70). The situative perspective advocates that students contribute to the practices that take place in their classrooms and thereby constituting the context for learning to take place effectively.

One major proposition of situative theory, according to Peressini et al., (2004), is that knowledge and beliefs, as well as the practices that they influence cannot be separated from the situations in which they are found. As one learns, the knowledge that one learns grows and becomes complex. This growing knowledge can be used in a variety of different contexts, each time the learner participates in a context different from the previous one. The same process applies to teachers who were trained to teach ML. In studying what and how their professional development was enhanced by their participation in the ACEML programme, one has to consider the situation in which their learning was embedded.

This is corroborated by Kelly (2006), who argues that the cognitivist approach looks at teacher learning as a process where there is a transfer of (teachers’) learning to the classroom, because it says that “both teacher learning and student learning are outcomes of a dynamic relationship between teachers’ and students’ conceptual resources, the physical resources available and the affordances and constraints of the classroom” (Kelly, 2006, p.515). Furthermore, their identities (both teacher and student) become central in this relationship. It is for this reason that Kelly (2006) says that “teachers should be supported in their identity exploration and building” (Kelly, 2006, p.517).

Whilst some people saw ML as an easier version of Mathematics, Debba (2011) warns that whilst ML was initially seen as simpler than Mathematics, it was not quite as simple as it seemed. Justifying this, a learner in Debba’s study confirmed that she gave a ML task to a mathematics peer student, who could not solve the ML problem. Stemming from this argument, one can clearly deduce that the way in which mathematics teachers are trained should not equally resemble the way in which ML teachers are trained. It should be taken into account that the ML classroom “emphasises the need to work collaborately in teams and groups to enhance mathematical understanding” (DoE, 2003, p.10). This emphasis is somehow different to the traditional view of mathematics where the subject was “seen as a subject of absolute truths with one correct answer to each problem (Debba, 2011, p.14).

The situative perspective of teacher training suggests that knowledge, beliefs and practices cannot be separated from the situation in which they are embedded. According to Cobb &

Bowers (1999), all activity in learning is seen as occurring in the context of social practice, a claim typical of the situated learning theory.

According to Sullivan (2008), “the complexity and challenge of identifying expected knowledge for teaching mathematics” is embedded in three perspectives (Sullivan, 2008, p.3). He identifies these three perspectives as:

i. *Knowledge of mathematics:*

This perspective deals with the ways in which a learner finds answers through the use of algorithms and intuitive reasoning.

ii. *Knowledge for teaching mathematics:*

Sullivan explains this perspective as “the process of working out how to use the question for teaching”, and he continues that “teachers need ways to describe what is needed to solve the question” (Sullivan, 2008, p.5). For Sullivan, teachers should be able to identify specific concepts associated with a question in order to match those concepts to curriculum documents. Having the knowledge for teaching mathematics helps in making the problem simpler.

iii. *Knowledge of the Pedagogy:*

After answering the question and identifying words to describe what the problem entails, teachers face the challenge of “converting the question to a learning experience” (Sullivan, 2008, p.6). It is therefore noted that while it is important for teachers to know the mathematics required, that on its own is not sufficient.

Closely related to the three perspectives discussed above is the structure of mathematical knowledge for teaching as outlined by Ball, Thames & Phelps (2008); where they identify four domains in their analysis for mathematical demands for teaching:

i. *Common Content Knowledge (CCK):*

CCK is defined as “the mathematical knowledge and skills used in settings other than teaching” (Ball et al., 2008, p.399). This could refer to any form of mathematics known by any other person, who does not necessarily use that knowledge to teach learners in a classroom setting. As mathematics teachers, CCK is needed for various purposes, one of which could be identifying inaccurate explanations that are found in a textbook.

ii. *Specialised Content Knowledge (SCK):*

This is mathematical knowledge that may not be needed for other purposes except teaching. For example, a medical doctor will not need SCK. This second domain is closely related to what Peressini et al. called content-specific pedagogy. Ball et al. (2008) maintain that “teaching involves making features of a particular content visible to and learnable by students” (Ball et al., 2008, p.400). As a teacher, one needs to be able to unpack a concept in a way that suits the assumed previous knowledge of the learner. Teachers have to be able to work with mathematics in “its decompressed or unpacked form” (Ball et al., 2008, p.400). In this way some specialised form of mathematics that is not needed in any other settings is essential for any mathematics teacher.

iii. *Knowledge of Content and Students (KCS):*

In this domain Ball et al., (2008) argue that the teacher’s choice of an example must be guided by their knowledge of what their students will find interesting, motivating and somehow familiar. In this way they are enabled to anticipate common mistakes that their students are likely to make. This domain seems to be closely related to the application of context in ML, where a concern is always raised on the use (by examiners) of context that may not be familiar to a section of the candidates taking up the exam. Copper & Dunne (1998) warned that failure to recognise context may lead to learners misjudging the mathematical demand of the question and hence giving answers that are based on their own everyday experiences. For this reason, teachers need to have knowledge of content and their students.

iv. *Knowledge of Content and Teaching (KCT):*

It is upon the teacher to know how the work is to be sequenced, which sections should be dealt with first, in order to facilitate easier understanding of the next section. teaching requires “knowledge at the intersection of content and teaching” (Ball et al, p.401).

The analysis discussed above led to Ball et al., (2008) refining earlier versions of subject matter knowledge to include what they called “horizon knowledge” by the teacher. Horizon knowledge involves being aware as a teacher, of how topics dealt with in mathematics are related throughout the span of the Mathematical curriculum. For example, teachers who teach Grade 4 Mathematics should know what the students will be learning in Grade 7. This knowledge helps in the laying of good foundations for future learning of the learner. It

becomes imperative to note that knowledge of the content only may not be sufficient for one to teach any subject successfully.

Whilst all of these domains were identified in the context of mathematics, they can also be applicable in the subject ML.

This study intends to look at three facets of professional development namely: content knowledge, knowledge of content specific pedagogy and the development of a professional identity as teachers of Mathematical Literacy in teachers who enrolled for the ACEML programme. These facets are outlined more clearly in the paragraphs that follow.

2.3.1. Content Knowledge

Content knowledge is not an entity, nor an acquisition for the teachers. It is not transferred from one teacher to a learner during the process of learning but is dependent on the situation in which the student and the teacher find themselves during the process of learning. This knowledge, according to Kelly (2006), “can only be created by practitioners in the context of their practice” (Kelly, 2006, p.509). This view is particularly important in the subject of ML, where the situations of application vary and are never fixed.

ML can be seen as an intersection of several domains. Firstly, content knowledge in ML involves “the use of elementary mathematical content and skills” (DoBE, 2011, p.8), which learners are supposed to have been exposed to in Grade 9. This elementary mathematics is used in “authentic real-life contexts....to solve familiar and unfamiliar problems” (DoBE, 2011, p.8). Content knowledge, sometimes called subject matter knowledge in this study, refers to the knowledge of concepts, rules, history of, fundamentals and basics of ML.

Secondly, ML also requires knowledge of various contextual domains specified in the curriculum documents (e.g. taxation, inflation, custom duties etc.), as well as those which learners will encounter in their daily lives (e.g. municipal billing systems, cell phone contracts, recreation etc.). Thus a detailed description of the content knowledge required by an ML teacher may be too cumbersome.

For purposes of this study, content knowledge in ML includes common content knowledge, specialised content knowledge as well as horizon knowledge (Ball et al., 2008) of elementary mathematics (as specified by DoBE, 2011). It also includes knowledge of the various contextual domains, (as specified in the curriculum documents), inter alia, the contextual

language, rules, pictures and graphs etc. commonly used in the various contextual domains. Thus content knowledge in ML can be summarised as knowing the subject and its organisational structures; having the ability to execute mathematical algorithms and contextual rules; draw and interpret graphs and maps; work with various shapes including 3D; and answering questions (Sullivan, 2008) based on various contexts.

2.3.2. Pedagogic Content Knowledge

For purposes of this study, PCK is used interchangeably with content specific pedagogy. Whilst the two are two separate concepts, PCK is seen as the ability by the teacher, to present the content known by him/herself to learners, in a way that will make such content to be understood and apprehended by the learners. It involves the ability of a teacher to become a reflective practitioner, who can look back into his/her own teaching and identify the strongpoints and weakpoints. Content specific pedagogy also allows for the integration of ideas in the content with real life situations that will be understood by the learners.

An important aspect of PCK in ML is task design. Tasks in ML serve a somewhat different purpose than Maths tasks. This is noticed by learners as well, as noted by Debba (2011) in his study when he stated that “in terms of the nature of classroom tasks, learners viewed contextual tasks as more accessible, practical, ‘visualise-able’ and providing opportunities for communication, participation and sense-making inside and outside school (Debba, 2011, p.11).

Peressini et al..assert that the selection of tasks given to learners is “situated in particular classrooms filled with students who bring with them different experiences and backgrounds” (Peressini et al.. 2004, p.78). Bansilal & Wallace (2008) identified six issues of concern which should be considered in the design of tasks by both mathematics and ML teachers, if the tasks are meant to deal with real-life contexts. Three of these six concerns, which seem to be most relevant to ML are:

- a) *Knowledge Gaps*: this refers to “a deficit in basic skills and foundational knowledge concepts for reasons largely beyond the control of the learners” (Bansilal & Wallace, 2008, p.84). Such ‘gaps’ are usually a result of an earlier misunderstanding by the learner and usually result in them failing to or struggling with any given task.

- b) *Task Language*: the poor language skills of the learners may interfere with their efforts to solve a given task and may result in learners having a ‘skewed’ understanding of the task requirements (Bansilal, & Wallace, 2008).
- c) *Information Overload*: Learners usually struggle in trying to sift ‘context information’ from ‘crucial information’ (Bansilal & Wallace, 2008). The teacher must try and present tasks that are not overloaded with information that will not be useful in solving the mathematical problem.

The concerns raised by Bansilal and Wallace (2008) show the enormity of the task at hand for teachers who train to become ML teachers, where this one element of task design becomes crucial in their professional development. Task design forms a huge part of the PCK of ML teachers.

As alluded to earlier, ML strives to produce learners who are “self-managing individuals, contributing workers and participating citizens” (DoE, 2008, p.7). This is quite distinct from the way in which most of South African mathematics teachers have been trained. Bansilal (2012) confirms this view when she says that “the subject ML is not about learning more mathematics but about developing skills that will enable them (learners) to participate in (and not be excluded from) situations which use numerically based arguments” (Bansilal, 2012, p.2).

As opposed to Mathematics, tasks in ML provide learners with the ability to ‘see’ what is being discussed and this leads to better understanding, as compared to mathematics tasks, which were “hard to visualise and the selection of procedures (was) often described in terms of random guessing rather than any notion of sense-making” (Venkat & Graven, 2008, p.37). It is for this reason that Hechter (2011) noted that teachers of ML should be familiar with the GET curriculum in order to facilitate the ‘visibility’ of the problem in a task in ML. This concern was also echoed indirectly by Pillay (2006), who stated that textbooks in ML always assumed that the learner was familiar with the work that was supposed to be done in the previous grades. Therefore task design in ML requires careful planning on the side of teachers, whose content knowledge and PCK should be well developed.

It is important to note that pedagogical content knowledge in ML is much more complex than it is in Mathematics. The way in which Mathematics is taught as well as the purpose of teaching that Mathematics, is quite different from the purpose and philosophy of ML.

A context can be seen as a contextual domain within which particular rules of engagement are recognized. Each context has specific attributes which need to be recognised and used in specific ways which may be different from those encountered in the traditional mathematics classroom. A learner must be able to understand these attributes in order to make meaningful decisions around the context (Bansilal & Debba, 2012).

Thus the teacher needs a sound understanding of the contexts that are specified in the curriculum. Furthermore the teacher will need to find ways of representing these attributes in ways which make it easier for their learners to understand.

Venkat& Graven (2008) point out that internationally, as well as in South Africa, there has been “evidence of low levels of confidence, disaffection and lack of engagement” (Venkat& Graven, 2008, p.31) in the teaching and learning of Mathematics (and hence, ML). They further assert that even with critiques of the ML curriculum being very pessimistic about the introduction of the subject, the “negative experiences of mathematics learning to positive perceptions of ML learning seemed to us to merit attention” (Venkat& Graven, 2008, p.31). It is for this reason and others that focus should be made towards why ML teachers need to be developed professionally in their content knowledge, their PCK and their identity and beliefs about the subject ML. Learners in the Venkat& Graven study indicated that there is “more room for sharing ideas and discussing a range of alternative solution strategies” within an ML class, this due to a “more collaborative learning environment in ML” (Venkat& Graven, 2008, p.35). In line with the situative learning view, two aspects identified by Venkat& Graven (2008) in a ML classroom were that “the nature of classroom tasks and the nature of classroom interactions in ML were in contrast to their (the learners’) prior experience in mathematics” (Venkat& Graven, 2008, p.36).

For purposes of this study, I will consider PCK for ML teachers as the awareness of common learner misconceptions and knowledge gaps in elementary mathematics; and consider how teachers may be able to address these misconceptions. PCK also involves the knowledge of various contextual settings and rules that operate within those settings as well as having the skill to design tasks and the ability to set up classrooms which foster collaborative learning environments.

In conclusion, it is important to reiterate that with PCK being a complex phenomenon in ML, due to the nature of the subject, a strong need to explore the professional development of teachers along such lines is imperative. The complexity of this PCK lies in the relative ability

(or lack thereof) of the ML teacher to realise what is important in the lives of ML learners, as this facilitates better choices in designing tasks suitable for ML. Barriers such as language and decoding of complex situations are better handled when the teacher identifies with the subject. The intention of this study is precisely to find out how the professional development of teachers of ML was enhanced by their participation in the ACEML programme.

2.3.3. Identity and Beliefs as ML teachers

For purposes of this study, the development of a new identity as a ML teacher refers to a process where teachers begin to see themselves as belonging to a new group of teachers, teachers of ML. Their previous specialisations are shifted into the background and a new sense of belonging emerges. It is an inner feeling where a teacher no longer associates him/herself with the old subject but develops a new sense of belonging, and feels prepared to face any challenge to his/her identity. The teacher believes and is prepared to engage in arguments that involve defending the existence and introduction of this new subject ML. Identifying with the subject involves the development of beliefs about the usefulness of the subject ML, not paying heed to the negative criticisms by those who see ML as a watered down version of mathematics (Jansen, 2012).

In Nel's study, (2009), which serves as an inspiration, teachers became passionate about ML and their "emerging identities were also competent and confident with, for example, the ML curriculum, the maths content knowledge, how to read and interpret graphs, how to marry content and context, how to work with probability" (Nel, 2009, p.77). This study strives to exact and then explore the same phenomenon with its own participants. The identity that evolved within teachers in Nel's study emerged beyond the classroom, to the extent where teachers began to see themselves as leaders in the field of ML. The new identity causes teachers to change their way of belonging, where one participant was even willing to conduct workshops "to share her knowledge of ML with newcomers" (Nel, 2009, p.78).

As teachers develop new identities, Nel identifies three categories where:

- I. *teachers background their previous identities and foreground new ones*
- II. *teachers have a dual identity, where they retain both the previous learning area identity and the 'new' ML identity*
- III. *the previous identity is held strong and the new ML identity becomes less strong*

Identity development, according to Nel (2009), results in teachers who change in their experiences (meaning), their way of doing (practice) and their way of belonging (community).

Development of an identity on a new subject brings about confidence in a teacher. In her argument on confidence, Graven (2004) states that “confidence is conceptualised as an additional component of learning and as such as an individual teachers’ movement from the periphery of various overlapping mathematics and education communities towards more central participation, identification and belonging within these communities” (Graven, 2004, p.179). The author further goes on to say that in her study “it became evident that teachers saw their learning as a process of developing new identities” (Graven, 2004, p.179). Citing the work of Beatrice (1999), Graven quotes a teacher who participated in the study who had always introduced herself as a music teacher but had changed to introduce herself as the Maths teacher. These were teachers who were involved in this in-service education and training project (INSET) program, conducted for two years for the senior phase (grade 7-9) Mathematics teachers learning. In the end it was evident that through their participation over a long period, their identity changed and they developed a sense of belonging in a community of Mathematics teachers.

As teachers identify with ML, they realise that, and are willing to defend ML as a legitimate subject. As confirmed in the statement by Clark (2012) that “Mathematical Literacy provides very necessary mathematical skills for learners who would never have had the opportunity to become mathematically literate before” (Clark, 2012, p.2), it can also be anticipated of teachers who participated in the programme that their identities would change significantly. Whilst Jansen (2012) sees ML as a subject for weaker learners, due to its “easier” nature for him, compared to Mathematics, ML teachers recognise the difference between the two subjects. As seen by Clark (2012), the “highly technical and abstract nature of pure Maths....” (Clark, 2012, p.2) makes it easier to draw a conclusion that ML “is actually more accessible in terms of language use than pure mathematics” (Clark, 2012, p.2). This shows a realisation of the difference between ML and Mathematics which, it was expected, would be attained by teachers who were trained to teach ML.

For the purposes of this study, by beliefs and identity development, I refer to the teachers’ understanding of the subject ML and their beliefs of the role played by the subject. In addition to this category I will also consider the positioning of the teachers in terms of their personal identities and role as ML teachers.

In conclusion, this chapter has highlighted various issues which are anticipated to have had much influence in the way in which the teachers who studied the ACEML were to be developed professionally. The chapter looked at the notion of the ever-changing South African curricula, which brought about the introduction of the subject ML in schools. It was also of importance to look at the outline of the ACEML curriculum itself, the teachers of ML and ML as a school subject, as well as the purpose and philosophy of the subject ML. Within this scope and beyond, it was important to look at some of the general issues around the professional development of teachers, in order to identify those issues that can be associated with the participants of this study. The broader outlook of the study is guided by content knowledge, pedagogical content knowledge and identity and belief of the participants as teachers of ML. These concepts have also been looked at in this chapter as it is hoped they are to serve as guidelines in trying to extract information from the participants of this study.

CHAPTER 3

METHODOLOGY AND RESEARCH DESIGN

3.1. INTRODUCTION

This chapter is devoted to the methods and methodology related to the study. I first discuss the methodology underpinning the study before going on to describe its data collection procedures. From this section I discuss the data collection instruments and participants of the study. I then discuss the data analysis procedures. This is followed by validity and trustworthiness issues. The final two sections focus on ethical considerations and the challenges I experienced in carrying out this study.

3.2. METHODOLOGY CHOSEN

The purpose of this study is to explore the professional development of teachers who participated in the ACEML programme at UKZN, in terms of their content knowledge, their content specific pedagogy and the development of an identity as ML teachers, as well as their beliefs about the subject ML and the programme in which they participated.

In order to achieve the above, the study was guided by the following research questions:

1. What are the ways in which the participation in the Advanced Certification of Education in Mathematical Literacy enhanced the professional development of teachers?
2. How did participation in the ACEML enhance the professional development of teachers?

The study is itself a case study on teachers who have participated in the Advanced Certificate in Education - Mathematical Literacy (ACEML) programme at the University of KwaZulu-Natal. A case study is an in-depth study of a detailed situation rather than a sweeping statistical survey, (Shuttleworth, 2008), and can be seen as “an investigation into a specific instance or phenomenon in its’ real-life context” (Cohen, Manion & Morrison, 2007, p.170). Case studies focus on individual actors or groups of actors, thereby seeking to understand their perception of events (Hitchcock & Hughes, 1995). In this study, the group of teachers who enrolled for an ACEML at UKZN is the case under scrutiny because they form the unit of analysis (Yin, 2009, p.30) and can be seen as an “exploratory study” (Yin, 2009, p.28) because I wanted to explore how their professional development was enhanced by participation in the programme. Stake (2006, p.126) writes that the case study “is a complex

entity located in ... a number of contexts or backgrounds” which can have subsections or groups. In this study each of the participants, especially in the interviews, came from different contexts, whilst being located within the specific group of teachers who had studied the ACEML programme at UKZN.

The study is informed by the naturalistic interpretivist paradigm, which holds the belief that the social world can only be understood from the standpoint of those individuals who are part of the ongoing action being investigated (Cohen et al., 2007). This is a qualitative study with the aim of producing information from the insider’s point of view. This methodology was chosen because qualitative studies provide “an understanding and description of people’s personal experiences of phenomena” (Johnson & Onwuegbuzie, 2004, p.20). Cohen et al., (2007), also assert that case studies are able to penetrate situations in ways that are not susceptible to quantitative analysis. As a result, events in a case study are made to speak for themselves, as opposed to them being interpreted and evaluated by the researcher. In this study, data from the participants is presented as spoken by the participants. Although the data may sometimes be quantified, the analysis is interpretive in order to ascertain how professional development of the participants was enhanced.

3.3. DATA SOURCES AND DATA COLLECTION

3.3.1. Why was data collected?

Data was collected so as to explore the professional development of the participants in terms of their subject matter knowledge, their content-specific pedagogy and the development of a professional identity and their beliefs. This assists in exploring their general perceptions of the programme itself.

3.3.2. Data Sources

The three main sources of data were the following:

1. Teacher Questionnaires:

Two questionnaires, A and B were used in the study. A questionnaire was designed as part of a larger project conducted jointly by three institutions, UKZN, University of Zululand (UNIZUL) and NMMU. The purpose of the larger project was to explore the nature and design of the ACE programmes offered by these institutions. It also aimed to investigate the effectiveness of the programmes as a professional

development tool. The questionnaire was redesigned for this study by changing some questions and adding new ones. I refer to this as Questionnaire A.

The design of **Questionnaire A** was semi-structured. In this type of questionnaire a “series of questions, statements or items are presented and the respondents are asked to answer or respond to them in a way they think best” (Cohen et al., 2007, p.320). I used this type of questionnaire because “it sets the agenda, but does not presuppose the nature of the response” (Cohen et al., 2007, p.321). This questionnaire had Likert-scale type questions, as well as open-ended questions, which “allow the researcher to make a truer assessment of what the respondent really believes” (Cohen et al., 2007, p.357). These type of questions were included in order to minimise restrictions on the respondents’ replies. The questionnaire also had closed, dichotomous questions in the questionnaire, as well as Likert scale-type questions, which is a useful way in which degrees of response, intensity of response and the move away from dichotomous questions can be managed (Cohen et al., 2007). The authors further suggest that Likert scales “afford the researcher the opportunity and freedom to fuse opinion with measurement, quality with quantity” (Cohen et al., 2007, p.327).

The seven page questionnaire consisted of four sections. The first dealt with personal information of the participant, covering issues like teaching experience, qualifications and reasons for joining the program. The second part, was designed to identify the impressions of the participant on the ACEML programme. The third part focused on the development of content knowledge and teaching strategies, while the last section comprised of general questions regarding the ACEML programme, where beliefs and identity with ML were the main issues of concern.

Most questionnaires were hand delivered by myself to each participant, but some of the participants were given the questionnaires by their colleagues after prior arrangement had been made.

Data from a second questionnaire which I refer to as **Questionnaire B**, was also used in the study. This questionnaire contained questions which sought information that was relevant to this study, and was therefore used as an additional source of data. I was advised by my supervisor to use this as an additional source of data that could be used to confirm or support trends identified by the data in Questionnaire A. The specific completed questionnaires used in this study were completed by a group of students who had completed the ACEML and were involved in further study.

Questionnaire B also had a similar structure to that of Questionnaire A, except that it included additional questions, which probed the nature and design of the programme, but did not include the general section. See Appendix F

2. Teacher Interviews:

The interview schedules of the larger project was amended so that it was in line with the research questions of this study. In the interviews, most questions were designed to serve as a follow up to questions found in the questionnaires. The questions were also influenced by the circumstances of each participant in the interview, considering that the interview participants varied in experience and background.

The interviews were therefore semi-structured. Unlike in the structured interview, where “the context and procedures are organised in advance, determining the sequence and wording of the questions by means of a schedule” (Cohen et al., 2007, p.355), a semi-structured interview is an open situation which has greater flexibility and freedom. However, the semi-structured interview also needs careful planning, even though it is designed to be flexible. These semi-structured interviews aimed at extracting authentic and rich responses from the participants, about some claims they made in the questionnaires.

Each interview was planned to last between 45 minutes to an hour. The duration of the interview depended on interviewees’ responses and elaborations on the specific question. The times and venues of the interviews were finalised in consultation with the participants. I used a dictaphone to record the interviews which were transcribed later by myself. The transcripts are in Appendices A; B; C and D

3. Records of Teachers’ Performance during their study period:

The records of the participants’ academic performances in the tests and examinations while they were students of the ACEML programme were obtained from UKZN, by permission of the relevant authorities. These were used to provide insight into participants’ knowledge of content. These records helped provide an idea of the participants’ content knowledge during their period of study.

3.3.3. The Participants of the Study

3.3.3.1. Participants in the Questionnaires

As mentioned in section 3.1., there were two versions of questionnaires, A and B that were used. For questionnaire A, there were 17 participants. The 17 teachers that were selected comprised a convenience sample, sometimes referred to as an accidental or opportunity sample. Such a sample “involves choosing the nearest individuals to serve as respondents and continuing that process until the required sample is obtained” (Cohen et al., 2007, p.113-114). These were teachers who were easily accessible to me, comprising mainly of teachers who worked within and around the district I worked in. There were also teachers who were identified by their colleagues and came from other districts. Sixteen of the participants were teachers who had completed the ACEML, except one who still had a single module pending. Initially this participant was not included because he did not complete the program. After discussions with my supervisor I decided to include him, because of the opportunity it offered to explore whether people who did not complete the programme also benefitted from the programme. The inclusion was also intended to help me identify aspects of the programme which were challenging for those participating.

Participants were handed semi-structured questionnaires (see AppendixE) which were hand delivered to them, either at their place of work or any other convenient meeting point. Some participants were canvassed during the Second Term Moderation of Matric Mathematical Literacy marks meeting by the Department of Education. I intended to leave questionnaires with the participants for at least a week, giving them enough time to complete. I collected the completed questionnaires after contacting the participants on an individual basis. Some participants took more than two weeks to complete the questionnaire, stating among other reasons, unforeseen commitments both at work and at their respective homes.

Of the seventeen questionnaires (A) handed out, only 15 respondents were considered. One teacher had misplaced the questionnaire and later reported that he was no more willing to participate. A second teacher did not study the ACEML at the University of KwaZulu-Natal, although she was a teacher of Mathematical Literacy. Her questionnaire could therefore not be utilised in this study. This left me with fifteen authentic questionnaires to examine.

3.3.3.2. *Participants in the Interview*

Semi-structured interviews were conducted at different times with four teachers who volunteered. The participants came from different contexts, enabling me to collect rich data:

the *first participant* had only done Mathematics up to Grade 9 level as a student in high school. She was different from the other remaining participants, who all had studied Mathematics at least up to Grade 12. She had never taught Mathematics or Mathematical Literacy before.

the *second participant* had studied Mathematics up to Grade 12 but had been teaching other subjects for more than twenty-five years. This long period was considered to have some impact on her memory of some of the Mathematical concepts.

the *third participant* had never taught any other subject except Mathematics. He only stopped teaching Mathematics on enrolling in the ACEML programme as a first year student.

the *fourth participant* was the only interviewee who had taught Mathematical Literacy prior to enrolling for the ACEML. Otherwise, she had been a Mathematics teacher prior to the introduction of Mathematical Literacy as a subject in schools.

Because of these variations, the interviews yielded rich information about the participants and their perceptions of the ACEML programme.

The questionnaires were also used in identifying suitable participants for follow-up interviews. The interviews were one-to-one semi-structured interviews which allowed the researcher to ascertain that questions were understood by both parties at the same level. Cohen et al., (2007) state that generally, interviews are prone to bias and subjectivity, however, they provide greater depth if compared to all other data collection methods. The questions in the semi-structured interview had a similar skeletal format but differed according to the participant's circumstances. For example, a participant who had never taught Grade 12 was asked why that was the case ; a participant who did Mathematics up to Grade 9 would be asked slightly different questions from the person who studied mathematics up to Grade 12 etc.

3.3.3.3. Participants in the Second Questionnaire [Questionnaire B]

Eight responses to Questionnaire B (see Appendix F) that had been completed by the participants after they had completed the ACEML were also a convenience sample. Together the group of participants formed a case consisting of students who participated in the ACEML programme at UKZN.

3.4. DATA ANALYSIS

One of the main objectives of data analysis in a qualitative study is to organise and explain the data. This organisation and explanation of data has to be in terms of the participants' definitions of the situation, where patterns are noted, themes are identified, categories are described and regularities discovered. This was an exploratory qualitative study where each individual case was explored to discover commonalities, differences and similarities (Cohen et al., 2007). The way in which each participant responded, both in the questionnaire and in the interviews for some, was used to explain the opinions of that participant, and not of the whole group.

In this study, the process of data analysis involved several steps which were undergone in a fluid manner, where a lot of "moving back and forth between the steps" (Taylor-Powell & Renner, 2003, p.2) occurred. The most important step was to read and re-read the text and also to listen to the interview recordings several times in order to create impressions about the data collected (Cohen et al., 2007; Taylor-Powell & Renner, 2003). This step helped in finding quality data from all the data collected.

Other steps that were used included categorizing the information by identifying themes and patterns as well as organising such themes and patterns into "coherent categories" (Taylor-Powell & Renner, 2003, p.2). With the help of my research questions as a guide, I identified key areas for analysis. Taylor-Powell & Renner (2003) refer to this as focussing the analysis, and they further suggest that the questions that you want answered may also change as you progress with your data analysis. This step is achieved when the researcher "looks at how all individuals or groups responded to each question or topic" (Taylor-Powell & Renner, 2003, p.2).

I thereafter identified patterns and connections within categories, a step which leads to establishment of key ideas that are expressed, allowing the researcher to "capture differences and similarities in the way people have responded" (Taylor-Powell & Renner, 2003, p.5).

The questionnaires were divided into sections, each with questions that were specifically designed to suit the given category. This design of the questionnaire (s) enabled me to “establish units of analysis of the data” which then allowed me to “indicate how these units are similar to and different from each other” (Cohen et al., 2007, p.184). Items were grouped into various related themes, where each question within a theme was analysed according to how it had been answered. For example, in Questionnaire A, Section A, I started by tabulating the subjects taught by most teachers as against those that were taught by one or two teachers. This was done in order to establish the frequency of a specific subject being taught by most teachers. The same procedure was repeated for teachers’ current post levels, qualifications, reasons for enrolling in the ACEML and identifying participants who are currently teaching ML. For all these questions the intention was, as mentioned earlier, to establish issues of commonality, differences, and similarities. For the last question in Section A, I identified the more interesting reasons that teachers gave for not teaching ML currently, after they had graduated with the ACEML qualification.

The first part of Section B, (Questions 5 to 9), consisted of the Likert-scale-type questions, where teachers had to give their impressions about the ACEML programme. For each of these questions, I counted the number of similar responses in each option. Data reduction was also used, where some responses to specific questions were counted, and hence presented in a table. Tables were useful in the sense that they allow the reader to “see, at a glance, where differences and similarities lie between individuals” (Cohen et al., 2007, p.466). These tables also helped in displaying frequencies of occurrences and responses at a glance. However, some of the data could only be reported as a narrative, where important issues from the data emerged during the narrative (Cohen et al., 2007).

From question 11 of Section B, where teachers had to give reasons for not dropping out from the ACEML, I listed all responses. In this study, I looked at the data individual by individual and then key issues that emerged across individuals were summarily reported and explained. I used a number of quotes from responses made by individual participants, especially from the interviews. Cohen et al., (2007) state that sometimes issues are “summarised without necessarily identifying exactly from whom specific data were derived” (Cohen et al., 2007, p.462). Summarising of issues in this manner, where the source is not identified, was done on the analysis of questionnaires. The number of participants with the same response in any given question was often mentioned in order to emphasize the regularity and frequency of such a response.

In question 12 and 13 of Section B, Questionnaire A, participants had to identify the most or least useful module. Clearly, in these two questions I had to tabulate the number of responses for each module chosen as most or least useful in order to establish the participants' preferences and dislikes of such modules.

3.5. VALIDITY and TRUSTWORTHINESS

Although some researchers caution that the concept of validity is more applicable in quantitative studies than it is to qualitative studies, (Golafshani, 2003; Stenbacka, 2001; Lincoln & Guba, 1985), it is important to use appropriate criteria to ensure that a qualitative study has rigour and depth. Lincoln & Guba (1985) put forward alternative criteria that could be used in qualitative research, in the place of the traditional criteria that are more applicable to quantitative studies. Drawing from Lincoln & Guba (1985), Trochim (2006) outlined the criteria for qualitative research, in Table 3.1. as follows:

Table 3.1. Criteria for Qualitative Research

Traditional Criteria (Quantitative)	Alternative Criteria (Qualitative)	Application in this Study
internal validity	– credibility	Phenomena are described and understood from the participants' perspective and hence participants judge the credibility of results. Testing of credibility of findings and interpretations is done through using various sources, i.e. triangulation. Participants were promised a copy of the final draft of the study.
external validity (generalizability)	– transferability	Transferring results to other settings becomes the responsibility of the one who transfers them. The use of a thick description about each context makes it easier for the reader to judge whether the results of one context may be applied to the other.

reliability	– dependability	An account for the ever-changing context within which the research occurs is given by the researcher. Consistency is visible on the produced findings.
objectivity	– confirmability	Examining data collection and analysis procedures to make judgement about potential bias or distortion. Data collection procedures and analysis has been certified not by the researcher but by the data itself. It is important for the researcher to provide a trail showing the basis for layers of increasing abstraction in the analysis process.

In a qualitative study, the researcher is the key instrument of research rather than a tool. The researcher is also part of the world that is being researched. As argued by Cohen et al., (2007), “the involvement and in-depth responses of individuals secure a sufficient level of validity and reliability” (Cohen et al., 2007, p.134). Cresswell & Miller (2000), further claim that it is the researcher who determines whether the “data are saturated to establish good themes or categories, and how the analysis of the data evolves into a persuasive narrative” (Cresswell & Miller, 2000, p.125). I am a peer to the participants, and so they did not feel pressurised to present themselves as highly successful and professional individuals if they were not.

I decided to conduct the interviews personally, to minimise perceptions of power that may have been held by the participants. For example, participants might have responded differently if they were interviewed by a Subject Advisor and may have felt that failure to give an expected answer would lead to some form of victimisation. This situation created a free and relaxed atmosphere for the interviewees, who were interviewed at a venue selected by them, at a time convenient to them and with no external interference of either an audience, a cameraman or any other distraction.

Cohen et al., (2007) suggest that crucial information may be lost during data analysis. For example, during the transcription phase of interviews, some important data may be lost or distorted. They warn that reliance on one method of data collection may distort the

researcher's picture of reality. To reduce the risk mentioned above, data triangulation was used in this study. As defined by Cohen et al., (2007), triangulation is “ the use of two or more methods of data collection in the study of some aspect of human behaviour” (Cohen et al., 2007 p.141). Triangulation is further defined as “a validity procedure where researchers search for convergence among multiple and different sources information to form themes or categories in a study” (Cresswell& Miller, 2000, p.126). Data from questionnaires, interviews as well as records of the participants' performance was triangulated.

When data that was collected through different methods of collection happen to yield the same results, a greater degree of confidence about the findings is achieved. Just as triangulation builds more confidence in the findings, it also serves as a tool by which the researcher checks the data collected. Triangulation also works to disconfirm emerging trends which did not hold across the data sources. However, Cresswell& Miller (2000) warn that the “search for disconfirming evidence is a difficult process because researchers have the proclivity to find confirming rather than disconfirming evidence” (Cresswell& Miller, 2000, p.127). There also exists the risk that disconfirming evidence could outweigh confirming evidence.

Participants completed the questionnaires in the absence of the researcher. This, according to Cohen et al., (2007), is helpful because “it enables the respondents to complete the questionnaire in private, to devote as much time as they wish to its completion... and to avoid the potential threat or pressure to participate caused by the researcher's presence” (Cohen et al., 2007 p.344). Cohen et al., (2007) further assert that the absence of the researcher when the questionnaire is completed also makes it easier for participants to reveal sensitive matters more than they would have done in the presence of the researcher.

Lastly and importantly, I described the setting of the study in detail, where participants were fully described in rich detail. This was especially true in the case of interviewees, where the biography of each participant was given, to highlight why such a participant was included in the interview. This provided a thick description, whose purpose according to Cresswell& Miller (2000), is “[to create] verisimilitude, statements that produce for the readers, the feeling that they have experienced or could have experienced” (Cresswell& Miller, 2000, p.129). This procedure of giving a thick description, “enables readers to make decisions about the applicability of the findings to other settings or similar contexts (Cresswell& Miller, 2000, p.129). Guba (1981) supports the notion that a thick description may “demonstrate an

essential similarity between two contexts”, thus making it “reasonable to suppose that tentative findings of Context A are also likely to hold in Context B” (Guba, 1981, p.81). The rich details given in this study helped to produce such validity.

3.6. ETHICAL CONSIDERATIONS

The study conformed to the requirements of the University of KwaZulu-Natal with respect to ethical considerations. As students of the ACEML, these participants had signed informed consent letters agreeing that their records could be used for research purposes. However, the participants of this study were further given an informed letter of consent (see AppendixH) which they signed. In this letter they were requested to give consent to be participants in the study. They were assured that their identity would never be revealed since pseudonyms would be used instead of their names in this study.

The participants were advised to complete questionnaires out of school hours. The interviews took place after school hours and during weekends and hence no permission had to be sought from the Department of Education. Participants were also informed that they could get the final report of the study after it had been completed, on request.

3.7. CHALLENGES OF THE STUDY

3.7.1. Identifying suitable Participants for the Questionnaire

The data collection stage was the most challenging and most time consuming, because teachers were at their workplace and not gathered together as students in a University setting. In trying to find possible participants I found that some teachers were teaching Mathematical Literacy at their schools, but had never studied an ACEML in any University. Others had done it through other universities, hence they were not suitable candidates for this study.

I was assisted by a colleague in this process of identification of suitable candidates. There was then the challenge of persuading them to agree to participate in the study.

Some teachers said they did not have time to complete the questionnaire after school hours. Those teachers who took the questionnaire required a lengthy period to complete it. Most of them had not finished by the time I contacted them, weeks after they received them. One participant even misplaced it and did not want a second copy. So he withdrew his participation.

3.7.2. Identifying suitable Participants for the Interview

Interviews were my biggest challenge. Initially, none of the teachers volunteered as participants. I even questioned whether teachers were reluctant because I was their colleague and they were suspicious of why I wanted to know about their teaching strategies and their content knowledge. One of the teachers offered to give an interview, on condition that it would be conducted in both IsiZulu and English. It must be noted that all of my participants were second language English speakers. It would have been more difficult for me to find first language English speakers who do not teach in areas close to me. It took me more than two full weeks to find four teachers who were willing to be interviewed. Nevertheless, I ultimately succeeded in finding four of them.

3.7.3. Avoiding Researcher bias

As both a Mathematical Literacy teacher and a former ACEML student of the University of KwaZulu-Natal, the intrusions of researcher bias were inevitable at some stages of this study. Sometimes participants gave opinions which I personally did not perceive as true, due to my earlier involvement in the ACEML programme. Although minimal, these circumstances posed a threat at some stage to the impartiality of the study. However, with professional help from academics and peer scrutiny of the research project (Shenton, 2004, p.67), I managed to overcome such as an impediment. For example, I already knew the importance of the generic modules included in the programme and it was not easy for me to understand why a person who has studied such modules would dare say that they should not be included in the programme. Through what I had learnt from the Research Methodology modules earlier on, I knew that the opinions of a participant should neither be encouraged nor discouraged, because opinions of the participant constitute part of the research itself. By identifying my “progressive subjectivity” (Guba & Lincoln, 1985) I ensured that it did not intrude on my interpretation of data.

At the beginning of each interview, I reminded each participant that it was important for them to be honest with me, and not just say things they thought I wanted to hear. As the interviews progressed, I would remind them of the need for honesty, whenever I felt that they were forgetting my earlier statement. For example, participants may not have admitted that they studied the ACEML because they wanted to upgrade their qualification and hence receive a better salary, or they would not have studied the ACEML if they had to fund their own studies.

CHAPTER 4

RESULTS

4.1. REPORT BASED ON THE QUESTIONNAIRES

4.1.1. The Report on the First Group of Questionnaires [Questionnaire A]

The questionnaire had four sections. Section A asked for the details about the background of the participant; Section B was on the participants' impressions about the ACEML programme; Section C dealt with content and Section D had general statements relating to identity and beliefs of the teachers about the ACEML and the subject ML. Questionnaire A had 15 respondents. Note that teachers' responses are reproduced verbatim, as written or spoken.

The questionnaires revealed that most (twelve out of fifteen) of the participants had taught ML in Grade 10 in the past few years. Various subjects were also taught by the participants prior to enrolling in the ACEML programme. These subjects included Accounting; Religion Studies; Life Orientation; English; Business Studies; Economics; History; Physical Science; Life Sciences and Natural Sciences. Nine of the teachers had only taught Mathematics in the GET phase including four who also taught in the FET phase. The number of teachers who had taught each subject is better illustrated in Table 4.1.below. (Some teachers indicated that they teach more than one subject):

Table 4.1. Number of teachers who taught different subjects

Subjects taught	No of Participants		No of Participants
Mathematics Gr 8	5	Accounting	2
Mathematics Gr 9	4	Religion Studies	1
Mathematics FET	4	Life Orientation	2
Physical Science	1	English	2
Life Science / Biology	2	Business Studies	1
Natural Science	2	Economics	1
Math Lit Gr 10 only	12	History	1

Math Lit Gr 11 & 12	10		
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The current post level and the qualifications of the fifteen participants is shown in Table 4.2. and Table 4.3. respectively:

Table 4.2. Current Post Level of Participants

Current Post Level				
PL1	PL2	PL3	PL4	Other
11	1	3	-	-

Table 4.3. Teacher qualification on entering the ACEML

Qualifications					
3yr Diploma	Post Grad. Diploma	Bachelor's.degree	Honours degree	Master's degree	other
8	3	6	3	1	-

(Some teachers hold more than 1 qualification)

When asked to select from a list of stipulated reasons why they enrolled in the ACEML programme, 13 of the participants stated that they enrolled because they were qualified to teach another subject and they wanted to be retrained to teach ML. From these 13, one also mentioned that she saw the need to be trained in the new subject which was unknown to anybody at her school. Four of them claimed they wanted to refresh their ML knowledge. Two were instructed by their School Management Teams to enrol whilst only one admitted that the intention was to upgrade to a M+4 teacher qualification category.

Twelve of the participants agreed that they were teaching ML currently while three were not. Some of the reasons given by the three who are not teaching the subject presently were the following:

- one is no longer a school-based teacher after she got promoted to an office-based post almost immediately after completing the ACEML programme.
- the other was prevented by her principal who claimed that there were sufficient ML teachers at their school. She had to return to her previous subject.

- the third stated that she could not teach two Grade 12 subjects in the same year and hence continued with her other specialisation subject.

Section B, as already mentioned earlier, sought to establish the participants' impressions about the programme whilst they were students. Ten of the participants agreed that the tutors knew the content well, 3 strongly agreed and two were neutral. Eleven said the tutors were able to explain the content well, 2 strongly agreed and 2 were neutral. Seven of the participants said the tutors were always well prepared, whilst four said they strongly agreed. Four were again neutral. Most of the participants (11) said tutors were considerate and empathic and treated them as colleagues and adults (12 participants). Only one participant disagreed with these last two statements. All the others strongly agreed.

Participants unanimously agreed that their content knowledge improved as a result of their participation as well as their teaching strategies, assessment skills and confidence as ML teachers. Only two participants were not sure whether the above had improved or not. Their responses about the results of their learners in ML were similar because 12 of the participants claimed these had improved. There were no responses from the three participants who are not teaching ML currently.

Asked whether their studies had been made easier because of readable materials, supportive tutors, knowledgeable tutors and support from other students, most of the participants (between 12 and 14) either agreed or strongly agreed. There were 2 neutral responses in these questions which reflected that some participants were not sure.

It was quite interesting to note that two female participants did not feel that the support of their family networks and their School Management Teams (SMT) contributed to making their studies easier. Whilst all the others agreed or strongly agreed to the above, the two participants continuously disagreed. These two participants also viewed the contact sessions as not being well paced and very intensive, giving them insufficient time to study. On the other hand, the remainder of the participants saw the opposite. Most, except for one participant, claimed that the centre was not far from their homes.

The responses to questions about reasons for dropping out reflected a shift from the trend of agreeing with each of the statements. Participants disagreed that reasons for dropping out were a lack of a supportive family network. Three participants were neutral. One of them did not respond at all. There was a similar trend observed in the responses about dropping out

because of a non-supportive SMT where participants disagreed with this statement; although the number of neutral responses rose to four. The pacing and intensity of the contact sessions was not seen as a reason for dropping out. However, eight of the participant thought colleagues might drop out because of insufficient study time, with two participants indicating strong agreement with this reason. Ten participants expressed their disagreement that distance from campus contributed to some students dropping out of the programme.

When asked about the issue of dropping out themselves, 13 of the participants said they never considered dropping out. Only two admitted that they once considered taking this action. There were three main reasons why participants said they did not drop out. Firstly, there were two participants who gave reasons related to their motivation being the upgrading of their qualifications or improvement in content knowledge. A second reason was that they were interested in the content or modules. Others mentioned that they managed with the course or received support.

Whilst six of the participants saw all modules as being equally useful, four saw Numbers and Operations as being the most useful while three saw Space, Shape and Measurement in that light as well. Only one participant saw Data Handling as the most useful module. Strangely, one participant said none of the modules was most useful. Unfortunately this participant did not elaborate on this statement, so it remains ambiguous as to whether they thought that all modules were equally useful, or not useful.

Eleven of the participants indicated that none of the modules was least useful. However, two of the participants claimed that Teaching & Learning was the least useful module and one said Education Policy & Professionalism together with Data Handling were the least useful modules.

Participants were required to name any issue that made a huge difference in their teaching and learning of ML, which they had encountered in any of the eight modules they had studied. The responses given were related to three main components. Firstly, there were those participants (8 participants) who mentioned a number of content-related problems that they claimed had been addressed during their study. These included introduction of graphs in functional relationships; interpretation of graphs and maps; calculation of areas and volumes; relating shapes to real life situations; solving word problems and equations; learning more about percentage; learning more about plotting of graphs and scales; calculation of hire

purchase; as well as tree diagrams in probability. Secondly, there were those who reported some development in their teaching strategies and classroom management styles (4 participants). These developments included being revived as a resilient teacher, regardless of the conditions under which one works, handling of large numbers in huge classrooms, learning different forms of assessing learners' work, usefulness of group work, as well as improvement in one's filing system. The rest of the participants (3) were general comments, for example, one said that studying made her realise some misconceptions that she had held; while the second said learning to deal with each of the different learning outcomes separately; and the third said improvement of 'self' as a teacher.

Section C intended to find out the participants' knowledge and understanding of the content from their own perspective.

When asked whether they had ever felt uncomfortable in teaching any concept, topic or section in ML, the responses given pointed to the following:

Five of the participants had problems in Space, Shape and Measurement. Specific sections of the learning outcome were not given except for Scales and Maps as well as calculation of litres of paint and bricks in building houses. These four participants indicated that they were weak in this learning outcome, and had more problems in it. Two of the participants mentioned sections in Data Handling, specifically percentiles and probability. Two expressed that they were never uncomfortable, where one mentioned the reason as being his/her long service of teaching Mathematics; while another said he/she was comfortable after studying the ACEML. Only one participant had a problem in Functional Relationships and the blame was shifted to learners who did not practice the work given to them. The remaining participant simply mentioned a few misconceptions which she claimed were cleared during her study.

Participants were asked to give their preference of grades that they enjoyed teaching in ML and to give reasons for their choices. Four preferred Grade 10 only, three Grade 11 only, six Grade 12 only and four all grades equally. The possible reasons for their choices were summarised as follows:

- One felt that Grade 12 is revision, hence she preferred teaching Grade 12
- Was not confident enough for Grade 12
- Was only given Grade 10 in her school
- Had only taught Grade 10 ever since she started teaching ML

- Preferred Grade 10 because it is where the subject is introduced
- Felt confident in Grade 12 and always “wanted to measure my guts against National Assessment”
- Math Lit is the same throughout the FET phase. Hence teaching Grade 10 automatically implied that you could teach Grade 12. This participant could teach any grade at any time.

In a question where participants were asked to rate the ML learning outcomes in order of their preferences, from 1 - 4, where 1 would indicate the **least preferred** and 4 **the most preferred**, the distribution of preferences was as shown in Table 4.4. below:

Table 4.4. Rating of Learning Outcomes

Learning Outcome and Rating	1	2	3	4
LO 1	2	1	5	7
LO 2	4	4	3	3
LO 3	2	2	4	6
LO 4	2	1	7	4

It seems as if some participants did not fully understand the instruction in this question. The analysis showed that some thought the rating was meant in terms of the level of difficulty, some rated all the LO's fourth. The misunderstanding that participants had in this question was disclosed (2 participants) on different occasions when returning the questionnaire. They actually asked me, referring to the question and pointing out the ambiguity that they encountered. As a result, the numbers do not match exactly with their total which was 15. However, it was clear that Learning Outcome 1, Numbers and Operations in ML was preferred by seven participants. LO 3, Space, Shape and Measurement (six participants). Those two were rated by 7 and 6 participants respectively as the most preferred modules (learning outcomes). Fewer teachers preferred LO 2 (three participants).

Fortunately, participants were asked to elaborate on why they rated fourth whatever learning outcome that they rated in that manner. One person who rated LO 1 as the most preferred wrote: “Our Number and Operations (LO1) tutor was so good” ;

Five of the participants had indicated a weakness in LO 3 in an earlier question, where they were required to indicate sections they were uncomfortable with, but these are some of the reasons given for rating LO3 fourth:

- I rated Space & Shape fourth because it has Geometry which is more useful
- I find shapes interesting in Math Lit and related to real life, unlike in Calculus where I had problems
- I understand Space & Shape (LO 3) & Data Handling (LO 4) better
- LO 3 is more authentic and relevant to real life and can be modelled easily

We also see rating of the LO's according to learners' weaknesses or strengths in that LO. For example, participants (2 of them) said, “learners battle with LO 1”; “learners hate LO 3 & 4.” One participant rated all LO's as fourth. There is a possibility that this was a response of the participant who had said she never felt uncomfortable in any section in the earlier question. Hence she preferred all LO's equally. Some had these reasons for LO2:

- I rated Functional relationships fourth because it is a bit challenging and difficult
- I just enjoy Functional Relationships;

Others gave the following for LO4:

- It is so easy and interesting, I enjoy teaching Data Handling a lot
- I think LO 4 is not a main feature in Maths syllabus but it is more important

While eleven of the participants had taught Grade 12 before, only 2 had not. Another two did not respond to the question that sought to ascertain whether they had taught Grade 12 before. The intention was to establish whether teaching of Grade 12 had been voluntary to the participant or had been imposed by either circumstances or an individual(s). Five said it was voluntary, four stated that it was an imposition and six did not respond. Here as well, participants were expected to give reasons why they had or had not taught Grade 12 in the past. These were their reasons:

- I taught Grade 12 because I was the only ML teacher in my school
- In my school, a teacher has to take his/her learners from Grade 10 to Grade 12

- The Grade 12 teacher was absent for a long time
- Teaching Grade 12 was not voluntary, yet it was not imposed
- I could not teach two subjects in Grade 12
- I was considered to be the better option than other colleagues and I was also willing.

The last of the Sections in the questionnaire, Section D, was one in which general statements were given to participants. They in turn were expected to respond in one of five ways to each question, either by indicating *strongly disagree (SD)*; *disagree (D)*; *neutral (N)*; *agree (A)*; or *strongly agree (SA)*. The results of this last section are better illustrated in Table 4.5. as shown below:

Numbers in the Table reflect the number of participants who chose that option in completing the questionnaire. It should be noted that for each question, the sum of the horizontal numbers is fifteen (15), which was the total number of questionnaires analysed.

Table 4.5. Responses to Section D of Questionnaire A

Statement	SD	D	N	A	SA	NR
	No of Participants					
20.1. Any Maths teacher can teach ML without the ACEML	5	5	4	1		
20.2. Subject Matter Knowledge of participant in ML was adequate before ACEML	3	5	4	3		
20.3. ACEML has improved participant's Subject Matter Knowledge				8	7	
20.4. ACEML could be replaced by a 3 weeks' Departmental Workshop	8	2	2	1	1	1
20.5. ACEML has introduced participant to new teaching strategies			1	7	7	
20.6. A formal ACEML qualification is not necessary for one to teach ML if one has Maths background in Gr 12	9	3	3			
20.7. Participant feels more confident in ML class than would have been without ACEML	1		2	3	9	
20.8. Participant can participate in any ML-related debate with peers because of ACEML			1	8	6	

20.9. Participant understands most Government policies in Education because of studying ACEML		1	2	9	3	
20.10. Can defend introduction of ML to people who criticise introduction of subject after completing / studying ACEML				6	9	
20.11. Sees self as belonging to group of professionals after studying ML			1	9	5	
20.12. Feels that he/she would not have been able to teach ML effectively if he/she had not enrolled in ML			1	5	9	
20.13. Would recommend to any ML teacher to study the ACEML programme			1	2	12	
20.14. Would not be ashamed and would instead prefer to be called an “ML teacher” after studying ACEML				2	13	
20.15. Would agree if someone were to say that Participant’s content knowledge was LIMITED before studying ACEML		1	2	2	6	4

There were ten participants who disagreed that any Mathematics teacher can teach ML. Four were neutral on this issue and only one participant agreed. This statement could be grouped with number 20.6, where nine participants strongly disagreed and three disagreed that a formal ACEML qualification is *not* an essential pre-requisite for one to teach ML. This response suggested that participants felt that to teach ML one needed an ACEML qualification.

Looking at these statements in terms of development of an identity as an ML professional, numbers 20.8; 20.9; 20.10; 20.11 and 20.14 are all suggestive of the fact that participants have a strong sense of identity in being ML professionals because they mostly either agreed or strongly agreed with all of these statements. In each of these statements we only observe one participant who stood out as being neutral.

In 20.2 and 20.3, as well as 20.15, most responses suggested that participants (all 15) felt that their content knowledge had been improved by their participation, and that such knowledge had been limited before their study as it had not been adequate.

4.1.2. The Report on the Second Group of Questionnaires [Questionnaire B]

This second questionnaire had three sections. Section A was asking about the details of the participants. Section B dealt with the participants' impressions about the ACEML programme and Section C asked for the participants' advices on future changes to the programme. Both closed and open-ended questions were found in the questionnaire. Section C was one of the prominent differences between Questionnaires A& B, because Questionnaire A did not have this section.

These eight completed questionnaires were obtained from the university and had been issued by the course co-ordinators of the ACEML programme in trying to consider arguments in support of teacher development through the Continuing Education route. Some of the questions in the questionnaire were similar to those in Questionnaire A, hence they were utilised in this study to triangulate sources of data and also as supplementary data sources.

Section A of this questionnaire asked participants about themselves, the geographical areas in which they taught, the name of the places where their schools were located, their teaching experiences and the subjects they taught as well as whether participants would continue to work in the areas they were working at after graduating from the ACEML. It may be interesting to note the subjects taught and the participants' experiences which are summarised in Table 4.6. below:

Table 4.6. Subjects taught and teaching experience of Participants in Questionnaire B

4. Subjects taught	Teaching experience
a) Life Science	19 years
b) ML	4 years
c) SS, Maths, English, Math Literacy	9 years
d) SS ; Maths; LO (Gr 4-5)	6, 8 and 6 years respectively
e) ML	Not mentioned
f) IsiZulu; Math Literacy	13 and 2 years respectively
g) Life Sciences; NS	9 years
h) Physical Science	15 years

It is noted that all but two of these participants had been teaching for long periods in different subject areas. Questionnaire A had similar results in this case.

When asked about the extent to which participation in the ACEML had improved some aspects and strategies of their teaching, seven of the eight participants indicated that there had been a big improvement in their classroom strategies, assessment skills, knowledge of ML concepts, knowledge of learning theories in ML and knowledge of contexts in ML. In this question they had to choose from *big; little or none*.

In a subsequent question, participants were required to indicate whether some stipulated issues had made their studies easier or difficult. Their expected response was either *easier or difficult*. The results of that question are shown in Table 4.7. below:

Table 4.7. Responses to Question 6 of Questionnaire B

6. Have the following issues made your studies easier or more difficult?		
ISSUES	DIFFICULT	EASIER
Level of difficulty of materials	4	4
Tutor explanations and support	1	7
Time constraints for studying	7	1
Intensity of Contact Sessions	6	2
Family support or responsibilities	7	1
Teaching duties at school	4	4

We note a balance in the number of participants who felt that the level of difficulty of materials as well as teaching duties at school made their studies both easier and more difficult, respectively. However seven of the eight participants felt that the tutors made their studies easier. When it comes to time constraints for studying as well as family support or responsibilities, seven of the eight participants felt that those two issues made their studies difficult. Contact sessions were seen as intensive by six of the participants and this made their studies difficult.

The question on factors that contributed to large numbers of drop outs was interesting when all eight participants unanimously felt that family commitments contributed significantly to the dropping out of students. Similarly, all eight participants disagreed that dropping out

could be as a result of lack of tutor explanations and support. For time constraints and travelling to contact sessions, seven participants in each aspect agree that these could contribute much to large drop out rates. This showed a difference of opinion from what the other group had said in Questionnaire A. Ten out fifteen in the first group (Questionnaire A), had seen distance from campus as not being an issue that can contribute to dropping out of students. Five participants thought the level of difficulty of materials and teaching duties also led to other students dropping out. When asked for other reasons that they could provide for this move, one participant complained that they had to do more work over a short period of time and this increased the number of drop outs. Six of the participants said they never considered dropping out. The two who did, said they held on because one got support from her husband and family and the other was pushed by the fact the government wanted all teachers to have an m+4 qualification category by 2014. His motivation was clearly to upgrade to a higher level of teacher qualification.

Participants were then asked to identify what they felt had made a big difference in their teaching of ML, from each of the eight modules. From the four content related modules, participants identified several topics and concepts which included the following mostly:

Table 4.8. Topics identified by Questionnaire B participants as making huge difference in their teaching of ML - (School Content related modules)

Number and Operations	Data Handling	Functional Rel.	Space & Shape
<ul style="list-style-type: none"> - cellphones - relating numbers to real life - conversions (currency) - bills & statements - compound interest 	<ul style="list-style-type: none"> - graphical representation - tree diagrams - learning that data can be misleading - scaling 	<ul style="list-style-type: none"> - formulae for graphs - linear programming - making learners aware of the Mathematics around them 	<ul style="list-style-type: none"> - surface area, volume & perimeter - ability to draw various difficult shapes - prisms - contextualised geometry is easy to understand

Participants had to do the same for the four generic modules and some of the comments that they made are given below:

Table 4.9. Comments by Questionnaire B participants on the Generic Modules

Learning & Teaching	Educ Policy & Prof	Teaching & Learning Maths in the FET	Professional Practice
<ul style="list-style-type: none"> - methods of teaching - taxonomy levels - Vygotsky's theory 	<ul style="list-style-type: none"> - Norms and standards for teachers - learning school policies 	<ul style="list-style-type: none"> - readings and metaphors - strands of mathematical proficiency - strategies of teaching & taxonomy levels theory - the purpose of ML - <i>I failed to understand the aim of this module</i> 	<ul style="list-style-type: none"> - how difficult it is to implement a new idea, but it is necessary to include new ideas - how to be a professional ML teacher - <i>coordinator was very supportive and understanding and thus changed the way I do things in class</i> - research

The eight participants had been asked to rank these modules from 1 to 8 in order of usefulness to them as ML teachers. No significant pattern was observed as opinions differed inexplicably. The best way to present the responses was also in the form of a table where the number of participants who ranked a specific module on that ranking are shown in *italics*. This is shown in Table 4.10 below:

Table 4.10. Ranking modules from 1 - 8 in order of usefulness to you as an ML teacher

Ranking→ Modules	1	2	3	4	5	6	7	8
	No of Participants							
Numbers & Op	<i>3</i>	-	<i>1</i>	<i>1</i>	-	<i>2</i>	-	-
Data Handling	<i>1</i>	<i>2</i>	<i>1</i>	-	<i>1</i>	<i>1</i>	<i>1</i>	-
Funct. Rel.	<i>2</i>	<i>1</i>	<i>1</i>	<i>1</i>	-	-	<i>1</i>	-
Learning & Teach.	<i>1</i>	-	-	<i>3</i>	-	<i>1</i>	<i>1</i>	<i>1</i>
Ed Pol & Prof	<i>1</i>	<i>1</i>	-	-	<i>2</i>	<i>1</i>	<i>1</i>	-
Space & Shape	<i>2</i>	-	<i>2</i>	-	-	<i>2</i>	<i>1</i>	-
Prof Prac.	-	-	-	-	<i>1</i>	-	<i>2</i>	<i>3</i>

Teaching & Learn.	-	-	-	-	1	-	3	2
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The reasons for enrolment in the ACEML programme were elicited as well; and a participant could tick more than one reason if that was applicable in his/her case. It is for this reason that we see ten responses from eight participants as shown in Table 4.11. below:

Table 4.11 Reasons for studying in the ACEML programme (Questionnaire B)

12. Reasons for studying ACEML	
You are underqualified and the ACE will allow you to upgrade your REQV level	1
You are qualified to teach another subject and the ACE will retrain you to teach ML	5
You wanted to refresh your ML knowledge	4

Only one participant admitted that his/her enrolment was for purposes of upgrading to a higher REQV level. Five claimed that they wanted to be retrained to teach another subject whilst four wanted to refresh their ML knowledge.

Subsequently, participants were asked whether they preferred to enrol for a full qualification of the ACEML or would have preferred to enrol for short courses that focussed on a particular section of the curriculum in which they required assistance. Five of them preferred the ACEML as a full qualification, whilst three would have wanted to do shorter courses. For these short courses, participants had to identify specific topics in which they would have been pleased to be assisted. One mentioned both Functional Relationships and working on cellphone charges. Another participant said any topic would have been welcome; whilst the third participants mostly preferred Space & Shape, but would also like to do all four learning outcomes only.

Towards the end of the questionnaire participants were asked to provide suggestions that they would give to the University of KwaZulu-Natal in order to improve the ACEML programme. Their suggestions were so diverse that I could not identify categories. However, two

suggested that contact sessions should be stretched over more days but fewer hours. They reported that they could not concentrate over a long day of more than five hours of learning. One suggested that the four generic modules should be merged into two where Learning & Teaching combines with Teaching and Learning whilst Educational Policy and Professionalism be combined with Professional Practice. One participant stated clearly that generic modules should be done away with because they were difficult modules. One participant felt that attending lectures during the holidays (all of the school holidays) was not good for them as parents. An unexpected claim was made by one participant who suggested: “ *Do not enrol genius (very clever) tutors. The standard of question papers must be not very far from the level of teachers (students).*” No further elaboration was given for this suggestion, and unfortunately the response was given in a questionnaire. This left me with no opportunity to ask the student for a deeper elaboration. It was only when I checked the student’s records that I realised what could have brought up such a comment. During her enrolment, the student had to write supplementary examinations in two modules. Those modules were: Functional Relationships and Teaching & Learning Maths in the FET. She failed in Functional Relationships and had to come back in 2010 to repeat this module, which she passed and obtained 68%. Her records therefore gave me a possible explanation of her dissatisfaction about “*genius tutors*” and “*the standard of the question papers.....*” This last section was not found in Questionnaire A.

4.2. REPORT ON THE INTERVIEWS with PARTICIPANTS

In this section, I first present the biographical data of each of the interviewees, in order to develop a deeper understanding of their responses. The aim was to look at professional development of each participant in terms of subject matter knowledge, interchangeably referred to as subject content, which might or might not have been acquired as a result of participation in the ACEML programme. This is followed by an exploration of the content specific pedagogy and lastly the development of a professional identity and the beliefs of an individual as a ML teacher. From the four participants who were interviewed separately, on a one-to-one basis, these are their cases:

4.2.1. TEACHER A: Miss ZN

BIOGRAPHY

Miss ZN was the only one of all the participants who had done Mathematics up to Grade 9 level. She joined the programme in the 2006 cohort of the ACEML programme at the University of KwaZulu-Natal, when the University had not strictly enforced the admission criterion of Grade 12 Mathematics. Miss ZN held a three-year teaching diploma, so was on an M+3 qualification category. Her main motivation in enrolling for the ACEML was to upgrade to a higher category which would enable her to increase her earnings. In her words, she says: *“So to be honest it was about money to me more than teaching it. I didn’t think that I would be able to teach it.”* In the interview, she disclosed that she had no intention of teaching the subject ML after completion of the programme. However, in the questionnaire she only mentioned that she was qualified to teach another subject and wanted to retrain and be reskilled to teach the new subject.

Prior to enrolling in the ACEML she taught Accounting in the FET (which she had been teaching from 2002 up to 2006) and Economic and Management Sciences (EMS) in the GET phases respectively. She openly admitted that she was not even comfortable in teaching Accounting, which was her major in her initial teacher qualification from the college of education she had attended. She made a big effort to teach and her discomfort with the subject was not recognised by other colleagues. However, after completing the ACEML in 2008, she stopped teaching Accounting and is presently teaching ML only, from Grade 10 to Grade 12.

ON SUBJECT MATTER KNOWLEDGE

One would expect, based on her biographical background, that Miss ZN would struggle in coping with the content in ML. She admitted that she did not know anything about areas, volumes and perimeters before enrolling for the course. She also pointed out that she did not know how to interpret graphs and maps, and could not even use the set of Mathematical instruments. In fact, on the questionnaire she stated that the list of concepts and topics that she did not know was seemingly endless. She further summarised her content knowledge by saying that Space, Shape and Measurement was her weakness. However her completion of the ACEML resulted in a turn-around in her confidence. When asked in the questionnaire,

the grade that she preferred to teach among 10; 11 and 12, she said, “I enjoy teaching Grade 12 because I am now confident in facing any other challenge that I may come across. I don’t think I will be able to teach Accounting again.”

Whilst some participants claim that their content knowledge was adequate even before they enrolled for the ACEML programme, Miss ZN strongly disagreed in her questionnaire response. She maintained that her participation in the programme had improved her subject matter knowledge. She stated that she would not have been able to teach the subject if she had not enrolled for the programme, because her content knowledge was limited before studying the ACEML.

During the interview, Miss ZN maintained that she would gladly write any ML test that could be set at Grade 12 level. This was her response to that question:

“Yes of course, not only at Grade 12 level, there were some workshops that we have undergone where we were supposed to write a pre-test, so ..and post-test, so.. and I was able to write those tests”.

Her feeling was that any teacher who wishes to teach ML should start by studying the ACEML. Some of the benefits of the programme was the opportunity to acquire new content, followed by the development of new teaching strategies and develop an identity. When asked whether she would have agreed to teach ML if she had not studied the ACEML, her response was as follows:

“I said earlier on that I hadn’t studied Maths...so I wouldn’t have agreed, ‘cause I hadn’t studied Maths”

Among the comments that she made, on subject content, the following response was one of the most interesting. She had been asked to single out just one thing that she felt she would not have known had she not studied the ACEML. She provided more than just one example, showing that she was positive about these developments. These are her exact words:

Miss ZN: eh... looking at Space and shape. I remember one day we had an argument with ...can I say a person’s name, the lecturer?

Interviewer: No.

Miss ZN: Oh. One of the lecturers who was teaching us Space and Shape... I didn’t know what is a prism. So I asked him “what is a prism?” and I don’t know whether

he was nagged by me asking what is a prism ... I didn't understand it, I didn't do Maths at school. So by his response, although it was harsh, it made me to study more of Space and Shape cos it was the one subject which was difficult for me. I didn't know those areas, those volumes...what and how am I going to explain to the kids... what are those things 'cause, since I haven't done Maths, it was very difficult for me. So it really makes sense now if I look back and if I look the way questions are being asked at the question papers for the learners. So concerning the tiling, which relates to the real life, the volume of the... maybe for instance a can of Coke™, how much liquid must be in there. So that really made me more aware...that was the new thing that I learnt, it helped me a lot. So I reason, I know that ML in Space and shape its not only volumes and those things like in Maths but it really link with the real life situation, like how many people can fit in the hall or in the cinema. So its ...it was a new thing to me to discover in ML.

The above excerpt reveals that Miss ZN was open enough to admit that she did not know about prisms. She also pointed out that she has learnt about volume and can relate it to real life by discussing a can of Coke™ and its contents. She further singled out the theorem of Pythagoras that she has learnt on her own, after completing the ACEML programme. This is what she said about the theorem:

Miss ZN: (Laughs) For instance eh... maybe myself I have forgotten it.... but I don't remember doing Pythagoras theorem from my study of ML. So that is the only chapter if I may say or module that I did not learn from ACE. I don't remember studying it but other things

Arguably, the tutors in the ACEML may not have spent too much (or any) attending to the Theorem of Pythagoras, on the assumption that everybody would be familiar with the concept. However, Miss ZN was affected by their omission, because she only learnt the theorem later, when she encountered it in her teaching. She added to the list the interpretation of maps, which she barely remembered from the ACEML programme. Be that as it may, Miss ZN still holds the opinion that whilst one can learn some concepts and topics on her own, the attitude of a person has a role to play in learning new concepts in ML. Asked whether any other teacher can learn ML as he/she teaches it, this is what she said:

Miss ZN: *It depends on one's a...*

Interviewer: *attitude?*

Yah. It depends on one's attitude, 'cause if you are just given ML whereas you do not like it, you won't be able to learn it. I was able to learn those maps, those interpretations of maps, those eh... that Pythagoras theorem because I did like ML.

Miss ZN's comment reveals that she learnt new subject matter throughout her studies. Miss ZN's determination on the issue of acquiring content knowledge was shown in her academic records. These were the records of the final marks that she obtained during her study. In the four content modules specifically, they were as follows:

For Numbers and Operations in Maths Literacy she obtained 60%; for Data Handling 70%; for Functional Relationships 61% and for Space, Shape and Measurement, 70%. It must be remembered that Space, Shape and Measurement is the module in which she herself had expressed her problems with, when she said:

"I didn't understand it, I didn't do Maths at school. So by his response, although it was harsh, it made me to study more of Space and Shape 'cause it was the one subject which was difficult for me".

However, a knowledge of subject matter only without knowledge of content specific pedagogy, is not of much use to a teacher. Hence it is imperative to examine her professional development in that aspect.

ON CONTENT SPECIFIC PEDAGOGY

Miss ZN expressed that she has changed her teaching strategies. Comparing the new subject ML, to her previous subject Accounting, she observed that she had started to use new strategies. This is part of what she said:

"...And my teaching strategies ... its just that they have changed. Not through... by courses, but through the experience I've got when teaching, when seeing more papers that are written each year by Matric. So it made me change my teaching strategies."

In the above quote Miss ZN said that her exposure to more examination papers and assessment tasks has resulted in changes to her teaching strategies, possibly because she is

getting a clearer idea of assessment in ML. She also said that her strategies are changing, because of her actual teaching experience. Miss ZN continued and explained more specifically about some changes:

“Another thing that I did ... normally in Accountin, I didn’t do charts. But in Math Literacy ‘cause there are those formulas, different formulas that appears each and every year in the question paper for Matric, as well as in Grade 11, I do have those formulas...I made charts, I posted them [on] the walls so that they make my teaching more easier; and so that they can see that its something not difficult.”

Her statement above revealed that the use of charts, is one of the aspects of her new teaching strategies. She admitted that she did not use charts when teaching Accounting, which might have been because of the nature of the subject. Nevertheless, it was a new teaching strategy for Miss ZN, who is new to another subject. One of the reasons for using such charts is that they can provide useful information to her learners, thus saving her some trouble. *“A learner who have forgotten the formula will have to look at the chart there which is on top, without me reminding them of what they should do.”*

I have already noted in the previous section that Miss ZN did not even know how to use a set of Mathematical instruments. However, as part of her process of learning to be a teacher of a new subject, she learnt how to use instruments as well as a scientific calculator. These had not been used in Accounting, hence she, together with her learners, had to find ways of remembering how to use specific keys for certain operations. In tackling this obstacle, and as a new strategy to make her teaching easier for her learners, this is what she said she did:

“And then there’s also some calculators that were introduced ..I don’t know whether is was CASIO, they are more difficult to operate and as a result I designed some charts with some keys to them so if they are doing some sums, those learners who are having those calculators they are able to look at those charts that I have designed for them. And I’m able.... before I didn’t mind using a calculator because I was using it in Accounting. I didn’t use Scientific calculator, I just used any calculator but now, I’m being more introduced to the other calculators like SHARP have developed a new calculator, and now I’m a person who’s more eh.... who has more knowledge of how to operate a calculator and it give me more knowledge about how do I handle myself in front of the learner.”

Although some participants felt that the other generic modules which were not directly linked to school level subject content, would help them in their classroom teaching strategies, Miss ZN does not concur. Her opinion was that such modules should not have been included in the ACEML programme. She did not see these modules as being of any help in the improvement of her teaching strategies. When asked about the inclusion of these modules, this was her response:

Miss ZN: My opinion is... it reminds me when I was doing the Education, where we studied about the dog behaviour..., unconditioned ... , I don't know whether I'm recalling it very well?

Interviewer: ...classical conditioning? [you mean] Pavlov?

Miss ZN: Yah. Pavlov. So I didn't see the need of studying that. Same thing applies here of what you have mentioned, Teaching & Learning... Its my opinion. Maybe some other people saw the need to do those things but to myself I didn't see the need of studying it. I will agree about those who say it must only focus on those learning outcomes in ML.

From what she says, it is obvious that she was against their inclusion, because she wanted a greater focus on content arising from the learning outcomes of ML. She even went further to say that

Miss ZN: Yah. I thought I would do only the content, though I didn't know what I was going to do there (in that content) . But I didn't think that I would do those other things that talk about Teaching & Learning, the Policies... I didn't know. Maybe if it was a teacher who was doing History he would enjoy those modules. I didn't enjoy them.

It seems like Miss ZN does not attribute her change in teaching strategies to the generic modules of the ACEML programme. In order to learn more about what brought about the changed strategies she alludes to, I now focus on her changed belief in herself, her identity with the new subject and the general impact of the programme on her.

ON BELIEFS AND DEVELOPMENT OF AN IDENTITY

It is clear that Miss ZN sees herself as a new teacher, who totally identifies with ML teachers; who believes in the importance of the subject that she now teaches; and who is pleased to be

referred to as a ML teacher. The fact that her whole attitude to teaching has changed is verified by her choice of ‘strongly agree’ to the statement: *You would not be ashamed and would instead prefer to be referred to as an ‘ML teacher’ after studying the ACEML.*

Miss ZN also strongly agreed that she sees herself as belonging to a group of professionals after studying the ACEML, and that she could take part in any form of debate that relates to the subject ML with confidence. In fact, in her interview she described an incident where she was involved in a discussion with her colleagues about a possible phasing out of the subject in their school. She gave an account of the situation as follows:

“So I’m not saying ML is easier but although challenging, it is the one subject which really links with the real life situation that happens around us. ‘Cause, one of the arguments that I had at work was that if they say some other schools are phasing out eh.. ML, as there are teachers... there was this eh... issue which was recently discussed about our increment, that it has been increased by 6.8% , so I asked them, how much is 6.8% to your salary? Can you be able to calculate that? But they didn’t know that. So I said ML is more important ‘cause it really link with what is happening around us. So maybe the love and the...and the, the love and what....? the love and the confident that I have its because of the way it is being linked with what is happening around us.”

The account presented reveals Miss ZN’s strong identification with the new subject she has just found. It is clear that she believes in the importance of ML and is willing to defend its’ implementation to those who hold other viewpoints. When asked to describe the professional development that she is assumed to have attained through her participation in the ACEML programme, she boldly stated:

“Okay, looking to myself I see myself as a new teacher, I see myself to learners as being the person they admire because of the way I deliver the subject matter to them.”

Her belief in both the subject and herself was also demonstrated when she said she would not allocate an ML class to a teacher who had not studied ML. Her participation in the programme has built so much confidence and identification that she feels that only those who have studied the programme should be allowed to teach ML. In her experience, some teachers dislike ML because it is studied by weaker learners. In her words she said:

Miss ZN: No, I would not allocate the duty load to a teacher who had not studied the

ACEML, because some other teachers they have this tendency....they don't like ML. Its like it is done by those learners who are not coping at school. So they feel that they are failures. But for a person who has done ML, he knows his job, he know what to... he knows the learning area very well, so I will not neglect the person who has undergone the course 'cause he is the one person who has more knowledge than the other person who has not studied it.

A changed identity of a teacher who has found a new home is also observed as she responds to a question whether she would encourage any teacher who wishes to teach ML to start by studying the ACEML. This she said with great enthusiasm and enormous belief in what she thought:

Miss ZN: Yes I would because looking at my point or side, because I didn't do Maths before. But now, I'm able to teach ML. I didn't have self-confidence in teaching the other learning area that I taught before. But now since I have undergone this programme on ML, I'm now more confident in teaching than before. So it is important for any other person to start by studying ML so he will be more comfortable with the learning area.

This concludes the report on the interviewee. The report described Miss ZN, a teacher who has acquired new subject matter knowledge, who feels that she is now using new classroom strategies in her teaching and who strongly identifies with, and sees herself as a member of a new group of ML professionals.

4.2.2.TEACHER B: Mrs PSK

BIOGRAPHY

Mrs. PSK is an experienced teacher who started her career in 1980. She had been teaching for more than 26 years when she decided to enrol in the ACEML programme. In fact, as one of her motivations, she mentioned that her Deputy Principal told her about the recruitment of teachers who had done Mathematics in Grade 12, of which she was one. She had not studied for a long time, due to personal and other commitments. On hearing about this opportunity to study at no cost, she decided to enrol for the ACEML in 2007. She gave the following reasons for her enrolment:

"I enrolled in the programme because I heard from my Deputy Principal that teachers who had Grade 12 Mathematics were required to go and train to teach a new subject called ML. I

had not studied anything for a very long time, and when I heard that the course would be offered free of charge I jumped at the opportunity.”

Mrs. PSK held a three-year teaching diploma, and so was on an M+3 qualification category for all these years. Among the subjects that she had taught, prior to enrolling for the ACEML, were Mathematics, Biology, General Science, and recently, Natural Science. She had been a teacher of Natural Science since its introduction in the early 2000's. She would teach Mathematics now and again, but only in the lower grades, i.e. Grade 8 and 9 only. This did not happen every year. So she considered herself as a Natural Science teacher. During her study of the ACEML, she once had to write a supplementary examination in one of the modules that are related to school level content, Numbers and Operations in ML. However, she passed on the second attempt. She thus graduating a year later than she should have.

Mrs. PSK said that she would have agreed to teach ML before enrolling for the ACEML, because at that time, she thought that ML and Mathematics were the same subject, only that the one was easier than the other. However, after studying the ACEML, she reported feeling very differently. Currently, she is still teaching Natural Science, but also teaches ML in Grade 10. She has never gone beyond Grade 10, since her completion of the ACEML in 2009. She was not at ease to disclose reasons for this.

This participant decided to do her interview in a mixture of both English and IsiZulu, hence some of her responses are translations where necessary.

ON SUBJECT MATTER KNOWLEDGE

Mrs. PSK said that because of her Mathematics background, and due to the fact that she had taught some GET Mathematics, she did not gain much that was new to her, but did gain more, in terms of subject matter knowledge. This is what she said:

Mrs. PSK: In terms of subject matter knowledge ... I'm finding myself very confident and I have gained more knowledge. Most of the things that I am teaching, I can say that I haven't got any problems teaching.

However, she reiterated that there was a remarkable difference between the content in Mathematics and the content in ML. For that reason, she felt that the ACEML programme partly assisted her in learning the content that she would need in a ML classroom. This we

see when she emphatically states that not any Mathematics teacher can teach ML. In her original words, she said:

Mrs. PSK: [translated] My comment is that ...my comments is that... it is not just any teacher who can teach iML. The fact that one has done Maths up until Grade 12, doesn't mean that you can teach ML because, the subject has its own things, which are totally different from Maths.

Commenting further, she said that in ML, most of the problems solved and exercises done are presented in context, in the form of word problems. This she contrasted to Mathematics, where she said one finds many variables, for example x and y .

Mrs. PSK: [translated] Yes, that is what I am saying, because most of the time in Math Lit. stories are related - but in Maths they speak of x 's and y 's. Therefore it is quite important that one should do the course in Math Lit in order to be able to teach the subject.

Although Mrs. PSK might not have been totally correct in her comment on the difference between Mathematics and ML, I nevertheless continued with the interview in order to allow the flow of her responses. Variables are also used to some extent in ML.

On responding to the question of whether she would have agreed to teach ML before studying the ACEML, Mrs. PSK said:

Mrs. PSK: [translated] I would have agreed, because I thought that Math Literacy to be the same as Maths, but after some time I would discover that I had made a mistake, because iMath Lit is totally different from Maths.

Mrs. PSK further acknowledged that during her participation in the ACEML, she studied very hard and was always prepared to go the extra mile. This dedication developed in her a love for the subject of ML, as opposed to Mathematics, which she said she did not like that much as a high school student. She felt that she would teach ML for the rest of her teaching career, because of the confidence she gained in herself. In her words she states:

Mrs. PSK: [translated] I think so because I love this subject and considering the things which I learnt while at Edgewood, I learnt so many things that developed an

interest in me. I did not like Maths that much whilst in high school, but when I learnt ML in Edgewood, I saw myself being in love with (interested more in) ML.

In the excerpt above, she declares her interest in the subject ML, which was developed during her stay at Edgewood campus. Going further, Mrs. PSK states that much of the content that she is supposed to teach did not give her any problems after completion of the ACEML programme. She said she was not scared to be given a test that is set at Grade 12 level, which she could write at any time.

This comment would lead one to think that she might also encourage any teacher who wished to teach ML to start by studying the ACEML programme, because of the advantages that she claimed she had seen in herself. In fact her response to this issue appears below:

Mrs. PSK: [translated] I can encourage any teacher who wishes to teach Math Lit to go and study the ACE Math Lit course, because that has so many advantages - that I have seen happening to me. One also develops some confidence. That is why I'm saying I would encourage any teacher in that manner.

It must be remembered that this teacher had been teaching other subjects for more than twenty-five years, and that it is possible that some of her Grade 12 Mathematics had faded in her memory.

Lastly, Mrs. PSK passed all the modules linked to school level content during her study. Her records indicated that she obtained 65% in Data Handling; 69% in Space, Shape and Measurement; 61% in Functional Relationships. She failed on first attempt in the module Numbers and Operations, obtaining 47%, and wrote a supplementary examination which she also failed. However, she repeated the module later in 2009 and passed it, this time getting 69%.

ON CONTENT SPECIFIC PEDAGOGY

This participant did not elaborate much on how her classroom teaching strategies had changed. Unlike Miss ZN, who pointed out that she had begun to use charts, something that she had not done before, Mrs. PSK only stated that she had learnt to handle large numbers of learners. Seemingly, this had been of more concern to her, before she found a solution

through participating in the ACEML. This I say because she mentioned this development both in the questionnaire, as well as during the interview where she said:

Mrs. PSK: In terms of classroom teaching strategies... I am... using different teaching strategies especially [translation henceforth] the ones we learnt when we were in our second year of study, in the module which dealt with research, that... if we have large numbers to teach, especially in our case, there are many strategies that we can use for example, using group work.

Finding a way to deal with the problem of large numbers, made the teaching of the new subject much easier for Mrs. PSK, who could not teach those classes as she would have liked. She felt that the problem had been resolved and was full of confidence again.

According to Mrs. PSK, Mathematics teachers who are allocated duties to teach ML without having studied the ACEML, “*don’t do it the way it should be done. They use the same methods that are used in Maths.*” Although she gave no description of how ML should be taught, as opposed to Mathematics, she sees a difference. In her words, this is what she said:

Mrs. PSK: “...[translated] as it is I have seen that teachers who have not studied the ACE in Math Lit , who only know Maths, look down upon ML in the first place. Secondly, if they do teach ML, they don’t do it the way it should be done. They use the same methods that are used in Maths. Therefore, I cannot be able to allocate an ML class to a teacher who has not studied the ACE in Math Lit when there is one who has been to the programme.”

What she was saying in the excerpt above, was that Maths teachers who did not do the course, had a negative attitude towards ML. Secondly, she said that when they teach ML, they do not employ the correct strategies. They teach as if they are teaching Mathematics, which she disapproves of. She would never allocate a ML class to a teacher who has not done the ACEML, if there was somebody available who had.

ON BELIEFS AND DEVELOPMENT OF AN IDENTITY

Mrs. PSK called herself a ML teacher. This is her response:

Interviewer: So in other words, you see yourself as a Math Literacy teacher now?

[Mrs.PSK: [translated]Oh yes....]

Mrs. PSK: I see myself as a ML teacher,... a very good one.

It seems as if the Biology, General Science and Natural Science teacher had been replaced. Through her studies, Mrs PSK exclaimed that she now sees herself as a ML teacher. She was bold enough to add “...a very good one.”

Mrs. PSK showed the belief she has in herself and the development of a sense of belonging to a group of specific ML professionals. She admitted that she had found and gained her confidence after she had studied the ACEML. Her exact words when asked the question below were:

Interviewer: And what would you say in terms of identifying with or seeing yourself as a Math Literacy teacher?

Mrs PSK: [translated] I can say that looking at the way in which I started teaching ML, I have... have developed much confidence year by year as I continue to teach.

Although she specifically referred to the time when she had started teaching ML in the excerpt above, Mrs. PSK expressed that she had developed much confidence year after year, as she continued to teach the new subject.

Mrs. PSK's feelings in the previous learning area were not openly disclosed, but when asked whether her confidence in ML resulted from her enrolment in the programme or not, she had this to say:

Mrs. PSK: [translated] Yes, that is exactly what I'm saying, that I got all my confidence after studying the ACEML.

She concluded her beliefs that she approved of the move to introduce ML at University for teachers by saying:

Mrs. PSK: [translated] I totally agree that the introduction of ML at University was a wise move, because I saw the programme being able to successfully equip much older teachers, who had never studied ML, with skills to teach the subject. Such teachers are teaching ML at their schools as we speak, and do not seem to have any problems.

Mrs PSK believed that the reason behind some teacher drop outs was as follows:

“Some teachers did not expect that as they went for the ACEML course, they would also be studying other modules, especially those who were Maths teachers. They usually got fed up when it was time for the generic modules, and some said they were leaving the course. Others dropped out because they had never studied Maths, and they were of a much older age. When we attended Numbers and Operations, they said that they did not have a clue of what was happening, and they quit.”

4.2.3. TEACHER C: Mr. PN

BIOGRAPHY

Mr. PN started teaching Mathematics in 1996 and only changed completely to ML on completion of the ACEML programme. He has never taught any other subject except Mathematics.

Mr. PN held a Bachelor's degree and a Postgraduate Teaching Diploma prior to his enrolment in the ACEML programme. Hence, he was in an M+4 qualification category, and therefore, the ACEML would not have helped him to upgrade his qualifications to a higher level. The most prominent reason for his enrolment, was a desire to gain confidence in the new subject. His belief is that a teacher needs to be confident and understand a subject before he can teach it successfully. He stated: *“the reason for me to enrol in this programme was simple. I[t i]s to increase the level of my confidence in the subject. To increase the level of my knowledge in the subject.”* With increasing numbers of ML learners at his school, as opposed to decreasing numbers of Mathematics learners in the FET, he felt it would be wise to be equipped with both subjects, for a more secure future in the profession.

Mr. PN alludes to the fact that the two subjects are not related; as most people might think. He stated that he would have agreed to teach ML before studying the ACEML, but realised on actual study of the subject that the two are *“not really related.”* It was in his first year of the ACEML study in 2007 that he started to teach the subject ML at his school, and has been doing so ever since.

ON SUBJECT MATTER KNOWLEDGE

Mr. PN's viewpoint of ML as a subject is that it equips learners and teachers with numeracy skills that they so greatly lack. As a former Mathematics teacher for close to ten years, it would have been expected that he would not have problems in all the content that was learnt during the ACEML programme. However, this has not been the case at all.

Mr. PN said that initially he felt that he knew most of the ML content, since he had a B.Com degree, which includes a Statistics module. However he admitted that in the module Space and Shape, he learnt new concepts. He did not have any problems with the module Data Handling in ML. When asked whether there was any aspect of the subject ML that he felt he had learnt somewhere else before, he said clearly that he was already familiar with most of the content, because of the courses he had studied at university. What is of interest in the case of Mr. PN is that he noted that Space, Shape and Measurement in ACEML came as something new to him. It is the only section that he seemed to have learnt during the ACEML years. In his own words he said:

Interviewer: Okay. Is there any aspect of the subject that you feel you knew even before you went to do the ACE?

Mr. PN: *Yes, there are so many, because at university I was doing Statistics. Data Handling is there... is part of things that I have done at the university level. Data Handling and...what else? Most of the other learning areas I have studied at university level except Space and Shape. Space and Shape was something that was new to me.*

Although Mr. PN was a Mathematics teacher for more than 10 years, he has learnt new content in ML.

Mr. PN felt that the ACEML was a necessary step for teachers who intended to teach ML. He saw teachers who attended the ACEML as displaying more knowledge than those who only attended the Departmental workshops. In his words, *"because the teachers when they are doing ACE, they commit themselves, they are not there, just to be part of ACE, they are committed because at the end of the day they have to get a Diploma."*

Mr. PN did not refute the importance of workshops. He felt that *"Workshops are good, especially as an ongoing process for teachers to get together and discuss the subject. But he felt that workshops were limited in that they were "not like something that would uplift the*

teachers.” However, he felt that the ACEML programme was more successful in equipping teachers to “*understand the content and the context of the subject.*” He also commented on his personal change in terms of content knowledge, as he said, “*After studying ACE, the subject matter increased*”.

In the questionnaire, Mr. PN admitted that whilst teaching Mathematics, he had a problem of teaching Calculus, because of the emphasis on shapes. However, after the ACEML, he states that he started to find shapes very interesting, and related to real-life situations. He cited an example of tiling a room, which he said helped learners to grasp mathematical concepts easily. The ability to relate shapes to real life situations done in the program has made a huge difference in his teaching and learning of ML.

Mr. PN also pointed out that he had a problem of teaching percentiles. To solve this problem, he consulted other colleagues and they used teamwork. Overall, his most preferred Learning Outcome was LO3, Space, Shape and Measurement in ML. He strongly agreed that the ACEML had improved his subject matter knowledge, especially in LO3. In the interview, when Mr. PN was asked to describe his professional development in terms of subject matter knowledge, he had this comment to make:

“The confidence that I have now, is because of ACEML. So I am always now involved in the subject argument, [whereas] before I was not... I was shy.” As much as this statement describes his belief about the subject and himself, he also made an admission, that his content knowledge was improved as a result of participating in the ACEML programme.

ON CONTENT SPECIFIC PEDAGOGY

Earlier, Mrs. PSK pointed out the problem of teachers using the same methods to teach ML that are used in Mathematics. Mr. PN made a similar observation.

In his teaching of Mathematics, his style was to give learners exercises and thereafter discuss solutions with them. “*What I was doing before [was that] I was just giving them the exercises and explain[ing] all th[at] stuff without understanding their prior knowledge, before I introduced that topic.*” His participation in the ACEML programme enabled him to change this strategy. He said that before introducing any new topic, it was important to establish the learners’ prior knowledge of the particular concept being taught. For him, teachers tend to take things for granted, assuming that learners know all that they (teachers)

think should be known by the learners. In warning against this phenomenon discussed above, Mr. PN stated that *“Sometimes there are topics that we as teachers take for granted that the learners will understand.”* He strongly advised against this practice. This indicated a new teaching strategy that had been acquired in the ACEML programme.

ON BELIEFS AND DEVELOPMENT OF AN IDENTITY

Mr. PN showed a significant development towards an identity as a teacher with the new subject ML. He felt he was still learning. He even learns from the learners themselves and alluded to the fact that there are issues that are sometimes raised by learners, when he had not been aware of. He reported that he sees himself as a teacher, a learner and a facilitator. In describing his identification with the new subject, this is what he said:

“I see myself as a good Math Lit teacher and am seeing myself as one of those teachers who are still learning. I’m still learning because this subject is new. I’m still learning even from the kids. The kids are good such that sometimes I find myself listening to kids explaining things sometimes some of which I’m not even aware. I’m enjoying as a teacher. I’m a teacher, I’m a learner, I’m a facilitator in this subject.”

The acknowledgement of being a learner, a teacher and a facilitator displays Mr. PN’s attitude towards the other four generic modules which were offered in the ACEML programme; those that do not deal directly with school-level content. Mr. PN felt that the generic modules had helped him learn more about the learners he taught everyday.

Mr. PN: Mh... I think those modules were very important to be part of the subject... to be part of the whole Math Lit programme.

Mr. PN also pointed out that those modules helped teachers to learn about new Policies and Acts which are disregarded by most teachers. He asked, *“And how are you going to deal with new Acts and Policies that the Government is implementing because there are those policies that we are neglecting as teachers?”*

Mr. PN believed that ML should be made compulsory for every learner and teacher, both at high school and university level. He complained about teachers who went on strike, for an additional 1,2% on the tabled offer. However, when asked what that 1,2% translates to in their salaries, most of them did not know. This situation was directly linked to what was covered in the course, when they were studying percentages, percentage increase etc. For that reason, Mr. PN suggested that: *“Maybe this subject we have to expand it from the kids, even*

to equip these older people who are qualified. All of them ...I think this has to be a compulsory subject even at the university level. So that these people they will understand. Even calculating their own groceries, taxes and all those stuff.”

Mr. PN’s belief was that some teachers were not fully committed in their studies, which was a reason for drop outs. Without any hesitation, Mr. PN claimed that teachers who dropped out of the programme did so because he thought they were lazy, because they expected to find something easier on enrolment. When faced with challenging tasks, they decided to give up:

“I think one of the reason for them to drop out, is the laziness and they are not committed on the subject and it means most of the teachers who dropped out are those teachers who do not teach the subject who thought that maybe by going to the university, they were gonna get something that is easy, something that they were gonna be able to do it, I don’t know”

Hence, for Mr. PN, the content in the programme was demanding, and those who lacked commitment did not cope.

At the end of the interview, Mr. PN expressed again that the programme had been of great benefit to him as an individual. He said *“the confidence that I have now, is because of the ACEML. So I am always now involved in the subject argument, wh[ere] before I was not... I was shy.”* He said this was because he would not have enrolled if he had to make his own payments, pointing out that family budget constraints and other financial commitments would not permit such an outlay of fees. He strongly expressed that he saw himself as a new and changed individual in a new world of ML professionals.

4.2.4. TEACHER D: Mrs. SP

BIOGRAPHY

Like Mr. PN, Mrs. SP has also been teaching Mathematics for her whole teaching career, from 1991 to 2005. She has taught all grades from Grade 8 to Grade 12 prior to enrolling for the ACEML in 2007. The only difference between herself and Mr. PN is that she started to teach ML at its inception in 2006. Mrs. SP held a Postgraduate Teaching Diploma prior to enrolling for the ACEML and was already on an M+4 qualification category at the time and therefore did not need the qualification for upgrading purposes.

Having taught Mathematics in the past, Mrs. SP noticed the differences between Maths and ML very early in her teaching of the new subject, because she said in response to the statement: *“any ML teacher needs the ACEML in order to teach the subject successfully”*.

“Mh... that is a fact. Many of us who teach Maths Literacy have to go through proper training, so as to avoid the confusion between the Maths and ML concepts, which in most cases are very much parallel to each other.”

Mrs. SP is currently teaching ML only, and has also stopped teaching Mathematics, which she had taught for a considerably longer period of time. This may explain her reasons for enrolment - to learn about a subject that was new to everybody around her at the time. However, when asked about her reasons for enrolment she said:

“It was that, I was eager to know that transformation [Interviewer: and know more?]and know more about this new subject, yes.” She also pointed to her characteristic love of challenges, love of reading and love of transformation.

ON SUBJECT MATTER KNOWLEDGE

Mrs. SP did not mention specifically what she gained in terms of subject matter knowledge. However, when she taught ML before studying it, she relied on consulting textbooks quite often because none of the people around her knew much about ML. This is how she explained her situation: *“because while I was teaching Math Lit before the enrolment, I was not confident enough. Most of the time, I always referred to books and nobody knows about this Math Lit, nobody was confident enough to explain certain concepts.”* This made her lose her confidence because she would do what she thought was the right thing, with her only backup being a textbook. Mrs. SP was not sure about which content to teach. Her only relief started to emerge the following year, when she was enrolled in the ACEML. She had this to say about her improvement: *“while I was enrolled, I gained more of confidence.”*

Mrs. SP maintained that she had a good school and university background in Mathematics, and had also gained a lot of experience since she started teaching in 1991. However, she drew a distinction between Mathematics and ML. She saw Mathematics as a subject in which learners can be taught information that they tend to reproduce. In her words:

“Whilst a pure Maths teacher teaches concepts that can easily be programmed without understanding, a Maths Literacy teacher teaches one to apply Maths concepts...”

The quote above suggests that Mrs. SP, who had been a Maths teacher for some time, felt that something was lacking in her teaching of ML prior to studying the ACEML. She might have been used to teaching abstract concepts of Mathematics, without much emphasis on their application to real life situations. Although it may be argued that this absence was not about subject matter knowledge, she admitted that she was not confident. In relation to the content knowledge of the subject, she said that *“Most of the time I always referred to books and nobody knows about this Math Lit, nobody was confident enough to explain certain concepts.”* This was only achieved through the ACEML programme. This phrase suggested that books could have been helpful, but not to same extent as the ACEML programme.

Mrs. SP suggested that every ML teacher should undergo training in the subject in order to distinguish between ML and Mathematics. In trying to highlight the distinction she said:

“I’ll compare the two. The Math Literacy teacher and the Pure Maths teacher are very different.” She went further to support her idea by saying: *“Many of us who teach Maths Literacy have to go through proper training, so as to avoid the confusion between the Maths and ML concepts, which in most cases are very much parallel to each other.”*

Mrs. SP did not approve of allocating a class of ML to a teacher who has not studied the ACEML. She said with determination that: *“No ways. Some of us are really mathematically challenged even though we did some Maths at school. So I would encourage..allocate to a person who did the ...yes.”* Unfortunately, I did not ask her for clarification of the term “mathematically challenged”. However, it seems possible that she meant that some teachers do struggle in dealing with some mathematical concepts, even if they have studied mathematics at school.

Although Mrs. SP did not give an implicit account of the content knowledge that she gained through her studies, she had more to say on the development of her teaching strategies.

ON CONTENT-SPECIFIC PEDAGOGY

Mrs. SP had taught ML for a year, prior to enrolling for the ACEML programme. As already mentioned in the previous section, she was uncomfortable and lacked confidence at the time. Some of the reasons she gave were that nobody around her knew much about the content and

the teaching of ML, and this seemed to be including both subject matter knowledge, as well as the specific pedagogy required in ML. Her enrolment was an attempt to learn about appropriate teaching strategies, in addition to the learning of new content. She struggled because she did not think she possessed the essential strategies required to deliver ML. Textbooks seemed to have been of little help, because she still lacked confidence with their use.

Early in the interview, when she was asked whether she had taught ML before studying, she responded by saying: *“Yah... it was in 2006. But I wasn’t confident enough, [because] I wasn’t sure of how to teach Math Lit until I enrolled at University of KZN in 2007, but it was in Grade 10 only in 2006.”* She was not sure of how to teach ML until after her enrolment in the programme.

When asked about what she learned in the ACEML programme, she said that the generic modules equipped her with necessary skills for handling her classes, how to teach, and how to be professional as far as the subject was concerned: *“...before I was enrolled in ACE, I was not confident enough to teach or to handle my classes. So after doing this module Teaching and Learning and Professionalism, I gained a lot on how to handle the class, how to teach, about strategies and so forth.”* It is interesting that Miss ZN with her limited Mathematical background did not find the modules beneficial, yet Mrs. SP felt differently. Mrs. SP said the modules *“should be included. It should be included because it works hand in hand, because in teaching you can’t teach without knowing the strategies of teaching.”* Thus, Mrs. SP stated that she acquired her teaching strategies from these modules.

She later said: *“But looking at the second part which is, in terms of the classroom teaching strategies, the educational courses offered were also implicit[ly part of] trying to help us use the correct classroom teaching strategies, that even a layman can easily see the connection of Maths Literacy in everyday life situation”* The quote above suggests that Mrs. SP felt that the generic modules helped improve her teaching strategies.

ON BELIEFS AND DEVELOPMENT OF AN IDENTITY

Although she did not mention it at first, Mrs. SP also believed that teachers who dropped out of the ACEML programme did so because they were lazy: *“Yah, it’s true, [be]cause to be enrolled, to be a learner, to be a student you need to work a lot.”* For her it was a matter of them not making time to study and dedicate themselves to going through the course. She

believed that if one was both a student and an employee, one had to make time and devise strategies that best worked for him or her: *“You need to devise a strategy of how to get time to do this, especially when you are a teacher and also a student. So you need to balance.[Yes] I think the laziness is one of the reasons”*.

Mrs. SP also revealed that some of her friends and colleagues admitted that they had come to work with numbers, when they enrolled for the programme . Their intention was only to undertake the content-related modules. They did not want to have longer periods of reading, but preferred calculation tasks. She stated: *“I do have [a] friend who also dropped [out] because he said “I can’t read, I’m not a person who is good in reading. So I only need something to work on, like figures... to solve problems” Y[es]. “...because I’m a problem solver, not a researcher... I think most of that percentage which dropped that year was because of that.”*

It seems that Mrs. SP did not identify with that group of teachers even though she was also a Mathematics teacher. She had developed an identity with a new group of professionals in a new subject. It is striking that she went further and applied to be employed as a Matric Examinations marker on completion of the ACEML. Mrs. SP strongly believes that she might have been chosen for this position because she submitted the good results that she had obtained in the ACEML. She obtained 52% in Numbers and Operations; 51% in Functional Relationships; 66% in Space, Shape & Measurement and 72% in Data Handling. On this she commented, *“I also enrolled for marking, so I already ... I think they enrolled me because I submitted my ACE results and they know that I’d gone for th[ese]... modules.”* The decision by Mrs. SP to apply for marking shows a significant development of a teacher’s identity to be seen amongst certain ML professionals.

Mrs. SP sees herself as a new ML teacher now, who has also stopped teaching Mathematics completely, and who strongly identifies with ML in her school. She expressed strong feelings about other people whom she felt contributed negatively to ML as a subject. This was her comment: *“learners are performing very badly because of the negligence of the teachers down there[Interviewer: GET and the lower Grades?] Yes. So even, other teachers.... even tell them that ‘you are so lazy, you can’t make it’ you are nothing. So already learners are demotivated.”* Mrs. SP went further and accused universities of not including ML in their booklets for prospective students. She said, *“Most of the Faculties at universities doesn’t include Math Lit. as if its just a useless subject. That’s another thing that makes our learners*

and also other teachers not want others to know that they can teach or were enrolled for Maths Lit as an ACE student.” This response suggested that some teachers who have been in the ACEML, but who are not teaching ML, do not want to be associated with the subject because of what other people think. She also went further with the blame. She said, *“Even the media, the society, the community... don’t recommend Math Lit as [a] subject. Its just like other subjects like Life Orientation subject, which is when you do Math Lit you are not taken as a person who is capable of ‘making it’.”*

All the opinions expressed by Mrs. SP above reveal her strong attachment to the subject. She was elaborating on some of the challenges that a ML teacher faced on a day to day basis at her school. Mrs. SP even suggested that because of bad publicity, learners did not want to take ML. She said, *“Even learners, they just run away from having Math Literacy as one of the[ir] subjects, because no one recommends Math Literacy to them as a subject like Maths, Physics and Life Sciences.”*

Finally, Mrs. SP suggested that the media and the government Education Department needed to change their attitude towards the subject with which she so dearly identified. To confirm her beliefs and feelings, she described the subject as follows: *“Yes. because it’s our daily life. It talks about our daily lives.”* With this last statement, she was responding to a suggestion that ML should be made compulsory to all learners, including those who do Mathematics. This was how Mrs. SP elaborated on her beliefs and identification with the new subject she had newly discovered.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1. INTRODUCTION

In the previous Chapter I have presented the results found from data collected through both semi-structured questionnaires and semi-structured interviews, from teachers who were students in the ACEML programme from 2006 up to and including 2011. In this chapter, I look across the data in order to discuss the professional development of the teachers concerned, in terms of their content knowledge, the knowledge of content-specific pedagogy and development of a professional identity and beliefs as ML teachers (Peressini et al., 2004). The participants who completed Questionnaire A are referred to as Participants A1 to A15. It should be noted that interview participants are also participants in Questionnaire A, and interview respondents are further identified as Miss ZN; Mr. PN; Mrs. PSK and Mrs. SP. Participants who completed Questionnaire B are referred to as Participants B16 to B23.

5.2. DISCUSSION OF PROFESSIONAL DEVELOPMENT IN THE THREE AREAS OF THE STUDY

The discussion of the results is an attempt to provide answers to the research questions of this study, which are as follows:

1. What are the ways in which participation in the ACEML programme enhanced teachers' professional development, and
2. How did participation in the ACEML programme enhance the teachers' professional development?

The first question is concerned with identifying particular ways in which the programme improved teachers' professional development while the second is concerned with providing a more nuanced understanding of how the professional development was enhanced in different ways. Both the "what" and the "how" questions are thus difficult to disentangle, because the "how" helps us understand the "what" and the "what" helps us understand the "how". I will therefore answer both of them together.

It is also important at this stage to reiterate the sub-questions as presented in Chapter 1 which enabled the answering of the two critical questions mentioned above. The sub-questions used were as follows:

- i. Did the teachers actually improve on or gain new content knowledge as a result of their participation in the programme? In which areas specifically?
- ii. Did their teaching strategies improve or change as a result of their participation?
- iii. Did the teachers actually develop a new identity with the new subject Mathematical Literacy over and above their previous teaching specialisations?
- iv. What were the teachers' 'new' beliefs that were developed on the subject ML as a result of their participation in the ACEML programme?
- v. What were the implications of the programme as a whole on the professional development of the teachers involved?

5.2.1. Influences on Content Knowledge

Content knowledge in ML may be described as the ability to execute mathematical algorithms, know the subject and its organisational structures; be able to solve problems and apply rules and formulae that are used in the subject ML; answer questions; interpret graphs and maps; draw 3-dimensional and other shapes; and sufficiently understand the demands of the school curriculum.

5.2.1.(a) Improvement of Existing Content Knowledge

All teachers in the study indicated that their content knowledge had improved as a result of their participation in the ACEML programme. All participants agreed in Questionnaire A, Questions 6.1 and 20.3, that their content knowledge was improved as a result of their participation. This we also see in Questionnaire B, where seven of the eight teachers indicated in Question 5 that there had been a big improvement in their knowledge of ML content as a result of their participation in the programme. The improvement in content knowledge was further reiterated by participants in the interviews. Participant A2 (Miss ZN), specifically provided a detailed account of how her limited mathematical knowledge prior to enrolling in the ACEML programme was vastly improved. The other interview participants as well, Participants A1 (Mr. PN); A11 (Mrs. PSK) and A14 (Mrs. SP) had much to say on their own improvement in content knowledge.

Some modules were more beneficial to the teachers than others. Space, Shape & Measurement was singled out as the module which posed more challenges for a number of teachers, when compared to other modules. During the interview, Participant A2 elaborated on the problems she had in this module (refer to results in Chapter 4). In Question 13 of Questionnaire A, five of the teachers indicated that LO3 was their weakness. Specific topics within this learning outcome were also mentioned in Question 14 of Questionnaire A by five teachers. There is a strong need to correct the gap between “knowing something for oneself and being able to enable others to know it” (Rowland, 2008, p.273). Teachers in the ACEML programme admit openly that they had problems with the module Space and Shape. Some teachers (Mr. PN in the interview) even claim that it was new to them, even though they had been mathematics teachers for periods longer than ten years. After revealing her limited knowledge of Mathematics, particularly in Space & Shape prior to enrolling in the ACEML programme, Participant A2, is currently the only teacher in her school who teaches Grade 11 and 12 ML. This suggests an ability by Participant A2, to assimilate “the ways of representing the subject which makes it comprehensible to others” (Shulman, 1986, p. 9). In that way a huge improvement in her content knowledge was shown.

5.2.1. (b) Acquisition of New Content Knowledge

The programme did not only provide improvement for teachers of their existing knowledge in mathematics. New content knowledge was also acquired. Individual teachers indicated that they had been having problems in different areas of the content prior to studying in the ACEML, which were subsequently ameliorated by the program. In Questionnaire A, Participant A3 revealed that he “was lost” in the section of tree diagrams in probability. Participant A2 had no knowledge of prisms, and also did not know anything about areas, volumes and perimeters. She said she could not interpret graphs and maps, could not use Mathematical instruments and could not calculate areas, volumes and perimeters. She went as far as to say that her list was “endless”. The revelations of Participant A2 provide concrete examples of common content knowledge that was gained. Participant A5 also mentioned that she did not understand anything in probability. Participant A6 gained a lot in the section where litres of paint had to be calculated in order to paint a house, when given a specific scale of the house. Participant A15 revealed that she saw the section on maps and scales as being too focused on geography at first, but with time she started to become familiar with ways of handling such problems.

The concepts, sections and topics that were mentioned by teachers as areas where they improved also included conversions of units of measurement, where Participant A11 mentioned that she discovered that it was not as easy for her to convert units of measurement from centimetres to metres and other units. The improvement only came as a result of her participation in the ACEML programme. Participant A12 had much to say about budgeting skills which she learnt in the programme. She also indicated that she saw an improvement in the way in which she could interpret graphs in Functional Relationships. The same sentiment was echoed by Participant A13, who indicated that she had a huge problem in the section on Functional Relationships, but saw a vast improvement as a result of participating in the ACEML programme. Participant A1, who had been a teacher of Mathematics, insisted that he had a problem of relating the work in calculus to real-life situations, whilst teaching calculus in Mathematics,. However through his participation in the Space, Shape and Measurement module of the ACEML, relating shapes to real-life scenarios was made easier. Being part of the programme also enabled participant A1 to learn more about percentiles, through discussions with other fellow participants.

From the responses in Questionnaire B, some teachers did mention that they had gained much new knowledge. Participant B23 mentioned that she had learned to draw difficult three-dimension shapes, which she had never thought she would be able to draw. Participant B19 also indicated that he had not known much about the calculation of compound interest, which he learnt in the programme. Other participants in Questionnaire B only mentioned some of the modules and not specific topics or concepts, where they experienced some improvement.

The interview with Mrs. SP revealed that a number of teachers had enrolled in the ACEML to learn more content in the subject ML. The fact that Mrs. SP, who had been teaching ML prior to enrolling, found the programme to be helpful in clarifying what content she was supposed to teach in ML, provides indication that some other teachers in the same position might have been enabled by the ACEML to understand better the content they were supposed to teach. Another point that was identified by this participant (Mrs. SP) was that textbooks available at the time were not very useful to the teachers, although she did not elaborate on why she said the books were not very useful. As a result, some teachers were assisted by their participation to know the content that they were supposed to teach in schools. The documents supplied by the Department of Education were seen to be of little or no use to the teachers. Hence Mrs. SP believed that most of the teachers who came to study in the ACEML had one objective,

namely, to learn more of the content that they were supposed to teach in ML. From the participants' perspective, it seems that this is an objective that was certainly achieved.

Improvement in other areas of content are also indicated by participants in Question 13 of Questionnaire A where eight teachers reported on content related problems which had been addressed during their participation in the ACEML programme. These were topics other than those found in Space & Shape. As described in the previous chapter, specific cases of teachers who knew very little about some basic concepts in LO 3 (Participant A2: Miss ZN in the interview) and other areas were exposed. Nonetheless, such challenges were resolved in the ACEML. It is therefore not surprising that 14 out of 15 teachers in Questionnaire A agree that they would not have been able to teach ML effectively and successfully if they had not enrolled in the ACEML programme.

5.2.1.(c) The Different Content Needs of Teachers

In terms of knowledge of the content, data from the questionnaires shows that teachers who came to study on the ACEML programme can be classified into various categories. Firstly, there are those who could be assumed to be familiar with most of the mathematical aspect of the subject ML, because they had been teaching Mathematics at the time of their enrolment and had prior qualifications in teaching Mathematics. A report by Goba, Webb, Bansilal, James & Khuzwayo (2011) states that out of 691 teachers who were registered for the ACEML in 2007, 273 were teaching Mathematics only, 65 were teaching both Maths and ML, 38 were teaching ML only and 182 were teaching other subjects. There was no data on the remaining 133. It can thus be assumed that the mathematical knowledge of the 273 teachers who were teaching Mathematics required minimal improvement in content knowledge, when receiving training for the subject ML, as confirmed by Participant A1 who said that he took Statistics while he was still at University, and hence, Data Handling was familiar to him. Participant A14 also mentioned that she knew most of the work from her experience both as a mathematics student at tertiary level, as well as being a Mathematics teacher prior to the introduction of ML.

Secondly, as shown in this study, there was a group of teachers whose content knowledge had faded significantly. Such teachers had last studied Mathematics whilst they were students themselves. They required more revival and retraining in order to be able to teach ML. These were teachers who had been teaching other learning areas for a number of years. Participant A11 (25years in Biology and Natural Science), Participant A12 (more than 15years in

isiZulu; Biblical Studies, Religion Studies and Life Orientation), Participant A13 (11 years in Biology and English) all fall in this second category. These participants acknowledged that their knowledge of Mathematics had faded significantly. This is also shown by the teachers' academic records where Participant A11 had to repeat the module Numbers and Operations in ML, a module done at the beginning of the programme. It is most probable that she was still adjusting to mathematical problem-solving strategies because of the long period that had passed since studying these concepts.

Thirdly, there are those whose content knowledge was limited because they had only studied Mathematics up to Grade 9 level (Participant A2). Within this category are the teachers who produced affidavits that they had attempted Mathematics at Grade 12, yet the subject did not appear in their Grade 12 certificates. Bansilal (2010) reports that there were 175 such teachers, from the 691, whose grade 12 Mathematics results remained unknown. Information in this regard on 103 of the teachers could not be found.

From the above discussion it is most likely that teachers came to the ACEML programme with limited content knowledge necessary to teach ML. Although knowledgeable in mathematics as a subject, teachers lacked the specialised content knowledge (SCK), that was necessary for them to be able to teach ML. Teachers themselves indicated that they had come to learn the content necessary for teaching ML (Participant A13 in Questionnaire). In discussing teacher education, Peressini et al. (2004) state that "teachers come to teacher education without the subject matter necessary to enact reform-based images of teaching".(Peressini et al., 2004, p.73). They further assert that participants in their study, who had undergone various mathematics courses, were found to have incomplete rule-based knowledge of mathematical concepts, such as function and the 'elementary' concept of division. From the evidence above and in the previous chapter, we can say that one of the main objectives of all the teachers in enrolling for the ACEML was to gain and improve their content knowledge of ML.

5.2.1.(d) The Link between Content and Real-life Situations

In this study there was evidence of teachers who were able to realise the importance of the link between content knowledge and real-life situations, as had already been noted by Nel (2009) in her study on teachers who participated in the ACEML. Examples were made by Participant A1 and A2 during their respective interviews on teachers' salary increases and the calculations that are involved. This indicated a shift from an abstract knowledge of

mathematical concepts to a context-based knowledge of ML. In this way, teachers will not only expose learners to a mathematical way of thinking, but the community and society as a whole can be exposed to this way of thinking. Nel (2009) refers to this awareness of the link between content and real-life as being indicative of “ML thinkers who observe the world through a mathematical lens” (Nel, 2009, p. 47). In her interview, Mrs. SP went as far as referring to ML as being “our daily life”. This she said on the realisation that ML is a subject that deals directly with the demands of everyday numerical knowledge. Based on this realisation of the link of content knowledge and real-life situations, only one teacher agreed in Questionnaire A that any Mathematics teacher could teach ML without needing to undertake the ACEML programme. The remaining fourteen disagreed completely, assuming that most Mathematics teachers are unable to merge content and context. On the same note, only 2 participants in Question 20.4. agreed that the ACEML could have been replaced by a three week departmental workshop.

There was a constant demand made by teachers that they required more content to be taught than having to learn what is contained in the generic modules. In her interview, Mrs. SP stated that some of the teachers who considered dropping out saw the teaching of content as being more worthy than the education and generic modules. One of them had said that she was a “numbers person” and would not cope with writing essays as demanded in the modules not related to school content. This constant demand by teachers to be taught more content shows that they felt their content knowledge in ML was limited, and they wanted more help in this aspect. It is worth noting that some of such teachers were Mathematics teachers at their respective schools, yet they demanded to be taught more ML content, inspite of the general perception that Mathematics teachers would make good ML teachers.

It was revealed in the study that some of the concepts done in some modules were “new” to some teachers (Participant A1 on Space, Shape and Measurement in interview). Participant A3 also mentioned that tree diagrams were new to him. He goes to the extent of referring to the ACEML as an “eye-opener”, a phrase that was also used by Mrs. SP in the interview, when she referred to the help she received in coming to know the kind of content she was supposed to teach in ML. All three of these participants were Mathematics teachers prior to their enrolment in the ACEML programme. They not only studied Mathematics up to Grade 12, but they had taught it. Yet they all seemed to have some problems with some areas of the content; which seem to have subsequently been resolved in the programme. Woolhouse & Cochrane (2010) report on a study on Science as a subject in the UK, the Science Additional

Specialism Programme (SASP), where teachers indicated openly that they thought their subject knowledge was insufficient. There were similar admissions by teachers in this study (Participant A1 in interview) that they found some of the content unfamiliar. Teachers in the SASP openly admitted that they had wanted to “get better understanding of chemistry and the knowledge behind the practicals” (Woolhouse & Cochrane, 2010, p.611). One of the participants in the SASP even referred to him/herself as “incomparable, to what I was before, I would have done anything to avoid teaching GCSE chemistry a year ago” (Woolhouse & Cochrane, 2010, p. 611). Such admissions are also found in this study, where Participant A11 said she realised after participating in the ACEML programme that it would have been a huge mistake to agree to teach ML without studying the ACEML. Based on the above, the assumption that teachers who had studied Mathematics up to Grade 12 would make better teachers of ML, seems to be inaccurate.

5.2.1.(e) Importance of Foundational Knowledge from GET (for learners and teachers)

Another important aspect that was emphasized by the teachers is the role of learners’ prior content knowledge in learning ML. In discussing his experience with ML learners, Mr. PN mentioned during the interview that learners prior knowledge should always be considered before a new concept is to be introduced. He said that he had not been considering learners’ prior knowledge whilst he was teaching Mathematics previously. Through his participation in the ACEML, he realised that he ought to consider previous content knowledge, because this helped him whilst studying in the programme. Hechter (2011) also noted the need for ML teachers to be familiar with the mathematical content in the GET curriculum “in order to be informed of learners’ prior mathematical content” (Hechter, 2011, p.149). The knowledge of the GET curriculum would help teachers of ML to ascertain the expected learners’ prior knowledge of mathematics.

The ACEML provided a suitable platform for teachers to revive their knowledge of the content that would be needed by learners in order to study ML. Knowledge of the GET curriculum by the teacher is of utmost importance, for the teacher to be able to teach ML successfully. Pillay (2006) had predicted that “teachers from redundant subjects and novices who were ‘recycled’ in the ACEML” (Pillay, 2006, p.67), would not have the patience to reteach previous mathematical concepts which should have been done in the GET. The ACEML was studied by some teachers who had been teaching in various other learning areas. Some teachers within this study (e.g. Mrs. PSK: Participant A14) had been teaching

other subjects for more than twenty-five years. In all likelihood, their content knowledge of school mathematics would have long faded. Hence, they required some revival of the ‘forgotten’ content through engaging in the ACEML programme. However, nine of the participants from Questionnaire A in this study had taught Mathematics in the GET, while only one in Questionnaire B indicated experience of teaching Mathematics in the GET for nine years. In his study, Pillay (2006) warned that “educators need to be aware that Mathematical Literacy books assume that learners have all the skills and knowledge pertaining to the previous work covered” (Pillay, 2006, p.71). Hence, teachers cannot rely on textbooks only.

The above discussion highlights the ways in which teachers’ content knowledge improved. However, ML teachers still need to be supported in restoring content gaps (Hechter, 2011). This support could come in the form of workshops (as suggested by Mr. PN in the interview), who saw workshops as being supplementary to the ACEML course, but not as a replacement. However Ball et al. (2008) still argue that the content knowledge needed for teaching is beyond simply ‘knowing the content’. Stacey (2008) also warns against the historical mistake of the past, where “mastery of the subject matter has been regarded as the only requirement to be a teacher” (Stacey, 2008, p.88). She further asserts that no distinction was considered between content and pedagogy, hence all those who knew the subject well were assumed to be able to teach it. As stated by Johnson et al, (2010), “Knowledge is a necessary condition for teachers to change their classroom practice, but it is not sufficient on its own” (Johnson et al, 2010, p. 181). It is for this reason that Mason (2008) alludes to the above claim, by saying that pedagogical content knowledge attempts to bridge the gap between “knowing for oneself and supporting others in coming to know as well” (Mason, 2008, p.302), which is the subject of the next section.

5.2.2. On the Knowledge of Content Specific Pedagogy

In the preceeding paragraph it has been mentioned that the knowledge of the content only does not guarantee an ability to be a successful teacher. The knowledge needed for teaching includes an understanding of what makes the learning of specific topics easy or difficult (Shulman, 1986). My understanding of content-specific pedagogy therefore, is the ability to present the ML content known by a teacher to learners in a way that will make such content understood and apprehended by the learners. This involves the Knowledge of Content and

Students (KCS), as well as the ability to become a reflective practitioner, where teachers are able to look into their own teaching and then reflect on their strongpoints and weakpoints.

Content specific pedagogy also involves the integration of ideas in the content with situations that will be understood by learners. In doing so teachers are then able to distinguish clearly between teaching and learning of Mathematics and ML, and this forms an important aspect of their content specific pedagogy. Most importantly, content-specific pedagogy encompasses the ability by teachers to design tasks that will be appropriate for their learners. Assessment of learners in ML should include tasks that are understandable to learners within a specific community. Task design therefore, is an important aspect of content specific pedagogy. As argued by Ball et al. (2008), teachers “require a host of other mathematical knowledge and skills, knowledge and skills not typically taught to teachers in the course of their formal mathematics preparation” (Ball et al, 2008, p.402). Content-specific pedagogy involves the ability to design appropriate tasks for assessing learners in that subject as well as identifying any misconceptions that learners might hold. Clarifying such misconceptions also forms part of content specific pedagogy.

5.2.2.(a) *Designing Tasks in ML*

One of the most important achievements reported by teachers was the ability to design tasks that are appropriate for ML. In responding to question 6.3 of Questionnaire A, 14 of the 15 teachers either agreed or strongly agreed that their assessment skills had improved. The one teacher (Participant A12) who did not concur with the rest, mentioned that she was using these assessment skills to teach other subjects. It turned out that she was not teaching ML.

As alluded to earlier in Chapter 2, Bansilal & Wallace (2008) identified six issues of concern which should be considered in the design of tasks by both mathematics and ML teachers. Three of these six concerns, that are most relevant to ML are:

- a) *Knowledge Gaps*: which basically refers to learners failure to grasp new concepts as a result of a misconception that was not addressed earlier on in their learning.
- b) *Task Language*: The language used in a task may prevent learners who are poor in that language from understanding the task requirements.
- c) *Information Overload*: Tasks that have too much unnecessary information distract learners from identifying the requirement of a task.

The concerns raised by Bansilal and Wallace show the enormity of the task at hand for teachers who train to become ML teachers, where this one element of task design becomes

crucial in their professional development. Task design forms a huge part of the PCK of ML teachers, because of the demand placed on ML teachers to find contexts that are relevant to their learners. In order to fulfil the mandate of ML, it is mainly teachers who have to find these contexts and then set tasks using these contexts.

The claim of an ability by teachers to design tasks is also observed in Questionnaire B, where 6 of the 8 participants indicated that there was a vast improvement in their assessment skills. In her study, Hechter (2011) argues that designing assessment tasks is an important aspect of teaching ML that has to be treated with care. Teachers should be able to distinguish between tasks in Mathematics and ML. This, she continues, should be considered because, according to the policy documents of the DoE, (DoE, 2003a; DoE, 2005; DoE, 2006; DoE, 2008), “mathematical knowledge per se is not the goal of ML in the way that it is in a Grade 8 and 9 Mathematics classroom” (Hechter, 2011, p.6). In his study, Isaac (2009) claims that “the depth of content knowledge determines the strength of the activities designed for teaching” (Isaac, 2009, p.82). After teachers had indicated that their content knowledge had improved, it stands to reason that teachers were able to design tasks that are appropriate to ML, after their participation in the programme. In that way the claim by Isaac (2009) above, is confirmed.

5.2.2.(b) Identifying Misconceptions in Teaching ML

There is evidence that teachers were enhanced by their participation in the programme to be able to identify misconceptions that may arise in teaching ML. In her interview, Mrs. SP refers to the programme as an “eye-opener”, which helped her deal with a number of misconceptions that she had held. Participant A3 also uses this term ‘open’ in describing how he was likewise able to identify the misconceptions he held on certain topics like Probability. This identification of misconceptions goes hand in hand with the teachers’ ability to introduce and explain concepts. A number of participants found the programme very helpful in this regard. As confirmed by Graven & Venkat (2007), teachers might have appeared to be unsure of how to teach and assess ML, but ways of explaining concepts which were discussed in the programme helped teachers (Participants A14; A3; A1; A6 & A8) to get clarity on how to handle specific topics or concepts.

Teachers of ML are usually faced with learners “who would otherwise have terminated the formal study of mathematics in Grade 9, learners with limited basic knowledge and skills and perhaps an unfavourable attitude to mathematics” (Pillay, 2006, p.66). This places a huge

burden and challenge on the ML teacher. It is therefore of utmost importance that teachers of ML should be prepared to face the task of identifying misconceptions in such learners if ML is to be endured. Such identification requires the knowledge of the necessary content by the teachers themselves. Whilst the ML curriculum assumes that learners have at least passed GET mathematics at 40%, many learners do not achieve this mark. Pillay (2006) warns that there is “an ongoing erosion of the culture of learning” in some schools where “marks are adjusted at schools to allow learners to pass Grade 9, something that learners are aware of”, and hence “there is no concerted effort to do well” (Pillay, 2006, p.66). In this study teachers claim to have improved and acquired new content knowledge (Question 6.1.& 20.2 in Questionnaire A and Question 5 in Questionnaire B, respectively), which will enable them to face this challenge.

5.2.2.(c) Ways in which the Studies in the Generic Modules contributed to Teachers’ PCK

There are adequate details in this study of the role of the generic modules in equipping teachers with knowledge of content and students (KCS) and thus building confidence in the teachers to teach ML. In Questionnaire A, number 6.4., thirteen participants stated that their confidence as ML teachers had improved. In Question 20.7 of Questionnaire A, twelve of the fifteen participants indicate that they feel more confident in an ML class than they would have been without the ACEML qualification. Also, in 20.9. of the same questionnaire, twelve participants state that they now understand most Government policies in Education, which were studied in the generic modules. In the interview, Mr. PN stated that he now understands the Schools’ Act, has learnt to deal with different learners differently and knows how to approach a new or difficult topic. All of these he attributes to the generic modules. In that way he sees himself as a “good ML teacher who is still learning, even from the learners.” He even mentions that through the generic modules, he now understands the thinking of different learners.

Some teachers emerged from the study as reflective practitioners who were able to look into their own teaching. They were able to point to specific changes and improvements which they saw in themselves and in their teaching as a result of participating in the ACEML programme. In the interview, Mrs. SP revealed that when she started teaching ML, she “was a good teacher. If I can score, I can give myself 40%” in terms of her knowledge and confidence. However, “after finishing the course it was 100%.” she said. Her upward

mobility (she said) had been gradual until reaching the 100% at which she saw herself. In discussing teachers as reflective practitioners, Chapman (2009) states that “reflection includes examining, framing and attempting to solve dilemmas of classroom practice, and being aware of and questioning the assumptions that (one) brings to the classroom” (Chapman, 2009, p.121). The study confirms that teachers were able to reflect on their practice, because they had engaged in the module Professional Practice, which concerned teachers reflecting on their own practice. Teachers had been asked in the module to identify a problem encountered in their own teaching, design lesson plans where they were to deal with the problem, implement their plans in the classroom, and ultimately write a full report on the process as a whole. This practice helped teachers in reflecting on their own teaching, a skill that could be used in future teaching of their ML classes or any other subject for that matter. In her study, Hechter (2011) agrees with the inclusion of such modules in the programme and asserts that teachers need to be trained more in implementation of the ML curriculum so that they can “alter their existing practice or develop a new practice” (Hechter, 2011, p.149). He states further that “the training with respect to teaching practice needs to include training with respect to curriculum implementation, lesson planning, lesson presentation and the setting of assessment tasks” (Hechter, 2011, p.149). He concludes by saying that teacher training should not be “restricted to workshops or short courses, but ideally needs to be implemented over a longer term to assist teachers to successfully alter an existing practice or develop a new one”. (Hechter, 2011, p.149). Such claims make one feel that Hechter (2011) was in favour of the generic modules, because that is what they actually dealt with particularly.

Also of importance, was the fact that some previously mathematics teachers (Mr. PN in interview), realised that they had to change their previous thinking about Mathematics in order to teach ML successfully. These and other examples are conclusive evidence that some teachers emerged from the ACEML programme as true reflective practitioners.

As mentioned earlier, teaching demands an integration of ideas in the content with ways that are apprehendable to the learner (Ball et al., 2008). Most of the teachers (in both Questionnaire A and B) indicate openly that through the ACEML, they have become more confident in teaching the subject. This is also shown by their willingness to teach any grade at any time. One teacher (Participant A4: Questionnaire A), even stated that she would rather teach Grade 12 only, because she wanted to “measure [herself] against national standards.” Hechter (2011) suggested a need to train teachers with respect to curriculum implementation. Curriculum implementation strategies are expected to have been achieved by teachers in the

educational modules like Professional Practice, which they underwent as they studied the ACEML. In that module, teachers were expected to identify problem areas in their teaching, and hence provide solutions on how they would overcome such problems. This practice enabled teachers to become introspective of their teaching practices, thus enabling them to improve and alter their curriculum implementation strategies. However, there were teachers who did not see such modules as being useful. For example, Miss ZN felt that such modules should not have been included in the programme. Her reasons were that most of the teachers were only eager to learn more content and had not expected to study such modules. The same sentiment was reiterated by Mrs. SP, even though she was not against the generic modules herself. She was referring to other colleagues with whom she had been studying the ACEML. However, some of them realised after completing the programme that such modules deserved inclusion.

The data from the interviews and the questionnaires also shows that some teachers did not appreciate having to learn modules that were not directly linked to the school content of ML. Mrs. PSK and Mrs. SP said specifically in the interviews that some teachers they knew decided to drop out of the programme because of the other modules that they had to study, which were not directly linked to school content in ML. However, those who remained until completion, realised later that in spite of achieving more content knowledge in the four modules, the generic modules were also helpful. This was confirmed by Mrs. SP in the interviews when she said that she was helped by these modules in learning to handle large classes. This was also reiterated by Mrs PSK who learnt the advantages of using group work in teaching large classes

5.2.2.(d) Understanding the Differences between Mathematics and ML

Teachers noted the difference between teaching and learning of Mathematics and ML with regards to their teaching practices. From post interview discussions with some participants, which were held as a follow up to their responses in the interviews, it emerged that some participants (Participant A1 and A11) saw Mathematics as a subject in which a set of rules are followed and adhered to in a manner that may be too abstract for the learners. Contrary to that, ML offers an opportunity for both the teacher and the learner to be creative, spontaneous and be able to use his/her own imagination. As stated in the Curriculum and Assessment Policy Statement (CAPS), “if the required calculations (in ML) cannot be performed using a basic four-function calculator, then the calculation is in all likelihood not appropriate for ML”

(DoBE, 2011). Context forms a huge part of ML problems, and therefore teachers need to be creative and spontaneous in designing problems whose context fits with their respective learners. Such creativity is not always necessary in mathematics lessons. “Mathematical content is needed to make sense of real-life contexts; on the other hand, contexts determine the content that is needed” (DoBE, 2011). As shown in their responses to Question 20.1. of Questionnaire A, fourteen of the fifteen teachers felt that it is not simply any mathematics teacher who is be able to teach ML successfully. In the interviews, Participants A2; A11 and A14 clearly disagreed that a teacher can teach ML by simple virtue of him/her being a Mathematics teacher. Hechter (2011) notes in her study that, teachers need to be aware of the different ML teaching practices to teach ML in order to achieve maximum student learning in their classrooms. Participant A11 stated, both in the questionnaire and the interview that teachers who had been Mathematics teachers previously usually “teach ML as if they are teaching Maths”. She further stated that as a previous Mathematics teacher herself, she would have agreed to teach ML if it was given to her at her school, prior to enrolling in the ACEML. However, after studying the ACEML, she noticed the difference between the two subjects and felt that it would have been a huge mistake to agree to teach ML without having participated in the ACEML programme. Alluding to this fact in her study, Nel (2009) states that teachers who find themselves having to teach ML without studying the ACEML find themselves “unable to marry content and context”. (Nel, 2009, p.77). This claim resembles the opinions of teachers in this study. While previously Mathematics teachers can be assumed to know the content required in ML, teaching of ML requires “trying to get the bigger picture, trying to see the wood instead of individual trees” (Mason, 2008, p.306).

5.2.2.(e) *Changing and Improving Teaching Strategies*

There are consistent reports that teachers have changed and improved their teaching strategies as a result of their involvement in the ACEML programme. Fourteen teachers in Question 20.5 of Questionnaire A, and seven in Question 5 of Questionnaire B all agreed that their teaching strategies have either changed or improved as a result of their participation in the ACEML programme. This change has led to learners enjoying the subject, as indicated by Miss ZN, in the interview. The change in teaching strategies and restructuring of the whole teaching process enhances the involvement of learners in the learning process, shown by the contributions they make. Participant A1, claimed that he also learns from the learners, just as Nel (2009) also reported that teachers in her study said they were also learning from their learners. The perceived improvement in teaching strategies makes it sufficient to say that

teachers in this study have also succeeded in learning to “relate their teaching to everyday experiences, integrating mathematics with contexts by linking content and context and differentiating between the two” (Nel, 2009, p.49). Miss ZN was adamant in her interview that a changed teaching strategy results in more learner involvement. She claimed that her learners actually told her that attending class is never the same when she is absent. Such statements by learners she attributes to her restructured teaching practices. In the discussion of the ZFI, Rogan (2006) wrote that “various members of the school community participate in drawing up a plan to implement change in a way that is appropriate and feasible for that school’s context and culture” (Rogan, 2006, p. 443). The ZFI within which Miss ZN worked, and which led to improved teaching strategies is determined by her current set of circumstances and also what is feasible within her context. For other teachers, they would be working within their own ZFI’s, which could be more or less constrained to that of Miss ZN.

Different methods were used by different teachers in changing their teaching strategies. Miss ZN elaborates in the interview on how she made the learning of different formulae easier for her learners through using charts. Other teachers (Participant A13 and A15), who had problems in introducing specific topics, as seen in the responses to question 13 of Questionnaire A, report what was also noted in Nel’s (2009) study where “a definite shift took place from being unable to introduce a concept to a more definite approach” (Nel, 2009, p.51). It should be noted that the teaching of ML is usually more challenging because ML is usually done by the weaker learners, compared to the more capable learners who are allowed to move on to mathematics in Grades 10 - 12. To progress to mathematics in Grade 10 requires a pass in Grade 9 mathematics but progression to ML has no conditions attached. Mr. PN added that there were concepts that he used to take for granted and hoped that learners would easily understand. Now he knows that it is important for him to always seek the prior knowledge of the learners before introducing anything new.

Fourteen teachers in Questionnaire A, Question 20.12 generally felt that they would not have been able to teach ML successfully if they had not enrolled in the ACEML programme. Even those teachers who had been teaching mathematics before, whom it was expected by principals and HOD’s that they would be most suitable to teach ML, also felt that they were enabled by the ACEML to teach ML effectively. These teachers’ experiences suggest that the ACEML has worked to extend their personal ZFI’s. Teachers who have smaller ZFI’s are limited in the improvements that they can effect because of their constraints. The ACEML has helped teachers identify new strategies and methodologies that can be used in their

current circumstances, thus effectively extending the space within which they work (that is, their ZFI).

Mrs.SP, elaborated on how she struggled to teach the subject prior to her enrolment, wherein with all her mathematics experience she could not be directed by ML textbooks that were the only teaching aid at her disposal. Locating her existing content knowledge within the ML classroom was a massive challenge for Mrs. SP.

The problem of huge classes among most schools cannot be emphasized enough. This problem has existed long ago, even during the apartheid era. As it forms one of the main causes for poor performance and low achievement among poorly resourced schools, it is a problem that needs to be addressed. However, in reporting on different strategies that they learnt, teachers mentioned that they had learnt to manage huge classes (Participant A11). Handling different learners differently (Participant A1), in cases where learners are a diverse community in terms of race, for example, was also one of the different strategies reported by teachers. The diversity of learners, which could also be based on their socio-economic status is also one of the reasons why teachers have to know strategies of handling such differences. As already mentioned, Participant A1 stated that he had learnt some strategies in this regard whilst studying the ACEML. Lastly, the usefulness of group work especially in assessment (Participant A13) also formed one of the new teaching strategies that teachers reported having achieved through their participation in the ACEML. Participant A1 also mentioned the importance of knowing learners prior knowledge before embarking on a new concept. This was a practice he had been ignoring while teaching Mathematics and prior to engaging in the ACEML programme. The changed strategies are all indicative of both knowledge of content and cognisance of students (KCS) that teachers had attained through the programme.

5.2.2.(f) Endorsement of the Value of the Programme in Developing the PCK

Most teachers (14 teachers in questionnaire A, question 20.13.), agreed that they would recommend any teacher who wishes to teach ML, to start by studying in the ACEML programme. This recommendation, is also seen in Questionnaire B number 5, from the extent to which participants in questionnaire B claim to have improved in their classroom strategies, assessment skills and knowledge of ML contexts. Therefore teachers saw the ACEML as a pre-requisite for anyone who wishes to teach ML successfully, (Questionnaire A, question 20.6) regardless of whether one has a mathematics background in Grade 12 or not. This can be seen as an example of achieving knowledge of content and teaching (KCT) as identified

by Ball et al., (2008). Teachers could make decisions that “require coordination between mathematical content at stake and the instructional options at play” (Ball et al., 2008, p. 401). To add to this, Mr. PN and Mrs. PSK both thought that it would have been a mistake to agree to teach ML without studying the ACEML. This was inspite of the two of them having been Mathematics teachers before.

In the interview, Mrs. SP mentioned that some teachers in her school, completed the programme but went back to the school to teach their previous specialisations. The programme might have helped them become more effective in their specialisations, as in the case of Participant A12, who stated in the questionnaire that she was using the strategies she learnt to teach other subjects. Therefore the ACEML contributed positively in developing teachers professionally even in cases where teaching of ML was discontinued.

5.2.3. On Beliefs and Development of an Identity as ML Professionals

All teachers who participated in the ACEML had been teaching in other specialisations prior to enrolling in the programme. They had identified with the subjects that they were teaching previously and were presumably confident in those specialisations. Development of a new ML identity is seen as a process where teachers begin to see themselves as belonging to a new group of teachers, teachers of ML. Their previous specialisations are shifted into the background, and a new sense of belonging emerges. It is an inner feeling, where a teacher no longer associates him/herself with the old subject but develops a new sense of belonging, where the teacher is prepared to face any challenge that threatens his/her identity. The teacher believes and is prepared to engage in arguments that involve defending the existence and introduction of this new subject ML. Identifying with a subject involves the development of beliefs about the usefulness of the subject ML, as opposed to the negative criticisms made by those who see ML as a watered-down version of Mathematics (Jansen, 2012).

5.2.3.(a) *Development of Self-Confidence*

Development of self-confidence is one of the main emerging themes in this study. Teachers repeatedly reported in both questionnaires as well as in the interviews that they felt improved confidence in teaching ML in their schools. Participant A14 (Mrs. SP), who had started teaching ML prior to enrolling in the ACEML, elaborated during the interview on how she was struggling with no support in her initial year of teaching ML, where she did not even know what content to teach. Trying to use textbooks did not help her either, because

“textbooks assume that learners have all the knowledge and skills pertaining to the previous work” (Pillay, 2006, p.71). However, after enrolling in the ACEML she was ready to “face any challenges” (Participant A14).

5.2.3.(b) Emergent Categories of Identity

There are three categories of identity that also emerged from this study. These identities were similar to those identified by Nel (2009) in her study, where (i) teachers foregrounded the new ML identity and backgrounded their previous identity; (ii) teachers who had a dual identity - the one they had before and a new ML identity and (iii) those whose ML identity was less strong, with their previous identity remaining strong. Twelve teachers from Questionnaire A, agreed that they would prefer to be called ML educators now (question 20.14). Although some teachers can be identified as having a “dual identity” (Nel, 2009, p.78), due to the fact that they still teach their previous subjects, they show a stronger preference to be called ML teachers as stated in (Question 20.14). A report (by Mrs. SP, interview) that even those who were not teaching ML due to their school having more ML teachers than needed, were also willing to teach ML, shows their identification with the new subject. Others, (Miss ZN; Mr. PN) have totally stopped teaching their old subjects. Miss ZN even states that she does not think that she will be able to teach the old subject ever again. This indicates the foregrounding of a new identity and backgrounding of the old. In a similar study by Graven (2004), where Mathematics teachers were learning through a 2-year senior phase in-service teacher education programme, it likewise emerged that teachers “saw their learning as a process of developing new identities” (Graven, 2004, p.181). This phenomenon is most evident as in the words of one participant, “You know before I always used to introduce myself as the music teacher, now I introduce myself as the maths teacher” (Graven, 2004, p.181). Similarly, in this study Mrs PSK said in the interview, “I now see myself as a Math Lit teacher, a very good one”. The same identity assumption situation also occurred in the Science Additional Specialism Programme (SASP) by Woolhouse & Cochrane (2010), where one participant said “I call of myself a Physics teacher now” (Woolhouse & Cochrane, 2010, p.615).

There is an indication that after the ACEML programme, teachers can face any challenge that threatens their ML identity. The programme provided a link between teachers’ classroom practices and real-life situations beyond the classroom. This changed they way they look at their life prior to studying. Participants A1 and A2, relate some of their experiences where

teachers' salary increases were discussed. Noteworthy is the fact that Miss ZN was able to show other teachers the importance of ML in their lives, as teachers were unable to calculate how much the stipulated percentage increment meant to their salaries. Mr. PN was also faced with a similar situation where teachers complain of not receiving an additional 1,2% but have no idea of what it translates into in their salaries. Nel (2009) also alludes to the fact that the teachers' ML identity evolved beyond the classroom. Teachers both in Nel's (2009) as well as in this study, started to see themselves as professionals and leaders in the subject. "Teachers began to see themselves as facilitators in the learner-centred classroom" (Nel, 2009, p.77) just as Mr. PN said he saw himself as a facilitator. Nel (2009) further asserts that there was an "emerging identity of seeing the subject as a good and easy subject." Mrs. SP had said earlier (in her interview) that the subject is good for learners who do commercial subjects as it deals with concepts like depreciation, profit margin etc. which are studied there. The same claim was echoed by Participant A1 in the interviews, who felt that the subject should be made compulsory for every learner, even those who take Mathematics, and all educators as well.

The identification with ML is further shown as teachers spoke strongly against the misleading idea in their schools (and elsewhere) that "ML is only for the weaker learners, is [a] lower grade [of] mathematics and does not help in any other way except to pass matric." Mrs. PSK even boldly claimed that "maths teachers look down upon ML", and was willing to challenge those teachers about their perceptions of ML, while Mrs. SP also asserted that "ML is not given the treatment it deserves by the media and society as a whole." She specifically referred to some universities where she claimed, ML is not included in their admission requirements brochures. This shows a strong will by teachers to defend the existence of the subject and confirms their response to question 20.8 in Questionnaire A, where teachers agreed that they can participate in ML-related debates with peers confidently because of the ACEML. It was mentioned earlier in Chapter 2 that within the situated learning perspective, focus is directed towards the broader community and away from the individual learner. The development of a new identity shown by participants, and their strong will to defend the existence of the subject is an example of how their focus was directed towards alerting the community on the purpose and philosophy behind ML. Clark (2012) also pointed out that "ML should not be seen as a culprit in taking good learners away from Pure Mathematics." This was in response to claims by critics, like Jansen (2012), who, according to Clark (2012) has "never had anything kind to say about Maths Literacy" (Clark, 2012, p.2). This author further claims that

Jansen is correct if one looks at Mathematics from the point of view of a high functioning school. However, Clark (2012) is quick to point out that “ML provides very necessary mathematics skills for learners who would never have had the opportunity to become mathematically literate before” (Clark 2012, p.2).

The generic modules also helped teachers learn strategies to deal with challenges that seem to hinder their progress and pose a threat to their newly developed identity. Mrs. SP, in the interview, spoke strongly against teachers who ridicule ML learners and call them unacceptable names. In proclaiming her sentiments, Mrs. SP said that she has found ways to make learners understand the importance of ML, as against the proclamations that ‘other’ subjects are more important than ML. It had been noted by Graven & Venkatakrishnan, (2007), that Maths teachers chase away learners midstream from Mathematics classes and expect such learners to join ML. In the ACEML, teachers were offered a module which “tried to promote transformative practice by encouraging teachers to take ownership of their practice by recognising and managing problems of practice they identified (Bansilal & Rosenberg, 2011, p.1). In the case of Mrs. SP, her participation has enabled her to deal with the problems of the negative perceptions of ML held by learners and teachers. Boaler (1999) had stated that the behaviours and practices of students in mathematical situations emerge as part of the relationship formed between learners and the people and systems of their environment. This is exactly what the situative perspective advocates, the importance of considering the context under which a teacher is working, because such context determines the practice. This is also reiterated in the concept of the ZFI, which compels the researcher to consider the context under which a teacher is working. (Rogan, 2007). Kelly (2006) refers to teacher identities as “the ways in which practitioners see themselves in response to the actions of others towards them” (Kelly, 2006, p.513). It is therefore through such actions of others that Mrs. SP began to find her identity. Nonetheless, three teachers out of 8 in Questionnaire B had negative comments about the generic modules (Question 15), where one said they should be excluded because they are difficult. The other two claimed they should be combined to make two instead of four modules whilst the last one seemed to want more focus on content-related modules, as discussed earlier. This shows that the take up of the programme was different for different teachers.

5.2.3.(c) Identity and Enhancement of the Will for Further Academic Progression

The study shows that teachers who had not been studying at all for very long periods were revived in seeking professional development through the ACEML programme. It is worth noting that some teachers who participated in the ACEML had not been studying at all after their initial teacher qualification (Mrs PSK-25years; Mr. PN-10 years), and many others (refer to Questionnaire B, question 4), who indicated having taught various subjects for longer periods. Such teachers may not have studied further were it not for the ACEML. In enhancing professional development, teachers were revived by the ACEML and ended up foregrounding a new identity of ML while backgrounding their previous identities of 10, 15, 20 or more years. On the same note, some teachers (Miss ZN) had not been comfortable in their previous subjects, but were working hard to conceal this discomfort from other peers. Hence the emergence of a new 'home' meant relief from stress that had seemed inescapable. It is indeed as a result of the ACEML that some teachers (Participants A3, A10, A14, for example) are currently furthering their studies in the fields of mathematics education, mathematical literacy and other fields. The first two are engaged in their Masters' studies whilst the third has completed her Honours degree recently. This shows that the ACEML also opened up a path for them for further academic progression.

The majority of teachers claimed that they never considered dropping out of the programme. 13 teachers from Questionnaire A and 6 from Questionnaire B had various reasons which kept them going, among which some indicated that they enjoyed the programme, had interest in the content that they learned or were motivated by the will to upgrade their qualifications. The five who considered dropping out at some stage (Participants A2; A4; A7; B20 and B22) were prevented from doing this by the support they got from other peers and family members. It was however the view of Mr. PN and Mrs. SP that teachers who wanted to drop out were lazy and lacked commitment in their studies. They (Mr. PN&Mrs. SP) further claim that some teachers had gone to enrol with a wrong attitude that the ACEML would be an easy course. When faced with challenges, they decided to quit. The comments of these two participants show that they feel that completing the programme was an achievement based on dedication. Although there may be various reasons for completing the ACEML, teachers generally show that they believed in the importance of obtaining this qualification.

It is quite striking to note that Mr. PN stated that he would not have been a student of the ACEML if he had to fund his studies himself. On the other hand, Mrs. SP said she would

have studied the ACEML even if it meant funding her studies herself. However, Mr. PN did allude to the fact that his decision would have been due to the “final constraints within his family” and not otherwise. Both teachers strongly supported the idea that the ACEML helped some teachers improve their qualifications, helped teachers to understand the subject more clearly and thus could improve the results in their schools.

5.3. LIMITATIONS OF THE STUDY

This study also has limitations which can be summarised below:

5.3.1. Sampling

The study used convenience sampling where participating teachers were obtained according to their availability and accessibility to the researcher (Cohen et al., 2007). This resulted in the study having teachers from basically the same geographical area and hence no distinction could be clearly made between urban and rural, gender issues, racial issues etc. Also of importance, is the fact that the sample size prohibited the use of statistical techniques in data analysis. The gender and race of the participants was not taken into account in the sampling procedure, although there could have been some differences between participants of different gender and race in terms of success.

It should be mentioned that the sample of eight which filled in Questionnaire B may also be seen as a limitation in this study, in the sense that their questionnaires could have been completed when they were in their post-graduate studies. Modules which they studied post the ACEML could have affected their perceptions of certain aspects of this study, particularly in terms of identity. However their further studies were enabled because of their initial enrolment in the ACE and their perceptions are therefore important to such studies.

5.3.2. Observations

Participating teachers were not observed conducting lessons, thereby no inferences could be made on the extent to which they had acquired new knowledge, as expected, after their involvement in the programme. Some of the events reported to be happening in class could not be verified.

5.3.3. Self-reported data

Data from the study is self-reported by the participants, leaving no room for verification of whatever they say. As alluded to previously, actual observations of certain situations would have been more beneficial. This would help in avoiding the possibility of participants giving false or fabricated information about certain situations in their teaching and learning.

The study reported on the teachers' perception of how the programme enhanced their professional development. Of course, their perceptions are based on their own realities. However, it would be useful to follow teachers into their classrooms to study the actual ways they benefitted from their participation in the programme. The study could not investigate the content knowledge of the teachers prior to and after their participation in the programme. This aspect requires further study which was beyond the current scope, yet this would have provided some insight into how their content knowledge had improved or how new content was gained.

5.3.4. Inability to locate drop-outs and those who returned to previous specialisations after completion.

Failure to locate teachers who dropped out of the programme made it difficult to find out from their own perspective why they had done so. It would have been ideal to have interviewed a sample of students who dropped out. Their reasons could have provided some insight that may have been concealed in this study.

The study could not establish or reveal the number of teachers who completed the ACEML programme, but went back to their schools to teach their old subject specialisations. This information could be useful in helping us to draw out further insights on the development of teachers, as a result of participating in the ACEML programme.

5.3.5. Avoiding the Hawthorne Effect

It seems that avoidance of the 'Hawthorne effect' could not be guaranteed. Shuttleworth (2009), defines the Hawthorne effect as a "process where human subjects of an experiment change their behaviour simply because they are being studied". The author goes further to say that this phenomenon is one of the "hardest inbuilt biases to eliminate" (Shuttleworth, 2009, p. 1). Participants usually modify their responses, giving the researcher what they feel would be an 'acceptable' response. It is sometimes called the 'effect of expectation'. Some

of the teachers' responses could be manipulated by the fact that they were closer to the researcher, in terms of work, such that they could easily be tempted into giving responses they thought were expected by the researcher. However, precautions were made beforehand when it was requested from teachers that they be as honest as possible in responding to both the questionnaire and the interview.

Most importantly, as mentioned earlier, with ML being a relatively new subject in South African schools, there were only four previous studies to refer and relate to, in order to make comparisons with this study. Most previous studies that were used in this study referred to Mathematics. Although these studies were also useful, it would have been ideal to find more studies that dealt specifically with the professional development of teachers within the scope of the subject mathematical literacy.

5.4. RECOMMENDATIONS

Whilst one of the main purposes of the introduction of the ACEML programme was to provide an adequate number of ML teachers to all schools in the province of KZN, the study has shown that there could be a significant number of teachers who participated in and completed the programme, yet such teachers are not teaching the subject in their schools. Whilst some schools have more ML teachers than are needed, some schools still remain without a qualified ML teacher. As stated by Mrs SP, her school has five teachers who are qualified, but who do not teach ML. There seems to be a strong need by the DoBE to identify such teachers and therefore try and devise a strategy to distribute these teachers evenly to all schools. However, caution must be taken that the process of redistributing these teachers does not resemble the notorious Redeployment and Rationalisation process previously used by the Department of Education. In addition the KZN DoE must ensure that any intervention is guided by accurate statistics relating to schools' needs, and teachers' availability to take up ML teaching opportunities.

One important aspect to consider in trying to achieve the above, could be to tighten the rules in the selection procedures of who should go and study the ACEML programme. Leaving the decision to schools themselves has shown, through this study, that this leads to teachers taking an opportunity to upgrade their qualifications, without any intention to teach the subject after completion. The Department of Education should therefore identify schools that are in need of ML teachers, and thereby work with the management of such schools to

identify teachers who are most suitable, in terms of the shortage in schools, to enrol and take part in the ACEML programme.

Institutions which offer the ACEML programme should ensure that entrance requirements are strictly adhered to, in the admission process of teachers who are to be trained to teach ML. This study has shown that some of the participants in the programme were teachers who had very limited knowledge of the basic requirement in the subject content of ML, namely, the GET Mathematical content knowledge. No teacher should be admitted on the mere production of an affidavit that he/she attempted Mathematics in Grade 12. Perhaps experience in Senior Phase Mathematics should be a more emphasized requirement. The importance of strict entrance requirements is seen through one participant, Miss ZN, who did Mathematics up to Grade 9 and hence found herself struggling with most sections of content studied in the modules of the ACEML. Hence Higher Education Institutions which offer the ACEML should consider carefully the requirements that they lay down for a teacher who wishes to enrol in the ACEML programme.

In terms of the programme, these institutions should ensure that they offer their training according to the basic needs of the teachers, which, according to this study, is content knowledge in the subject ML. Whilst it may not be possible to address all of the basic content knowledge required, the constant demand stated by participants in this study, of wanting to learn more content, illustrates the enormity of the need for teachers to be trained in this aspect of the subject, more than in their general professional development as any ordinary teacher of another subject.

As alluded to in the first Chapter, the findings of this study could be used in tailoring further professional development programmes. Teachers in the study expressed their concerns about the importance of studying more of school content related modules. This suggests that they may be needing more assistance with the actual content that they teach. These concerns suggest that future provisions of professional development qualifications like the ACE, should attempt to include more content rich modules, where teachers would be reskilled in the teaching of specific topics within the school ML curriculum. It was also suggested by some participants that the ACEML should have been designed such that contact sessions were spread over the weekends throughout the year. Perhaps this would have kept teachers on their toes in keeping up with learning the content throughout the year, rather than having to squeeze much work in a week long contact session. At the moment the delivery of the

programme is constrained by the university's own calendar which is designed with the needs of the full-time young adult who form the majority of the student population of the university. The students who have enrolled on the ACE are very different — they are mature adults who have a full time occupation. Perhaps the university should consider organising programmes for these teachers in more convenient times, such as teaching them out of the semesterised times of the university.

This study has shown that some teachers found themselves struggling in the field, even after completing the ACEML, when they were faced with aspects of the curriculum that they were not familiar with. One participant, Miss ZN, had to learn the Theorem of Pythagoras together with the learners that she was teaching. This problem advocates the strong need by the Department of Basic Education, to work hand in hand with Higher institutions, in conducting more in-service programmes, that would address topics that are posing problems to ML teachers. In the current situation, teachers are not offered classroom support from subject advisors (for a variety of reasons), yet the study has shown that teachers need help in teaching ML. It is essential that graduates be supported in their place of work, even after successful completion.

It emerged from the study that there exists a portion of teachers who teach subjects they do not identify with. Such teachers, the study has shown, teach up to Grade 12 level, based on the mere fact that they were trained to teach such subjects earlier in the profession. The identity of the teacher with the subject is rarely taken into consideration, this resulting in a teacher who teaches a subject he/she may not be comfortable with. This study has shown, through Miss ZN and Accounting, that she was never comfortable in that subject. She was nevertheless teaching it in Grade 12. From this study, one can deduce that there may exist a large number of such teachers out there, who teach subjects in which they are not comfortable. This could be one of the major contributing factors in the low Grade 12 pass rates experienced over the years in the whole of South Africa.

One revelation in the study is the one of teachers dropping out because they were not expecting to study modules which to them, seemed to have nothing to do with the school-related ML content. This suggests that the institution from which these participants studied, may consider evaluating whether the current structure of the ACEML could be revised in the light of the many comments of teachers. Perhaps it may reduce the high drop-out rate in the programme. Restructuring of the ACEML programme could even include a change in the

times for contact sessions during school vacations, as it emerged from the study that some teachers found the contact sessions to be too tight and not giving them enough time during the holidays. Perhaps they would have preferred more Saturdays than week-long lectures.

5.5.FINAL CONCLUSIONS

In this study, the role of the ACEML in enhancing Mathematical Literacy teachers' professional development has been shown in many forms. The reports made by teachers through the data collected and analysed, have shown that teachers emerged from the ACEML programme as changed persons. Through this study, teachers themselves gave lengthy and detailed accounts of how this professional development was enhanced in their lives through participation in the programme.

Teachers reported on their improved content knowledge, on new content knowledge that was acquired as well as on some misconceptions previously held that were corrected through their involvement in the programme. Extensive descriptions were given by some teachers on how participation in the programme enabled them to teach the new subject ML with confidence. It even emerges from the study that teachers felt that they would not have been able to teach the subject effectively without participation in the ACEML programme.

The ACEML programme provided teachers with various strategies that they could use in the classroom, not only in teaching ML, but also in teaching other subjects as well. Some of these strategies were new whilst others had been known to the teachers, yet ignored. It is through their participation that implementation of such teaching strategies was revived. Teachers who had been uncomfortable in the subjects that they taught, prior to engagement in the ACEML programme, emerged as innovative teachers, who could manage their classroom well under any circumstances. They (the teachers) were full of confidence and some even reported that their learners also took notice of their changed strategies.

Through the ACEML programme, teachers managed to find a new home, a subject with which they could identify. Most of them displayed strong beliefs in the subject and its importance, thereby assuming new identities with the new subject, abandoning their previous identities with the subjects that they had been teaching before. Most teachers confirmed that they could withstand any critique of the subject ML and would be willing to engage in any debates that were against the introduction of ML in South African schools.

The participants have reported that none of the above, would have been achieved without full participation in the ACEML programme. Noteworthy is the fact that, even with some teachers having gone back to their schools to teach their previous subjects, the impact of the ACEML programme on their daily teaching activities could not be ignored.

Teacher professional development is an ongoing process throughout the career of any teacher. The ACEML has provided a significant boost enhancing such professional development of teachers. Not only have teachers improved their content knowledge, their teaching strategies and content specific pedagogy, as well as developing their identities with the subject, but teachers have been made to see the education of learners generally in a different light. Reflective practitioners who are lifelong learners and researchers have been created. The initiative of the KZNDoE and the University of KwaZulu Natal seem to have borne the desired output through the ACEML programme.

With more research into the ML field of study and various contributions yet to be made by academics, the subject ML is bound to prosper. The change brought about by the ACEML in a number of teachers has not reached its final destination. More and more improvements in the way in which programmes similar to the ACEML are handled will certainly be beneficial to the education of the learner and ultimately to the whole of the South African community. In that way, learners that leave the system will be filled with the “knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society as citizens of a free country” (Department of Education, 2012, p.4).

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APPENDIX A

TRANSCRIPT of INTERVIEW with Miss ZN- by T.E. Thembela

Interviewer: Today I'm sitting with Miss ZN, who was a student of the ACE Mathematical Literacy. Eh ... we are here to do an interview on the impact of the ACE Mathematical Literacy on her. Because of time, I'll start right away with the first question: Miss ZN, the ACEML is a vital, essential and necessary pre-requisite for any educator who is willing to teach Mathematical Literacy successfully. In other words I'm saying a teacher needs the ACEML in order to teach Mathematical Literacy. What are your comments to this claim?

Miss ZN: *Alright, I'll.... my comment to that is yah, a teacher do need to go under a course for Math Literacy in order to teach Mathematical Literacy, cos Math Literacy its not the same as Mathematics. So one needs a background or foundation of Mathematical Literacy on how ... on the many areas that are within the syllabus. So it's more of word problem than eh... than sums like in Maths. So it is important for any person even a pure Maths teacher, he or she needs to undergo a Math Literacy course.*

Interviewer: Okay. I'll come to you now. Are you teaching Mathematical Literacy currently?

Miss ZN: *Yes.*

Interviewer: ..and are you planning to teach it for the rest of your teaching career?

Miss ZN: *Yes, if they won't change the aim that they have about Math Literacy 'cos there are rumours which says that other school will phase out Mathematical Literacy 'cos they don't see the need of teaching it.*

Interviewer: So you're saying that as long as it is there in your school you'll be teaching it.

Miss ZN: *Yes.*

Interviewer: So I'll skip this next question cos you've already said that you are teaching Mathematical Literacy. Are you also teaching the other subjects that you taught before you studied the ACEML? If you do, which side has more

classes than the other? You have more Mathematical Literacy classes or more of the other subject?

Miss ZN: *Eh...since the load of Mathematical Literacy has gone up, I'm now teaching only Mathematical Literacy. I'm no longer teaching the subject that I was teaching before so my focus is only on Mathematical Literacy, they have given me that load, so I'm no longer teaching the subject that I was teaching before.*

Interviewer: In other words you would be prepared at any time to write a Mathematical Literacy test that would be set at Grade 12 level?

Miss ZN: *Yes of course, not only at grade 12 level, there were some workshops that we have undergone where we were supposed to write a pre-test, so ..andpost test, so and I was able to write those tests.*

Interviewer: Mhm. ...and since you've said yes, would you say that your study of the ACEML is the reason for this preparedness?

Miss ZN: *Not alone the study, but the friends that I had on my side when I was studying ACEML, they are the one who had made me gain more confidence in teaching Mathematical Literacy, and to have this enthusiasitics about Mathematical Literacy.*

Interviewer: So at any time you can teach any Grade in Mathematical Literacy?

Miss ZN: *Yes.*

Interviewer: Thats fine. Would you also encourage any other educator who wishes to teach Mathematical Literacy to start by studying the ACE Mathematical Literacy?

Miss ZN: *Yes I would because looking at my point or side, because I didn't do Maths before. But now, I'm able to teach Mathematical Literacy. I didn't have self-confidence in teaching the other learning area that I taught before. But now since I have undergone this programme on Mathematical Literacy, I'm now more confident in teaching than before. So it is important for any other person to start by studying Mathematical Literacy so he will be more*

comfortable with the learning area.

Interviewer: If I may ask you one question ... as a follow up. You said you did not any Maths? How far did you do Mathematics in high school?

Miss ZN: *I've done it from Grade eh... at high school I've done it from Grade 8 to Grade 9 then at Grade 10 we were having choices so I didn't do Maths at high school.*

Interviewer: Okay. Now if you were to be in charge of the distribution of the duty load at your school, say, that responsibility is given to you, would you allocate a Mathematical Literacy class to any teacher who has not studied the ACEML, and neglect another teacher who has studied the ACEML for any reason whatsoever?

Miss ZN: *No, I would not allocate the duty load to a teacher who had not studied the ACEML, because some other teachers they have this tendency....they don't like Mathematical Literacy. Its like it is done by those learners who are not coping at school. So they feel that they are failures. But for a person who has done Mathematical Literacy, he knows his job, he know what to... he knows the learning area very well, so I will not neglect the person who has undergone the course 'cause he is the one person who has more knowledge than the other person who has not studied it.*

Interviewer: Even if the teacher who has not done Math Literacy is known to be the so called 'good teacher', you won't give him?

Miss ZN: *It depends. As you have specified now that he's a good teacher. If he is a good teacher and is willing to teach Mathematical Literacy, he's having a positive attitude, so maybe that person will cope into teaching Mathematical Literacy. But again, he also needs to go and do a course in Mathematical Literacy in order to be familiar with the subject.*

Interviewer: So in short you are saying that every Mathematical Literacy teacher needs to have the ACEML?

Miss ZN: *Yes*

Interviewer: Thats your opinion?

Miss ZN: *Yes.*

Interviewer: Okay. Would you have agreed to teach Mathematical Literacy if you had not studied the ACE?

Miss ZN: *I said earlier on that I hadn't studied Maths...so I wouldn't have agreed, cos I hadn't studied Maths.*

Interviewer: So based on your response in this previous question, you can say that all the confidence that you might have of the subject comes from your study of the ACEML?

Miss ZN: *Yes.*

Interviewer: Okay. Now if we were to be more specific, what can you single out as something new that you acquired through your enrolment in the ACE programme? Eh... this may be from any of the eight modules and is not restricted to... to Numbers; Functional Relationships, Space and Shape and/or Data Handling., including the 'other' four modules. What "something new" did you acquire through your enrolment?

Miss ZN: *What something new did I acquire...? in Maths Literacy?*

Interviewer: ...on your enrolment in the ACE Mathematical Literacy programme? If you can just single out one thing from the many things that we assume you have acquired? Can you single out just one thing that you think .."I wouldn't have known this thing if I did not do the ACEML". Just one.

Miss ZN: *Mhh. Real life..it must be real life related or content related?*

Interviewer: Any.

Miss ZN: *eh... looking at Space and shape. I remember one day whe had an argument with ...can I say a person's name, the lecturer? Interviewer: No. Oh. One of the lecturers who was teaching us Space and shape... I didn't know what is a prism. So I asked him "what is a prism?" and I don't know whether he was nagged by me asking what is a prism ... I didn't understand it, I didn't*

doMaths at school. So by his response, although it was harsh, it made me to study more of Space and shape cos it was the one subject which was difficult for me. I didn't know those areas, those volumes...what and how am I going to explain to the kids... what are those things cos, since I haven't done Maths, it was very difficult for me. So it really makes sense now if I look back and if I look the way questions are being asked at the question papers for the learners. So concerning the tiling, which relates to the real life, the volume of the... maybe for instance a can of Coke, how much liquid must be in there. So that really made me more aware...that was the new thing that I learnt, it helped me a lot. So I reason, I know that Mathematical Literacy in Space and shape its not only volumes and those things like in Maths but it really link with the real life situation, like how many people can fit in the hall or in the cinema. So its ...it was a new thing to me to discover in Mathematical Literacy.

Interviewer: Oh..right... eh... is there any aspect of the subject that you feel you learnt from anywhere else other than in the ACEML? Something that you feel: “this belongs to Mathematical Literacy but I did not learn this whilst I was doing the ACE?” In other words I’m saying ...will it be true to say that all that you know in Mathematical Literacy, is what you learnt when you were doing the ACE? [Miss ZN: No] Or there are some things that you learnt from somewhere else?

Miss ZN: *(Laughs) For instance eh... maybe myself I have forgotten it... but I don't remember doing Pythagoras theorem from my study of Mathematical Literacy. So that is the only chapter if I may say or module that I did not learn from ACE. I don't remember studying it but other things ...*

Interviewer: So its something that you've just come across as a teacher and not as a student of ACE?

Miss ZN: *Ya. And I was ... the other one I don't remember interpreting maps or maybe I didn't understand it that time when I was doing Math Lit, but I did understand it now as I was teaching it after finishing the course. I dont remember a lot about maps.*

Interviewer: Does that not say then that a teacher who has not studied the ACEML can also learn Mathematical Literacy as he teaches it?

Miss ZN: *It depends on one's attitude? Interviewer: attitude? Yah. It depends on one's attitude, cos if you are just given Mathematical Literacy whereas you do not like it, you won't be able to learn it. I was able to learn those maps, those interpretations of maps, those eh... that Pythagoras theorem because I did like Mathematical Literacy.*

Interviewer: Okay. Right. Now if I can give you this statement, and I want you to give me any further claims based on this statement or counter-claims (against) this statement that: *'The introduction of the ACEML at University level for educators was one of the wisest moves made by the authorities'*. Maybe I should clarify what I mean by this statement. Eh... usually before the introduction of the ACE, teachers would be called to go to Workshops for two to three weeks like during the introduction of OBE. As a result we saw that most teachers came from those two-three weeks workshops having no idea of what OBE is. So in this statement I'm saying that the University, together with the Departmental authorities were wise to introduce the ACEML for educators so that educators can be able to teach Mathematical Literacy. Do you think that this was a good move or ..?

Miss ZN: *Yah it was a good move to enrol at Universities to do Mathematical Literacy cos courses like you have mentioned in OBE it was two days, three days then you are finished, you are supposed to apply it at school. Unlike when you are studying the course, Interviewer: studying to get a qualification? Yah. when you are studying you have more time, although time would be limited by some other reasons, but you do have some sequences that you do this, once you finish this you have more understanding of where you are going, rather than exhausting everything in two days.*

Interviewer: What would you say if I were to say there were OBE workshops that lasted for a week, or a week is also short?

Miss ZN: *(laughs) Still teachers... it was a new thing, teachers they were confused at that time, it was related to the change of how they are teaching in OBE*

and what they must apply. But in Math Literacy you sit as a group, you have some other people who are always there. You are able to go to the lecturer if you want. You may even ... once you have done Space and shape, and you are done with it, but I do have time to go to the lecturer and ask if I come across with any problem. But in OBE where were we supposed to go when I got lost in the class? Did I do this thing right if I was in class? If I was in class, who I have to liaise with in OBE? But in this case when you're studying a course or for a qualification it's more easier like if you get lost somewhere you are able to go to the lecturer and get help.

Interviewer: Okay. I can hear you know what you are saying. Right. Now it has been reported that eh... the groups, the cohorts, the groups of teachers who enrolled for the ACE, in those groups a lot of them dropped out before completing the ACEML programme. In your opinion, why do you think that some teachers dropped out?

Miss ZN: *(laughs) Eh..... I think that eh.... one of the things that cause them to drop out, there are teachers who were staying far from the campus, Edgewood. So it was strenuous for them to travel every holidays or during weekends if there are some sessions. And another thing that maybe the support. I was so fortunate to have enough support on my side of my friends that I met at the varsity. But to them maybe they didn't get this support from their colleagues who were studying with them. Maybe that caused ... those are the other reasons.*

Interviewer: May I just dwell on this 'support' thing. If you say support, do you mean that those teachers found the content to be difficult and then they dropped out?

Miss ZN: *Yah. They didn't manage, they found the content to be difficult. Or else they just assumed it was an easy thing cos as they were saying before it's for those learners who are not coping in Mathematics. Everyone assumed that it would be more easier, although it is difficult but it's not difficult as in pure Maths.*

Interviewer: They had that in mind? **Miss ZN:** *Yah.* But when they came there they found something different?

Miss ZN: *Yah.*

Interviewer: Then they decided to drop out? **Miss ZN:** *Yah.* Okay. From this question... I want you tell me in a few sentences..about yourself as a teacher. In your response I want you tell me about yourself before you studied the ACEML i.e. what kind of a teacher you were, what did you teach and so on; and then tell me about yourself during the time when you were actually doing the ACE, during the two years. and lastly tell me about yourself after you had finished the ACE. In a few sentences, each of the three sections in a few sentences.

Miss ZN: *Okay. Before I studied eh... Math Literacy, I was a very shy person and I was not confident with the learning area that I was teaching which is Accounting, although other people may seem to see me as a person who is being confident but deep down in my heart, I did know that before I had to go to class, I need to prepare myself thoroughly, cos it was.... it gave me a lot of challenge ...the Accounting. And so I think Accounting is very difficult than Mathematical Literacy if I compare those two. Then during the time when I was actually doing Math Lit, it was difficult, I felt like eh.... dropping it ...eh ... the support would come now and again cos I have those good friends of mine who were able to stay with me after lectures, and explain to me as I was the only person who haven't done Maths, then that made me felt the love and belonging and the love of Mathematical Literacy developed that time. And then after finishing theMath Literacy course, some of my friends, I did bother them calling them, I'm having a problem how can I handle this. Some ...they were more patient, we made some arrangements where can we meet, and they would explain to me again, and ...yah. Lots and lots I gained experience through the friends, good friends that I had during that time and just the friends of mine. So I'm not saying Mathematical Literacy is easier but although challenging, it is the one subject which really links with the real life situation tha happens around us. Cos, one of the arguments that I had at work was that if they say some other schools are facing out eh.. Mathematical Literacy, as there are teachers... there was this eh... issue which was recently discussed about our increment, that it has been increased by 6.8% , so*

I asked them, how much is 6.8% to your salary? Can you be able to calculate that? But they didn't know that. So I said Mathematical Literacy is more important 'cause it really link with what is happening around us. So maybe the love and the...and the, the love and what....? the love and the confident that I have its because of the way it is being linked with what is happening around us. So I think I prefer teaching Math Lit than other subjects which is more difficult for me to shift to the other subject if it is phased out.

Interviewer: Yah. From what you've just said I get the feeling that, before studying the ACEML, you were a teacher who was not very comfortable with the subject that you were teaching, who had to prepare thoroughly each day before you go to class, but now...then you did the ACE and after the ACE you changed from that subject to Mathematical Literacy, and now you feel more comfortable teaching this new subject? Is that what you're saying?

Miss ZN: *(agrees silently by nodding her head)*

Interviewer: Okay. So... this links with the following question, of which some of the questions have been answered indirectly from the previous questions. How would you describe your professional development that you have ... you are supposed to have attained from studying the ACEML programme? One, in terms of subject matter knowledge, two, in terms of your classroom teaching strategies and three in terms of identifying with and seeing yourself as a Mathematical Literacy teacher now? Dont mind repeating what you have already said, because I can see that most of what is required by this question is what you have somehow said before.

Miss ZN: *Can you rephrase your question? How would I....?*

Interviewer: ...describe your development ? Let me put it this way: When you went to do the ACE, the expectation is that after finishing this you would have been developed professionally by the programme. Now, the question is... how would you describe that development in you, in terms of subject matter knowledge? Have you gained more subject matter knowledge through studying the ACEML? Have your classroom teaching strategies changed

through studying the ACEML? Do you see yourself now as a new teacher who teaches Mathematical Literacy and not as that teacher who was teaching that subject before? So this question wants you to briefly describe that.

Miss ZN: *Can I start top-up?* Interviewer: Yes. Okay, looking to myself I see myself as a new teacher, I see myself to learners as being the person they admire because of the way I deliver the subject matter to them. 'Cause I think I have gained more knowledge in Mathematical Literacy. And my teaching strategies ... its just that they have changed. Not through by courses, but through the experience I've got when teaching, when seeing more papers that are written each year by Matric. So it made me change my teaching strategies. To tell you that some of the learners, if I say I will not come to work tomorrow, they will say..Oh, we don't see the need of coming to school. So maybe because the way I teach or the way that I deliver the subject to them, they are beginning to love me or they are beginning to love the subject.

Interviewer: Have you exhausted all that you want to say?

Miss ZN: *Yah...I think so. Ya. Another thing that I did ... normally in Accounting I didn't do charts. But in Math Literacy 'cause there are those formulas, different formulas that appears each and every year in the question paper for Matrics, as well as in grade 11, I do have those formulas...I made charts, I post them in the walls so that they make my teaching more easier and so that they can see that it something not difficult. A learner who have forgotten the formula will have to look at the chart there which is on top without me reminding them of what they should do. And then there's also some calculators that were introduced ..I don't know whether is was CASIO, they are more difficult to operate and as a result i designed some charts with some keys to them so if they are doing some sums, those learners who are having those calculators they are able to look at those charts that I have designed for them. And I'm able.... before I didn't mind using a calculator because I was using it in Accounting. I didn't use Scientific calculator, I just used any calculator but now, I'm being more introduced to the other calculators like SHARP have developed a new calculator, and now I'm a person who's more eh.... who has more knowledge of how to operate a calculator and it give me*

more knowledge about how do I handle myself in front of the learners. So that's all...

Interviewer:all of this forms part of your professional development? Yah. Now...a claim has been made that some teachers who studied the ACE like you, felt that the other four modules, by the other four modules I mean those that are not directly linked to content that is learnt at school level. The Teaching & Learning, the Professionalism, the Teaching and Learning Maths in the FET and Professional Practice, those four modules. Some teachers felt that these should not have been included in the ACEML programme. They felt that the ACEML programme should have been dealing with content that is done at school only. What is your opinion based on that?

Miss ZN: *My opinion is.... it reminds me when I was doing the Education, where we studied about the dog behaviour..., unconditioned ... , I don't know whether I'm recalling it very well?*

Interviewer: ...classical conditioning?.... All those things by Pavlov?

Miss ZN: *Yah. Pavlov. So I didn't see the need of studying that. Same thing applies here of what you have mentioned, Teaching & Learning... Its my opinion. Maybe some other people saw the need to do those things but to myself I didn't see the need of studying it. I will agree about those who say it must only focus on those learning outcomes in Mathematical Literacy.*

Interviewer: In other words, when you went to do the ACE, did you or did you not expect to do any of those modules?

Miss ZN: *Yah. I thought I would do only the content, though I didn't know what I was going to do there (in that content) . But I didn't think that I would do those other things that talk about Teaching & Learning, the Policies... I didn't know. Maybe if it was a teacher who was doing History he would enjoy those modules. I didnt enjoy them.*

Interviewer: Okay. An opinion is an opinion. Now most importantly when I went through the questionnaires that I had asked you to complete earlier, I saw your

qualifications. I've seen your qualifications and based on that, why did you actually enrol for the ACEML? I'm asking this question because some of the teachers don't admit that they did the ACE in order to upgrade their qualifications to M+4, yet it seems like their intention was exactly that because after passing the ACE they go back to their schools and they don't teach Mathematical Literacy. So, my question is was upgrading your qualifications any of or your most important motivation? Was it any of your motivation that I'm going to do the ACE because I want to be M+4. *(full stop)*. Or it was part of the motivation but there was something else that motivated you?

Miss ZN: *I remember again during the first year when we were doing Math Literacy. One lecturer asked us why we had decided to do this ACEML? And my response was I did it because of money, I wanted to upgrade my qualification. So there was no motivation behind it, it was just that I wanted to increase my.... to be on the next level of what I am cause I was M+3 so now for doing this course it would make me M+4. So to be honest it was about money to me more than teaching it. I didn't think that I would be able to teach it.*

Interviewer: Do you still hold the same opinion?

Miss ZN: *Nooooo! Come on (laughs). No, no nono. Now cause I am teaching it, its not about money now. Its about the love that I have, its about the knowledge that I have, its about the experience that I have now. So I'm enjoying Math Literacy. Its not about money.*

Interviewer: Right. Now... Thank you very much Miss ZN. I've gained a lot from what was said.

APPENDIX B

TRANSCRIPT OF INTERVIEW with Mr. PN - by T.E. Thembela

- Interviewer:** Today I'm with Mr. PN who was one of the ACE Mathematical Literacy students, in 2007-2008. Because of time I'll shoot straight-away to the questions. Eh, Mr. PN I want you to respond to this statement: "The ACE Mathematical Literacy is a vital, essential and necessary pre-requisite for any teacher who is willing to teach Mathematical literacy successfully". In other words I'm saying, a teacher needs the ACEML in order to teach Mathematical Literacy. What are your comments to this claim?
- Mr. PN:** *No, I agree with this statement. Really for a teacher to increase his or her confidence in the subject, he or she really needs Maths Lit. Its very very important especially for teacher confidence in a subject. That's what I can say.*
- Interviewer:** Okay, we'll move to the next question. I'm aware you are teaching Mathematical Literacy currently. Eh, Are you going to be teaching it as long as you are still a teacher?
- Mr. PN:** *Eh, its an interesting subject, I'm enjoying teaching it, but I'm not sure it will depend to the Management whether they're still giving me the subject or not. But I enjoy it, I prefer it other than other subjects.*
- Interviewer:** Right. And... again I know that you are not teaching any other subject but you are teaching Mathematical Literacy only.
- Mr. PN:** *Ya*
- Interviewer:** So I'll skip that question. Now would you be prepared at any given time to write any Mathematical literacy test that has been set at Grade 12 level?
- Mr. PN:** *Yes, eh normally what I'm always doing, everytime if Grade 12 is writing the test or exam, I'm always writing it as I'm writing the solutions for that test. So, yes the answer is yes.*
- Interviewer:** Okay, and I know you would teach Grade 12 at any time. You don't have

a problem with that?

Mr. PN: *Ya*

Interviewer: Now, Would you encourage any other educator who wishes to teach Mathematical Literacy, to start by studying the ACEML?

Mr. PN: *Yes I can do. Why I have to encourage them its because, besides that Mathematical Literacy is a new subject for the learners, but for educators themselves, it equips them with skills, numeracy skills they're lacking. Sometimes I'm always complaining about teachers whereby teachers fail to calculate the increment of his or her salary, the salary increment when they are given percentage. That is why sometimes teachers ... I find teachers going to strike and you find that the 2% that they want is just a small amount. (chuckles). So I think because they lack that numeracy skill, so they don't understand. That's why I'm saying now really I can encourage them. Even the older teachers, even all the teachers. Maybe this subject we have to expand it from the kids, even to equip these older people who are qualified. All of them ..I think this has to be a compulsory subject even at the University level. So that these people they will understand. Even calculating their own groceries, taxes and all those stuff.*

Interviewer: Okay, now, say you were in charge of the distribution of the duty load at your school, eh..., you were given that responsibility, would you allocate a Mathematical Literacy class to any educator who has not studied the ACEML, and neglect another teacher who has studied the ACEML for any reason whatsoever?

Mr. PN: *As I elaborated earlier on, I said, it is important to study Math.Lit for one reason, to increase the level of confidence in a teacher. So I'm not gonna allocate any duty to a teacher who didn't study ACEML whereas there is a teacher who completed the studies. So I prefer the one who did Maths Lit instead of one who didn't study it.*

Interviewer: For argument sake, even if the one who did not study the ACEML is the so-called good teacher, you would still prefer the one who has studied the

ACE?

Mr. PN: *Eh..if a teacher shows a confidence because what is important about teaching, is a teacher who is confident about the subject. If the teacher is confident enough because confidence goes with understanding of a subject. If that teacher really shows me that he really understands the subject...the content and the context of the subject , definitely I would give that teacher.*

Interviewer: Okay. Now coming back to you. Would you have agreed anyway to teach Mathematical Literacy if you had not studied the ACEML?

Mr. PN: *I can say now, I would agree for one reason. I was teaching Mathematics before Maths Lit and I was confident in Mathematics but when I studied Math Lit, I thought before that maybe I can be able to teach Math Lit. But when I studied Math Lit, I find that no..., these subjects..they are not really related. So before studying Math Lit, yes I can accept it, but now I've just realised after completing Math Lit that these no subjects are not related.*

Interviewer: So based on your response, we can be true if we say that all the confidence that you might have now of the subject came from your study of the ACE?

Mr. PN: *Yes. Yes, yes. All ... what I can say now is ..before I enrolled with eh.. eh.. the University, I was not teaching Math Lit. I started teaching Math Lit on my first year enrolment at ACE. So with the confidence that I got from there, yes.*

Interviewer: So, if we were to be more specific now, eh in the content of both the modules that were..are school related, and those that are not school related, is there anything that you can single out as something 'new' that you learnt from the ACE programme?

Mr. PN: *Eh most of the things in this module, there were four modules that I have done. Professionalism taught us things that we are neglecting as educators. Sometimes we are not behaving as the policies requires. So what I learn from ..from these modules, is that how I have to behave as a*

teacher outside the classroom, outside the school, inside the classroom, inside the school premises, how I have to behave like a professional. So I gain even, the other things that I learn from these modules, especially The Schools' Act. I'm always neglecting these things ...these laws, but now I'm equipped, I'm positive now with all these Acts. Even how I gonna discipline the kids, how I gonna approach the a...a..the difficult topic, how I gonna deal with different learners and how I'm gonna introduce a new subject in the classroom.

Interviewer: Okay. Now is there any aspect of the subject that you feel you knew even before you went to do the ACE?

Mr. PN: *Yes there are so many because at University I was doing Statistics. Data Handling is there..is part of things that I have done at the University level. Data Handling and mh....mmm...what else? Most of the , mo... most of the other learning areas I have studied at University level except Space and Shape. Space and Shape was something that was new to me.*

Interviewer: Okay. Now, the introduction of the ACE at University level for educators was one of the wisest moves made by the authorities. Maybe if I can rephrase this and clarify further..there was a feeling that instead of doing the ACE for two years, teachers could be called in for Workshops, eh.. two - three weeks' workshops, and then go back to school and teach Mathematical Literacy. Now, what further claims or counter claims (against) this statement that the introduction was a wise move can you provide, eh... based on that statement?

Mr. PN: *Eh When it comes to the introduction of this ACE Math Lit, I think what the University did, especially for our KZN educators was good... and this thing is ... is fruitful for our kids. Yes because the teachers when they are doing ACE, they commit themselves, they are not there, just to be part of ACE, they are committed because at the end of the day they have to get a Diploma. And then for workshops, Workshops are good, especially as an ongoing process for educators to get together and discuss the subject. But its not like something that would uplift the educators and equip the*

educators to understand the content and the context of the subject. So I think both ways, the University they did a good thing but the workshops are important even if the educators have already completed their diplomas. But they need to sit down again and discuss some new concepts, and discuss some problems they are experiencing in the classroom.

Interviewer: Alright, eh ...now it has been reported that eh..in both the group that came in 2007 and 2008 at UKZN to do the ACEML, a number of teachers dropped out and did not complete the programme. Some statistics point out that eh ...about eh ... more than 40% of teachers in one cohort dropped out / did not complete the programme. Why do you think that some teachers dropped out?

Mr. PN: *Firstly, and in fact I was not aware of that statistics, but what I can say now is, it is unfortunate for those educators who dropped out. I think one of the reason for them to drop out, is the laziness and they are not committed on the subject and it means most of the teachers who dropped out are those teachers who do not teach the subject who thought that maybe by going to the University they were gonna get something that is easy, something that they were gonna be able to do it, I don't know. But I think they are lazy because that opportunity that we got there, was the opportunity that some other people they need it and they are not getting it because this thing is reallyone, its helping educators with their qualifications, its helping the educators to understand the subject and its helping the educators to improve the results of the subject at schools.*

Interviewer: So, in other words maybe you are saying that when the teachers came there, they did not get what they expected. They ... maybe they expected something else but when they got there they found something else?

Mr. PN: *Yes, then they decided to drop out.*

Interviewer: Okay. Now briefly, I want you to be brief here because some of the things that I expect you to say have come up in our previous talk. I want you to tell me about yourself as a teacher, where you will start by telling me

about yourself before you studied the ACE. Also tell me about yourself during the time when you were actually doing the ACE - the two years, and then tell me about yourself after you had completed the ACE. You can start from anywhere.

Mr. PN: *Okay. Before studying the ACE I was teaching Maths at my school before. So I heard that there is this new subject, and that this new subject ..the department is offering bursaries for teachers who want enrol in this ACE programme. So I decided to enrol in this programme and during the time when I was studying this ACEML, really I was enjoying each and every session, even the tutors were good and were making this subject enjoyable. And the time when I was doing it, I dedicated all my time on it and even after completing it I spoke to the management and they gave me some classes and then they end up ... after that they end up with me teaching Math Lit only at my school. I am not teaching Maths anymore now. I am only teaching Math lit.*

Interviewer: Okay. Eh... how would you describe your professional development that you are supposed to have attained from studying the ACEML programme, in terms of the subject matter knowledge (i), and (ii) in terms of your teaching strategies, classroom teaching strategies and (iii) in terms of identifying with and seeing yourself now as a Mathematical Literacy teacher?

Mr. PN: *Eh .. I would start with the subject matter. After studying ACE, the subject matter increased. The confidence that I have now, is because of ACEML. So I am always now involved in the subject argument, of which before I was not... I was shy. So now what I'm talking about if I'm talking about Math Lit. And then in terms of classroom teaching strategies..hey I gained a lot on that thing. Sometimes there are topics that we as educators we take it for granted that the learners will understand. And I really now knows that if you really want to introduce a subject to the learners, sometimes you have to start with understanding their prior knowledge of that topic first. What I was doing before I was just giving them the exercises and explain all those stuff, without understanding their prior*

knowledge before, before I introduced that topic. In terms of identifying and seeing myself as a Mathematical Literacy teacher, what I can say is that now, I see myself as a good Math Lit teacher and am seeing myself as one of those teachers who are still learning. I'm still learning because this subject is new. I'm still learning even from the kids. The kids are good such that sometimes I find myself listening to kids explaining things sometimes some of which I'm not even aware. I'm enjoying as a teacher. I'm a teacher, I'm a learner, I'm a facilitator in this subject.

Interviewer: Right. I can see that you really know what you are talking about. Eh, I want to take you a little bit further..back when you were still a student. A claim is made that some teachers who have gone through the ACEML feel that the other four modules, when I say the other four modules, I'm referring to those modules which eh ... are not, which do not give the school level subject content. Some teachers feel that those modules should not have been included in the programme. What is your opinion on that?

Mr. PN: *Mh .. I think those modules were very very important to be part of the subject ... to be part of the whole Math Lit programme. One of the reasons is, as educators sometimes we must have a knowledge of the context of the subject that you are teaching. But you don't understand the consequences that can follow after, like lets say what would..., how you gonna deal with the behaviour of a certain learner in the classroom? How you gonna manage to deal with the learners who are not capable of doing the subject. Because in those modules there are those modules that deal with Psychology. Like when I'm talking about Psychology I'm talking about how you deal with the understanding, the thinking of a learner. How are you going to approach, how are you going to approach eh your introduction in a new subject. So I think those modules are very very important. And how are you going to deal with new Acts and Policies that the Government is implementing because there is those policies that we are neglecting as educators. So by attending, by doing those modules at the University level, or those modules that are included at ACE, they equip us with understanding of how are we going to implement those policies*

and acts that the government is implementing and is trying to implement at our schools.

Interviewer: So they shouldn't have been left?

Mr. PN: *They shouldn't. They should be there!*

Interviewer: Oh, thank you. Now most importantly towards the end I've seen your qualifications from the questionnaire prior to going for the ACE and eh ... it became clear to me that you are not one of those teachers who went there to upgrade their qualifications. Based on that, why did you actually decide to enrol for the ACE?

Mr. PN: *No, the reason for me to enrol in this programme was simple. Is to increase the level of my confidence in the subject. To increase the level of my knowledge in the subject. That's why I enrolled in the ACE.*

Interviewer: It had nothing to do with upgrading your qualifications?

Mr. PN: *No, its nothing, nothing to do with that.*

Interviewer: Now lastly Mr. PN, would you have studied the ACEML if you had to fund your studies yourself? That is, if you were to pay from your own pocket?

Mr. PN: *Eh ... Really to be honest, that question is really challenging. To me, because of budget constraints, and eh ... all those stuff because we are family committed people I wouldn't. So I think that the bursary that we got from the department has played a good, good role. A vital role in my studies.*

Interviewer: So, this opportunity was beneficial to you?

Mr. PN: *Was very, very beneficial to me, because without that fund, I wouldn't do this programme.*

Interviewer: Thank you very much Mr Mkhw...Mr. PN. I think we'll have to end it here.

Mr. PN: *Thank you.*

APPENDIX C

TRANSCRIPT OF INTERVIEW with Mrs PSK [English Version]

- Interviewer:** The ACEML is a vital, essential and necessary pre-requisite for any educator who wants to teach ML successfully. What are your comments to this claim.
- Mrs PSK:** *Not every Mathematics teacher can teach Mathematical Literacy. The fact that one did mathematics up to Grade 12 does not mean that one can teach Mathematical Literacy because most of the time Mathematical Literacy has word problems, whereas Mathematics has lots of x's and y's.*
- Interviewer:** Are you teaching ML currently? Are you going to be teaching it for the rest of your teaching career?
- Mrs PSK:** *Yes, I am teaching Mathematical Literacy currently, Grade 10 only. I will be teaching it in future because I learnt many things at Edgewood while studying ACEML. I did not like Mathematics, but I love Mathematical Literacy.*
- Interviewer:** Are you also teaching the other subjects/LA's that you taught before enrolling for the ACEML? Which side has more classes? [ML or those that you taught before?]
- Mrs PSK:** *Yes, I'm also teaching the other Learning Areas that I taught before studying the ACEML but I have more Mathematical Literacy classes than the other Learning Areas.*
- Interviewer:** How would you describe your 'professional development' that you are supposed to have attained from studying the ACEML? In terms of (i) subject matter knowledge, (ii) classroom teaching strategies and (iii) development of an identity as a ML teacher?
- Mrs PSK:** *Yes my professional development has been enhanced by my study of the ACEML and I have gained more subject matter knowledge. I am also using different teaching strategies that I learnt while studying the ACEML, especially when it comes to the handling of large numbers of learners in our classrooms, where I use group work.*

I have developed an identity as a Mathematical Literacy teacher as I now see myself as a Mathematical Literacy teacher with confidence.

Interviewer: Would you be prepared to write a ML test that is set at Grade 12 level at any time?

Mrs PSK: *I am prepared to write a test that is set at grade 12 level at any time and would teach Grade 12 anytime because I am always in touch with other teachers who teach or have taught Grade 12 before.*

Interviewer: Would you encourage any teacher who wants to teach ML to start by studying the ACEML?

Mrs PSK: *I would definitely encourage any teacher who wants to teach Mathematical Literacy to start by doing the ACEML because I gained a lot whilst I was at Edgewood.*

Interviewer: If you were to be in charge of the distribution of the duty load at your school, would you allocate a ML class to a teacher who has not studied the ACEML and neglect a teacher who has studied the ACEML for any reason whatsoever?

Mrs PSK: *I would not allocate a Mathematical literacy class to a teacher with no ACEML because Mathematics teachers tend to look down and despise Mathematical Literacy. They teach it as if they were teaching Mathematics.*

Interviewer: Would you have agreed to teach ML if you had not studied the ACEML? Why or why not?

Mrs PSK: *I would have agreed to teach Mathematical Literacy **before** going for the ACEML because at the time I thought that Mathematical Literacy was the same as Mathematics. But now that I know that the two are two totally different subjects, I would not agree.*

Interviewer: What can you single out as “something new” that you acquired through your study of the ACEML? This can be from any of the modules and is not restricted to the school content modules only.

Mrs PSK: *Something new that I can say I learnt from the ACEML is that we should not complain about teaching large numbers in our classrooms. One of the Modules made it very clear to us how we should handle large numbers in our classrooms.*

Interviewer: Is there any aspect of the subject that you ‘learnt from somewhere else’ other than in the ACEML programme?

Mrs PSK: *I can say that I knew some aspects of Mathematical Literacy because I had Grade 12 Mathematics. So some of the aspects I already knew but some of them I learnt in the ACEML programme.*

Interviewer: The introduction of the ACEML at University was one of the wisest moves made by the authorities. What further claims or counter-claims can you provide based on this statement?

Mrs PSK: *The move made by the authorities to introduce Mathematical Literacy at University level was a good move indeed because some teachers who had never taught Mathematics before were made to know how to teach Mathematics.*

Interviewer: In your opinion, what made other teachers drop out from the ACEML programme?

Mrs PSK: *I can say that teachers dropped out because:
Some teachers, especially the Mathematics teachers, did not expect to learn the other modules which were not directly linked to school level Mathematical Literacy subject content. As a result they got fed up with these modules and decided to drop the programme.
Some teachers had not been studying Mathematics for a long time and found the whole programme very difficult and/or hard. What they found out in the programme was not what they expected.*

Interviewer: In closing, what made you enrol for the ACEML programme?

Mrs PSK: *I enrolled in the programme because I heard from my Deputy Principal that teachers who had Grade 12 Mathematics were required to go and train to*

teach a new subject called Mathematical Literacy. I had not been studying anything for a very long time and when I heard that the course would be offered free of charge I jumped into the opportunity.

APPENDIX D

TRANSCRIPT OF INTERVIEW with Mrs. SP - by Mr T.E. Thembela

Interviewer: Today I'm sitting with Mrs P...SP, one of the students at the University of KwaZulu Natal who did the ACE Math Lit in 2007/2008. Because of time....., we are not going to waste any time, I'll go straight to the first question. Eh..Mrs. SP the statement is: "The ACE Mathematical Literacy is an indispensable pre-requisite for any educator who is willing to teach Mathematical Literacy successfully". In other words I'm saying a teacher needs the ACEML in order to teach Mathematical Literacy. What are your comments to this statement?

Mrs. SP: *Mh... that is a fact. Many of us who teach Maths Literacy has to go through proper training, so as to avoid the confusion between the Maths and Mathematical Literacy concepts which is most causes a very much parallel to each other.*

Interviewer: So in other words you are saying 'yes, you think every teacher should go for the ACEML. Okay. Now, are you teaching Mathematical Literacy currently?

Mrs. SP: *Yes.*

Interviewer: If I may ask you, which Grades are you teaching?

Mrs. SP: *Grades 10 and 12.*

Interviewer: Grades 10 and Grade 12?

Mrs. SP: *Yes*

Interviewer: So, how would you describe your teacher professional development that you are supposed to have attained from studying the ACEML programme? In terms of your subject matter knowledge, in terms of your classroom teaching strategies, and in terms of identifying with and seeing yourself as a Mathematical Literacy teacher?

Mrs. SP: *Mmmm ..in terms of eh.. subject matter knowledge, it was a very.. an eye-opener to me. It made me realise that the importance of learning Mathematical Literacy by all the people in the society, as opposed to knowing*

your pure Maths excellently because of the two subjects were not aimed to pursue the same purpose in life. But looking at the second part which is eh..in terms of the classroom teaching strategies, the educational courses offered were also implicit in trying to help us use the correct classroom teaching strategies, that even a layman can easily see the correction of Maths Literacy in everyday life situations.

For the third part which you said is in terms of ...?

Interviewer:seeing yourself now as a Mathematical Literacy teacher after studying the ACE.

Mrs. SP: *Mmm... a Math Literacy teacher and a pure... I'll compare the two. The Math Literacy teacher and the Pure Maths teacher are very different. Whilst a pure Maths teacher teaches concepts that can easily be programmed without understanding, a Maths Literacy teacher teaches one to apply Maths concepts in relationship to life experiences, so he/she can become a better person who can contribute positively to the economy of his/her country.*

Interviewer: Okay. So if I may just ask you just in passing..which subjects did you teach before you went for the ACEML ?

Mrs. SP: *It was Maths.*

Interviewer: Mathematics

Mrs. SP: *Pure Maths, Mathematics yes.*

Interviewer: So ..the next question would be, would you be prepared at any given time, to write a Mathematical Literacy test that has been set at Grade 12 level?

Mrs. SP: (Laughs)*Of course yes.*(Laughs again)

Interviewer: And you think you can do very well in that test? ... I'm asking this question because I want to, to find out from you the confidence that you have as far as the content is concerned. (Mrs. SP nods)So its a yes. If its yes so can would you say that the study of the ACEML is also the reason for this preparedness?

Mrs. SP: *Yes, the reason for that is a good background I have from my secondary and high school, and also learning at varsity, experience acquired from teaching the subject on both GET band and FET band.*

Interviewer: Okay. Now ... would you encourage any other educator who wishes to teach Mathematical Literacy to start by studying the ACEML?

Mrs. SP: *Mh m. (agrees). I would.*

Interviewer: If I may ask you to give your reasons..?

Mrs. SP: *From the question one, where you were asking the reasons, it is advisable to study Math Literacy if he or she wishes to teach it at school. So thats why I will encourage people to go to..to study ACEML.*

Interviewer: Let's now give you some powers. Say, if you were to be in charge of the distribution of the duty load at your school, would you allocate a Mathematical Literacy class to any teacher who has not studied the ACEML, whilst you neglect another teacher who has studied the ACE for any reasons whatsoever?

Mrs. SP: *No ways. Some of us are really Mathematically challenged even though we did some Maths at school. So I would encourage..allocate to a person who did the* Interviewer: ...the ACEML ..Yes.

Interviewer: Okay. In other words you are saying that the fact that one knows Mathematics doesn't mean that [Mrs. SP: ..he can teach] Mathematical Literacy. [Mrs. SP: ...yes].

Mrs. SP: *...he has to go through the ACE Math Lit.*

Interviewer: Now..coming to you now, would you have agreed to teach Mathematical literacy if you had not studied the ACE? Or maybe I should re-phrase this question: Did you teach Mathematical Literacy before you did the ACE?

Mrs. SP: *Yah..it was in 2006. But I wasn't confident enough, cos I wasn't sure of how to teach Math Lit until I've enrolled at University of KZN in 2007, but it was in Grade 10 only in 2006.*

Interviewer: So in other word, the answer to the question that I first asked you would be yes you already agreed to teach Mathematical Literacy before you went for the ACE, but it was only for that year?

Mrs. SP: *Yes, but I was not confident enough.*

Interviewer: So, based on this response can we say that now... can we boldly say that the confidence that you have of the subject comes from your study of the ACE?

Mrs. SP: *Yes.*

Interviewer: Okay. Let us be more specific now. What can you single out as something new that you acquired through your enrolment in the ACEML programme? Now this may be from any of the eight modules that you did, I'm not specifically restricted to modules which deal with school level content only but even the educational ones, the Professionalism, Teaching and Learning .. Is there anything new that you acquired from any of those modules?

Mrs. SP: *Yah. All of the modules, I've gained something new from it cos it teaches me the way I can handle my class, especially Teaching and Learning and also the Professionalism. It teaches me to behave as a professional person since before I was enrolled in ACE, I was not confident enough to teach or to handle my classes. So after doing this module .. Teaching and Learning and Professionalism I gained a lot how to handle the class, how to teach, about strategies and so forth.*

Interviewer: OK.

Mrs. SP: *...and also the four LO's, which is LO 1 up to LO 4, I also gained a lot from it.*

Interviewer: Now this question links with one of the questions that I was going to ask you later, where it says... a claim is made that some teachers who have gone through the ACEML feel that the other four modules which are not ML subject content at school level, should not have been included in the ACEML programme.

Mrs. SP: *I'm totally not in agreement with that. It should be included. It should*

beincluded because it works hand in hand, because in teaching you can't teach without knowing the strategies of teaching. Because it also helps us to make a well planned lesson plan in our classes and find the other ways of teaching the subject.

Interviewer: So your response ...

Mrs. SP: *My opinion is that it should be ..should be inclusive. Yes.*

Interviewer: Now is there any part, any aspect of the subject Mathematical Literacy that you feel you already knew before you went for the ACEML? that you learnt from somewhere else and not from the ACE?

Mrs. SP: *But its' part of the ACE?*

Interviewer: Yah. Its part of Mathematical Literacy subject.

Mrs. SP: *Yah but not 100 percent, here are some aspects from from*

Interviewer: Because you are Maths person...?

Mrs. SP: *Yah.*

Interviewer: Okay. Now, the introduction of Mathematical Literacy at University level, that is the ACE for educators, was one of the wisest moves made by the University. In other words I'm saying when the subject Mathematical Literacy was to be introduced in schools, the University together with the Department decided to start the ACE mathematical Literacy. The statement says that was a very good move. Would you have any claims that are against that statement or that agree with the statement?

Mrs. SP: *It was good for us that ifif the subject is introduced at schools, the teacher institution also opens that door for us to learn more so that we can bring that knowledge to the classroom.*

Interviewer: Now this one..., I dont want you to say much because most of what I think is required by these questions is what we've already said [**Mrs. SP:** ..covered] we've already covered in the other questions. But I wanted you to tell me

about yourself as a teacher and I wanted you start before studying the ACE.....
what kind of a teacher you think you were? ... during the time when you were
actually doing the ACE .. during the two years/ after finishing the ACE.

Mrs. SP: *Before ...*

Interviewer: Before doing the ACE, during the time when you were doing the ACE, and
after you had finished the ACE, because I have a feeling that

Mrs. SP: *...stages...?*

Interviewer: Yah

Mrs. SP: *Before I was studying the ACE .. I was a good teacher. If I can score, I can
give myself 40% .*

Interviewer: 40.....?

Mrs. SP: *Yah. 40 to 50%. Mmmm why I am saying that is eh ... because while I was
teaching math Lit before the enrolment, I was not confident enough. Most of
the time I always referred to books and nobody knows about this Math lit,
nobody was confident enough to explain certain concepts. Eh... while I was
doing it in class ..while I was enrolled, I gained more of confidence. Even my
teaching strategy improves, even understanding of the way they phrases
questions also improved. Because most part of the Math Lit is all about
scenarios, so you have to read all of the time and understand the question. So
that part is also improved. So I moved from 50 to 85%. [Interviewer: Mh..]
After the ... finishing the course, it was 100%. (laughs). I can face any
challenges. I can face any, any. Fortunately for me, I also enrolled for
marking, so I already ... I think they enrolled me because I submitted my ACE
results and they know that I'd gone for this ..eh ...eh.. modules.*

Interviewer: Okay. Right.

Mrs. SP: *Now, I'm confident enough.*

Interviewer: Now still on that.... eh, it has been mentioned somewhere, there are some
statistics which reveal that during the time when you were doing the ACE, a

number of teachers dropped out/ didn't finish the course. I'm not sure of the numbers here but it was a huge number..close to 40% of them. Why do you think that some teachers dropped out of the programme?

Mrs. SP: *As I said before, eh..most of the teachers who was enrolled that time, they were just prepared to do eh... something with figures. Not Professionalism and ... what do you call...?*

Interviewer: Teaching and Learning. They wanted just the school level content?

Mrs. SP: *Yes. To solve problems, nothing else. But when they come across this ... Teaching & Learning and Professionalism, they become demotivated and just drop it. Because others... I do have my friend who also dropped because he said "I can't read, I'm not a person who is good in reading. So I only need something to work on, like figures... to solve problems" Ya. "...because I'm a problem solver, not a researcher.." I think most of that percentage which dropped that year was because of that.*

Interviewer: What would you say if I were to tell you that one of the people that I interviewed said, teachers dropped out because they were lazy?

Mrs. SP: *Yah...yah...yah, it's true, cos to be enrolled, to be a learner, to be a student you need to work a lot. Interviewer: ...commitment Yah. You need to devise a strategy of how to get time to do this, especially when you are a teacher and also a student. So you need to balance. Yah.... yah, yah. I think the laziness is one of the reasons.*

Interviewer: So, can we say that teachers dropped out because they did not get what they expected to get when they got there. (*Mrs. SP nods*)

Okay, I'll just take that as a yes.

Now, I've seen your qualifications prior to the ACE from the questionnaire, and based on that, why did you actually enrol for the ACEML?

Mrs. SP: *I like challenges. I like...something new, I like to read, I like the... transformation.*

Interviewer: I'm asking this question because some of the teachers, it would seem,

enrolled for the ACE in order to upgrade their qualifications from M+3 to M+4 only, and when they got back to their schools, they are not teaching Mathematical Literacy? So, was upgrading your qualifications any ofof your motivation?

Mrs. SP: *It was just the motivation to enrol..because I was already M+4 when I enrolled.*

Interviewer: Okay, oh.

Mrs. SP: *It was that, I was eager to know that transformation [Interviewer: and know more?] and know more about this new subject. Yes.*

Interviewer: Now do you know any other teachers who have studied the ACE but who are not teaching the subject?

Mrs. SP: *Especialy in my school, yah. We were five here at school but only two who teaches Math Lit.*

Interviewer: Would you be free to reveal the reasons why they are not?

Mrs. SP: *Yah. It's the workload. The Principal gave us the workload, because they came here as Geography teachers, Technical teachers.... Technical...Tech...?Interviewer: Technical drawing Yah, Technical Drawing teachers. They teach those subjects.*

Interviewer: Oh so... there's a lot of Mathematical Literacy manpower than is required?

Mrs. SP: *Yah.*

Myself: Okay. But do you think they are willing to teach....

Mrs. SP: *Yes they are.*

Interviewer; Because now this study.... one of the issues is to find out about those teachers who went for the ACE and then ... are not teaching it, to get to the bottom of it as to why they are not teaching it?

Mrs. SP: *No, they are willing. All of them they are willing. Its just that other Learning Areas needs them more than this because Math Lit as I said, we **are five, but***

we are only two who's teaching it.

Interviewer: Okay. Now I want you to listen to this statement, and then when I've read the statement I want you to tell me whether you agree or disagree with it. And maybe elaborate on why do you agree or why you do disagree. The statement is: *'most Mathematics teachers (that you know), do not know that Mathematical Literacy is a different subject from Mathematics, and they think of it as Standard Grade Maths or Lower grade Maths.'*

Mrs. SP: *Yah. Interviewer: ...if you say 'yah' you agree with the statement? Yes I'm agreeing. Most of teachers who are Maths teachers see that Math Lit is just forInterviewer: ...those learners who do not cope in Maths...yah, who are not capable. Even from Grade 9, they just select them, taking from grade 9 learners who do not perform well in all subjects, so they just put them to learn math Lit. Because they think they won't cope, eh... in Maths.*

Interviewer: Does that not pose a challenge to you as a Mathematical Literacy teacher

Mrs. SP: *Yes. Its a lot of challenges, because up to now nje learners are performing very badly because of the negligence of the teachers down there Interviewer: GETand lower Grades? Yes. So even, other teachers.... even tell them that you are so lazy, you can't make it' you are nothing. So already learners are demotivated. I want to add there, ehthis is for Math Lit. Even the media, the society, the community... doesn't recommend Math Lit as one of the subjects. Its just like other subjects like LO subject, which is when you do Math Lit you are not taken as a person who is capable of making it. Even the Prospe... prospe..what do you call the prospectus? lezincwadizasemaUniversity? Most of the Faculties at Universities doesn't include Math Lit as if its just a useless subject. That's another thing that makes our learners and also other teachers not like others to know that they can teach or was enrolled for iMaths Lit as an ACE student. Even learners they just run away from having Math Literacy as one of the subjects because no one recommends Math Literacy to them as a subject like Maths, Physics and Life Sciences. If the media, even the Education can change that and make other people to know that Math literacy is the one subject ... eh*

ekhulumangempiloyakho, and everyday life situations.

Interviewer: Just to cut you short on that, one of the teachers said that Math Literacy should have been made compulsory to all learners *Mrs. SP: Yes, yes ...* even those who do Mathematics.

Mrs. SP: *Yes. because it's our daily life. It talks about our daily lives. Especially when we were doing iFinancial Maths, kwi group yani, eh... there is a group of Commercecommerce learners. They did very well because they understand depreciation, any o profit margin, all that.... terms, but when they go out with Math Literacy, the University level can't enrol them because they do have Math Lit, but they are looking for Maths. But I think the more subject that is fit exactly to eh...eh...eh..commerce subjects is Math Literacy. Cos its all about calculations, talking about depreciation, selling houses and so forth.*

Interviewer: Alright, we have said... I think we have said much now, but I have ... I think an ultimate comment that I require from you, from this question: 'would you have studied the ACEML if you had to fund your studies?' i.e. if you had to pay from your own pocket?

Mrs. SP: *Mhm. Definitely.*

Interviewer: Maybe you'll wonder why I'm asking this question, it has come up again, from some people that if they had to pay from their own pockets, they wouldn't have done the ACE. They just did it because it was free..? (*Mrs. SP chuckles*). I'm glad to find someone who says that she would have done it even if she had to pay from her own pocket.

Mrs. SP: *Yes.*

Interviewer: No I think we should stop it here, Mrs. SP that you very much for your contribution.

APPENDIX E

TEACHER QUESTIONNAIRE A

ACE - Mathematical Literacy Questionnaire

Dear Participant

Thank you in advance for your participation in this questionnaire. Please answer the questions below as honestly as you can, in order to assist us consider arguments in support of teacher professional development through the ACE Mathematical Literacy programme. This questionnaire consists of 7 pages and 20 questions that are divided into FOUR sections.

Section A : About yourself

1. Complete the table by providing your teaching experience in the last few years:

Subject (s)	Grade (s)	How long?
<i>e.g. Accounting</i>	<i>10; 11 & 12</i>	<i>1990 - 2006</i>

2. Please make a cross [X] next to your current post level. Also make a cross next to your qualification(s) you had prior to enrolling for the ACEML programme: [*You may tick more than one where applicable*].

Current Post level		Three-year Teaching Diploma	
Post level 1		Post-Graduate Teaching Diploma	
Post level 2		Bachelors' Degree	
Post level 3		Honours' Degree	
Post level 4		Masters' Degree	
Other: (Specify)		Other: (Specify)	
.....		

3. What are your reasons for enrolling in the ACEML?

From the options below, make a cross (X) next to the one that suits you most:

You were “underqualified” and the ACEML would allow you to upgrade your REQV qualification level.	
You were qualified to teach another subject and the ACEML would RETRAIN you to teach ML.	
You just wanted to refresh your Mathematical Literacy knowledge.	
When the offer came, you were the only teacher in your school who could be persuaded to go and enrol.	
You could not refuse because the school management selected you to go and enrol, giving you no alternate options.	
Other (Specify)	

4. Are you currently teaching ML? (Y / N)

4.1. If not, what is your reason for not teaching ML? _____

Section B: Impressions about the programme

Using the following 1 - 5 scale, please indicate by circling the most correct response, the degree to which you agree with the statements listed below:

1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE
---------------------------	---------------	--------------	------------	------------------------

5. I found that the tutors in the programme:

- | | |
|---|-----------|
| 5.1. knew the content very well | 1 2 3 4 5 |
| 5.2. were able to explain the content well | 1 2 3 4 5 |
| 5.3. were always well prepared | 1 2 3 4 5 |
| 5.4. were considerate and empathetic to our situation | 1 2 3 4 5 |

5.5. treated us as adults and colleagues 1 2 3 4 5

Any other comment: _____

6. As a result of my participation in the ACEML programme:

6.1. my *content knowledge* has improved 1 2 3 4 5

6.2. my *teaching strategies* have improved 1 2 3 4 5

6.3. my *assessment skills* have improved 1 2 3 4 5

6.4. my *confidence as an ML teacher* has increased 1 2 3 4 5

6.5. the ML results of my learners have improved 1 2 3 4 5

Any other comment: _____

7. I found that my studies were made easier because:

7.1. the materials (guides) were readable, clear and useful 1 2 3 4 5

7.2. the tutors were supportive 1 2 3 4 5

7.3. the tutors were knowledgeable 1 2 3 4 5

7.4. there was a good link between what we learnt in the sessions and what we were assessed on
1 2 3 4 5

7.5. The other students in my class were supportive and helpful 1 2 3 4 5

Any other comment: _____

8. My studies were made easier because

8.1. I had a supportive family network 1 2 3 4 5

8.2. I had support from my school management and colleagues 1 2 3 4 5

8.3. I found the contact sessions to be well paced and not too intensive 1 2 3 4 5

8.4. I had sufficient time to study 1 2 3 4 5

8.5. the centre is not very far away from me 1 2 3 4 5

Any other comment: _____

9. The ACEML programme has a large drop out rate. Some reasons for this could be that students:

9.1. do not have a supportive family network 1 2 3 4 5

9.2. do not have support from their school management and colleagues 1 2 3 4 5

9.3. find contact sessions to be too intensive and poorly paced 1 2 3 4 5

9.4. do not have sufficient time to study 1 2 3 4 5

9.5. have to far to travel to the centres 1 2 3 4 5

Any other comment: _____

10. Have you ever considered dropping out of the programme? (Yes/No)

11. Briefly describe what **stopped** you from dropping out:

.....
.....
.....

12.1. Which module(s) would you describe as **most useful** to you?

.....
.....
.....

12.2. Which module(s) would you describe as **least useful** to you?

.....
.....
.....

13. From **each, some or all of your modules**, write down anything you remember which you think has made a huge difference in your teaching and learning of ML.

.....
.....
.....

Section C : About the Content in Mathematical Literacy

14. Has there ever been a time in your teaching of ML, where you felt uncomfortable with the teaching of any section / topic / concept that you were supposed to teach? (Elaborate on your response).

.....
.....
.....
.....

15. Which of the three Grades (Grade 10; 11 or 12) do you **prefer** to teach? Does your choice have anything to do with your confidence?

.....

.....

.....

16. In the table below, rate the four ML Learning Outcomes from 1 to 4, where 1 is the **least preferred** and 4 is the **most preferred**, by placing numbers 1 - 4 in the relevant boxes:

LO 1: Number and Operations in Mathematical Literacy	
LO 2: Functional Relationships in Mathematical Literacy	
LO 3: Space, Shape and Measurement in Mathematical Literacy	
LO 4: Data Handling in Mathematical Literacy	

17. What are some of your reasons for rating **fourth** the Learning Outcome that you have rated fourth.

.....

.....

.....

.....

18. After completing your ACEML, have you ever taught Grade 12 ML? (Yes / No)

19. Whether you have responded with a YES or a NO in the above question, briefly explain whether the situation you are in was **voluntary** or was **imposed** upon you by any circumstances.

.....

.....

.....

Section D : General

20. Here are a series of statements. Indicate your level of agreement or disagreement with each one by making a circle around one number.

20.1. For you, any Mathematics teacher can confidently teach ML without having studied in the ACEML programme.

1 2 3 4 5

20.2. Your subject matter knowledge in ML was adequate even before you enrolled for the ACEML programme.

1 2 3 4 5

20.3. The ACEML programme has improved your subject matter knowledge (i.e. concepts and applications) through your studies.

1 2 3 4 5

20.4. The ACEML programme could have been replaced by two to three weeks' Departmental workshops.

1 2 3 4 5

20.5. The ACEML programme has introduced you to new teaching strategies that you have been able to use in your classroom teaching.

1 2 3 4 5

20.6. A formal ACEML qualification is not necessary for one to teach ML if one has some background in Grade 12 Mathematics.

1 2 3 4 5

20.7. You feel more confident in a ML class than you would have been if you had not studied the ACEML programme.

1 2 3 4 5

20.8. You can participate in any ML-related debate with confidence with peer educators as a result of studying in the ACEML programme.

1 2 3 4 5

20.9. You understand most Government policies in Education better after enrolling in the ACEML programme.

1 2 3 4 5

20.10. You can confidently defend the introduction of ML in the FET to any of those people who still criticise the introduction of the subject, after studying the ACEML

1 2 3 4 5

20.11. You see yourself as belonging to a group of professionals after studying the ACEML

1 2 3 4 5

20.12. Now that you have completed the ACEML programme, you really feel that you would **not** have been able to teach the subject effectively had you not enrolled for the ACEML programme.

1 2 3 4 5

20.13. You would recommend to any ML teacher that they should study in this programme.

1 2 3 4 5

20.14. You would not be ashamed and would instead prefer to be referred to as an "ML teacher" after studying the ACEML programme.

1 2 3 4 5

20.15. You would agree if someone were to say that your content knowledge of ML was **limited** before you studied the ACEML.

1 2 3 4 5

APPENDIX F

ACE (ML) Questionnaire B

Dear Student Please answer the questions below in order to help us consider arguments in support of teacher development through the Continuing Education route, and to evaluate the ACE(ML) programme. This questionnaire consists of 4 pages and 15 questions that are divided into 3 parts.

However, completing this questionnaire is completely voluntary so please fill in all or some of it if you choose. We are asking you to fill in your student number just for organisation purposes.

Thanks, Sarah.

Student Number _____ Centre _____

Section A: About yourself

1. Please tick next to the closest answer:

Would you describe the school in which you teach as being situated within an area that is called:	farm	
	rural village	
	informal rural settlement	
	informal urba settlement	
	township	
	town / city	

2. What is the name of the place that your school is in?

--

3. Please tick next to the closest answer:

When you have graduated from this ACE course, do you think you will stay in the school where yu are presently teaching for three or more years at least?	Yes	
	Probably	
	Maybe	
	No	
Can you say what the reason for your answer is?		

4. What is your teaching experience? (what subjects, how long, what grade)

Section B: Your impressions about the ACE (ML) programme

5. To what extent has your participation in the ACE(ML) improved your		Big Improvement	Little	None
	Classroom strategies			
	Assessment skills			
	Knowledge of ML concepts			
	Knowledge of learning theories in Maths / ML			
	Knowledge of contexts used in teaching ML			
	Any other aspect?			

6. Have the following issues made your ACE (ML) studies easier or more difficult?		More difficult	Easier
	Level of difficulty of materials		
	Tutor explanations and support		
	Time constraints for studying		
	Intensity of Contact sessions		
	Family support of responsibilities		
	Teaching duties at school		
	Any other factor?		

7. The ACE (ML) programme at UKZN has had a large dropout rate. Do you think the following factors may have contributed to this?		Yes	No
	Level of difficulty of materials		
	Tutor explanations and support		
	Time constraints for studying		
	travel to contact sessions		
	Family commitments		
	Teaching duties at school		
	Any other factor?		

8. Have you ever considered dropping out from this programme? _____ (Y/N)

9. What has stopped you from dropping out? _____

10. For each of the following modules, write down some things that you remember or that has made a big difference in your teaching or learning of ML

Numbers and Operations	Data Handling
------------------------	---------------

Functional Relationships	Learning and Teaching
--------------------------	-----------------------

Shape & Space	Education Policy ad Professionalism
---------------	-------------------------------------

Professional Practice in ML	Teaching and Learning Maths in the FET
-----------------------------	--

11. Rank the modules from 1 to 8 in order of increasing usefulness to you as an ML teacher.

N/O	D/H	FR	Learning and Teaching	Educ Policy & Prof	Shape & Space	Prof Pract	Teaching and Learning Maths in FET

Section C: Your advice on future changes to the programme

The ACE that you are studying is a full qualification, consisting of ML, Maths Education and General education modules. Below are some options, tick the one that suits you.

12. What is the reason for you studying the ACE (ML)?	You are underqualified and the ACE will allow you to upgrade your REQV level	
	You are qualified to teach another subject and the ACE will retrain you to teach ML	
	You wanted to refresh your ML knowledge	
	Other - explain:	
13. Would you have preferred to	enrol for the whole ACE qualification as it is?	
	enrol for short courses focused on particular aspects of the curriculum that you need help in?	
	Reason	

14. If we were to offer short in-service courses to ML teachers, what topics do you suggest we offer? _____

15. What suggestions would you give to UKZN in order to improve this programme?

16. If you were the Minister of education, what are the issues that you would attend to immediately, in order to improve the mathematics and science results in our schools?

THANK YOU VERY MUCH

APPENDIX G

Interview Schedule with Participants

1. “The ACEML is an indispensable pre-requisite for any educator who is willing to teach ML successfully” What are your comments to this statement?
2. Are you currently teaching Mathematical Literacy? If yes, which Grades are you teaching?
3. How would you describe your teacher professional development that you are supposed to have attained through your study of the ACEML programme? In terms of your subject matter knowledge, in terms of your classroom teaching strategies and in terms of identifying with and seeing yourself as a Mathematical Literacy teacher?
4. Which subjects did you teach before you enrolled in the ACEML programme?
5. Would you be prepared at any given time to write a ML test that has been set at Grade 12 level?
6. Would you encourage any teacher who wishes to teach ML to start by studying in the ACEML programme? What would be your reasons for doing that?
7. If you were to be in charge of distributing the duty load at your school, would you allocate a class of ML to a teacher who has not studied the ACEML, whilst you neglect any teacher who has studied in the ACEML? What would be your reasons to do what you would do?
8. Did you teach ML before you studied the ACEML? If no, would you have agreed to teach ML if you were asked to do it before you studied the ACEML?
9. What can you single out as something new that you acquired through your enrolment in the ACEML programme?
10. A claim is made that some teachers who have undergone the ACEML felt that the four modules which are not directly linked to school content in ML, should not have been included in the programme. What is your comment on that?
11. Is there any aspect of the subject ML that you feel you learnt from somewhere else other than in the ACEML programme?

12. Do you feel that the introduction of the ACEML at Universities was a wise move by both the University and the DoE, when the subject was to be introduced in schools? Please elaborate on your response.
13. Tell me about yourself as a teacher **before** you studied the ACEML, **during** the time when you studied the ACEML and **after** you had completed the ACEML programme.
14. It is reported that a significant number of teachers dropped out of the programme. Why do you think that some teachers dropped out of the programme?
15. Based on your qualifications prior to enrolling in the ACEML, why did you actually decide to enrol in the programme?
16. Do you know any teachers who have completed the programme but who are not teaching the subject currently? If yes, would you be free to reveal their reasons for not teaching the subject?
17. Agree or disagree to the following statement and then elaborate on your response: *"most Mathematics teachers (that you know), do not know that Mathematical Literacy is a different subject from Mathematics. They think of ML as Standard Grade Maths or Lower grade Maths"*.
18. In your opinion, should ML have been made compulsory to all learners including those who take Mathematics as an option in the FET? Please elaborate on your response.
19. Would you have studied the ACEML if you had to fund your studies from your own pocket?
20. Would it be true to say that all the confidence that you have in teaching ML comes from your study of the ACEML programme?

APPENDIX H



**UNIVERSITY OF
KWAZULU-NATAL**

School of Science, Mathematics and

Technology Education

Faculty of Education
Private Bag X03

Ashwood, 3605

Informed Consent Form

We are carrying out a research project entitled: Exploring the impact of the ACE programmes on education in KZN. The purpose of the study is to examine the impact and effectiveness of the ACE programme as a model of professional development for teachers of ML, Mathematics, Science and Physical Science.

In order to look at the effectiveness of the programme, we need to find out from yourself about ways in which the programmes has impacted on the teachers' knowledge and practices in the class. We seek permission from yourself to use your responses to the questionnaire and if necessary to conduct an interview with you. Confidentiality is assured because no names will be used in the analysis or the reports. Participation is voluntary and you are free to withdraw from the study at any stage and for any reason. It is hoped that researching the effectiveness of the programme would help education planners to devise new and strengthen existing professional development programmes for practising teachers. It would therefore contribute to improving the teaching and learning situation in KZN schools.

If you need further information or clarity you may contact Dr. S. Bansilal (project leader) or Dr D Govender (Head of School SMTE)

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E-mail: Bansilals@ukzn.ac.za

Govenderd50@ukzn.ac.za

Declaration:

I (full names of participant), hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT

DATE

.....

.....

APPENDIX I

Certificate of Service Provided

Edit of Med dissertation entitled:

AN EXPLORATION OF THE ROLE OF
THE ADVANCED CERTIFICATE IN EDUCATION ON
THE PROFESSIONAL DEVELOPMENT OF MATHEMATICAL
LITERACY TEACHERS

Editor: G.J. Wood, BAFA Hons (UCT), postgraduate candidate
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Institution: University of KwaZulu-Natal

APPENDIX J

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