LANGUAGE AS A FACTOR INFLUENCING TEACHING AND LEARNING MATHEMATICAL LITERACY AT GRADE 12 IN MOLOTO CIRCUIT OF LIMPOPO PROVINCE

by

KINGSTON NYANDORO

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ABSTRACT

The study was carried out to: (1) determine the relationship between English and mathematical literacy scores at Grade 12 in Moloto Circuit, (2) understand and describe the learning difficulties experienced by learners when English language was used as a medium of instruction, and (3) suggest guidelines that could be used in teaching mathematical literacy. Regression and correlation analyses were carried out to determine the functional and strength of relationship between English language and mathematical literacy in the ten schools of Moloto Circuit. The views of the learners on the use of English language in the learning of mathematical literacy and the use of technical terms were sourced and analysed. The views of the educators about the use of English language as the medium of instruction were also analysed. A mixed approach methodology was used since both quantitative and qualitative methods were employed. The target population consisted of 305 learners who wrote the Grade 12 public examinations in 2016, 585 Grade 12 learners and 10 educators who completed questionnaires in January 2017. A census approach was carried out because everyone in Moloto Circuit doing Mathematical Literacy at Grade 12 level and their educators were studied. Grade 12 results for English and Mathematical Literacy for the 2016 academic year were collected and analysed. Questionnaires with closed and open-ended items were administered on Grade 12 learners and educators for the 2017 academic year in January 2017. Results in the ten schools showed that there was a positive relationship between performances in the two areas. In all cases the computed correlations were significant. This suggested that English influenced performance in Mathematical Literacy. This was supported by coefficients of determination calculations which ranged from 15% to 40%. Most responses indicated that learners found Mathematical Literacy difficult when English language was used as the medium of instruction. The learners preferred that Mathematical Literacy be taught in their mother tongue and that educators explain technical terms associated with mathematics. The educators said that learners had problems in Mathematical Literacy because of the use of English as the medium of instruction. They also said that learners found it difficult to relate Mathematical Literacy questions to real life situations and that the learners lacked adequate practice. The educators recommended the use of code-switching in their teaching in order to enhance understanding of Mathematical Literacy.

KEY TERMS

Mathematical literacy, language, factor, relationship and correlation,

DECLARATION

I, Kingston Nyandoro, has read and understood the University's policy on plagiarism. This is my own work, and where I have drawn on the work of others, I have referenced appropriately. This work has not been submitted to fulfil the requirements of a degree at any other university.

.... 25/02/19 ....

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Nyandoro Kingston (45278113)

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LIST OF ABBREVIATIONS

FL	-	First Language
HL	-	Home Language
NSC	-	National Senior Certificate
PISA	-	Program for International Student Assessment
SL	-	Second Language
STM	-	Science, Technology and Mathematics
SPSS	-	Statistical Package for the Society Science
UNESCO	-	United Nations Educational Scientific and Cultural Organisation

CHAPTER 1

BACKGROUND AND OVERVIEW OF STUDY

1.1 Introduction

There are a number of factors that affect the teaching and learning of mathematical literacy at grade twelve levels in South Africa. Some of these factors include home background, class size, resources, and attitude. The use of English language as the medium of instruction and methods of assessment is among some of the key factors that drew much debate in recent years. English language is a key element that determines the understanding and performance of learners in numeracy. South Africa's low performance in the Third International Mathematics and Science Study in 1995 and 1999 in comparison with other participating countries was a cause of concern. The causes of this low performance have been a subject of much debate and ongoing research. Of interest, the language used in the evaluation emerged as the leading factor in determining levels of numeracy. Howie (2003) found that the pupils' proficiency in the language of instruction was a reliable predictor of their success in mathematics. However, influence of the native language was found to have no significant effect on achievement in mathematics. However, some recent studies in different countries have produced contrary results, most likely due to some new developments that have taken place over time. Howie's (2003) study, nonetheless, raised some debatable but pertinent and relevant issues that could explain the underachievement. Although the study found a number of reasons for the underachievement, the use of English language as the medium of instruction was the dominant factor. Learners expressed that they had challenges in understanding concepts when they were writing or explaining mathematics in English. They preferred their educators to explain some of the concepts in their mother tongue. This assertion by the learners agrees with Sarwadi & Shahrill (2014)'s view that the learners' mathematical misconceptions have a direct relationship with their proficiency in the language used for teaching and learning. For example, the level of competency in a language affects what the learner can understand or explain.

1.2 Background

This study was based on my experience as a mathematics and mathematical literacy educator who used English language as a medium of instruction in South Africa over five years. The study was motivated by learners' continual failure in mathematical tasks such as class work, homework, tests, and examinations coupled with their inability to clearly express themselves in English during class discussions. This led me to suspect that the use of English language as a medium of instruction and assessment had an effect on their performance. There was need for evidence to verify this. In my interaction with the learners, I noticed that most learners could hardly construct a correct sentence in English and that a number of them switched between Sepedi and English languages in discussions. This scenario created some challenges for me as an educator because I often repeated my instructions to make sure that they understand. Sometimes I relied on my best learners to explain a concept in Sepedi. However, the problem with this approach was that mathematical misconceptions could be passed on to other learners without being detected by the teacher.

The situation was exacerbated by the fact that the reading materials used by learners, exercises, tests, assignments, and examinations written by learners were all in English, a language in which they were not good in. When the researcher asked the learners why they found mathematical literacy difficult one of the reasons they gave was that they had problems with communicating in English. They encouraged me to use Sepedi words in my teaching like their previous teachers. The researcher’s own experience was that across all grade levels, understanding the teacher’s instructions was a common challenge. Furthermore it was noticed that there were problems in understanding the textbook contents and examination questions that were written in English. For example, when the researcher used the word product, some learners would associate it with items that were sold in shops. This was further compounded by the fact that mathematical literacy was a language with its own linguistic characteristics (Mbugua, 2012). It therefore, follows that learners had problems with understanding of mathematical concepts in English in addition to the problems they had with the English language. From these observations, the researcher suspected that the level of proficiency in the English language had some effect on the understanding of mathematical concepts.

It is worth noting that the language situation in South Africa was complex. Howie (2001) revealed that English was the first language for 8.2% of South Africans and Afrikaans was the first language for approximately 13.3%. English and Afrikaans were used as media of instruction in schools and institutions of higher education in South Africa. Meanwhile, English was used as a medium of instruction and testing in most South African institutions of higher learning while only a few of them such as Stellenbosch university used Afrikaans. Furthermore, English was used as a medium of assessment in national examinations such as the National Senior Certificate. Learning materials at schools and colleges like textbooks were written in English, except for a few vernacular subjects.

For the black indigenous South Africans, comprising about 80% of the population, English or Afrikaans was their second or third language. Thus, South Africa was a bilingual/multilingual society. Since English was the main medium of instruction in most South African schools, this means for the majority of black South Africans, English was a second language. The communication challenges of the classroom situation alluded to earlier can be traced back to this linguistic landscape across the country.

1.3 Research problem

The use of the English language in rural schools in the teaching and testing of mathematical concepts was a subject of debate in developing countries where English was not the first language. For example, Benlet (2007) analysed the manner in which teachers engaged learners in the explanation of mathematical concepts and procedures, and how language impacted learning. Her findings agreed with those of Kaput (1988) who suggested that the language of mathematics was both a means of communication and an instrument of thought. The implication was that teachers needed to use clear language that revealed the reasoning behind mathematical procedures by making clear the distinction between the symbol (signifier) and concept/referent (signified). Mathematical literacy uses specialised vocabulary which learners need to master and use during a lesson. This makes the teacher's role to be that of understanding the learners' difficulties in making sense of mathematical language and using their language in the classroom in a manner that demonstrated effective communication. Unfortunately, this is not usually the case. Raiker (2002) noted that spoken language was sometimes different from the mathematical discourse used in mathematical lessons. For example, when the term product was used in a mathematical literacy class, it would be different when used in Business Studies lessons. In the former, the term would mean the result of the multiplication of two or more numbers and the latter will mean something that is produced or sold. This lack of clarification of terms used in the everyday mathematical literacy class was partly responsible for the teaching and learning problems in the subject.

The effect of the use of English language in the teaching and learning of mathematical literacy in a rural setup was not one dimensional. Meaney (2007) explored how Maori's (year) register in New Zealand could be included within the mathematical, pedagogical, content knowledge of teachers and the language of instruction. He emphasised the need for teachers of mathematical literacy to be aware of the linguistic features within the language that could support learners in understanding mathematical concepts. Howie (2003) found that the use of English language in mathematical and science subjects contributed to the underachievement in these subjects in schools where English was not the first language of the learners. The study revealed that only 26% of South African learners "almost always or always" spoke the test language at home. Howie (2003) found that South African pupils tended to achieve higher scores in mathematics when their proficiency in the English language was higher and vice versa.

1.4 Research questions

The research questions for the study were as follows:

1.4.1. What is the nature relationship that exists between the scores in English and mathematical literacy?

1.4.2. To what extent does the use of English language as the medium of instruction affect the teaching and learning of mathematical literacy?

1.4.3. In what ways can mathematical literacy educators teach using a second language to improve performance?

1.5 Objectives of the study

The objectives of the study were to:

1.5.1. determine the nature of relationship between the scores in English and mathematical literacy.

1.5.2. explore the learning difficulties faced by learners through the use of English as the medium of instruction in learning mathematical literacy.

1.5.3. suggest how the mathematical literacy educator can teach using a second language.

1.6 Purpose of the study

This study was undertaken to establish how proficiency in the English language affected the learners' performance in mathematical literacy at Grade 12 in Moloto Circuit of the Limpopo Province. The study attempted to come up with ways of helping teachers and learners to understand each other and contribute to an improvement of mathematical literacy achievement in the schools.

1.7 Significance of the study

This study was significant in that it attempted to reveal some of the challenges that teachers in Moloto Circuit faced in the use of English as a medium of instruction of mathematical literacy. It was believed that the study would contribute to the debate on language and mathematics teaching and learning. More importantly, the study would suggest possible solutions on how to improve the understanding of mathematical concepts. Furthermore, the study had the possibility of contributing to the body of knowledge that that is required to effectively teach mathematical literacy in schools.

1.8 Delimitation of the study

The study was carried out in Moloto Circuit in the Molejie area in Limpopo Province of South Africa. The circuit had ten secondary schools and all learners took mathematical literacy at Grade 12. The study was carried out on grade 12 learners and educators in the circuit. The focus of the study was on relationship between English language and mathematical literacy.

1.9 Limitations

A number of limitations were noted in the design of this study which could influence the findings of the study. Firstly, the questionnaires were written in English which is a second language for both the learners and teachers; as a result, some of the learners could make incorrect responses due to their limited understanding of the language used in the instrument. However, the researcher used simple English so as to reduce misunderstandings. Furthermore, respondents were allowed where possible to complete the questionnaire in a language that they were comfortable with. Translators were used to transcribe responses made in vernacular.

The use of English in the questionnaire for the teachers did not negatively affect them as they possessed enough linguistic skills to complete the questionnaire. There was a possibility that some of the questionnaires would never be returned, or may be returned late or partly completed. These scenarios were minimised by encouraging participants to submit the questionnaires on time with the assistance of the deputy principals in the schools. The researcher contacted deputy principals at least once per week in to encourage the respondents to complete the questionnaires and therefore, increase the rate of return.

1.10 Organisation of chapters

This dissertation is organised into five chapters. Chapter 1 is an introduction, and it consists of the background, statement of the problem, research questions, the purpose, delimitation, and limitations of the study. Chapter 2 is a review of relevant literature particularly focusing on the teaching and learning practices in mathematical literacy. Emphasis of this literature review is on the role and influence of the language of instruction and assessment on learners' performance. In Chapter 3, a detailed description of the research methodology is presented; particularly research design, research instruments, sampling procedures, data analysis and ethics. The findings of the study are discussed in Chapter 4. The dissertation ends with a summary of the research findings together with the possible implications of the study, the strengths and areas requiring further studies in Chapter 4.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

How language impacted on the teaching and learning of Mathematics was a question that occupied the minds of Mathematics educators (ref). This chapter reviewed the several efforts that have been made in an attempt to unravel the complexities that surround language and Mathematics teaching. The question whether English language proficiency influenced performance in school subjects including Mathematics led to studies by previous researchers including the New York National Research Council (2011) in the United States of America (USA), Lee, Queen and Valdes (2013) in the USA, Awofala, Neji and Fatade (2012) in Nigeria, Wilson job, Komb Sotco Claudius (2012) in Tanzania, Chivhanga (2008) in Zimbabwe, Vale (2013) in South Africa. Robelle and Candy (2016) found a significant relationship between the learners' English language and their academic performance in Science and Mathematics.

These and other studies suggest a positive correlation between English language proficiency and mathematics achievement, especially at high school level. For instance, in a study of the relationship between linguistic complexity of mathematical literacy examination and types of learner errors, Vale (2013) found significant correlations between the linguistic complexity of items and language related errors. The author also found a positive correlation between the cognitive complexity of items and all types of errors. This was consistent with some earlier studies that suggested that learners who had a poor command of the language in which they were taught suffered serious and complex disadvantages (Barton & Neville, 2003). Prendergast, Faulkner, and O'Hara (2015) also found that learners' proficiency levels in English language influenced their performance in mathematics.

2.2 English language proficiency and academic performance

The New York National Research Council (2011) studied the importance of English language proficiency for learners in the learning of science and mathematics subjects and noted the importance of language in the teaching and learning process. The report recommended that learners must obtain, evaluate and communicate information in English as they participated in classroom discourse of science and mathematics. Learners were supposed to read, view and visually represent explanations using English as the medium. Lee, Quinn and Valdes (2013) suggested that learners needed to speak and listen to each other as they presented their ideas or engaged in reasoned arguments with others to refine their ideas. Yushau and Omar (2015) findings indicated that the learners' proficiency levels in English language affected their performance in mathematics.

In New Zealand, Barton and Barton (2005) undertook similar studies at five colleges, Wellington Girls High, Macleans College, Tangaora College, Auckland Girls Grammar School and Auckland University focusing on the relationship between English language and mathematics learning. Evidence from these studies indicated that learners with little or no English language proficiency experienced problems in understanding mathematics concepts and solving mathematics problems. Barton and Barton (2005) further argued that the findings from the studies also showed that learners had language difficulties.

Awofala, Nneiji, and Fatade (2012) noted that language was considered a critical resource in all human endeavours, especially in the educative process. Language performed three functions of informing, expressing and directing, thus it was regarded as a vehicle of teaching and learning. Language and cognition were interrelated in that a person's ability to think in an elaborate and abstract way was a product of the use of language especially the spoken language. For example, academic language was characteristically abstract in that it did not generally refer to physical objects but to ideas and concepts. Based on this thinking, Awofala *et al.* (2012) found that in Nigeria, the learners' performance in the Science, Technology, and Mathematics (STM) subjects was closely related to their level of proficiency in English language. In the study of candidates' performance in senior secondary certificate examinations in STM, it was revealed that candidates did not understand the questions they were answering and as such, 80.3% of them committed errors due to their misconceptions. The results of the project by Awofala *et al.* (2012) also indicated that learners performed better in various school subjects if the mother tongue was used as the language of instruction. The research in Nigeria was advocating for the use of the native language as it was believed that this would enhance pupil performance. Awofala *et al.* (2012) felt that educationists should avoid the temptation of running away from the problem of low-level English proficiency and opting for the mother language as the language of instruction. Rather, they should realize the importance of stressing the need for English language competency among educators and learners.

Zangani and Maleki (2007) examined the relationship between English language and science subjects. Furthermore, they noted that when learners at high school level had difficulties in understanding the content and concepts of the subjects that were presented in English language, their academic performance would be negatively affected. However, these findings contradicted those of an earlier study by Adewoye (1983) in Nigeria, who concluded that there was no positive correlation between English language proficiency and academic achievement in Physics. To the contrary, the research findings indicated that learners who were good in the English language were not necessarily good in Physics and that there are other factors that accounted for the better performance in Physics. Fall (1972) also compared performance in English language and Chemistry using learners' scores and found that learners who performed brilliantly in Chemistry also performed brilliantly in English language. He, therefore, concluded that proficiency in English language has positive effects on the performance of learners in Chemistry. Aina *et al.* (2013) found a correlation between learners' proficiency in English language and academic performance in science education. Adesoji (2008) in his study asserts that English proficiency had a low predictive value for performance in Physics. This led some researchers to suggest that a credit pass in English should not be mandatory for learners seeking admission to study the sciences. It, therefore, means that the relationship between English and science subjects was minimal or none at all according to Adewoye (1983) and Adesoji (2008) but Aina (2013) concluded that there is a relationship between the two variables.

Aina, Ogundele and Olanpekun (2013) observed that learners who had English language difficulties such as poor listening, speaking, reading and writing abilities, failed to function well in other subjects. When learners' proficiency in English language was high their academic performance improved. Low proficiency in English language was considered a barrier to learning and academic success as the learners lacked the language required to understand academic work. Some researchers like Akintola (1998) and Adesoji (2008) also supported the idea when they argued that English language abilities influenced knowledge of learners in other subjects in the curriculum. Fayehum (1991) also suggested that the knowledge of English language particularly as a medium of instruction at the secondary school level affected the comprehension ability of the learners.

Taylor (1966) conducted a survey of studies on educational problems and potential of coloured immigrant children from Africa and concluded that language was a major factor affecting their actual school performance in Britain. This meant that all schools which used English language as the language of instruction while it was a second language in the country faced difficulties in the academic performance of their pupils. From my teaching experience both in Zimbabwe and South Africa, this was generally true. In the Philippines, similar studies were carried out at Isabela State University and researchers realized the importance of acquiring competency in English as a second language to learners' academic success.

Wilson and Claudium (2012) investigated the link between English language and academic performance in Tanzanian Secondary schools. They concluded that the poor performance in academic work in their national examinations was attributable to low proficiency in the language of instruction which was English. Wilkinson and Silliman (2008) also viewed that learners' success in school depended upon their proficiency in the language of instruction. Malekela (2003) in support of this view argued that if the learner was handicapped in the language of instruction, then learning could not take place as the instructor and the learner would not be communicating. Most language experts in Tanzania considered English language as a key factor influencing academic achievement for most learners at higher levels of education because learners failed to learn effectively through the sole medium of English (Adamson, 2014).

Dooeyn and Oliver (1994) on the other hand argued that there was no relationship between language proficiency and academic achievement. According to these authors, language was important but did not play a major and dominant role in academic success. However, the researchers were of the view that in the teaching and learning of Mathematical lLiteracy, there was need to find out whether there was any relationship between English and Mathematical literacy since the subject was taught and learnt in English.

Similar research was also carried out in Zimbabwe by Chiwanga (2008) to determine the influence of English on the performance of learners writing the ordinary level Shona examination in secondary schools. Chiwanga (2008) concluded that the use of English language in the teaching of Shona tended to hve a negative influence on the performance of learners in Shona. In the Midlands province of Zimbabwe, a study was carried out to address poor performance in the advanced level Agriculture (ref?). English language was found to be one of the factors that contribute to poor performance in Agriculture. The argument made was that language spoken at home affected student learning as most Zimbabwean families used vernacular language for communication yet the language of instruction at school was English. Vygotsky (1962), in support of this argument, was of the view that there was a relationship between the language of instruction and performance. Aina *et al.* (2013) further viewed that English proficiency helped in academic reading, which means that the English language ultimately has an effect on learners' academic performance in other disciplines.

2.3 Language and mathematical literacy in the South African education system

Gerber (2005) studied the influence of second language teaching on undergraduate calculus learners. The quantitative survey was conducted on two groups, where one group was taught using home language and the other group taught using second language EnglishThe study showed that there was no significant difference between the adjusted means on the entire group. The reason was that in calculus most of the questions set were more in symbolic form and as such very little English vocabulary acquisition was required. Learners in calculus could be simply required to differentiate, integrate, find maximum and minimum values and if a learner acquired the mathematical meaning of these terms, then the learner was bound to perform the required task successfully.

Gardiner (2008) made the fundamental point that language shaped how people thought and understand the world. This was true in everyday ordinary language use as well as the more specialized language used in instances such as academic and professional contexts. In light of this important fact, institutions and governments around the world came up with language policies. The South African language policy in education currently maintains the home language together with one additional language in the early phases of education. Gardiner (2008) summarized the South African language policy. He expressed that South African children should be taught in their mother tongue at the beginning of their formal schooling. In grade 4, they should then switch to a different language of learning. English should be one of the different languages that should be introduced at this stage. It appears the policy would change in the near future, and that children would continue to learn in their home language until the end of Grade 6, as decided by the Western Cape Department of Education. This would strengthen their ability to learn, understand, speak and analyze in that language before switching over to learning through another language. Language-in-education experts argued that this initial acquisition in the home language would improve competency in mathematics later.

Gardiner’s (2008) description of the South African language-in-education and observation highlights a critical point that competence in the mother tongue (L1) was a prerequisite for competence in the second and subsequent languages. This meant that the mother tongue as a medium of instruction and language of study needed to be taken seriously and handled effectively in a manner that cultivated learning, understanding, speaking, analysis and interpretation (thinking) in that language. This would lay a solid foundation for learning through a second language (usually English). This was supported by the fact that Grade 5 South African children came last out of 40 countries in literacy tests conducted in the mother tongue. The second point that emerges from the above assertion was that South African language-in-education has been constantly shifting and this suggested the ever-changing understanding of the relationship between language and cognition. The language policy clearly had its underlying goal, which was the preparation of a bilingual learner in the upper levels of education.

It would appear the South African education system failed to equip the learners with the requisite linguistic competencies that would help them to function effectively in mathematical reasoning. However, Jordan (2011) argued that the linguistic diversity in South Africa created an ideal context to provide learners with educational opportunities that promoted high levels of linguistic proficiency in their home and additional languages. This would entail coming up with language policies that take advantage of the large linguistic repertoire of the learners at home and in the classroom by clearly defining the roles and relationships of the home language and English. For instance, should the relationship be that of complementarities in the classroom or should English's current undisputed dominance in the classroom be maintained? Jordan (2011) further lamented the education system's failure to bring to fruition the constitutionally guaranteed imperative of promoting multilingualism. Since multilingualism was constitutionally guaranteed in South Africa, it was expected that the education system would provide a multilingual education policy that allowed the learners to realise their full academic potential by removing any language barriers to effective learning. The continued dominance of English as a medium of instruction and the marginalization of the African languages clearly negated the language-in-education policy referred to above.

2.4 Theoretical frameworks

The debate between the language of instruction and learning went back in time and elicited two schools of thought namely, that (1) language influenced thought and (2) language had limited influence on thought. Jordan and Jordan (1989) noted that the relationship between language and thinking occupied the minds of philosophers, linguists, anthropologists and psychologists such as Wharf, Piaget, and Vygotsky (year?) among others.

Theorists such as Wholf (1956) suggested that language defined thought while others such as Piaget (1896-1980) and Vygotsky (1896-1934) tended to accept only a limited effect of language on thought. Jordan and Jordan (1989: 422) characterized the intercommunicative function of language in the following ways:

i. We must be able to associate speech sounds with their respective meanings.
ii. We must be able to associate the words with things and ideas (concepts) for which they are symbols.
iii. We must learn to apply rules in accordance with the words of a language in order to achieve understandable communication.

South Africa's multilingualism made language a complex and critical factor in the teaching and learning of Mathematics in many South African schools. Understanding this complexity would contribute significantly to the teaching and learning of mathematics. The teaching and learning of Mathematical concepts in South African schools mostly entailed the operation of more than one language for teacher and learner alike, that is a first language (home language) and a second language (usually English). For instance, when the teacher taught that x^2-1 = 0 is a quadratic equation where x^2-1 was a difference between two squares; it raised the question, "which language does the learner use between the first and second, or even third language to process this?" Sokolov (1971) argued that there was an inner form of speech that "organises and directs thought, maintains its purposive character and leads to a logical completion of the whole process." The inner form of speech that Sokolov (1971) referred to here was what de Saussure (1916) terms competence.

Competence referred to the individual's inherent (subconscious) knowledge of the rules governing the formation of speech, usually in their mother tongue or first language. Piaget (1928) explained why linguistic competence promoted effective thinking by pointing out that; linguistic competence helped a child to classify and stabilize his/her perceptions, that is, to place them in conceptual categories which facilitated meaningful attribution in future perceptual situations. For example, a learner's classification of 'x^2-1 = 0' as a quadratic equation helped him/her to think of the methods that could be used to solve quadratic equations.

Words served as symbols of concepts which were representative of things, situations and ideas. The child's ability to master a language made it easier for him or her to form, apply and manipulate concepts. For instance, the learner could recall the decomposition of the term 'x' before factorisation. Once the learner could conceptualize that the term '0x' was equal to '1x-1x', then the quadratic equation could be rewritten as 'x^2-1x+1x-1 = 0'. This then simplified to '(x-1) (x+1) = 0'. Therefore the solution of the quadratic equation would be 'x = 1 or x = -1'. Language enabled the child to comprehend the relationship between concepts and thus later facilitated the application of concepts.

Piaget (Year?) linked linguistic competence to effective thinking in the points above. Gardner (1983; 1995) explained the relationship between the language of instruction and the thinking process using his theory on linguistic intelligence and logical-mathematical intelligence. The author defined and explained linguistic intelligence as the sensitivity to spoken and written language, the ability to learn languages and the capacity to use language to accomplish certain goals. This intelligence included the ability to effectively use language to express oneself rhetorically or poetically, and language as a means to remember information. Gardner (1983; 1995) further identified writers, poets, lawyers, and speakers as having high linguistic intelligence. This linguistic intelligence made them very effective logical thinkers and by extension, strong linguistic skills would be an asset to a mathematics learner.

2.5 The nature of mathematics

Logical-mathematical intelligence consisted of the capacity to analyse problems logically, carry out mathematical operations and investigate issues scientifically. According to Gardner (1983; 1995) logical-mathematical intelligence entailed the ability to detect patterns, reason deductively and think logically. While Gardner's (1983; 1995) theory of linguistic and logical-mathematical intelligence has not been universally accepted within the academic psychology, it has been met with a strong positive response from a considerable number of educators. It has been embraced by a range of educationists including theorists, teachers and policymakers, who have applied it to solve teaching and learning problems. A number of schools in North America have moved to structure curricula according to the intelligence, and to design classrooms, even whole schools to reflect the understandings developed by Gardner (1983; 1995). Application of this theory is evident in pre-schools, higher, vocational and adult educational initiatives. It should, however, be pointed out that treating linguistic and logical-mathematical intelligence as separate entities can only be for analytical purposes. In practice, the medium of scientific and mathematical discussions remain rooted in the language itself.

Since the time of Euclid (300BC), Mathematics has been presented in the definition-theorem-proof format. This has been extensively and explicitly described in Euclid's Elements that were written over two millennia ago and has been adopted as the standard practice, even for the mathematical concepts that were discovered later. It has been noted that this structure is often poorly handled in terms of teaching, leading to learning difficulties in the acquisition of mathematical rigor. Jamison (2000: 46), for instance, observed that the majority of learners ended up concluding that "Mathematics is just mystical gibberish." The challenge is how to come up with methods and teaching materials that make Mathematics teaching effective and make its learning meaningful to the learner. To that end, Jamison (2000) has been developing teaching strategies and teaching materials for making the syntactical and logical structure of advanced Mathematics more effective and meaningful to the learner. This represented a serious attempt at addressing the linguistic complexities that were at the core of Mathematics teaching and learning. This was relevant to the current study's focus on language and learning of mathematical literacy.

Jamison's (2000) contribution has revealed interesting learner perceptions of mathematics which are important for manipulating mathematical concepts. Jamison (2000) noted three important ways in which the use of language in Mathematics differed from ordinary speech. The first one was that in Mathematics temporal was not temporal: there was no past, present or future in mathematics which was significant in forming logical arguments. The second was that Mathematics was devoid of emotional content. However, the absence of emotional content from formal mathematical discourse presented no difficulty for learners. The third feature of mathematical language was that it was very precise. This clarity and lack of ambiguity often presented a challenge to new learners of Mathematics as most learners, especially in the South African context, were not afforded this by their native languages.

Jamison (2000) was also of the view that mathematical concepts could not be learnt effectively without being understood the process entailed more than just committing certain formulae to memory and mechanically applying them. This involved the acquisition of the language of Mathematics and the learning its tools, speaking, listening and reading. These were the same basic macro-skills of language in general but in mathematics learning, this meant memorising models and learning the history and culture of a particular mathematical concept. Systematic mathematical thought required precise verbal expression which was a characteristic that indigenous languages had not yet attained.

2.6 Language development

It follows from the foregoing that Mathematics educators should possess the right pedagogical knowledge for them to effectively assist the learners to succeed in Mathematics. Although Mathematics learning was based on symbols and numbers, teaching it required a considerable amount of communication skills including an understanding of language development in learners. Cummins (1999) found out that social language development occurred within a year or two, while academic language took four to seven years. The issue of language in Mathematics education became more complex where bilinguals whose mother tongue was other than English. Educators had to be more sensitive to such learners. Highlighting the importance of language, Jamison (2000: 1) stated that "once students understand how things are said, they can understand better the WHAT of what is being said and only then do they have a chance to know WHY it is said."

The language of instruction which conveys mathematical ideas took a centre stage in the investigation of underachievement in Mathematics over the last few years. Clarkson (2003, 2005 and 2006) argued that fluency in the learners' home language or mother tongue, alongside the language of Learning and Teaching (LoLT) has a positive influence on learners' learning and performance in Mathematics. This research investigated how the language of instruction can be effectively used to maximise the acquisition of Mathematics concepts in the teaching and learning process at the school level. Fillmore (1982: 6) observed that "the language of the textbooks and instructions frequently called for a high degree of familiarity with words, grammatical patterns, and styles of presentation and arguments that were wholly alien to ordinary informal talk." Cummins (1980) described the language of the textbook as "cognitive academic proficiency."

Krashen (1978) proved that there existed some similarities between the process of acquiring one's first language and learning a second language. For example, mathematical concepts had a distinct grammar since they followed a different convention of writing and reading equations and formulae from that of ordinary language. Though the English language was commonly used for worded problems and equations written in sentences, mathematics was considered a neutral language because its equations and formulae could be read by any mathematician around the world regardless of their native language. However, when it came to learners, this did not seem to hold true in most cases.

2.7 Language register

Linguists used the term language register to refer to the meanings that served a particular function in the language as well as the words and structures that conveyed those meanings. A mathematics register refers to the meanings that belong to language that is used in mathematics, and is more precise and narrower in scope than the natural language (Halliday, 1975). According to Bruner (1976), Mathematics terms gave a rise to an almost totally non-redundant and relatively unambiguous language.

Benlet (2007) and Kaput (1988) agreed that the language of Mathematics was both a means of communication and an instrument of thought. The implication was that teachers needed to use accessible language that revealed clearly the reasoning behind mathematical procedures in a manner that distinguished between the symbol (signifier) and concept/referent (signified). Mathematics used a special type of vocabulary and structures which learners had to learn and be able to apply. Very often, the neglect of this aspect has yielded disastrous results in the learning environment. The teacher's role, therefore, was that of understanding the learner's difficulties in making sense of mathematical language and using the language in a manner that demonstrated effective communication.

Effective communication entailed both being heard and understood. Noting that this was often not the case, Raiker (2002) argued that spoken language was partly responsible for the teaching and learning of problems in mathematics and mathematical literacy. It emerged clearly in this work that the language factor in mathematics teaching and learning was not one-dimensional. Meaney *et al.* (2007) explored Maori register that could be included within mathematical pedagogy. They emphasized the need for teachers of Mathematics to be aware of the linguistic features within the language that could support learners' mastery of mathematics register.

2.8 Language and mathematics education in South Africa

South Africa witnessed some significant studies on language and mathematics education. Langa (2006) argued for the use of the home language to support mathematics learning. The limitation of this strategy, however, was that it put the educator who was a non-speaker of the learners' language at a disadvantage. It also underscored the complexity of the issue of the medium of instruction in South Africa's multi-lingual situation in general. Sepeng's (2010) study of the relationship between isiXhosa and English revealed that although English was the language of learning and teaching, the majority of learners actually preferred code-switching between English and isiXhosa for the teaching and learning of Mathematics. There were, however, some positive observations on the relationship between the first and second language. Archibald (2006) made two interesting observations on the effects of the second language (L2) on the first language (L1): the exposure to a second language could enhance the complexity of the first-language syntax used, language use skills (narrative strategies, reading and writing skills) in the first language and non-linguistic skills, attitude towards others, mathematics scores and skills. The second was that acquiring knowledge in the second language did not impede the ability to access that knowledge in the second language.

From this perspective, it could be deduced that learners who have minimal proficiency in either L1 or L2 were at the risk of cognitive deficiencies. This observation was interesting in that it sheds a positive light on both the first and second language thereby suggesting their complementarities. Rather than view the other negatively, they could actually be used in mutually beneficial ways in the teaching and learning of Mathematics.

There has been a considerable amount of research on language competency and mathematics education in recent years. Setati (2008) contributed significantly to these studies in South Africa. In mathematics education and language: policy, research, and practice in multilingual contexts, Setati (2004) explored the relationship between language and mathematics education in multilingual classrooms using data collected through interviews with mathematics teachers and learners. The study focused on South Africa based on the recognition of the country as “one of the most complex multilingual countries in the world”. The study also outlined that both teachers and learners recognised English language competency as critical for successful learning of mathematics and actually expressed a preference for learning and teaching mathematics in English. This study further noted that the language preference by the teachers and students was not necessarily driven by “pedagogical or curriculum factors”, but economic, political and ideological ones.

In a related study, Essien and Setati (2007) investigated how the improvement of the learners’ English language proficiency enabled or constrained the development of their mathematical proficiency (2007: 217). There were two major findings here. The first was that “any attempt to improve the language proficiency of the learners with the aim of improving academic proficiency should be done in such a way as to develop concurrently both the basic interpersonal communicative skills and the cognitive academic language proficiency”. The second was that “proficiency in the language of instruction (English) is an important index in mathematics proficiency, but the improvement of learners’ language proficiency, even though important for achievement in mathematics, could not be sufficient to impact on classroom interaction” (Setati et al, 2007:217).

Rather than viewing the home languages as an impediment to mathematics learning and teaching, they could actually be deployed as resources in mathematics education by translating mathematics tasks into these languages (Kazima 2007). The author reported that this approach has been successful been adopted in Tanzania, Nigeria and Malawi. This entailed, according to Setati (2008) “the deliberate, proactive and strategic use of the learners’ main languages and the selection of real life, interesting and high cognitive demand tasks”. However, this strategy would run into serious challenges where the teachers spoke or knew a different home language from learners’ home language(s) as argued (Langa, 2006).

In another study, Setati (2008) came up with the interesting finding that “learners, who position themselves in relation to mathematics and so epistemological access, support the use of their home languages as languages of learning and teaching”. This is unlike those teachers and learners who positioned themselves in relation to English and whose concern is, therefore, access to social goods occasioned by the social and economic power of English. This clearly placed language as a factor in the learning and teaching of mathematics in a bilingual/multilingual context such as South Africa.

A study by Gerber, Engelbrecht, and Harding (2005) of undergraduate mathematics students’ performance revealed the significant influence that was played by language. They noted the difficulty of understanding abstract concepts and ideas in mathematics even when taught in the student's first language. For the majority of South African learners, this problem is compounded by the need for learners to master the concepts and ideas through a second language. Gerber *et al.* (2005:3) found that in South Africa, Afrikaans learners who attended Afrikaans lectures outperformed Afrikaans learners who attended English lectures. This finding showed that in a bilingual/multilingual environment, choice of the language of instruction and linguistic strategies was important in enhancing learner performance up to university level.

Similar studies undertaken beyond the South African borders also found a strong correlation between language proficiency and Mathematics performance. In a study on Latino secondary school youths, Mosqueda (2010) found that non-native English speakers who had good proficiency in English achieved higher performance scores in Mathematics than their counterparts who were native English speakers.

While most writers tended to talk in terms of general language proficiency, Hammil (2010) clearly described, defined and explained the verbal component of a mathematics text as almost always multi-modal containing text, symbolic notation, and graphics. The language of mathematics was precise and technical, the diagrams and graphs made extensive use of implicit conventions, and mathematical notation was information dense, often nonlinear, and could occupy a cognitive space somewhere between text and graphics. It would appear that general language proficiency, though not enough by itself placed a learner in a better position to acquire and develop mathematical language. On the other hand, those learners who have a weak language background would probably find it difficult to cope with mathematical language. Wiest (2003) described the literacy factors that influenced comprehension of mathematical text such as the form and style of reading material, the purpose of reading, which determined how they read it. Wiest (2003) also argued that despite having a reasonably good proficiency, a second language speaker of English faced the challenge that mathematical expressions did not always directly translate into other languages.

2.9 Mathematical literacy

Literacy was generally defined as the ability to read and write. But this general definition would clearly be inadequate and unhelpful in understanding what mathematical literacy might be. In this regard, UNESCO's (2005:148) broadly defines of literacy as "an autonomous set of skills, literacy as applied, practised and situated; literacy as a learning process and literacy as text,". UNESCO (2005:21) proposed the operational definition of literacy as "the ability to identify, understand, interpret, create, communicate and compute using printed and written materials associated with various contexts". Thus, literacy involved a continuum of learning in enabling an individual to achieve his or her goals, develop his knowledge and potential and participate fully in the community and wider society. Mathematical literacy as defined by the PISA Governing Board (2010:5) is “an individual’s capacity to recognize, do and use mathematics, including to reason mathematically in a variety of contexts, and to identify the roles that mathematics plays in the world by describing, modelling, explaining and predicting phenomena”. Mathematical literacy is distinguished from mathematics in that the latter is more focused on abstraction whereas mathematical literacy is more grounded in social practice. The Department of Basic Education (2011:10) listed the competencies that constituted mathematical literacy as “the ability to reason, make decisions, solve problems, manage resources, interpret information, schedule events and use and apply technology”. Development theories pioneered by Piaget (1896-1980) and Vygotsky (1896-1934) suggested a link between mathematical thinking and language. Vale (2013) argued that while there was discontinuity between the language used in the home, where initial development occurred, and the language used at school, the development of mathematical language must be influenced to the same extent”.

Vale (2013) argued that for those students whose second language was English, part of their learning was in their home language. The transfer of mathematical skills they developed in their home language into contexts presented in a second language, became complicated for them. Examples of such terms which might present challenges to second language learners taken from the final examination mathematical literacy P2 of November 2014 were: data, discrete, continuous, model, range, mean, quartile, randomly, probability, maximum, unbiased, outcomes, average, trend, gross, inflation, increase, income, and approximate. This implied that, as part of mathematical literacy teaching, including testing, language had to be seriously taken into account (Vale, Murray, & Brown, 2012). In Mathematical Literacy Examination Items and Student Errors: An Analysis of English Second Language Students’ Responses, Vale *et al.* (2012: 66) argue that “Mathematical literacy is a real-world practical attribute, yet learners write a high stakes examination in order to pass the subject mathematical literacy. In these examinations, all sources of information are contextualized in language. It can be effortful for English second language students to decode text”.

Vale *et al.* (2012:77) found that “38% of the students’ errors were attributed to decoding”, and of these,” 26% were reading comprehension errors, and 12% were viewing errors owing to a lack of comprehension of symbolic notations, tables or graphs. Encoding accounted for 7% of the errors”. What this suggests is that language is a significant factor in mathematical literacy teaching and learning.

2.10 Conclusion

This chapter has discussed some of the leading research on the question of language and mathematics education in South Africa and abroad and how these debates informed the current study. The literature reviewed here generally indicated how important language was in the teaching and learning of mathematics. It is expected that this study would add to that knowledge by exploring the relationship between the South African language-in-education policy and language-in-education practice in Moloto circuit.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The methodology detailed in this Chapter was adopted in a bid to address the problem and research gaps that were spelt out in Chapters 1 and 2. Data that was collected using this methodology was then used to examine the impact language on learning of mathematical literacy at Grade 12 in Moloto Circuit in Limpopo Province, South Africa. In this Chapter, the research approach and the design adopted are described and the justification for their adoption is also provided. This was followed by a description of the target population, sample and sampling procedures. The last part of the chapter focuses on data collection instruments, data collection procedures, data presentation, and analysis plans.

3.2 Research approach

The mixed methods research approach was used in this study. This approach combines quantitative and qualitative approaches, provides an elaborate understanding of the phenomenon of interest and therefore, enhances confidence in the conclusions generated by study (Johnson, Onwuegbuzie, and Turner, 2007; Tashakkori and Creswell, 2007). The use of mixed methods in this study offered more choices for gathering data and a better lens to examine how the language of instruction affected the understanding of mathematical concepts.

Quantitative methods provided data on the relationship between the LoLT. Data that were collected enabled the computation of a correlation between mathematical literacy and English language proficiency and also the functional relationship between the variables. Qualitative methods were used to gain insights into the preferred language and the method of instruction. Questionnaires for teachers were designed to gather the teachers' insights on the relationship between proficiency in the English language and achievement in mathematical literacy.

3.3 Research design

A cross-sectional correlation research design was used for this study. This was done to correlate mathematical literacy competency with the level of performance in English. Mathematics literacy was the response variable and performance in English language was the treatment variable. It was a cross-sectional design because the design enabled the researcher to observe two variables at a point in time. The design had the advantage of describing the relationship between two variables (Breakwell, Hammond, Fife-Schaw, & Smith, 2006). The shortcoming of this type of design was that results obtained from this kind of analysis may not allow for strong findings to be made concerning a cause-and-effect relationship between variables. However, the computation of the coefficient of determination would make it possible to estimate the influence of one variable on the other. The coefficient of determination is symbolized by R^2, where R is the coefficient of correlation. The coefficient of determination ranges from is 0 to +1. It is important to note that a high coefficient of determination did not guarantee that a cause-and-effect relationship existed. However, a cause-and-effect relationship between the independent and dependent variable would result in a high coefficient determination. For qualitative data, a cross-sectional descriptive design was adopted so as to adequately describe and understand phenomena.

3.4 The study sample

3.4.1 Target Population

The target population consisted of all Grade 12 learners of mathematical literacy in 2016 and 2017. Educators who taught mathematical literacy were part of the target population. The study focussed on Moloto Circuit located in Limpopo Province of South Africa which consisted of 10 secondary schools.

3.4.2 Sample Size

The respondents consisted of 585 Grade 12 learners and 10 educators who taught Grade 12 literacy, giving a total sample size of 595. Statistically, the sample in terms of learners is regarded a large. The learners who responded to the questionnaires were 280 and those who wrote the examination were 305. The distribution by gender is as shown in Table 3.1.

Table 3.1: Sample distribution for educators and learners from 10 schools in Moloto Circuit, Limpopo Province, South Africa

	Examination Group			**Questionnaires**			**Educators**			**Totals**
School	Males	Females	Total	Males	Females	Total	Males	Females	Total	
A	29	33	**62**	29	29	**58**	1		**1**	**121**
B	20	15	**35**	8	16	**24**	1		**1**	**60**
C	7	6	**13**	2	9	**11**	1		**1**	**25**
D	16	10	**26**	16	9	**25**		1	**1**	**52**
E	9	13	**22**	12	7	**19**		1	**1**	**42**
F	19	21	**40**	22	16	**38**	1		**1**	**79**
G	8	9	**17**	6	8	**14**	1		**1**	**32**
H	10	20	**30**	23	10	**33**	1		**1**	**64**
I	22	16	**38**	16	19	**35**		1	**1**	**74**
J	6	16	**22**	14	9	**23**	1		**1**	**46**
Total			**305**			**280**			**10**	**595**

3.4.3 Sampling Procedures

A census approach was used to purposively select participants for the study from Moloto Circuit of Limpopo Province. The census approach was used because it provided a complete and comprehensive picture of the problem. The sample was composed of 10 Grade 12 mathematical literacy educators and their 595 learners. One mathematical literacy educator was selected from each of the 10 schools in Moloto Circuit. The basis of the educators' selection was teaching mathematical literacy at Grade 12 level. The selected participants were then requested to complete a questionnaire.

3.4.4 Research site(s)

The study was conducted in Limpopo Province in South Africa, northwest of Polokwane in a rural set-up. The red rectangle in Figure 3.1 shows the location of the Moloto Circuit.

Figure 0.1: Location of the 10 schools in Moloto Circuit, Limpopo Province in South Africa, where the research was conducted

3.5 Research instruments

Three instruments were used during the data collection process which included two questionnaires and an observation schedule. The observation schedule was based on the 2016 national results schedule for Moloto Circuit and the questionnaires were completed by participants in 2017. Quantitative data was collected from the content analysis schedule and closed questions in the questionnaires. Qualitative data was collected from the open-ended questions in the questionnaires.

3.5.1 Questionnaires

The researcher drafted two questionnaires, one for Grade 12 learners and another for educators who taught mathematical literacy at Grade 12.

3.5.1.1 Questionnaires for learners

The questionnaire for learners had three sections namely; biographic, closed-ended items, and open-ended items. The biographic data included the following details: gender, age, and home language. The second section of the questionnaire contained close-ended items that were specific on a number of aspects relating to the use of English or home language in the teaching and learning of mathematical literacy. For example disadvantages, advantages, impact, and modalities of integrating English and mother language in the teaching and learning of mathematical literacy were examined. The closed-ended items used the Likert scale where the responses were coded: strongly disagree = 1; disagree = 2; undecided = 3; agree = 4, and strongly agree = 5. For example, respondents were asked to answer questions such as “Mathematical literacy gives me problems because I don’t understand the English terms that are used” and they responded using the above Likert scale.

The third section of the questionnaire contained open-ended items and solicited for their views on the use of English and home language as a language of teaching and learning in mathematical literacy. For example, this section included questions like “What are the challenges that you face when you are taught using English as the language of instruction in your mathematical literacy classes?”

The last section contained questions similar to those asked in mathematical literacy examinations (Appendix H). The rationale of including such questions was to check whether learners understood the English language terms that were used in such questions. The sections and items in the questionnaires were numbered in order to facilitate the discussions and analysis of these sections in chapter 4.

3.5.1.2 Questionnaire for Educators

The questionnaire for educators teaching mathematical literacy at Grade 12 also had three sections namely; biographic, closed-ended items and open-ended items (Appendix I). Biographic data included the number of years spent by educators in the current position and the highest level of formal qualification.

The second section of the questionnaires contained closed-ended items that focussed on the similar specific items as the learners given above. The questionnaires were similarly coded using the Likert scale. The closed-ended questionnaires for the educators included questions like “Poor English language proficiency affects the academic performance of Grade 12 learners in mathematical literacy.”

The last section of the questionnaire contained open-ended items and solicited for participants' views on the use of English and L1 as a language of teaching and learning of mathematical literacy. For example, "What are the challenges that you face when you are teaching mathematical literacy using English as the language of instruction to your Grade 12 learners?" The sections and items in the questionnaires were numbered.

Closed-ended items were used because they had the advantage of focussing the attention of the respondents on specific issues of concern while open-ended items gave the respondents an opportunity to express their opinion and thereby reducing researcher bias (Bernard & Ryan, 2010). The inclusion of both types of items strengthened the quality of the research findings. In addition, the inclusion of both open and closed items enabled the researcher to collect both qualitative and quantitative data for this mixed methods study.

The rationale of using questionnaires as the main data collection instrument was that they were economic in terms of time and cost, and also they covered a large number of respondents scattered over a wide area. Furthermore, questionnaires were easy to standardise, they reduced researcher bias, and also ensured the anonymity and confidentiality of the respondents (McMillan & Schumacher, 2010). The use of the questionnaires also had an additional advantage in that they were completed during the spare time of the participants and had minimal interference in the day-to-day running of lessons in schools in the circuit.

3.5.2 Construction of the Questionnaire

In designing the questionnaire the researcher was guided by Borg & Gall (1989) who suggested the following guidelines in the compilation of the questionnaire:

i. Only items that relate directly to the objectives of the researcher should be included.

ii. The questions in the questionnaire should be clear and straight to the point.

iii. Double-barrelled questions should be avoided, which means a question should be limited to a single idea only.

iv. Short questions are preferable.

v. The questions should be drawn up in such a way that they would be easy to answer.

vi. Questions should be grouped according to subjects. This would make questions logical and enable the respondents to understand the relationship between them.

The process of validation of questionnaires involved sending the questionnaires to a language editor to check for grammatical errors and ambiguity. Thereafter, the questionnaires were pilot-tested with respondents from another circuit in order to find out whether they would yield the intended results without difficulties. During the pilot test, two mathematical literacy educators and 10 of their learners were asked to complete the questionnaires. Feedback from the pilot study was used to fine-tune the questionnaires before they were used on the actual participants. These two processes enhanced the validity and reliability of the instruments (Delport, 2005).

3.5.3 Content Analysis

Content analysis is a research tool used to determine the presence of certain words or concepts within texts or sets of texts. Researchers quantify and analyse the presence, meanings, and relationships of such words and concepts, then make inferences about the messages within the texts, writer(s), the audience and even the culture and time of which these are a part (Writing@CSU, 2004).

In this study, content analysis involved analysing results of 2016 learners that were obtained from documents from the Moloto Circuit Office. The researcher made use of the Grade 12 November 2016 NSC examination results. The advantage of content analysis was that it was economic in terms of time and money, it had a high level of reliability and validity, and it was an unobtrusive approach (McMillan & Schumacher, 2010). However, content analysis is inherently reductive, particularly when dealing with complex texts and its automation or computerization can be a challenge (Writing@CSU, 2004).

Since the study sought to investigate the effect of the language of instruction on the performance of Grade 12 mathematical literacy learners, the researcher found it necessary to use the Grade 12 November 2016 NSC examination results. In the examination papers, the researcher focused more on the English and Mathematical English terms which were used in the construction of the examination questions. Some examples of language difficulties according to Steinhardt (2009) included:

a) *Polysemous words*

Polysemous words, which are words with the same spelling and pronunciation but different meanings, can be confusing for the student to understand. Examples of polysemous words are listed in the Table 3.2:

Table 3.2 Some examples of polysemous words word that are used in mathematical literacy

Word	Meaning in Everyday Life	Meaning in Math
angle	a viewpoint or standpoint	In geometry, it's the space within two lines.
mean	(adj) offensive* (v) to intend*	An average
table	furniture	An arrangement of numbers, symbols or words to exhibit facts or relations
volume	loudness	Amount, total of
tree	a plant	Tree diagrams
area	a space or surface	The quantitative measure of a plane or curved surface
root	the underground part of a plant	The quantity raised to the power 1/r
gross	offensive, disgusting	The total income from sales
operation	medical surgery	A math process, addition, multiplication…
domain	territory	The set of values assigned
degree	diploma	The sum of the exponents of the variables in an algebraic term
expression	a look indicating a feeling	A symbol representing a value
order	a command.	In algebra, the degree
power	the ability to do something, strength	the product obtained by multiplying a quantity by itself one or more times (3 diff meanings)

Odd	bizarre	leaving a remainder of 1 when divided by 2. Numbers such as 3, 5…
even	smooth, straight	a number divisible by two

b) Syntactic features of word problems

The arrangement of words in a sentence, or syntax, plays a major role in understanding phrases, clauses or sentences. Faulty syntax is especially detrimental in the reading, understanding, and solving of word problems in mathematics. Here is an example of an algebraic expression, which would cause problems if translated word for word:

The number "a" is 5 less than the number "b".

In the example, the syntactic mistake would be in reading the sentence word for word as it usually is logical to do so. Hence the student would undoubtedly write $a = 5 - b$

However, the sentence calls for the student to understand what? The correct answer would be

$a = b - 5$

c) Semantic features that may cause challenges for students.

Synonyms: add, plus, combine, sum

Homophones: sum, some; whole, hole

Difficult expressions: If…then, given that…

Prepositions (phrasal verbs): divided into vs. divided by, above, over, from, near, to, until, toward, beside

Comparative constructions: If Amy is taller than Peter, and Peter is taller than Scott, then Amy must be taller than Scott.

Passive structures: Five books were purchased by John.

Conditional clauses: Assuming X is true, then Y

Language function words: to give instructions, to explain, to make requests-What?

For each question of paper 1 and paper 2, November 2016 NSC examination, the terms are detailed below. After analysing the 2016 NSC mathematical literacy examination papers, the following terms were identified as some of the terms which may have created some challenges for learners in Paper 1:

i. Question 1: home loan statement, transaction history, administration fee, constant, difference, registered bond amount, fee payable, decreased, included, home loan, outstanding balance, decreases monthly, debit order, rectified the error, adjustment,

adjustment amount, reflected, debit, credit, interest rate, quotations, fixed rental cost, variable cost, maximum, and total profit.

ii. Question 2: convert, cylindrical, circumference, and most appropriate.

iii. Question 3: middle block, furthest, randomly choosing, most unlikely, predicted, screwed or unscrewed, to assemble, associated, and determine.

iv. Question 4: difference, highest, lowest, determine, identify, probability, randomly selecting, data, discrete data, and best attendance.

v. Question 5: purchasing power, average local price, simplified ratio, similar purchasing power, define, median, descending order, and mean price.

In Paper 2, the following terms were identified:

i. Question 1: installed, employees' wages, cash-withdrawal fee, probability, valid reason, not necessarily, lowest bank charges, withdrawal fee, verify, statement is valid, monthly wage, decrease, shipped globally, decrease, difference, and greater percentage decrease.

ii. Question 2: more appropriate, average amount, verify, 'tourism-related item', gross domestic product, remained constant, annual compound interest rate, total amount, modes of transport, departed, returned, train schedules, modal stopover time, average speed, excluding stopover, and return train trip.

iii. Question 3: maximum capacity, constant rate, verify, statement is valid, registered participants, mean attendance, interquartile range, probability, and randomly choosing.

iv. Question 4: participated, equivalent, approximate distance, rises steeply, maximum height, predator enclosure, will encounter, estimate, shortest distance, verify, most people, said with certainty, possible trends, states, and justify.

3.6 Data collection procedures

The master mark schedules for the 2016 Grade 12 examinations results from Moloto Circuit office were reviewed. The mathematical literacy and English scores, gender and corresponding schools (Given anonymous names from A to J) were recorded. Questionnaires (Appendices H & I) were distributed to the Grade 12 educators and Grade 12 learners of 2017, respectively. The questionnaires were completed, collected and results were tabulated for analysis.

3.6 Data presentation

The data from questionnaires was summarised and categorized into qualitative and quantitative data before analysis. Data was presented using tables, bar charts, scatter diagrams and text. Frequency tables were used to summarise data and to show trends in the data. Bar charts were used to clearly show trends in the data. Scatter diagrams were used to show relationships between the English marks and mathematical literacy marks. Some of the qualitative data was represented in terms of text; the actual words written by the respondent.

Quantitative data from the content analysis and questionnaires were summarised into tables and exported into SPSS by first defining the appropriate variables and measurement scales. Tables and graphs that were generated from the SPSS were used initially to describe the data, for example, frequency tables and descriptive statistics tables. The nominal variables were described in frequency tables while the scale variables were described in descriptive tables with mean, standard deviation, minimum and maximum and so on.

3.7 Data analysis

Regression and correlation analyses were used to determine the strength of and functional nature of relationships between predictor and response variables. Regression analysis techniques were used to establish the relationship between English language and mathematical literacy marks. This was achieved by calculating the correlation coefficient, determining the regression line and the coefficient of determination. SPSS package was used for this analysis. Microsoft Excel was also used in data analysis. Diagrams and regression equations were used where the relationship needed to be established between English language proficiency and mathematical literacy. Qualitative data was put into categories.

3.8 Issues of validity and reliability

The value and practicability of a study are determined by the quality of data collection and analysis employed. This is called validity and reliability, trustworthiness and dependability or legitimation and synchronic reliability in quantitative, qualitative and mixed methods research, respectively (Onwuegbuzie & Johnson, 2006). Barrett, Mayan, Olson and Spiers (2002) noted that validity and reliability were achieved by rigorously following a number of verification strategies during the research process. To ensure the quality of the results in this mixed methods case study, key validity and reliability, credibility and dependability, as well as legitimation and synchronic reliability issues were all incorporated into the research design.

3.9 Quantitative validation procedures

3.9.1 Validity

Validity is a quantitative concept that is widely used in a number of ways in research and it has numerous viewpoints. Kirkhart (2005: 30) defines validity as “an overall judgement of the adequacy and appropriateness of evaluation-based inferences and actions and their respective consequences”. In this study, validity was understood as a concept that measures the degree to which the collected evidence supports the interpretation of the data. In other words, validity was equated to the soundness of the researcher’s inferences from the evidence that was gathered during the investigation.

It is generally agreed that the discussion of potential threats to a study enhances the quality of the study (Viswanath, Sue, & Hillol, 2013). Discussion of potential threats provides readers with adequate information upon which to judge the quality of inferences that were drawn from this study. Potential threats to this study were selection bias and attrition or experimental mortality. Selection bias was minimised by using the entire population for both the quantitative and qualitative phases. Threats arising from non-submission or late submission of the questionnaire were foreseen and this may have led to the skewness of final sample from which information was used to draw up inferences. As a precaution to minimise the effects of experimental mortality, follow-up reminders and promises of anonymity were done to improve the response rate of the questionnaires.

3.9.2 Reliability

Reliability is also an important measure in quantitative research which is concerned with the consistency of an instrument or data collection in a study. This means reliability is concerned with the consistency of one’s research design to yield similar results when it is used by other researchers. In this study, the reliability of the questionnaires was enhanced by using questionnaires that had been assessed by a team of experts and piloted before it was used. Reliability in the questionnaires was enhanced by asking similar questions not asked in the same way to determine whether the student will give the same response to similar questions. Validity in the questionnaires was enhanced by testing whether the questionnaires were addressing the problem at hand. Questionnaires were field tested to check whether the responses were as expected.

3.9.3 Qualitative validation procedures

One of the main focuses of any research is to authentically capture the experiences of the participants and present them in a manner that shows that the researcher has clearly understood the phenomenon under study. Teddlie and Tashakkori (2009) proposed two questions to be considered in assessing the validity of the qualitative phase:

i. Am I truly measuring/recording/capturing what I intend to, rather than something else?
ii. Assuming that I am measuring/capturing what I intend to, is my measurement/recording consistent and accurate (i.e., yield little error)?

3.9.3.1 Credibility

The first question relates to the research credibility and the second relates to the research dependability. Credibility refers to the match between the participants' experience of reality and how it was presented to the readers as a true and accurate account of the phenomenon (Paul & Jeanne, 2014). Credibility in this study was satisfied by staying in the field for some time and including rich and thick accounts of the participant's experiences for readers to draw their own conclusions.

3.9.3.2 Transferability

In addition to ensuring the credibility of the findings, the researcher considered the transferability of the research findings. Transferability of results from a qualitative phase in a study is not advisable because the sample that is selected may not be representative of another sample in a different population (Johnson & Onwuegbuzie, 2004: 20). However, in this study, the transferability of results was accomplished by presenting the findings in such a manner that allowed readers to assess their applicability to other contexts. This was achieved by providing thick descriptions of the settings under which the study was conducted.

3.9.3.3 Dependability

Like quantitative research, qualitative research also has its own unique measure of obtaining consistent findings under the same or similar contexts. Reliability in qualitative research deals with dependability, consistency or replicability of the research findings (Nunan, 1999: 14). For dependability to be achieved, the researcher gave a detailed account of how the study was done. A conformability audit was conducted in conjunction with the dependability audit. The former addressed both the conformability and dependability of this study. Furthermore, peers were requested to review the field notes and interview transcripts to determine whether the conclusions were supported by the data.

3.10 Ethical considerations

Ethical considerations dealt mainly with issues of morality in the research. Creswell and Planoclark (2011) and Patton (2015) state that ethics in research explain the working relationship among researcher, participants or respondents, and the community at large. Leedy and Ormrod (2014: 106) identified four main categories related to ethical issues, namely: "protection from harm, voluntary and informed participation, right to privacy, and honesty with professional colleagues". Some of these categories were factored into this study as explained below.

3.10.1.1 Ethical clearance

Prior to the commencement of the study, the researcher requested for permission to conduct the study from the Limpopo Department of Basic Education and Moloto Circuit office (Appendix A). A further written request was also sought from the principals of all schools and mathematical literacy educators (Appendices B & C). The researcher also applied for ethical clearance from the UNISA Research Ethics Committee to proceed with the study. Approval of the study was granted after analysing the researcher's proposal including ethical considerations and the rights of the participants during data collection, analysis, and interpretation.

3.10.1.2 Informed consent

Participants were made aware of the researcher's intention to conduct this study and how the data would be used in the investigation of language as a factor influencing teaching and learning of mathematical literacy. At all the research sites, time was taken to explain verbally and in writing (Appendix D), the researcher's aim and objectives, why the information was being sought, how the respondents were required to participate during the study, and how the study directly or indirectly affected them. In addition, participants were informed of how data would be collected, utilised and the rationale for their use. All these activities were conducted so that the participants could freely decide to participate in the study or not, as suggested by Teddlie and Tashakkori, (2009).

During the briefing sessions before data collection, participants were also informed of their right to decline to participate in the study or to withdraw from the study at any point without being ridiculed or penalised. Thereafter, participants were requested to sign a consent form (Appendices E & F) in which they acknowledged that they were fully aware of what it meant to be part of the study and that they had voluntarily accepted the invitation to participate without being pressurised before they could participate in the study. Participants were assured that there were no anticipated risks associated with their participation in the study. No rewards (in cash or in kind) were promised or given to any of the participants.

The researcher also obtained parental consent for all learners in the study since they were minors. Therefore, both guardian and learner were required to sign consent forms as proof that the learner voluntarily accepted to participate in the study. Similarly, principals and teachers were also required to sign consent forms.

3.10.2 Anonymity and confidentiality of participants

The researcher took steps to protect the anonymity and confidentiality of the participants. This was achieved by requesting the participants not to write their names on the questionnaires and not using names of the learners from results sheets collected from the Circuit Office. Upon receiving a questionnaire, the researcher assigned codes for easy capturing of details and analysis and also to make it impossible to track their source. Furthermore, to ensure confidentiality, all documents from the Circuit office as well as data collected from participants were stored in a place that was accessible to the researcher only. In addition to protecting the confidentiality of the participants, the researcher also sought to protect the privacy of the participants by not revealing their names.

3.11 Conclusion

The research adopted mixed methods approach where quantitative and qualitative methods were integrated. A descriptive survey and a correlation design were adopted. The target population was Grade 12 learners of Moloto Circuit. A census of 2016 and 2017 Grade 12 learners of Moloto Circuit was studied including their 10 educators, one from each school. The instruments used were tests and questionnaires. Data was to be represented using tables, bar charts, and graphs. The chapter concluded with a discussion of the ethical considerations made in this study. In the next chapter, the results of the study are presented and analysed.

CHAPTER 4

PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

4.1 Introduction

The focus of this chapter was to present, analyse, and interpret the data in relation to literature that was reviewed in Chapter 2. A detailed analysis of data was made to determine the relationship between English language and Mathematical literacy in ten schools. The chapter also examined the view of learners in the use of their mother language in teaching and learning of Mathematical literacy. Furthermore, the views of Mathematical literacy educators about the use of English language as the medium of instruction were analysed and discussed. The results of study were presented and analysed guided by the research questions.

4.2 Research question 1: What is the relationship between the scores in English and Mathematical literacy?

4.2.1 Relationship between English language and Mathematics literacy scores in School A

There was a positive relationship between performance in English language and mathematics literacy as shown by the positive trend in the diagram (Figure 4.1). The coefficient of x in the regression $y = 0.5365x + 12.98$ shows that a unit increase in performance in English causes a 0.5365 increase in performance in Mathematical literacy. The regression line $y = 0.5365x+12.98$ has a positive gradient signifying positive relationship between the two variables. Results of regression analysis also confirmed that there was a significant relationship between English language and Mathematical literacy ($P = 0.002$, Table 4.1). Based on these results, it can be suggested that English (independent variable) had a positive influence on Mathematical literacy (dependent variable) among the learners of School A. This agrees with the findings from Wilson and Komba (2012) who also observed a positive relationship between English language proficiency and students' academic achievement.

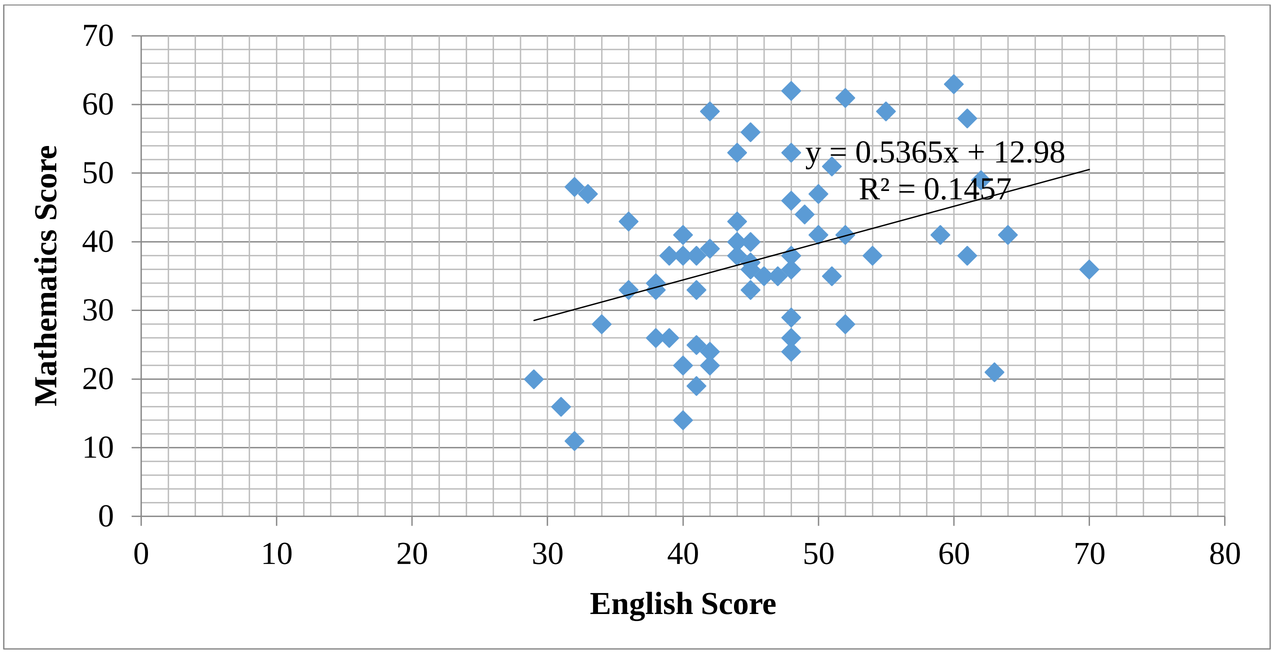

Figure 0.1: Relationship between performance in English language and Mathematics literacy in School A, Moloto Circuit, South Africa

Table 0.1: Results of regression analysis for the relationship between English language and Mathematical literacy for school A, Moloto Circuit, Limpopo Province, South Africa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1345.182	1	1345.182	10.229	.002[b]
	Residual	7890.060	60	131.501		
	Total	9235.242	61			

a. Dependent Variable: Maths

b. Predictors: (Constant), English

There was a significant positive correlation between English language and Mathematical literacy ($P = 0.002$, Table 4.2). The results showed that the mean performance by the learners was higher in English language than in Mathematics literacy (45.82 and 37.56, respectively, Table 4.3).

Table 0.2: Correlation between English language and Mathematics literacy among learners at School A in Moloto Circuit, Limpopo Province, South Africa

		English	Maths
English	Pearson Correlation	1	.382**
	Sig. (2-tailed)		.002
	N	62	62
Maths	Pearson Correlation	.382**	1
	Sig. (2-tailed)	.002	
	N	62	62

**. Correlation is significant at the 0.01 level (2-tailed).

Table 0.3 Mean performance of English language and Mathematics literacy among learners at School A in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Maths	37.56	12.304	62
English	45.82	8.753	62

In this study, 14.6% of the variation in performance in Mathematics literacy performance at School A was explained by changes in the performance in English (Table 4.4). This means that at this study site, English was contributing only 14.6% to the performance in Mathematical literacy. These results further suggest that there could be other factors like home background, teaching methods and so on that might affect the performance in Mathematical literacy. However, the impact of these other factors on Mathematical literacy was beyond the scope of this study.

Table 0.4 Model Summary for School A, Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.382[a]	.146	.131	11.467	.146	10.229	1	60	.002

a. Predictors: (Constant), English

4.2.2 The Relationship between English language and Mathematics literacy scores at School B

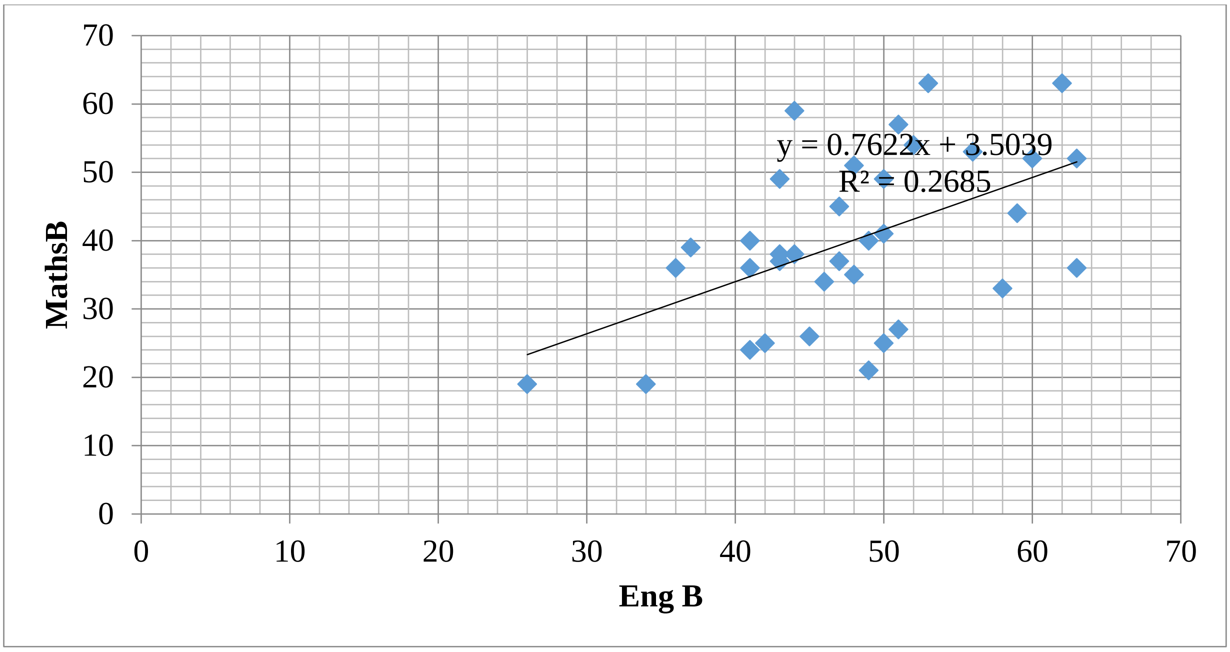

Figure 0.2: Relationship between performance in English language and Mathematics literacy at School B, Moloto Circuit, Limpopo Province, South Africa

At School B, the results showed that there was a positive relationship between performance in English language and Mathematical literacy (Figure 4.2). The coefficient of x in the regression equation y = 0.7622x + 3.039 shows that a unit increase in performance in English causes a 0.7622 increase in performance in mathematics literacy. The ANOVA also showed a significant relationship between English language and Mathematical literacy (P=0.001, Table 4.5). It can be suggested that at School B, English language is a predictor of Mathematical literacy. Furthermore, based on these results, it can be argued that English (independent variable) had a positive influence on Mathematical literacy (dependent variable) at School B in Moloto Circuit.

Table 0.5: Relationship between performance in English language and Mathematics literacy in School B, Moloto Circuit, South Africa

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	1391.980	1	1391.980	12.111	.001[b]
1	Residual	3792.762	33	114.932		
	Total	5184.743	34			

a. Dependent Variable: Maths B

b. Predictors: (Constant), Eng B

Table 0.6: Mean performance of English language and Mathematics literacy among learners at School B in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Eng B	47.77	8.39498	35
Maths B	39.91	12.34878	35

Mean performance of learners for the two subjects was higher in English language than Mathematical literacy (47.77 and 39.91, respectively; Table 4.6). A higher standard deviation in mathematics indicates a higher spread in performance in Mathematical literacy than in English.

Table 0.7: Correlation between English language and Mathematics literacy among learners at School B in Moloto Circuit, Limpopo Province, South Africa

		Eng B	Maths B
Eng B	Pearson Correlation	1	.518**
	Sig. (2-tailed)		.001
	N	35	35
Maths B	Pearson Correlation	.518**	1
	Sig. (2-tailed)	.001	
	N	35	35

**. Correlation is significant at the 0.01 level (2-tailed).

There was a significant positive correlation (0.518, P=0.001) between the two subjects (Table 4.7) at School B. The results showed that at School B in Moloto Circuit, 26.8% of the variation in Mathematical literacy performance was explained by changes in the learners' performance in English language (Table 4.8).

Table 0.8: Model Summary for School B, Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.518[a]	.268	.246	10.72064	.268	12.111	1	33	.001

a. Predictors: (Constant), Eng B

4.2.3 The Relationship between English language and Mathematics literacy scores at School C

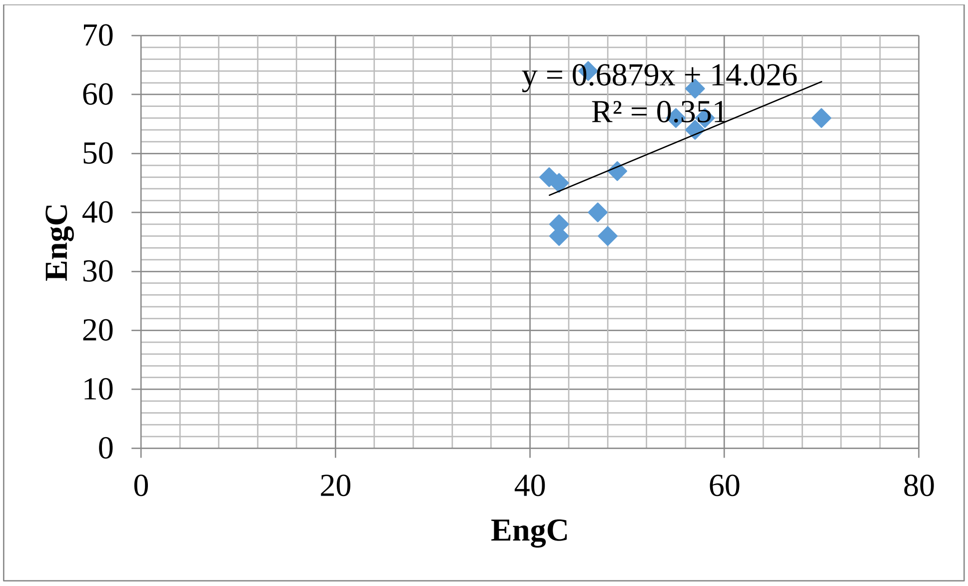

Figure 0.3: Relationship between performance in English language and Mathematics literacy at School C, Moloto Circuit, Limpopo Province, South Africa

There was a significant positive relationship between performance in English language and mathematical literacy (Figure 4.3, Table 4.9, P=0.033). The coefficient of x in the regression equation $y = 0.6879x + 14.026$ shows that a unit increase in performance in English causes a 0.6879 increase in performance in mathematical literacy. The regression has a positive gradient emphasising the positive relationship. Based on these results, it can be argued that English (independent variable) has a positive influence on Mathematical literacy (dependent variable). Moreover, it can be suggested that, similar to Schools A and B, English was also a predictor of Mathematical literacy at school C.

Table 0.9: Relationship between performance in English language and Mathematics literacy in School C, Moloto Circuit, Limpopo Province, South Africa

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	389.535	1	389.535	5.950	.033[b]
Residual	720.157	11	65.469		
Total	1109.692	12			

Table 0.10: Mean performance of English language and Mathematics literacy among learners at School C in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Eng C	50.62	8.28189	13
Maths C	48.85	9.61636	13

Mean performance in the two subjects is higher in English language than in Mathematical literacy (Table 4.10). A higher standard deviation in mathematical literacy also There was a higher spread in performance in Mathematical literacy (standard deviation = 9.62) than in English (standard deviation = 8.28). There was a significant positive correlation between performances in the two subjects (Pearson's correlation = 0.592, P=0.033, Table 4.11).

Table 0.1: Correlation between English language and Mathematics literacy among learners at School C in Moloto Circuit, Limpopo Province, South Africa

		Eng C	Maths C
Eng C	Pearson Correlation	1	.592*
	Sig. (2-tailed)		.033
	N	13	13
Maths C	Pearson Correlation	.592*	1
	Sig. (2-tailed)	.033	
	N	13	13

*. Correlation is significant at the 0.05 level (2-tailed).

Table 0.2 Table 0.8: Model Summary for School C, Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
	.592[a]	.351	.292	8.09128	.351	5.950	1	11	.033

a. Predictors: (Constant), Eng C

The results for School C revealed that English contributed 35.1% to the performance in Mathematical literacy (Table 4.12). These results imply that English language proficiency contributes more than one third towards learners' overall performance in Mathematical literacy while all other factors contribute the remaining two-thirds.

4.2.4 Relationship between English language and Mathematics literacy scores at School D

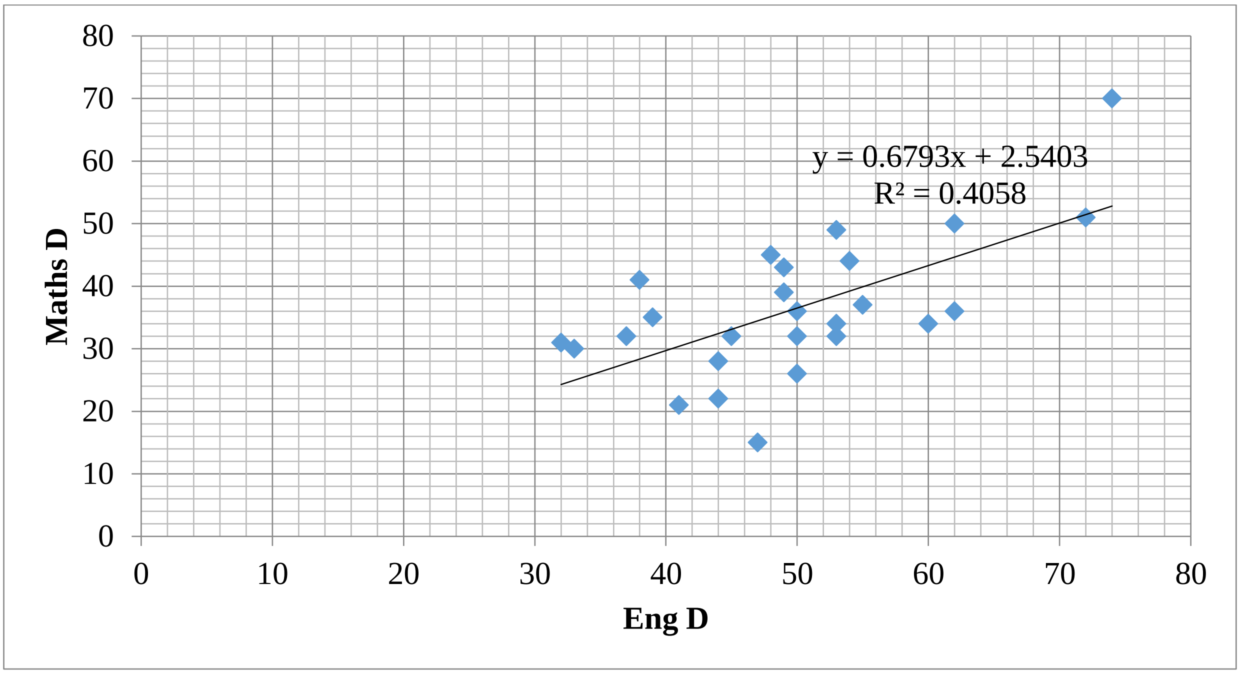

Figure 0.4: Relationship between performance in English language and Mathematics literacy at School D, Moloto Circuit, Limpopo Province, South Africa

There is a significant positive relationship between performance in English language and mathematics literacy (Figure 4.4, Table 4.13, P=0.000). The coefficient of x in the regression equation $y = 0.6793x + 2.5403$ shows that a unit increase in performance in English causes a 0.6793 increase in performance in mathematical literacy. There is evidence from these results that English language proficiency has a positive influence on Mathematical literacy and is a predictor of Mathematical literacy.

Table 0.3: Relationship between performance in English language and Mathematics literacy in School D, Moloto Circuit, Limpopo Province, South Africa

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1270.932	1	1270.932	16.391	.000[b]
Residual	1860.953	24	77.540		
Total	3131.885	25			

a. Dependent Variable: Maths D

b. Predictors: (Constant), Eng D

Table 0.4: Mean performance of English language and Mathematics literacy among learners at School D in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Maths D	36.35	11.19265	26
Eng D	49.77	10.49689	26

Similar the Schools A-C, learners' at School D performed in English than in Mathematical literacy (49.77 and 36.35, respectively, Table 4.14). There was a higher standard deviation in Mathematical literacy than in English language, indicating a higher spread in performance in the former that the latter. There was a significant strong positive correlation (P=0.000, Pearson's correlation = 0.637) between performances in English language and in Mathematical literacy (Table 4.15).

Table 0.5 Correlation between English language and Mathematics literacy among learners at School D in Moloto Circuit, Limpopo Province, South Africa

		Maths D	Eng D
Pearson Correlation	Maths D	1.000	.637
	Eng D	.637	1.000
Sig. (1-tailed)	Maths D	.	.000
	Eng D	.000	.
N	Maths D	26	26
	Eng D	26	26

Table 0.6: Model Summary for School D, Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.637[a]	.406	.381	8.80566	.406	16.391	1	24	.000

a. Predictors: (Constant), Eng D

The coefficient of determination of 0.406 = 40.6% shows that 40.6% of the variation in performance in mathematical literacy is explained by changes in the performance in English language (Table 4.16). This means that English contribution to the performance in Mathematical literacy is about 40.6% with the other contributory factors coming from other variables.

4.2.5 Relationship between English language and Mathematics literacy scores at School E

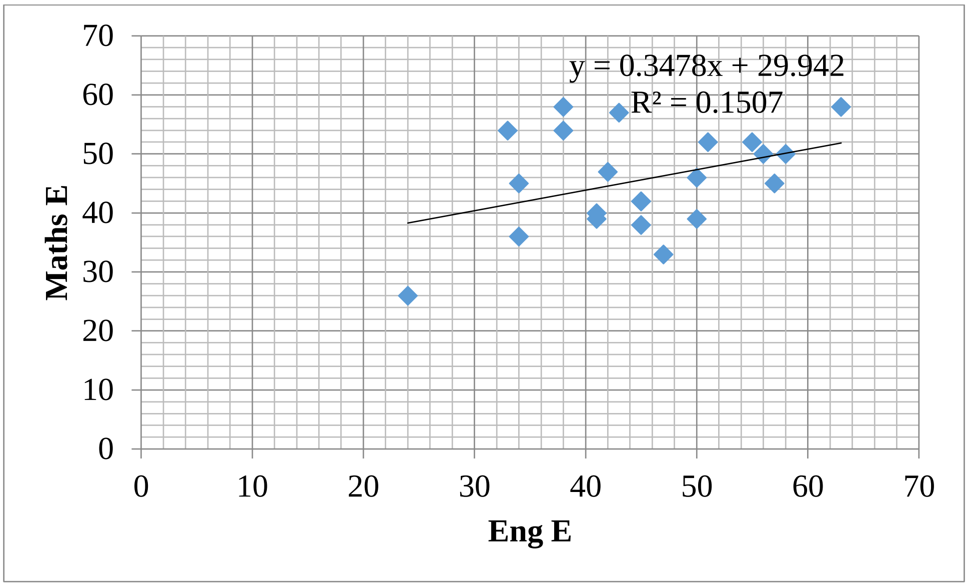

Figure 0.5: Relationship between performance in English language and Mathematics literacy at School E, Moloto Circuit, Limpopo Province, South Africa.

The scatter plot shows that there is a positive relationship between performance in English language and mathematical literacy (Figure 4.5). The coefficient of x in the regression equation y = 0.3478x + 29.942 shows that a unit increase in performance in English causes a 0.3478 increase in performance in Mathematical literacy. The regression line has a positive gradient symbolising a positive relationship between the two variables. However, the regression coefficient was only significant at the 10% level of significance (Table 4.17, P=0.074).

Table 0.17: Relationship between performance in English language and Mathematics literacy in School D, Moloto Circuit, Limpopo Province, South Africa

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	231.955	1	231.955	3.548	.074[b]
1	Residual	1307.364	20	65.368		
	Total	1539.318	21			

a. Dependent Variable: Maths E

b. Predictors: (Constant), Eng E

Table 0.7: Mean performance of English language and Mathematics literacy among learners at School E in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Math E	45.59	8.56159	22
Eng E	45.00	9.55685	22

In School E, the trends in the descriptive statistics are different from those in previously discussed schools. The mean mark for Mathematical literacy is slightly higher than in English language. The standard deviation for English is slightly higher meaning that the Mathematical literacy indicating a higher spread of performance in English.

Table 0.89: Correlation between English language and Mathematics literacy among learners at School E in Moloto Circuit, Limpopo Province, South Africa

		Maths E	Eng E
Pearson Correlation	Maths E	1.000	.388
	Eng E	.388	1.000
Sig. (1-tailed)	Maths E	.	.037
	Eng E	.037	.
N	Maths E	22	22
	Eng E	22	22

As shown in Table 4.19 there was a significant positive correlation (P = 0.037, R = 0.388) between performances in the two subjects. Meanwhile, the results showed that 15.1% of the variation in performance in Mathematical literacy at School E was explained by changes in the performance in English (Table 4.20) while all other factors contributed 44.9%.

Table 0.9: Model Summary for School E, Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
	.388 a	.151	.108	8.08506	.151	3.548	1	20	.074

a. Predictors: (Constant), Eng E

4.2.6 Relationship between English language and Mathematics literacy scores at School F

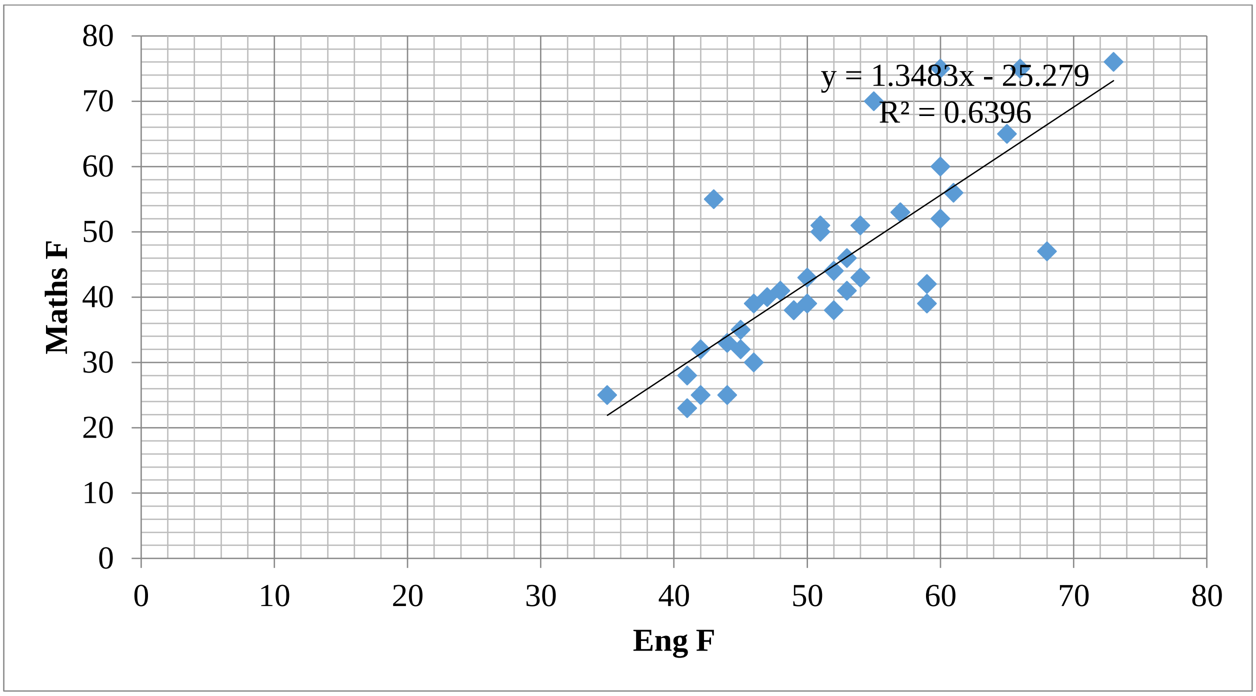

Figure 0.6: Relationship between performance in English language and Mathematics literacy at School F, Moloto Circuit, Limpopo Province, South Africa

The scatter plot shows that there was a positive relationship between performance in English language and mathematics literacy at School F (Figure 4.6). The coefficient of x in the regression equation y = 1.3483x - 25.279 shows that a unit increase in performance in English causes a 1.3483 increase in performance in mathematical literacy. The regression line has a positive gradient emphasizing the positive relationship. There is also evidence from the results of this study that English language is a high predictor of Mathematical literacy results as shown by a strongly significant regression coefficient is (P = 0.000, Table 4.21). This means that if we know the score obtained in English by a learner we can find a very approximate score obtained in Mathematical literacy by calculation using the regression equation. The learners' mean mark for Mathematics literacy was lower than that for English language (44.80 and 51.98, respectively, Table 4.22).

Table 0.10: Relationship between performance in English language and Mathematics literacy in School F, Moloto Circuit, Limpopo Province, South Africa

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	4873.891	1	4873.891	67.434	.000[b]
Residual	2746.509	38	72.277		
Total	7620.400	39			

a. Dependent Variable: Maths F

b. Predictors: (Constant), Eng F

Table 0.11 Mean performance of English language and Mathematics literacy among learners at School E in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Maths F	44.80	13.97837	40
Eng F	51.980	8.29114	40

Table 0.12: Correlation between English language and Mathematics literacy among learners at School F in Moloto Circuit, Limpopo Province, South Africa

		Maths F	Eng F
Pearson Correlation	Maths F	1.000	.800
	Eng F	.800	1.000
Sig. (1-tailed)	Maths F	.	.000
	Eng F	.000	.
N	Maths F	40	40
	Eng F	40	40

There was a significant positive correlation (P = 0.000) between performances in the two subjects (Table 4.23). The correlation coefficient between performance in English and Mathematical literacy was also high (0,800), indicating that the English scores at School F were greatly related to the Mathematical literacy scores. The results of this study show that changes in the performance in English influenced 64.0% of the variation in performance in Mathematical literacy (Table 4.24). This means that English language contributed more than half to the performance in Mathematical literacy at School F. This is also explained by the high positive correlation of 0.80 between English and Mathematical literacy as seen above.

Table 0.13: Model Summary for School F, Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
	.800[a]	.640	.630	8.50156	.640	67.434	1	38	.000

a. Predictors: (Constant), Eng F

4.2.7 Relationship between English language and Mathematics literacy scores at School E

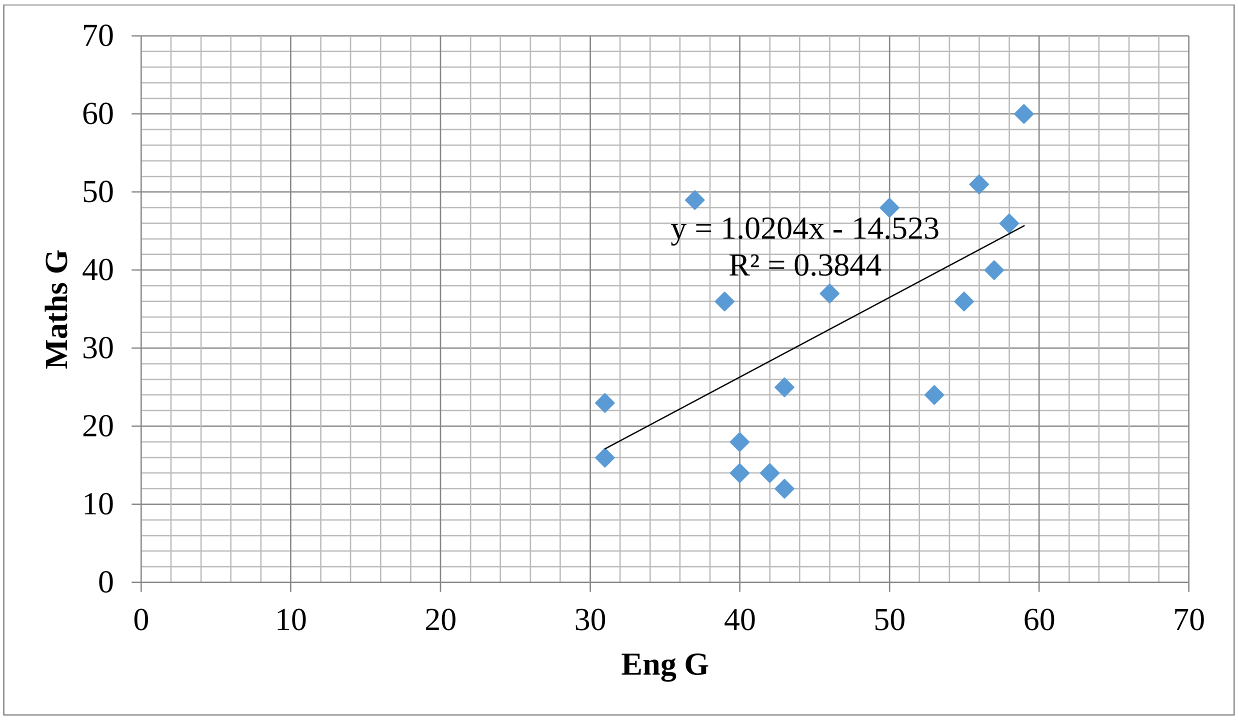

Figure 0.7: Relationship between performance in English language and Mathematics literacy at School G, Moloto Circuit, Limpopo Province, South Africa

The scatter plot shows that there is a positive relationship between performance in English language and mathematical literacy (Figure 4.7). The coefficient of x in the regression equation $y = 1.0204x - 14.523$ shows that a unit increase in performance in English causes a 1.0204 increase in performance in mathematics literacy. The regression line has a positive gradient emphasizing the positive relationship. There was also a significant regression coefficient ($P = 0.008$, Table 4.25), indicating that English language was a predictor of Mathematical literacy at School G. As such, Mathematical literacy scores for learners at this school can be estimated from English language scores using the regression equation.

Table 0.14: Relationship between performance in English language and Mathematics literacy in School G, Moloto Circuit, South Africa

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1421.979	1	1421.979	9.365	.008[b]
Residual	2277.551	15	151.837		
Total	3699.529	16			

a. Dependent Variable: Maths G, b. Predictors: (Constant), Eng G

Table 0.15: Mean performance of English language and Mathematics literacy among learners at School G in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Maths G	32.29	15.20594	17
Eng G	45.88	9.23906	17

The descriptive statistics show that the mean performance in the two subjects was higher in English language than in Mathematical literacy (Table 4.26). A higher standard deviation in Mathematical literacy (15.21) also indicates a higher spread in performance in Mathematical literacy than in English language (9.24). This shows that there was more variation in Mathematical literacy than in English language performance.

Table 0.16; Correlation between English language and Mathematics literacy among learners at School G in Moloto Circuit, Limpopo Province, South Africa

		Maths G	Eng G
Pearson Correlation	Maths G	1.000	.620
	Eng G	.620	1.000
Sig. (1-tailed)	Maths G	.	.004
	Eng G	.004	.
N	Maths G	17	17
	Eng G	17	17

There was a significant positive correlation (P = 0.04, R = 0.620) between performances in the two subjects (Table 4.27). This is positive and significant at a p-value of 0.04. Results of this study also showed that 32.8% of the variation in performance in Mathematical literacy was explained by changes in the performance in English (Table 4.28).

Table 0.17: Model Summary for School G, Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
	.620[a]	.384	.343	12.32220	.384	9.365	1	15	.008

a. Predictors: (Constant), Eng G

4.2.8 Relationship between English language and Mathematics literacy scores at School H

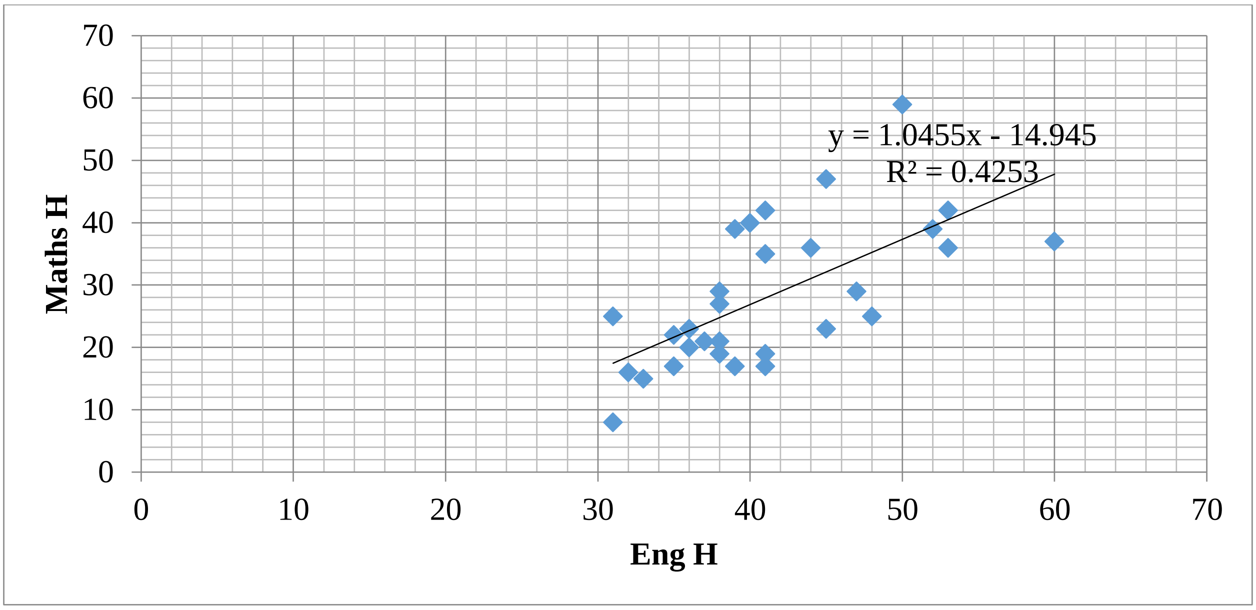

Figure 0.8: Relationship between performance in English language and Mathematics literacy at School H, Moloto Circuit, Limpopo Province, South Africa

The scatter plot shows that there is a positive relationship between performance in English language and mathematics literacy (Figure 4.8) at School H. The coefficient of x in the regression equation $y = 1.0455x - 14.945$ shows that a unit increase in performance in English causes a 1.0455 increase in performance in Mathematical literacy. The regression line has a positive gradient emphasising the positive relationship. There was evidence of a strongly significant relationship between English language and Mathematics literacy ($P = 0.000$, Table 4.29). I can therefore, be suggested that English language was a predictor of Mathematical literacy at School H. This means that, using the regression equation, Mathematical literacy scores for learners at this school can be calculated from English language scores.

Table 0.29: Relationship between performance in English language and Mathematics literacy in School H, Moloto Circuit, South Africa

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	1643.418	1	1643.418	20.721	.000[b]
	Residual	2220.749	28	79.312		
	Total	3864.167	29			

a. Dependent Variable: Maths H b. Predictors: (Constant), Eng H

Table 0.30: Mean performance of English language and Mathematics literacy among learners at School H in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Maths H	28.17	11.54327	30
Eng H	41.23	7.20002	30

The descriptive statistics show that the mean performance was higher in English language than in Mathematical literacy (Table 4.30). Higher standard deviation and coefficient of variation values in Mathematical literacy (Std. deviation = 11.54, CV = 41%) indicated a more variation and inconsistent performance in Mathematical literacy than in English language (Std. deviation = 7.20, CV = 17.5%).

Table 0.18: Correlation between English language and Mathematics literacy among learners at School H in Moloto Circuit, Limpopo Province, South Africa

		Maths H	Eng H
Pearson Correlation	Maths H	1.000	.652
	Eng H	.652	1.000
Sig. (1-tailed)	Maths H	.	.000
	Eng H	.000	.
N	Maths H	30	30
	Eng H	30	30

A strongly significant positive correlation (P = 0.000, R = 0.652) between performances in the two subjects at School H was observed (Table 4.31). At this school, it was also found that English language contributed about 42.5% to the performance in Mathematical literacy (Table 4.32).

Table 0.192: Model Summary for School H, Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.652[a]	.425	.405	8.90575	.425	20.721	1	28	.000

a. Predictors: (Constant), Eng H

4.2.9 Relationship between English language and Mathematics literacy scores at School I

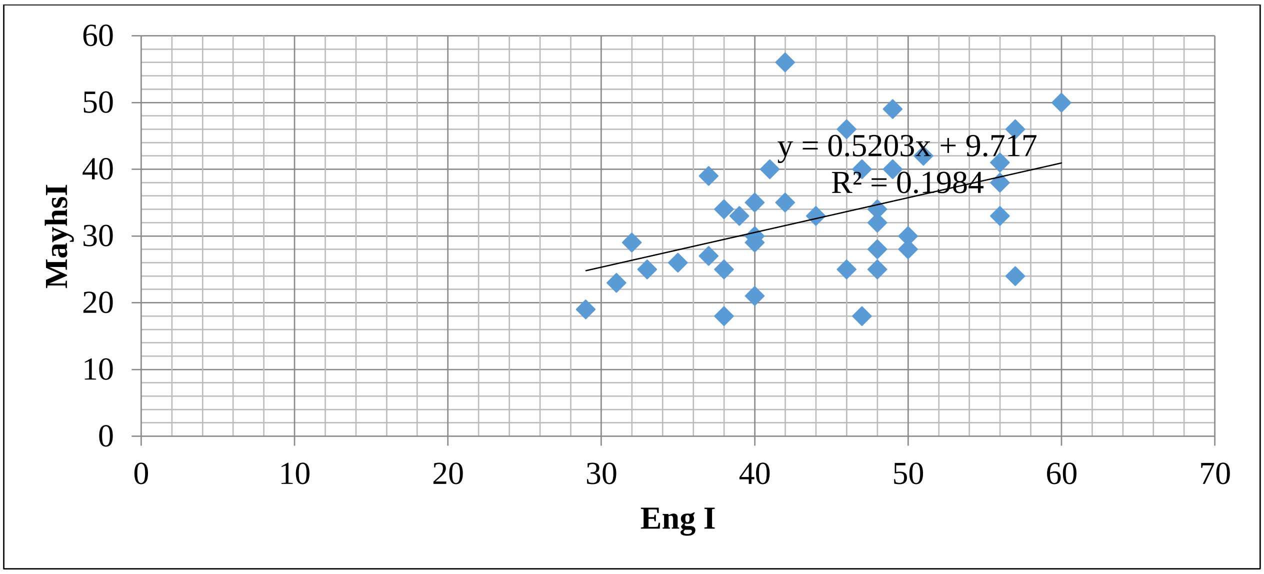

Figure 0.9: Relationship between performance in English language and Mathematics literacy at School I, Moloto Circuit, Limpopo Province, South Africa

The scatter plot shows that there was a positive relationship between performance in English language and Mathematical literacy (Figure 4.9). The coefficient of x in the regression equation y = 0.5203x + 9.7175 shows that a unit increase in performance in English causes a 0.5203 increase in performance in Mathematical literacy. The regression line has a positive gradient emphasising the positive relationship. These results were confirmed by a significant regression coefficient that was observed (Table 4.33, P = 0.005). There is evidence from this study suggesting that English language was a predictor of Mathematical literacy. This implies that at School I, Mathematical literacy scores for the learners can be predicted from their English language scores.

Table 0.20: Relationship between performance in English language and Mathematics literacy in School I, Moloto Circuit, Limpopo Province, South Africa

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	632.064	1	632.064	8.908	.005[b]
Residual	2554.252	36	70.951		
Total	3186.316	37			

a. Dependent Variable: Maths I

b. Predictors: (Constant), Eng I

Table 0.21: Mean performance of English language and Mathematics literacy among learners at School I in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Maths I	32.79	9.27991	38
Eng I	44.34	7.94330	38

The descriptive statistics show that the mean performance in the two subjects is higher in English than in Mathematical literacy (44.34 and 32.79, respectively, Table 4.34). Variation in performance was higher and inconsistent Mathematical literacy (Std. deviation = 9.28, CV = 28.3%) relative English language (Std. deviation = 7.94, CV = 17.9%).

Table 0.22: Correlation between English language and Mathematics literacy among learners at School H in Moloto Circuit, Limpopo Province, South Africa

		Maths I	Eng I
Pearson Correlation	Maths I	1.000	.445
	Eng I	.445	1.000
Sig. (1-tailed)	Maths I	.	.003
	Eng I	.003	.
N	Maths I	38	38
	Eng I	38	38

The between English language and Mathematics literacy at School I was positive and significant (P = 0.003, R = 0.445, Table 4.35). Moreover, if was observed that at this school, English language contributed 19.8% to the performance in Mathematical literacy. It therefore follows that that there other factors such as home background and environment, though not measured in this study, had a larger influence on learners' performance in Mathematical literacy at School I.

Table 0.23: Model Summary for School I, Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
	.445[a]	.198	.176	8.42327	.198	8.908	1	36	.005

a. Predictors: (Constant), Eng I

4.2.10 Relationship between English language and Mathematics literacy scores at School J

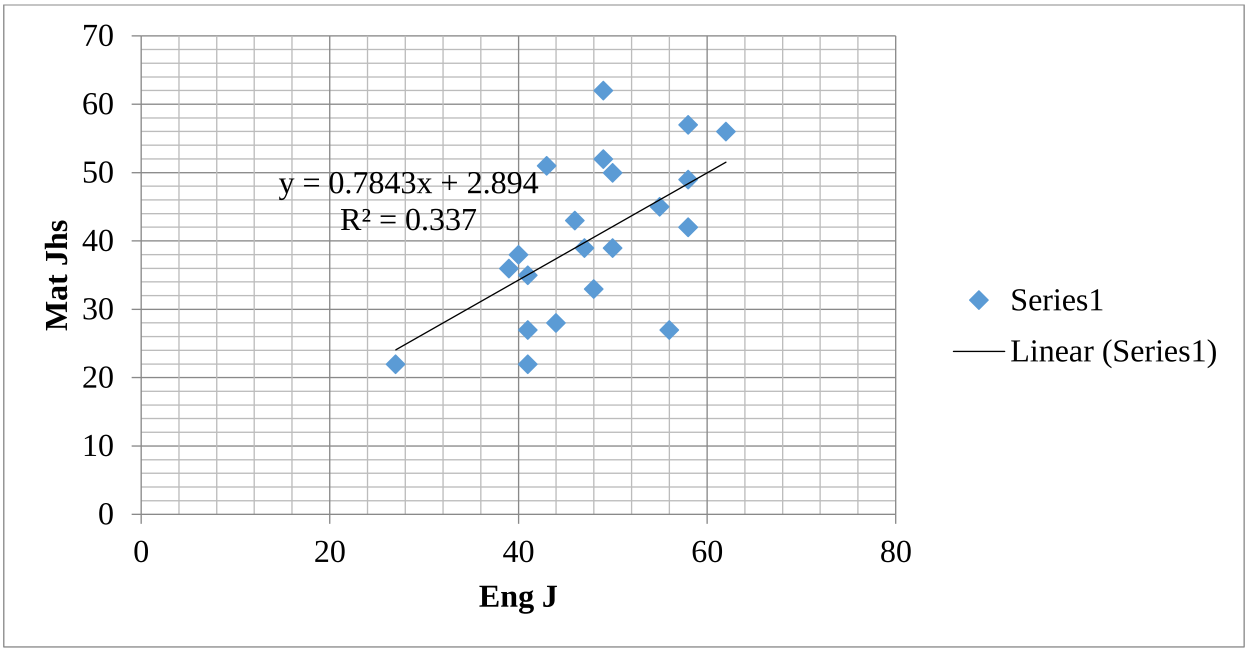

Figure 0.10: Relationship between performance in English language and Mathematics literacy at School J, Moloto Circuit, Limpopo Province, South Africa

The scatter plot shows that there is a positive relationship between performance in English language and Mathematical literacy (Figure 4.10). The coefficient of x in the regression equation y = 0.7843x + 2.894 shows that a unit increase in performance in English causes a 0.7843 increase in performance in Mathematical literacy. The regression line y = 0.7843x + 2.894 has a positive gradient emphasizing the positive relationship. There was a also a significant regression coefficient (P = 0.005, Table 4.37). Based on these results, it can be suggested that English language had a positive influence and was therefore a predictor of Mathematical literacy performance at School J.

Table 0.247: Relationship between performance in English language and Mathematics literacy in School J, Moloto Circuit, Limpopo Province, South Africa

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	920.952	1	920.952	10.166	.005[b]
Residual	1811.821	20	90.591		
Total	2732.773	21			

a. Dependent Variable: Maths J

b. Predictors: (Constant), Eng J

Table 0.258: Mean performance of English language and Mathematics literacy among learners at School I in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Maths J	40.68	11.40754	22
Eng J	48.18	8.44386	22

The descriptive statistics show that mean performance of learner at School J was higher in English language than in Mathematical literacy (Table 4.38). There was higher spread and inconsistency in Mathematical literacy than relative to English language performance. This is shown by higher standard deviation and coefficient of variation in Mathematical literacy (11.41 and 28.0%, respectively) compared to English language (8.44 and 17.5%) (Results showed that English language contributed 33.7% to the learners' performance in Mathematical literacy at School J.

Table 0.26 Model summary for School J, Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
	.581[a]	.337	.304	9.51793	.337	10.166	1	20	.005

a. Predictors: (Constant), Eng J

4.3 Relationship between performance in English language and mathematical literacy in the ten schools combined

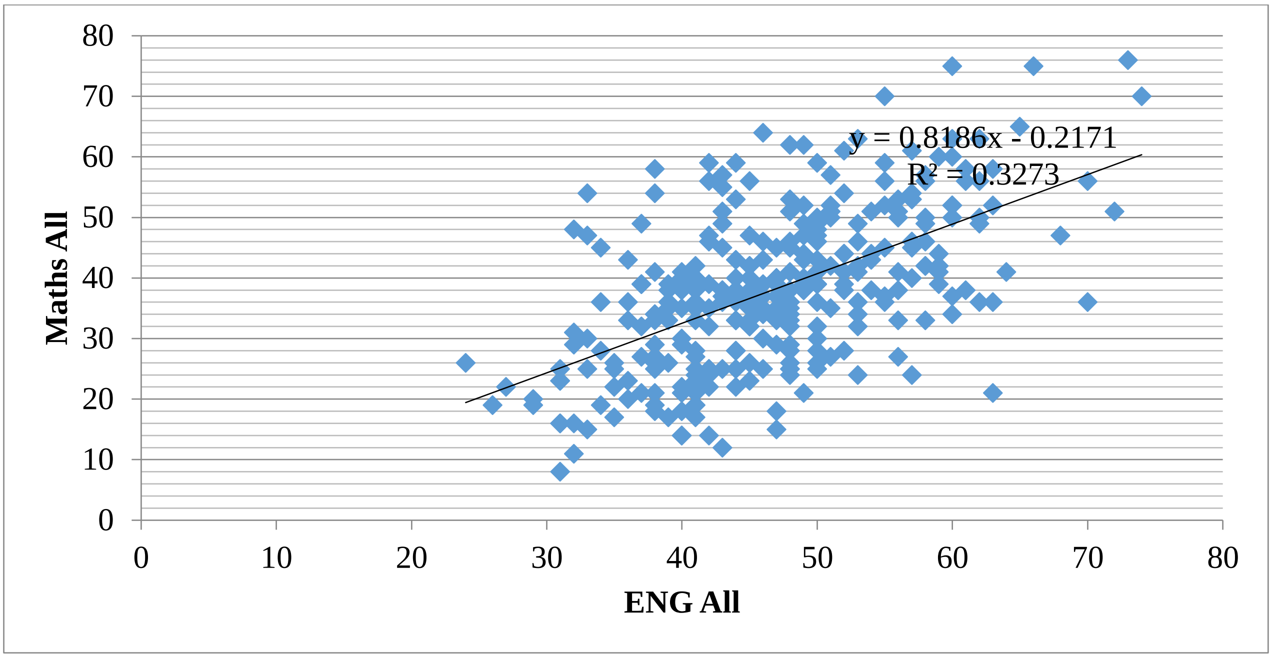

Figure 0.11: Relationship between performance in English language and Mathematics literacy at ten schools in Moloto Circuit, Limpopo Province, South Africa

The composite profile scatter plot shows that there was a positive relationship between performance in English language and mathematical literacy. The coefficient of x in the regression equation $y = 0.8186x - 0.2171$ shows that a unit increase in performance in English causes a 0.8186 increase in performance in Mathematical literacy. The regression line $y = 0.8186 - 0.2171$ has a positive gradient emphasizing the positive relationship, indicating that English (independent variable)language had a positive influence on Mathematical literacy (dependent variable). The regression coefficient was significant ($P = 0.000$, Table 4.40), meaning that there was a relationship between English language and Mathematical literacy across all schools. These results show that English language was a predictor of Mathematical literacy performance at these schools. This means that learners' performance in Mathematical literacy can be estimated from English language scores.

Table 0.27: Relationship between performance in English language and Mathematics literacy at ten schools in Moloto Circuit, Limpopo Province, South Africa

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	16626.595	1	16626.595	147.424	.000[b]
1	Residual	34172.467	303	112.780		
	Total	50799.062	304			

a. Dependent Variable: Maths All b. Predictors: (Constant), Eng All

Table 0.28: Mean performance of English language and Mathematics literacy among learners at School I in Moloto Circuit, Limpopo Province, South Africa

	Mean	Std. Deviation	N
Maths All	38.15	12.92680	305
Eng All	46.87	9.03466	305

The descriptive statistics show that the mean performance was higher in English language than in Mathematical literacy (Table 4.41). A higher standard deviation in Mathematical literacy (12.93) indicates a higher spread in performance in Mathematical literacy than in English language (9.03). The coefficient of variation of Mathematical literacy (33.9%) was also higher than that of English language (19.3%). These observations show that there was more variation in Mathematical literacy than in English language. Performance in English was more consistent. There was a also a significant positive correlation (P = 0.000, R = 0.572) between performances in the two subjects is (Table 4.42). Meanwhile, English language contributed 32.7% to the performance in Mathematical literacy (Table 4.43).

Table 0.29 Correlation between English language and Mathematics literacy among learners at ten schools in Moloto Circuit, Limpopo Province, South Africa

		Maths All	Eng All
Pearson Correlation	Maths All	1.000	.572
	Eng All	.572	1.000
Sig. (1-tailed)	Maths All	.	.000
	Eng All	.000	.
N	Maths All	305	305
	Eng All	305	305

Table 0.30 Model ummary for then schools in Moloto Circuit, Limpopo Province, South Africa

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
	.572[a]	.327	.325	10.61981	.327	147.424	1	303	.000

a. Predictors: (Constant), Eng All

4.4 Observations of scatter diagrams and tables drawn for research question one

The foregoing sections will discuss the scatter diagrams and tables drawn as well as making some relevant conclusions about each of them.

4.4.1 Scatter diagrams

All the scatter diagrams drawn show a positive correlation between English language and Mathematical literacy scores. This implies that both variables move in the same direction. The results from these ten schools agree with Vale (2013) who noted that there is usually positive association between English language proficiency and Mathematical literacy, especially at high school level. Studies by Barton and Neville (2003) in New Zealand also confirmed this type of association between these two subjects. This suggests that poor English language proficiency affects performance in mathematical literacy. It is important to note that the scatter diagrams for School A and School E had the weakest positive relationship as their points were more scattered. However, in general, the data seemed to suggest that performance in Mathematical literacy is strongly affected by performance in English language.

4.4.2 Descriptive statistics tables

The mean score for English language was higher than that for Mathematical literacy in all the ten schools except for school E. This means that in general, learners performed better in English language than in Mathematical literacy. Across all schools except School E, the standard deviations in English language were all smaller than in Mathematical literacy. This indicates a higher spread of performance in Mathematical literacy than in English language. Coefficients of variations were calculated using the formula:

Coefficient of variation = (standard deviation/mean) x 100%. It was found that in all the ten schools, the coefficient of variation for Mathematical literacy was higher than of English language. This implied that there was more variation in Mathematical literacy, while performance in English language was more consistent.

4.4.3 Correlation tables

Correlations between the two subject were determined using Minitab package for each school and combined for all ten schools. It was found that the correlation coefficients between performance in English language and Mathematical literacy for all the schools were positive and significant. The highest correlation was 0.800 (School F) and the lowest was 0.382 (School A). The results of this study revealed that English language and Mathematical literacy at the ten schools of Moloto were highly correlated. This finding agrees to some extent with Iseke (2000) who showed that language had a positive on performance in mathematics.

4.4.4 Model summary tables

Model summary tables gave us the value of the correlation coefficient, **R** as well as the value of R^2. The value of R^2 gave us the coefficient of determination by multiplying it by 100%. The value of the coefficient of determination gave us the contribution made by English language as a percentage to the achievement in Mathematical literacy. The least value of the coefficient of determination in the ten schools was 14.6% (School A) and the greatest value of the coefficient of determination is 64.0% (School F). The coefficient of determination for all schools combined was 32.7%. It has been seen that in all schools English language was contributing at least 14.6% to as high as 64.0% to the achievement in Mathematical literacy. The coefficient of determination for the schools combined being 32.7% means that on a global point of view about the ten schools, English language was contributing more than one-third to the performance in Mathematical literacy. We can conclude that acquisition in the language of instruction which is English does affect achievement in Mathematical literacy.

Relationship between performance in English language and Mathematics literacy at ten schools in Moloto Circuit, South Africa Data analysis using ANOVA showed the f-values and determining the significance of the regression coefficient x. The significance of the regression coefficient x is determined by the p-value**.** If the calculated or obtained p-value is less than 0.01, then the regression coefficient x is said to be significant at 1% level of significance similarly, if the calculated or obtained p-value is less than 0.05 and so on, then the regression coefficient x is said to be significant at the 5% level of significance. In this case, a regression coefficient x which is significant at 1% is more significant than a regression coefficient x which is significant at 5%. In statistical terms, we say that a test that is performed at a 1% level of significance is more powerful than a test performed at a 5% level of significance.

In all the ten schools, regression coefficient x was significant. The ten schools had p-values which were significant at 0.10 or 10% level of significance. Seven of the schools had p-values which were significant at 0.01, School C had a p-value that was significant at 0.05, and School E and School G had p-values significant at 10% or 0.10. The ANOVA table for the ten schools combined gave us a F-value of 147.424 with a p-value of 0.000 which is very significant at 0.01 level of significance. This means that the regression coefficient x is very significant since 0.000 is less than 0.01 the 1% level of significance. We can safely conclude that English language was a predictor of Mathematical literacy. This means that if we know the score obtained by a learner in English, we can calculate the approximate mark obtained in Mathematical literacy.

4.5 Research question 2: how does the use of English language as the medium of instruction affect the teaching and learning of mathematical literacy?

4.5.1 Collection of data

To answer research question 2, two hundred and ninety-six (296) learners from the 2017 Grade 12 learners of Moloto Circuit of Limpopo Province completed a questionnaire in the month of January 2017. In the first section, learners responded to gender, age group, the area they lived most of their school career, and their home language. All the learners who completed the questionnaire had Sepedi as their home language and as such the responses on home language were not captured and presented in the spreadsheets. The next part of the questionnaire required learners to complete closed-ended questions with responses given in a Likert scale. The last part of the questionnaire required learners to complete open-ended questionnaires where they responded in their own words giving their own views. This section also required learners to work out some Mathematical literacy questions for checking whether the learners understand the technical mathematical terms that were used to ask the questions. This section also required learners to give suggestions on how Mathematical educators should teach for them to understand better and as such achieve higher marks in Mathematical literacy examinations. The questionnaires for learners are given in Appendix H.

After the data was collected, it was organised, categorised and put into themes in the forms of spreadsheets. The Excel program was used to generate the spreadsheets which were used to analyse the data using Mini-tab. The quantitative and qualitative questions were codified and the major themes that emerged were identified and noted. The results from questionnaires were presented in Appendix L. After the results were presented, a conclusion to summarise research question 2 was given.

4.5.2 Presentation of results on the categorised themes for Research Question 2

4.5.2.1 English as the medium of instruction

Learners were asked whether they had problems in the understanding of technical terms used in the teaching of Mathematical literacy. It was observed that 70% of the respondents said that they had problems with understanding English language terms that were used when teaching mathematics (Figure 4.12). The 70% is obtained from adding 63% and 7% who had agreed and strongly agreed. We see that 19% (i.e. 3% added to 16%) said that they had no problem in the use of English language terms used in setting Mathematical literacy examinations as indicated by them not agreeing with the above-given statement. The learners who were neutral were 11%. It was observed that a high percentage of 70% of the learners were confirming that English language terms that were used to set Mathematical literacy examinations affected their performance.

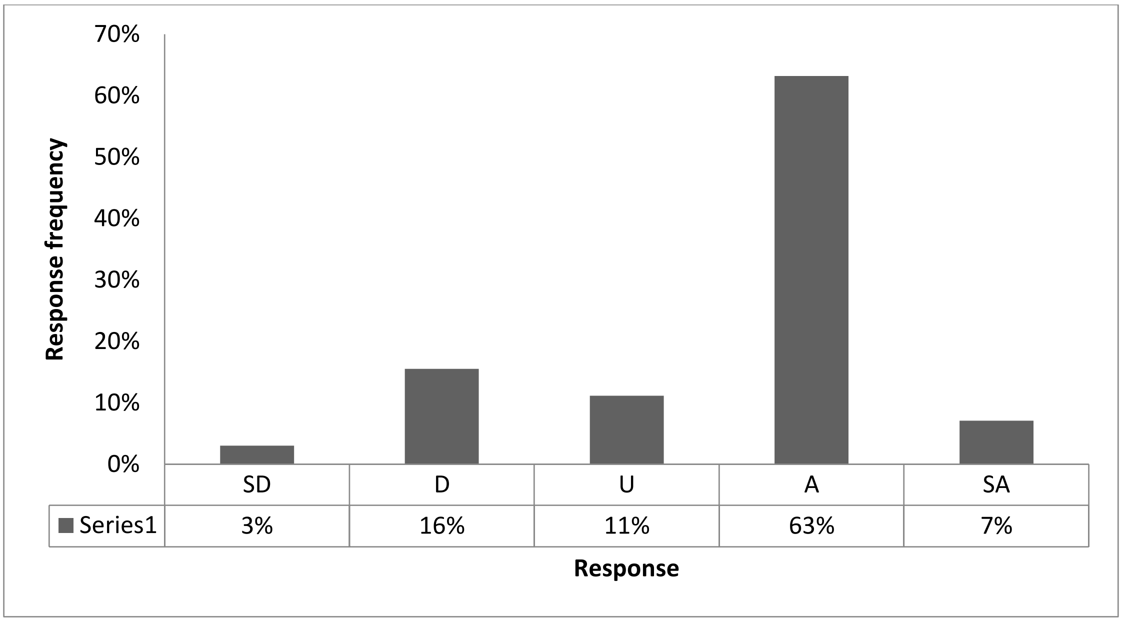

Figure 0.12: Learners' responses on not understanding English language terms used in Mathematics literacy

4.5.2.2 Failure to answer questions because of English language terms that are used

Learners' responses of not being able to answer Mathematical literacy questions because of the terms used in question items are represented in Figure 4.13. The findings from this question were in agreement with the previous one. We see that 53% of the learners said they failed to answer Mathematical literacy questions because of the English language terms that were used. Learners who were neutral were 9% while 39% had no problems with English language terms used. A high percentage of 53% is also confirming that English language terms used do affect the performance in Mathematical literacy examinations.

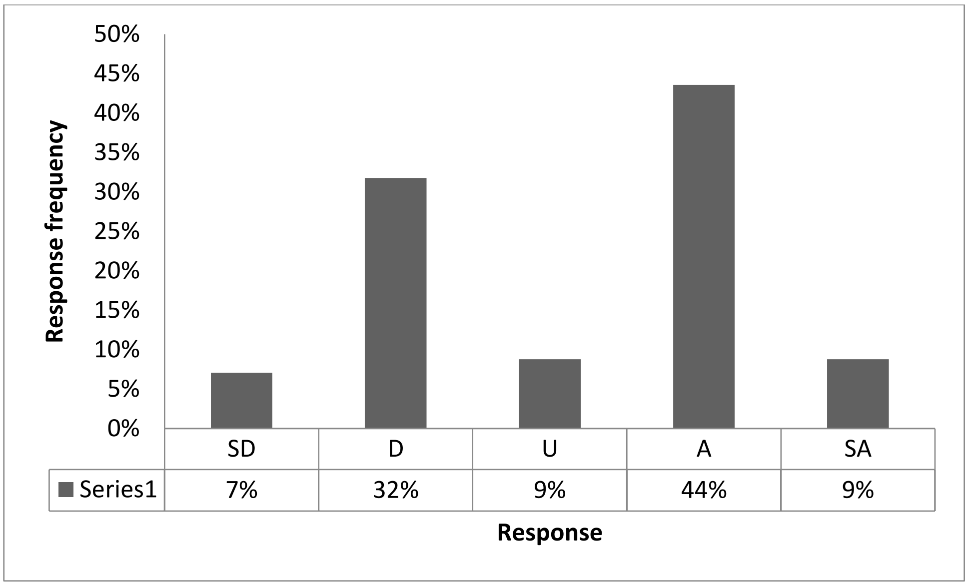

Figure 0.13: Bar chart on learners' responses on failure to answer Mathematical literacy questions because of the English language terms that are used

4.5.2.3 Use of English and failure to work Mathematical literacy questions

Table 0.31: Use of English language and failure to work Mathematical literacy examples

SD	9%
D	25%
N	11%
A	41%
SA	14%

Some 55% of the learners said that they were failing to work out Mathematical literacy questions because of the English language that was being used to set the questions (Table 4.44). The learners who were neutral were 11% while 34% indicated that they did not fail Mathematical questions because of English language. More than half of the learners said that lack of proficiency in English language was disadvantaging them to answer Mathematical literacy questions successfully which conforms to Vale (2013) were who found a significant correlation between the linguistic complexity of terms and language-related areas and between the cognitive complexity of items and language related errors and between the cognitive complexity of items and all types of errors.

4.5.2.4 Understanding of English terms used

Table 0.32: Those who understand English Terms

I do not understand English terms	
SD	5%
D	27%
U	10%
A	48%
SA	10%

Learners who said they did not understand English language terms were 58%. This indicates that the English terms that were used in setting Mathematical literacy questions negatively affected performance in Mathematical literacy to a learner who was not well conversant with the English language. Only 10% of the learners were neutral and 32% said that they understood the English language terms.

4.5.3 Results from open-ended questionnaires completed by learners

The following statements are the summaries of responses of the 305 learners from open-ended questionnaires. The responses from the learners were summarised and put into themes. The major themes that emerged were recorded and revealed some patterns that are described below.

The majority of respondents indicated that the questions were too long resulting in failure to understand what to do and failure to repeat steps made by the teacher in the revision of a test. The majority of respondents (66%) singled out English language as the reason for their failure to attain high marks in Mathematical literacy tests and examinations. Related to that, a significant number of students indicated that they could not transfer mathematical ideas from home language into English language.

Another interesting point that came up was that they found Mathematical literacy difficult because they could not effectively participate in the classroom discourse by, for example, asking the teacher questions where they did not understand. In this regard, a significant number complained that the teacher used English language every time, suggesting that they would understand better if the teacher used the mother language. The majority of students indicated that they had problems in answering Mathematical literacy questions because they did not understand the English language terms that were used in setting the questions. An interesting observation from the data was that the setting of the examination questions itself was not a significant performance factor according to the majority of respondents but lack of practice was cited as a strong factor. However, it could not be established if lack of practice was a consequence of the language problems generating a lack of enthusiasm or not. The data appears to confirm that English language as a medium of instruction has a significant impact on learners' performance. This is consistent with the similar studies which found that the scores of non-native English language speakers in college track with higher levels of English were however higher than their peers in the college track (Mosqueda, 2010).

4.5.4 Learners' suggestions on how to improve their performance in Mathematical literacy

The learners suggested several strategies on how to improve their performance in Mathematical literacy. These included the use of simple English, the use of home language, the setting of a full range of questions ranging from easy to difficult, slowing down the pace of instruction, and the use of more textbook examples.

4.5.5 Summary of results on the question on shoe sizes

To test the learners' ability to identify data as discrete or continuous, they were asked to answer questions on five shoe sizes: 2, 4, 5, 7, and 7 (Appendix ?) for the detailed question on the learner. The learners were also required to find the medium, modal, minimum, maximum, range, and mean of the shoe sizes respectively. A summary of the learners' answers are represented in Table 4.46.

Table 0.33 Summary of results on shoe sizes

	Q 30 a	Q 30 b	Q 30 c	Q 30 d	Q 30 e	Q 30 f
C	32% (95)	81% (239)	77% (227)	70% (207)	71% (210)	53% (158)
Na	1% (4)	2% (5)	2% (6)	2% (6)	2% (5)	2% (5)
W	67% (197)	17% (52)	21% (63)	28% (83)	27% (81)	45% (133)
	100% (296)	100% (296)	100% (296)	100% (296)	100% (296)	100% (296

In Table 4.46, row named **C** represents that the question was correctly answered, **Na** represent that the question was not answered, **W** represents that the question was answered wrongly. A total of 296 learners responded to the question. The percentages are given and the numbers in brackets represent the number of learners corresponding to the percentages. For example, question 30a was correctly answered by 95 learners and this represented 32% of the learners answering the question correctly and so on.

It can be suggested that the majority of the learners (67% of the learners) got question 30a wrong because the words discrete and continuous are too technical and therefore learners might have failed to understand their meanings in the Mathematical field (Vale P. , 2013). The failure by a larger percentage of the learners (45%) to find the mean might be due to failure to understand the meaning of the word MEAN or maybe a result of arithmetical errors. The reason for learners to perform well on average for finding medium, mode, minimum, maximum and range may be because learners understand these terms or have been drilled by their educators since these terms are taught right from primary school level.

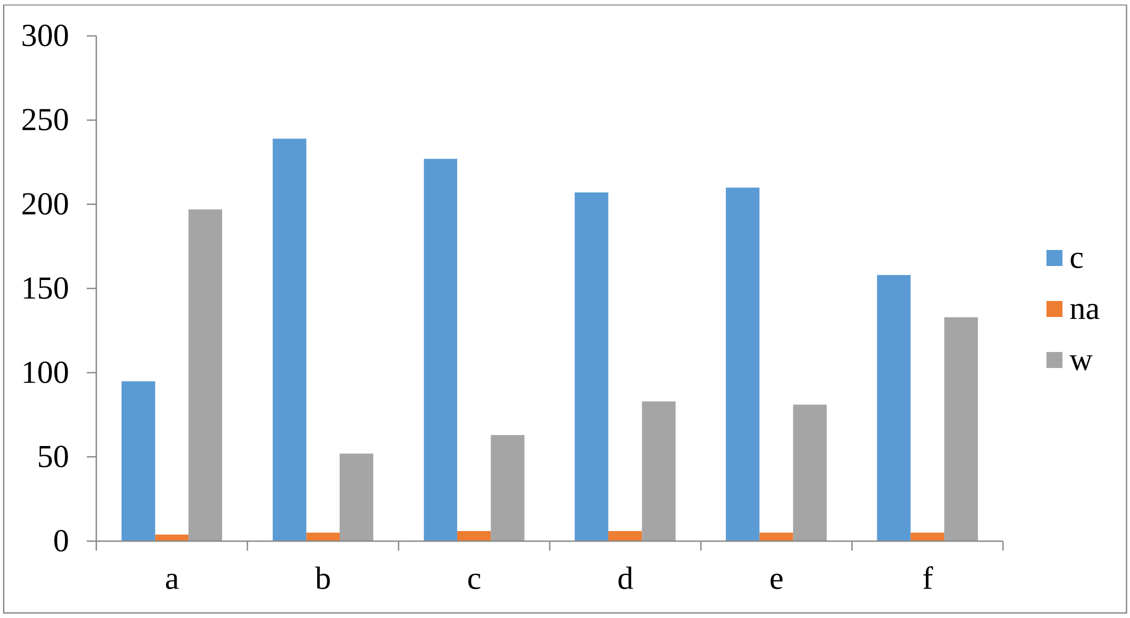

Figure 0.14 Bar graph showing the distribution of performance of learners to question 29

4.5.6 Concerns expressed by learners on learning Mathematical literacy using English as the medium of instruction

The qualitative questions were codified, and the major themes that emerged are discussed in this section. The percentages were generated using Microsoft Excel package. The spreadsheets displayed the major themes that emerged.

The most notable observation was that the majority of the learners pointed out that the questions used in the tests were too long for them to understand what to do, and that they failed to repeat steps that were made by the teacher in revision tests. They attributed their failure to achieve high marks to the use of English language in setting the tests and examinations and singled out the English language terminology of Mathematical concepts.

A significant number also indicated that they had problems transferring Mathematical ideas from home language into the English language. In class, they experienced problems in asking questions where they did not understand because the teacher always used English language which they viewed as a barrier to understanding the Mathematical concepts. Interestingly, they indicated that they would understand better when taught using their home language as the medium of instruction. This data reveals that English language as a medium of instruction is a strong factor in the learners' performance.

4.5.7 Conclusion and Summary of Research Question 2

The learners said that they found Mathematical literacy to be difficult because of the use of English language as the medium of instruction, the fact that set questions were too long, and the consistent use of English language in instruction. The learners preferred that Mathematical literacy should be taught in their mother language and that educators should explain technical terms.

4.6 Research question 3: how best can mathematical literacy educators teach using English as a medium of instruction?

To answer Research Question 3, the responses that were obtained from the questionnaires given to educators were used. The first section of educators' questionnaire required educators to give information about their experience, qualifications, and number of years they had taught. The ten educators, one from each school in Moloto Circuit, teaching Mathematical literacy responded to closed and open-ended questionnaires in the second part of the questionnaire. The responses on closed-ended questionnaires were given on a Likert scale with codes 1, 2, 3, 4 and 5 corresponding to Strongly Disagree, Disagree, Undecided, Agree, and Strongly Agree respectively. The open-ended questionnaires investigated the views of teaching and learning of Mathematical literacy (Appendix H). These views were then put in major themes which were presented, discussed, and analyzed.

4.6.1 Characteristics of educators

A significant number of respondents had 11-15 years of teaching experience and the majority of the educators had university degrees in the subjects which they taught.

4.6.2 Educators perceptions of the language used in the teaching and learning of Mathematical literacy to Grade 12 learners

The responses on the questionnaires Questions 3 to 14 completed by educators were summarised and were put in Table 4.42. The values given under each research question is the **average response** for each given question. For example, under research question 3, we have a value 2.67 which is the average response of the ten educators on this question. The value of 2.67 is approximately 3 to the nearest whole number. On the Likert scale this value of 3 represents a neutral response, that is, **UNDECIDED**. Question 3 (Appendix I) reads 'Poor English language proficiency affects the academic performance of Grade 12 learners in Mathematical literacy.' With this value of 3 as the average response on question 3, we conclude that of the ten educators who completed a questionnaire, they are neutral or undecided on whether poor English language proficiency affected the academic performance of Grade 12 learners in Mathematical literacy in Moloto Circuit.

Table 0.34: Summary of the educators' responses on the perceptions of the language used in the teaching and learning Mathematical literacy

Question	3	4	5	6	7	8	9	10	11	12	13	14
Response level on Likert scale	2.7	2.5	2.5	4.2	4	4	4	4	4	4	4	4

Table 4.47 shows that generally educators either agreed or were neutral on the responses as is indicated by the average scores of responses from scores 3 (rounded off) and 4. Educators were undecided for question 4 which reads 'Learners fail to answer questions in Mathematical literacy because they fail to answer the questions' as indicated by the average score 2.5 rounded to give us 3 which tallies with 'Undecided' on our Likert scale. The educators gave the same average Undecided response on question 4 which reads 'Learners do not comprehend well concepts taught in Mathematical literacy because they don't ask questions in situations where they fail to understand what the teacher is teaching.'

We see that question 6 and 7 relate to mother language of instruction in Mathematical literacy. Educators responses indicated that they agreed that learners would get higher marks in Mathematical literacy if it could be taught using their mother language as the medium of instruction as indicated by the average response score of 4. The above suggestion is supported by the view that was forwarded by Gardiner (2008:20) who indicated that most South African children are taught in their mother tongue in the first three Grades at the beginning of their formal schooling and then switch to a different language of learning and teaching in Grade 4 which is usually English. He further indicated that the policy would change in future and that children would continue to learn in their language until the end of Grade 6 as was already indicated by the Western Cape Department of Education. The disadvantage that could be incurred with the above idea is the challenge of learner viability in the social and economic world after school which uses the English language in most communication at different levels of social and economic life. This means that a learner who has learnt Mathematical literacy in a mother language such as IsiZulu in the province of KwaZulu Natal would not be able to teach or do related courses in Limpopo Province where IsiZulu is not the mother language. This would leave educational authorities to have no choice except to let Mathematical literacy be taught in English language and Afrikaans as is the case in the Republic of South Africa. Langa (2006) also argued that problem with the use of home language to support

Mathematics learning is that it puts the educator who is non-speaker of learners' mother language at a disadvantage. This then underscores the complexity of the issue of medium of instruction in South Africa's multi-lingual situation in general.

The educators generally agreed that learners failed to achieve best scores in Mathematical literacy questions because the questions were too long, and learners failed to comprehend the requirement of the question as indicated by the average response value of 4 on Educators' responses on Question 8. This fact is related to the fact that the questions were being asked in English language besides the fact the questions were too long. The language factor obviously came in because the questions were asked in English language for which some learners had low proficiency. This agrees with Aina, Ogundele, and Olanpekun (2013) who observed that learners who had English language difficulties such as poor listening, speaking, reading, and writing abilities were failing to function well in their other subjects. As already indicated in Chapter 2, low proficiency in English language is considered a barrier to learning and academic success as the learners lack the language proficiency required to understand the test content and academic work.

Educators agreed that learners would answer Mathematical literacy successfully if the teacher would first explain the mathematical terms that were used in Mathematical literacy. This was indicated by the average response score of 4 on question 9. The above thought was noted by Vale (2013) who said that "for these students whose second language is English, part of their learning will have been in their home language. Transferring the mathematical skills that they have developed in their home language into contexts presented in a second language, therefore, becomes more complicated for them.'' The educators agreed that learners fail to answer questions individually whereas they contribute positively in class as evidenced by an average response score of 4 on question 10. This also can be contributed to language problem whereby learners fail to express Mathematical literacy ideas in English due to inadequacy of acquisition of the English language.

Questions 11, 12, 13 and 14 refer to the language used when teaching Mathematical literacy. The educators agreed to all issues outlined which were revealed by an average response score of 4 in all cases. The educators agreed to use mother instruction as asked in question 11, they agreed that they faced challenges when they used the English language in their teaching as asked in question 12, agreed that they used code-switching to enhance teaching and learning as asked in question 13, and also agreed that they used English language when teaching Mathematical literacy. There seemed to be a contradiction of agreement in question 11 and question 14 but there was not. The common stance of thought is identified in question 13 where educators agreed that they used code-switching to enhance teaching and learning. This agrees with a study by Sepeng (2010) on the relationship between isiXhosa and English language which revealed that learners preferred code-switching English and isiXhosa languages for the teaching and learning of Mathematics.

Educators' responses on open-ended questionnaires on the teaching and learning of Mathematical literacy

The open-ended questions given later showed different results as shown from questionnaires number 15 to 20. The responses from questionnaires 15 to 20 were put in themes and the major themes that emerged were identified and gave the following summarised results.

4.6.1.1 Challenges that educators face when teaching Mathematical literacy using English as a language of instruction

Asked about the challenges that they face when teaching Mathematical literacy using English as a language of instruction, 90% of educators said learners had problems in understanding Mathematical literacy questions because of English language and only 10% indicated that they had no challenges. These statistics are a cause for concern as they suggest that English language as a medium of instruction is a huge barrier to effective teaching and learning of Mathematical Literacy in Moloto circuit. It raises the question 'What can be done to empower teachers to deliver more effectively under the existing conditions?' Some form of in-service training could go a long way in addressing this problem.

4.6.1.2 Language of instruction preferred by Mathematical literacy educators

Though 80% of the educators expressed a preference for English language as a medium of instruction against 20% who preferred Sepedi, it should be noted that the preference does not seem to be based on pedagogical considerations. Instead, it appears to be a pragmatic approach to the fact that English language is the official language of Mathematical literacy instruction and assessment. Again, in view of that, it is suggested that a carefully planned and well thought out in-service programme could empower the educators with knowledge, strategies, and skills to enhance the teaching of Mathematical literacy.

4.6.1.3 Why learners fail Mathematical literacy examinations?

Question 17 sought for the reasons why learners failed in Mathematical literacy examinations. From the educators' perspective, long questions, inability to apply Mathematical literacy to real life and most importantly, the language barrier, were the factors behind the learners' poor performance in the subject.

4.6.1.4 Suggestions on how mathematical literacy questions should be set

Responses from Question 18 showed that there were several ways in which Mathematical literacy questions could be set for learners who learnt the subject using a second language. Some of the educators felt that the number of word problems should be reduced as this is not an English examination. The use of Bloom's taxonomy in setting test items was also suggested where items should be spread out between knowledge, comprehension, application, analysis, synthesis, and evaluation. What these educators were questioning was "What are the good attributes of a good Mathematical literacy problem? Are word problems the only effective method of setting Mathematical literacy test items? It was not easy to address these questions but what was clear was the fact that the writers of test items should take into account of the type of learners for whom the test items were intended.

4.6.1.5 How should educators teach using English language as a medium of instruction?

On how Mathematical literacy educators should teach using English as a medium of instruction with the background knowledge that its use affected learners' performance, the educators expressed an awareness of the seemingly dominant position of English language not only in the South African system but the internationally. This shows the necessity of the learners to be taught using English language as a medium of instruction. To that end they suggested the use of simple English language to teach, clear and adequate explanation of the unfamiliar terms and a limited use of code switching to facilitate understanding where it is absolutely necessary to do so.

4.6.1.6 Problems of instructing in second language

The educators were clear in their response that language presented the single biggest problem in the teaching and learning of Mathematical literacy and that this manifested itself in the failure by learners to understand the questions, the concepts and the terminology used.

The prominent suggestions on how to address the challenges encountered when teaching Mathematical literacy using a second language were the use of code switching, explaining questions first in the mother tongue, using English language more in the classroom discourse and introducing English language at the earliest stages of learning. As noted earlier these suggestions were based on the assumptions that no fundamental change in the language policy could be in the offering in the short to medium term.

4.7 Summary of the chapter

The results in the ten schools showed that there was a positive relationship and the correlation was significant in all cases. This indicates that English influenced performance in Mathematical literacy in Moloto Circuit. This was supported by coefficients of determination cited in the ten schools.

The learners said that they found Mathematical literacy difficult because of use of English language as the medium of instruction, the way questions were set i.e. being too long, and the consistent use of English language in instruction. The learners preferred that Mathematical literacy should be taught in their mother tongue and that educators should explain technical terms. The educators also said that learners had problems in Mathematical literacy because of use of English language as the medium of instruction. They said that they should use code switching in their teaching to enhance understanding.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

A summary of the study of language as a factor affecting the teaching and learning of Mathematical literacy at Grade 12 and the implications for Mathematical literacy teaching and learning in South Africa is presented in this chapter. The summary of the findings addressed the three main questions of the study. In light of the findings of this study, suggestions for further research are made. Finally, some recommendations on the teaching and learning of Mathematical literacy are also made. The study focussed on Grade 12 educators learners in the Moloto Circuit in the Limpopo province but the findings are generalizable to rural high schools in the rest of South Africa.

5.2 Summary of the Study

This study investigated the impact of English language as a medium of instruction in the teaching of Mathematical literacy in the Moloto circuit in Limpopo province, South Africa. The study sought to establish the correlation between English language competence and mathematical literacy paying close attention to the learning difficulties experienced by the learners arising from the use of English as a medium of instruction. A question related to this study was how best the Mathematical literacy educator can teach using a second language.

A review of related literature in Chapter 2 of the study yielded some useful insights into the problem of language and Mathematical literacy teaching in general and the knowledge gaps which informed the current study in respect of the framework of ideas and method used in this study. Using a mixed methods approach the study investigated the language of instruction as a factor in the teaching and learning of Mathematical literacy at Grade 12 in the Moloto circuit. This means that the study drew upon both quantitative and qualitative methods to generate data. To that end, a cross-sectional correlation research design was used. This was aimed at determining the correlation between Mathematical literacy (the response variable) and linguistic competency (the treatment variable). Two sets of questionnaires, one for the teachers and the other for the learners, were designed and administered to collect data. In addition, syllabus documents, and Grade 12 Mathematical literacy examination papers were identified and used as sources of data. The main objectives of the study were to determine the relationship between the scores in English language and Mathematical literacy, explore the learning difficulties faced by learners through the use of English language as the medium of instruction, and suggest possible ways of strengthening the teaching of Mathematical literacy using a second language.

The target population consisted of 305 learners who wrote the Grade 12 examinations in 2016, 585 Grade 12 learners and 10 educators who completed the questionnaires in January 2017. A census approach was used because everyone in Moloto circuit doing Mathematical literacy and their educators in the ten schools were studied. A content analysis of the Grade 12 results for English language and Mathematical literacy for the 2016 academic year was then undertaken. Questionnaires with closed and open-ended items were administered to Grade 12 learners and 10 educators for the 2017 academic year in January 2017.

Data collected using questionnaires, examinations/tests and a syllabus document was presented using correlation tables, descriptive statistics tables, model summary tables, and ANOVA tables. The data was analysed using regression and correlation analysis techniques and interpreted in Chapter 4.

5.3 Summary of Findings

The major findings of the study are summarized under the three main research questions below.

Research question 1

What is the relationship between the scores in English and Mathematical Literacy?

Regarding this question, the study aimed at determining the relationship between competency in English language and Mathematical literacy.

<u>The relationship between scores in English language and Mathematical literacy</u>

The findings were that in all 10 schools under study there was a positive correlation between performance in English language and Mathematical literacy. The coefficient of x in the regression equation $y = 0.8186x – 0.2171$ indicates that a unit increase in performance in English causes a 0.8186 increase in performance in Mathematical Literacy. The regression line $y = 8186x - 0.2171$ shows a positive gradient emphasizing the positive relationship that indicates that English language (independent variable) had a positive influence on Mathematical literacy (dependent variable). This finding is consistent with the conclusion reached by Robelle and Candy (2016) and Vale (2013) in similar studies earlier.

The study, therefore, established that there was a significant correlation between performance in English language and Mathematical literacy. It was found that the learners had problems in Mathematical literacy when the language of instruction was English language. The learners and educators suggested that the language of instruction should be simplified and technical terms used in the teaching and learning of Mathematical literacy should be clearly explained first.

Research question 2

How does the use of English language as the medium of instruction affect the teaching and learning of Mathematical literacy?

The study also investigated the impact of using English language as a medium of instruction on the teaching and learning of Mathematical literacy among learners in Moloto circuit who are second language speakers of English. A medium of instruction is the language used by the teacher to teach. It is not by accident that English language is the medium of instruction in South African Schools but a result of policy choices made at some particular moments in the colonial and post-colonial history of the nation. This is a result of the dominance and importance of English language in both the national and international socio-economic and political contexts which dictates its use to deliver educational content, in this case, Mathematical literacy. The rationale is that this increases the amount of exposure that the learner gets to English language and the opportunities to communicate in and develop some sort of mastery over it. That sounds reasonable enough, but the problem is that, as a consequence, the learner has to learn Mathematical literacy but English language (the subject) as well at the same time. Therefore, not unexpectedly, the findings suggest that the learners' difficulties in Mathematical literacy arise from the use of English language as a medium of instruction.

English as a medium of instruction

The majority of respondents to the questionnaire (students) revealed that they had difficulties understanding the Mathematical literacy concepts and problems due to the language particularly the specialized vocabulary (technical terms) and complex syntax often used in the teaching, tests, exercises, and examination questions. This impacted negatively on their understanding of the questions or content. The educators also agreed that the questions tended to be too long and complex and that learners found it difficult to relate Mathematical literacy questions to real-life situations. About 80 percent of the educators generally agreed that learners performed badly because of the poor grasp of the English language used in the instruction of Mathematical literacy. It can, therefore, be concluded that the use of English as the language of instruction in Mathematical literacy causes some learning difficulties for a significant number of students in the circuit.

Research question 3

How best can Mathematical literacy educators teach using English language as a medium of instruction?

The study attempted to explore some possible solutions to the problem of language of instruction and performance in Mathematical literacy within the existing language policy framework by soliciting the views of the classroom practitioners. The respondents (educators) to the questionnaire were qualified Mathematical literacy teachers with 90% percent of them holding degree qualifications with appropriate teaching experience. On whether poor English language proficiency affected the academic performance of Grade 12 learners in Mathematical literacy, they expressed mixed views but when asked if the use of the home language (mother tongue) would lead to better performance, they were positive about it. The educators also agreed that learners fail to achieve high scores in Mathematical literacy questions because these questions are usually too long and complex. Consequently, the learners failed to understand the demands of the questions leading to poor responses.

The learner's limited linguistic competence creates some communication barriers between the teachers and the students resulting in reduced classroom teacher-learner and learner-learner interaction. For instance, where learners do not comprehend concepts that were being taught, they tended to shy away from asking questions to get clarification or help.

A possible alternative that was suggested was code-switching where the mother tongue or home language would be together with English language to help learners understand difficult concepts. While the educators viewed the use of the home language as a medium of instruction as a possible strategy to improve learners' performance in Mathematical literacy, they thought that its operationalization would face serious challenges. They pointed out the fact that South Africa was a multilingual society where English had become a lingua franca that facilitates communication across different languages. A teacher whose mother tongue was different from that of the students would find it very difficult to teach in many places.

This left the educators with no choice but to operate within the existing language policy framework where English was the medium of instruction. In that scenario, they made such suggestions aimed at alleviating the learners' language problems. These included the need for teachers to first explain the specialized terms that were used in Mathematical literacy and the use of simpler English language in teaching as well as the phrasing of the exercises and examination questions. This would mean making changes to the questioning techniques so that the learners are tested for Mathematical and not linguistic knowledge.

Suggestions on Mathematical Literacy Questions

The educators suggested that the Mathematical Literacy questions should be short, objective and simple in structure and that the number of questions should be reduced. This was meant to reduce unnecessary linguistic complexities so that the language would not unduly draw attention to itself so as to maintain focus on the Mathematical concept or problem.

Teaching Mathematical Literacy Using English as a Medium of Instruction

The study appeared to confirm the need to continue teaching Mathematical literacy using English language as a medium of instruction. However, a simpler form of English language that was accessible to the majority of the learners was preferred so that they would not have to struggle with both language and the Mathematics content at the same time. There was need to give serious attention to the definition and explanation of unfamiliar terms. The educators also called for the use of code-switching in all instances where it would aid the learners' understanding of the concepts.

5.4 Insights

This study enhanced my understanding of the complexities involved in conducting academic research including the need to conduct research within ethical constraints. Though some issues apparently seem like simple classroom problems, in real sense they are often intricately connected to the wider network of socio-cultural, political and economic issues. In that sense, I learned that the relationship between the medium of instruction and Mathematical literacy is a complex one that requires the concerted effort of educators, learners, parents and government in order to strengthen the teaching and learning of Mathematical literacy.

5.5 Conclusions

5.5.1 The relationship between Mathematical literacy and performance in English language

The present study established that there was a positive and significant correlation between performance in English language and Mathematical literacy, and this was consistent in all the individual ten schools that were studied. It can, therefore, be concluded that English language as a medium of instruction affects performance in Mathematical Literacy in the Moloto Circuit.

5.5.2 Learning difficulties faced by learners through the use of English as a second language

The participants (learners) cited failure to adequately understand the language used in setting Mathematical literacy questions in the tests, exercises, and national examinations. As a result, they could not tackle the questions successfully. Sentences used in the setting of examinations tended to be too long and complex and that presented a huge challenge for the learners. The educators were also in agreement that the questions tended to be too long and complex and that learners found it difficult to relate Mathematical literacy questions to real-life situations. About 80 percent of the educators generally agreed that learners performed badly because of the poor grasp of the English language used in the instruction of Mathematical literacy. It can, therefore, be concluded that the use of English as a medium of instruction in Mathematical literacy has caused some learning difficulties for a significant number of students in the circuit.

5.5.3 Suggestions on how Mathematical literacy educators should teach using a second language

From the findings, it can be concluded that since radical changes to the language policy would have to involve government and may not happen in the near future, English language would continue to be the medium of instruction for some time to come. It therefore meant that strengthening of the teaching of English language and its use as a medium of instruction in Mathematical literacy was the only viable option. To that end, the educators suggested that learners should start to learn in English language from as early as the third grade. The rationale was that this would help the learners to establish a strong English language foundation that would enable them to handle the complex language and Mathematical concepts at the higher levels of education. In addition to that, teachers should use English language more to teach Mathematical literacy. Code-switching between English and the mother tongue should only be resorted to when absolutely necessary to explain difficult concepts and questions.

5.6 Recommendations

On the basis of the findings of this study and conclusions drawn from that, I propose some recommendations for educators, policymakers, and researchers. It is recommended that more emphasis should be placed on the acquisition and grasp of the English language.

Educators

Since it was established that learners have difficulties because of long, complex questions and technical terms, which are often not adequately explained, it is recommended that the test and examination questions should be short and precise, testing Mathematical literacy concepts rather than testing understanding of the English language as the case seems to be currently. The terms used should be adequately explained to the learners for them to understand the Mathematical concepts better.

Within the existing language policy framework, the educators can improve performance in Mathematical literacy by using simple English, simplifying some of the concepts and slowing down the pace when teaching Mathematical literacy in order to aid comprehension. The use of code-switching between Sepedi and English during instruction should be resorted to only if it is absolutely necessary.

Policymakers

The results of this study indicated that the problem of language and performance in Mathematical literacy went beyond the classroom and required some central government attention in the form of policy intervention. A rethink on the continued use of English language or viability of the introduction of the home language (mother tongue) as a medium of instruction in Mathematical literacy is a national question that requires the deliberation and guidance of the national policymakers.

Researchers

The findings of this study revealed that a causal relationship existed between English language proficiency and performance in Mathematical literacy. There also emerged the question of whether teaching Mathematical literacy using the home language as a medium of instruction would lead to higher performance in the subject or alternatively allow for widespread use of code-switching in the Mathematical literacy classes. These issues did not receive adequate attention in this study and further research at a larger scale on these is recommended to inform government policy on language and education.

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APPENDICES

APPENDIX A: Letter of request for permission to conduct research in schools

Mochedi Secondary School
P.O. Box 222
Lonsdale
18 August 2016

THE PROVINCIAL DIRECTOR OF EDUCATION
LIMPOPO DEPARTMENT OF EDUCATION

Dear Sir/Madam,

REQUEST FOR PERMISSION TO DO RESEARCH IN SCHOOLS

My name is Kingston Nyandoro and a student at UNISA. l am presently enrolled for the MEd with a specialization in mathematics education. In order to complete the requirements for the degree, l need to conduct a research that is related to the area of my specialization. My research project is entitled: ***Language as a factor in the learning of mathematical literacy at Grade 12 in Moloto circuit of Limpopo province***.

My supervisor is Professor MG Ngoepe of the Department of Mathematics Education. Her office telephone number is 0124298375.

Twelve educators who are teaching Mathematical Literacy in Moloto Circuit together with their learners including will participate in the study. The respondents will be requested to complete to complete one questionnaires. Participants will take approximately 15 minutes to complete the questionnaire.

l believe that the work l am doing is extremely relevant to education in Moloto Circuit. l hereby give undertaking that:

- No school will be pressurised to complete the questionnaires.

- Information will be treated as confidential and no school will be identifiable. l would appreciate an early reply to the request.

Thank you for your assistance in this matter.

Sincerely yours,

Kingston Nyandoro
(Cell Number 0787409671)

APPENDIX B: Request to principals to conduct research in schools

Mochedi Secondary School
P.O. Box 222
Lonsdale
18August 2016

TO: MOLOTO SECONDARY SCHOOL PRINCIPALS

Dear Sir/Madam,

My name is Kingston Nyandoro. l am a student at UNISA. l am presently enrolled for the MEd with a specialization in mathematics education. In order to complete the requirements for the degree, l need to conduct a research that is related to the area of my specialization. l would like to conduct my research at your school which will focus on investigating language as a factor of achievement in mathematical literacy at Grade 12 in Moloto circuit. If the permission is granted, I will hold a meeting with all participants to explain all activities related to my research and answer all clarity-seeking questions.

If you allow me to use your school as a site for this research l will share the results of this study with you. Your school and those that will participate in the study will be kept anonymous. Participation in this research is completely voluntary and withdrawal of participation at any stage of the research is permissible. After reading this letter, please complete the attached consent form and return to the researcher.

You are welcome to contact me for any issues related to my research. My phone number is 0787409671

Yours faithfully,

Kingstone Nyandoro

APPENDIX C: Letter to request grade 12 mathematical literacy teachers to participate in research

Mochedi Secondary School
P.O. Box 222
Lonsdale
18 August 2016

Dear Grade 12 Mathematical Literacy teacher,

My name is Kingston Nyandoro. l am a student at UNISA and am presently enrolled for the MEd degree with a specialization in mathematics education. In order to complete the requirements for the degree, l need to conduct a research that will involve mathematical literacy teachers in your school. My research will focus on language as a factor of achievement in mathematical literacy at Grade 12 in Moloto circuit.

If you agree to participate in this research you will be expected to complete a questionnaire that will address some aspects of teaching mathematical literacy. Your identity and that of your school will not be revealed. In reporting about the findings from the research, pseudonyms will be used. The results of the study will be availed to you and to your school. If you agree to participate in this study, you may contribute improving the teaching and learning of mathematical literacy. Prior to the commencement of the research I will convene a meeting with all participants to explain the objective of the study and clarify other related issues. You are free to withdraw your participation at any stage of the research. After reading this letter, please complete the attached consent form and return to the researcher. You are free to call me at 0787409671.

Yours truly,

Kingston Nyandoro

APPENDIX D Participant letter of information

Mochedi Secondary School

P.O. Box 222

Lonsdale

18 August 2016

Dear participant,

My name is Kingston Nyandoro, a post-graduate student in the Faculty of Education of UNISA. I am conducting a research project under the supervision of Professor MG Ngoepe of the Department of Mathematics Education as part of the requirements towards a M Ed in mathematics education degree. This letter serves to inform you of my research project: ***Language as a factor in the learning of mathematical literacy at Grade 12 in Moloto circuit of Limpopo province***, so that you can make an informed decision concerning your participation in this study.

The aim of this research is to *examine how the language used in the teaching and learning of Mathematical Literacy affect the understanding and performance of Grade 12 learners in a rural setting of Moloto Circuit in Limpopo Province in South Africa.* Data will be collected using a questionnaire and it will take at most 15 minutes of your time to complete.

The responses to this questionnaire will only be used for research purposes. This questionnaire is strictly confidential. Hence, you are not requested to write your name. To complete the questionnaire, please put a tick in the space provided or write your response in the spaces provided. The result of the survey will be supplied to each respondent on request upon completion of the project.

In line with the ethical guidelines of UNISA, participation in this research is voluntary with full anonymity and confidentiality. You are free to withdraw from the research study at any time. There will be no personal identification details requested during the completion of the questionnaire. The head of education has granted the researcher permission to conduct this investigation. Your cooperation and assistance in this survey will be greatly appreciated.

If you have any questions regarding this research study, please feel free to conduct my supervisor Professor MG Ngoepe of the Department of Mathematics Education. Her office telephone number is 0124298375. Thank you for your time and consideration.

Yours sincerely,

Kingston Nyandoro

APPENDIX E: Consent form for learners

Mochedi Secondary School
P.O. Box 222
Lonsdale
18 August 2016

As a participant in this study, I ……………………………………..…………………………………….. understand that I will be asked to complete a questionnaire relating to a research study entitled ***Language as a factor in the learning of mathematical literacy at Grade 12 in Moloto circuit of Limpopo province*** being conducted by Mr K Nyandoro as part of his M Ed in mathematics at UNISA.

l have read through the information sheet that the researcher has provided to explain the aim of the research study and my role in this study. I understand that participation in this study is voluntary and I am free to withdraw from the study at any time. I have also been made aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

By signing below, I state that I wish to participate in the research being conducted by Mr K Nyandoro.

Name of guardian:	…………………………………………………………..
Signature of guardian:	…………………………………………………………..
Date:	…………………………………………………………..
Name of participant:	…………………………………………………………..
Signature of participant:	…………………………………………………………..
Signed at:	…………………………………………………………..
Date:	…………………………………………………………..

APPENDIX F: Consent form for educators

As a participant in this study, I ……………………………………..…………………………………….. understand that I will be asked to complete a questionnaire relating to a research study entitled ***Language as a factor in the learning of mathematical literacy at Grade 12 in Moloto circuit of Limpopo province*** being conducted by Mr K Nyandoro as part of his M Ed in mathematics at UNISA.

l have read through the information sheet that the researcher has provided to explain the aim of the research study and my role in this study. I understand that participation in this study is voluntary and I am free to withdraw from the study at any time. I have also been made aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.
By signing below, I state that I am over eighteen (18) years of age and wish to participate in the research being conducted by Mr K Nyandoro.

Name of participant: …………………………………………………………..
Signature of participant: …………………………………………………………..
Signed at: …………………………………………………………..
Date: …………………………………………………………..

APPENDIX G: A letter requesting parental consent for participation of minors in a research project

Mochedi Secondary School
P.O. Box 222
Lonsdale
18 August 2016

Dear Parent,

My name is Kingston Nyandoro. l am a student at UNISA and am presently enrolled for the M. Ed degree with a specialisation in mathematics education. In order to complete the requirements for the degree, l need to conduct a research that will involve mathematical literacy teachers at the school where your child attends. My research will focus on language as a factor of achievement in mathematical literacy at Grade 12 in Moloto circuit.

Your child …………………………………………………………………………………………………. is being invited to participate in a study entitled: ***Language as a factor in the learning of mathematical literacy at Grade 12 in Moloto circuit of Limpopo province***. The purpose of the study is to examine the influence of language in the teaching and learning of mathematical literacy at Grade 12 in Moloto circuit. The possible benefits of the study are the improvement of teaching and learning of mathematical literacy. I am asking permission to involve your child in this study because he/she will be required to fill a questionnaire together with children of their class. If you allow your child to participate, l shall request him/her to complete a questionnaire.

Any information that is obtained in connection with this study will remain confidential and will only be disclosed with your permission. His/her responses will not be linked to his/her name or your name in any written or verbal report based on this study. Such a report will be used for research purposes only. There are no foreseeable risks to your child by participating in the study. Neither your child nor you will receive any type of payment for participating in this study. Your child's participation in this study is voluntary.

The study will take place during regular classroom activities with the prior approval of the school principal and your child's teacher. In addition to your permission your child must agree to participate in the study and your child will also be asked to sign the consent form. The information gathered from the study and your child’s participation in the study will be stored securely on a password locked computer in my locked office for five years and thereafter records will be erased.

If you have question about this study please ask my study supervisor Prof M.G Ngoepe of the department of mathematics education of UNISA on telephone number 0124298375. My phone number is: 0787409671. My email address is knyndoro1@yahoo.co.uk. My supervisor’s email address is ngoepmg@unisa.ac.za.You are making a decision about allowing your child to participate in this study. Your signature below indicates that you have read the information provided above and have decided to allow him/her to participate in the study.

Sincerely yours

Kingston Nyandoro

APPENDIX H: Questionnaire for learners

The purpose of this questionnaire is to find out your views about how the language used in the teaching and learning of Mathematics Literacy (ML) to Grade 12 learners of Moloto Circuit affect their performance in Mathematical Literacy examinations. Kindly respond to the questions given below as frankly and honestly as possible.

Section A

Please answer the following by ticking the number that corresponds to your answer.

Tick with an X

1. Gender: Male ☐
   Female ☐

2. Age: 12 – 15 Years ☐
   16 – 18 Years ☐
   19 - 21 Years ☐

3. The area where I have lived most of my school career is in
   Rural ☐
   Urban ☐

4. Home Language: Sepedi ☐
   Ndebele ☐
   IsiZulu ☐
   Venda ☐
   Shangani ☐
   Other ☐

Section B

The following statements are designed to seek your responses regarding the language used in the teaching and learning of ML to Grade12 learners. For each statement, tick category which best describes your response.

	Strongly disagree (1)	Disagree (2)	Undecided (3)	Agree (4)	Strongly agree (5)
5. I find problems on answering ML questions well because I don't understand some of the English terms that are used in setting questions.					
6. I sometimes fail to understand and answer questions in ML asked by the teacher when he uses the English language.					
7. ML gives me problems because I don't understand the English terms that are used.					
8. When the teacher ask a question using English and I fail to understand it, I am afraid to ask the teacher to repeat the question because I find it difficult to ask a question using the English language.					
9. Most questions in ML are too long so I fail to understand them well as to whether I should add, subtract, multiply or divide to get the correct answer.					
10. When the teacher is revising a test with us, I understand but when I try to do on my own I fail to repeat the steps to follow in order to arrive at a correct answer.					
11. I fail to get high marks in ML because I don't understand English very well and ML is all about English.					
12. I usually fail to transfer Mathematical ideas I know in my home language into content in English language and as such it becomes a problem to me to understand Mathematical ideas that are presented in English.					

13. ML is a problem to me because I don't ask questions to the teacher when I fail to understand what the teacher is teaching.					
14. ML is problem to me because the teacher uses the English language every time he is teaching.					
15. I understand ML better when the teacher uses my mother language (Sepedi) when he is teaching.					
16. I don't understand ML because I don't understand the way the teacher teaches because he is using English to teach.					

From item 17 respond in your own words to the following questions

17. Do you find ML difficult? State YES or NO ……………………………………………………

Give reasons for your answer.

REASONS

………

18. What are the challenges that you face when you are taught using English as the language of instruction in your mathematical literacy classes?

………

19. Which language would you prefer the teacher to use when he is teaching you mathematical literacy? Why do you prefer this language?

………

20. Give TWO or THREE reasons why you think learners of Grade 12 fail to achieve high marks in mathematical literacy examinations?

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………

21. Do you understand ML examination questions well in the way they are set?
State YES or NO
……………………………………………………………………………..

Give suggestions on how ML questions should be set in order that you understand them better. SUGGESTION:

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
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…………………………………………………………………………………………………
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22. Give suggestions on how teachers could teach Mathematical literacy in order for learners to understand better and as such achieve higher marks in mathematical literacy examinations?
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…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
……………………………………………………………………………

FROM ITEM 23 respond on the spaces provided showing NECESSARY WORKING where applicable.

23. John has planned to spend R1000 for birthday present for his mother. He bought a watch for R500, a cake for R200 and groceries for R400.

(a) How much money has John budgeted for his mother's birthday?

……
……
…………..………………………………

(b) Did John exceeded his budgeted amount? Justify your answer.

……
……
……
………………………………

(c) On another day, John decided to please his father and bought him a bicycle at a cost of R1000

excluding 14% VAT. How much did he pay for the bicycle including VAT?

……
……
……
……
……
……
…

(d) John is earning a monthly salary of R1200. His salary was decreased by R200. What is his new monthly salary?

……
……
……
……………………………………………………………

(e) Simon is working at the same company with John and is earning a higher salary of R1500 a month. His salary was increased by R1000. What is his new monthly salary?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
…………………………………………………………………

24. Peter is working at Shoprite as a cleaner. In this case;

(a)The employer is ……………………………………………………………………………………………...…

(b)The employee is ……………………………………………………………………………………………..…

25. John weighs 65kg and Peter weighs 60kg. Calculate the difference in their masses.

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
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26. On one Saturday Thembeka spend R80 on food and R40 on airtime. Thembeka states that the amount of money she can spend on any given Saturday does not exceed R100. Verify with calculations whether Thembeka's statement is valid.

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
…………………………………………………………………

27. Mr Ncube wanted to buy a radio valued at R1000. He paid a deposit of R200. Calculate the balance.

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
…………………………………………………………………

28. The distance from Polokwane to Johannesburg is 360km. Andrew has a car which consumes petrol above normal consumption. For him to travel to travel to travel Johannesburg and back he

requires R1200 worth of fuel. If he travels with public transport he would require a maximum of R500 for the same journey. Give ONE economic reason why it is not advisable for Andrew to use his car for this journey.

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…………………………………………

29. Tom said with certainty that his father has gone to town.

What is the most appropriate statement A, B, C or D that refers to Tom's statement?

A Tom is not sure whether his father has gone to town or not.

B Tom is 100% sure that his father has gone to town.

C Tom thinks his father has gone to town.

D Tom does not know whether his father has gone to town or not.

Answer

………………………………………………………………………

…………………………………………..

30. The shoe sizes of 5 learners are given below

2 4 5 7 7

Answer the following questions:

(a) Is the data above discrete or continuous?

………………………………………………….……..

(b) The median shoe size is

…………………………………………………………………….……

(c) The modal shoe size is

………………………………………………………………………………

(d) The minimum shoe size is

……………………………………………………………………………..

(e) The range is

……………………………………………………………………………..…………

(f) The mean shoe size is ....

APPENDIX I   Questionnaire to educators

The purpose of this questionnaire is to find out your views about how the language used in the teaching and learning of Mathematics Literacy (ML) to Grade 12 learners of Moloto Circuit affect their performance in Mathematical Literacy examinations. Kindly respond to the questions given below as frankly and honestly as possible.

Section A

Please answer the following by ticking the number that corresponds to your answer.

1. Years in the current position as Educators.

   0 – 5 Years ☐
   6 – 10 Years ☐
   11 - 15 Years ☐
   16 – 20 Years ☐
   21 – 25 Years ☐
   26 years and older ☐

2. Highest formal qualification

   P.T.C. ☐
   P.T.D. ☐
   J.S.T.C. ☐
   S.T.D. ☐
   B Ed. ☐
   H.E.D. ☐
   B.A.Ed. ☐
   M Ed ☐
   Any Other (State)

……………………………………………………………………

Section B

The following statements are designed to seek your perceptions regarding the language used in the teaching and learning of ML to Grade12 learners. For each statement, tick category which best describes your response.

	Strongly disagree (1)	Disagree (2)	Undecided (3)	Agree (4)	Strongly agree (5)
3. Poor English language proficiency affect the academic performance of Grade 12 learners in ML.					
4. Learners fail to answer questions in ML well because they fail to understand the questions.					
5. Learners do not comprehend well concepts taught in ML because they don't ask questions in situations where they fail to understand what the teacher is teaching.					
6. Learners in Grade 12 would obtain a pass and even higher marks in ML if they can be taught using the mother tongue.					
7. If ML textbooks can be written in the learner's mother tongue, the examinations written in the mother tongue, then the learners would obtain higher marks in ML examinations.					
8. Learners fail to achieve best in ML questions because the questions are too long and learners fail to comprehend the requirements of the question.					
9. Learners would understand and answer ML questions successfully if the teacher would explain first the Mathematical terms that are used in Mathematical Literacy, e.g. Product, sum, square, difference, etc. then proceed to teach related concepts for which the words are used.					
10. Learners contribute positively in class discussion when I am teaching and give correct responses but fail to respond correctly when they are answering questions individually in ML tests and examinations.					

11. I prefer to use mother language instruction in Grade 12.					
12. I face challenges with the use of English for teaching and learning.					
13. I used code switching to enhance teaching and learning. (N.B Code is switching alternating between the language of teaching and vernacular)					
14. I use English as a medium of instruction when I am teaching ML.					

From item 15, respond in your own words to the following questions:

15. What are the challenges that you face when you are teaching Mathematical literacy using English as the language of instruction to your Grade 12 learners?..
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16. Which language of communication would you prefer to use when you teach Mathematical literacy to your Grade 12 learners? Why would you prefer to use this language?
....
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17. In your opinion, what would you think are the major reasons Grade 12 learners failing to achieve high marks in Mathematical literacy Examinations?
....
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18. Give TWO or THREE suggestions on how mathematical literacy examination questions should be set so that learners will understand them better
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
………………………………………………………………………………

19. Give TWO or THREE suggestions on how teachers of Grade 12 Mathematical Literacy should teach using English as a medium of instruction in order that learners understand better and as such achieve higher marks in Mathematical literacy

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20. (a) In your opinion, what are the learning difficulties faced by learners when they are taught Mathematical Literacy using a second language as a medium of instruction?

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(b) How can you as a Grade 12 Mathematical Literacy teacher do in order to encounter such difficulties?

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APPENDIX J: Mathematical literacy p1 November 2016

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MATHEMATICAL LITERACY P1

NOVEMBER 2016

MARKS: 150

TIME: 3 hours

This question paper consists of 10 pages, 2 answer sheets and an addendum with 4 annexures (5 pages).

Please turn over

INSTRUCTIONS AND INFORMATION

1. This question paper consists of FIVE questions. Answer ALL the questions.

2. 2.1 Use the ANNEXURES in the ADDENDUM to answer the following questions:

   ANNEXURE A for QUESTION 1.1
   ANNEXURE B for QUESTION 3.1
   ANNEXURE C for QUESTION 3.2
   ANNEXURE D for QUESTION 5

   2.2 Answer QUESTION 1.2.4(a) on the attached ANSWER SHEET 1.
   Answer QUESTION 4.2.6 on the attached ANSWER SHEET 2.

   2.3 Write your centre number and examination number in the spaces on the ANSWER SHEETS. Hand in the ANSWER SHEETS with your ANSWER BOOK.

3. Number the answers correctly according to the numbering system used in this question paper.

4. Start EACH question on a NEW page.

5. You may use an approved calculator (non-programmable and non-graphical), unless stated otherwise.

6. Show ALL calculations clearly.

7. Round off ALL final answers appropriately according to the given context, unless stated otherwise.

8. Indicate units of measurement, where applicable.

9. Maps and diagrams are NOT necessarily drawn to scale, unless stated otherwise.

10. Write neatly and legibly.

QUESTION 1

1.1

ANNEXURE A shows a home loan statement and transaction history for the period 22 September 2013 to 22 March 2014.

NOTE:
- The period of the home loan is 20 years.
- The monthly administration fee remains constant throughout the period of the loan.
- The interest rate changed only once during this statement period.

Use ANNEXURE A to answer the questions that follow.

1.1.1 Give the name of the borrower. (2)

1.1.2 State the end date (month and year) of the loan. (2)

1.1.3 Calculate the difference between the insured value of the property and the registered bond amount. (2)

1.1.4 Determine the total administration fee payable for the whole loan period. (3)

1.1.5 On 30 January 2014 the interest rate was decreased by 0,5%.

Find the interest rate used before 30 January 2014. (2)

1.1.6 Calculate the VAT amount that is included in the monthly administration fee. (3)

1.1.7 Explain the term *home loan*. (2)

1.1.8 Choose ONE of the following statements that correctly explains why the interest amounts charged for February and March are different:

A The interest rate changed.
B Interest is charged on the daily outstanding balance.
C The amount of interest decreases monthly. (2)

1.1.9 Due to a bank error the debit order was unpaid on 1 October 2013. The debit order was paid on 2 October 2013. The bank rectified the error by making an adjustment, as shown in the statement.

(a) Calculate the adjustment amount. (2)

(b) Hence, state whether this adjustment amount should be reflected as a debit or a credit. (2)

1.1.10 Calculate the amount of interest due on 1 April 2014 to be shown on the next statement.

You may use the formula: $\textbf{Interest} = \dfrac{\mathbf{B \times n \times r}}{\mathbf{365}}$ where

B = balance on 1st of the previous month
n = the number of days in the month
r = the interest rate (3)

1.2 Khumu is planning an event to raise funds for needy learners.

Part of her plan is to find a suitable venue for about 200 to 300 people. She obtains quotations from three different service providers. Each venue had a fixed rental cost as well as a variable cost per person.

TABLE 1 below shows the costing structure of these three venues.

TABLE 1: VENUE COSTING STRUCTURE

VENUE	FIXED RENTAL COST	VARIABLE COST PER PERSON
Avon	R3 000	R75
Beach Hotel	R6 000	R45
Castle	R11 000	R25

The graphs representing the total cost of the three venues are given on ANSWER SHEET 1.

Use the information in the table above and the graphs on ANSWER SHEET 1 to answer the questions that follow.

1.2.1 Explain the term *variable cost* in this context. (2)

1.2.2 Calculate the exact total cost of renting the Beach Hotel venue for 230 people.

You may use the following formula:

Total cost (in rand) = fixed cost + 230 × variable cost (3)

1.2.3 Determine:

(a) The cheapest venue if only 90 persons attend the event (2)

(b) The maximum number of people that can attend the event if the total cost of the venue is R15 000 (2)

1.2.4 Khumu sells the tickets for R150 each.

(a) Draw the income graph from the sale of up to 200 tickets on the same grid as the total cost graphs on ANSWER SHEET 1. (4)

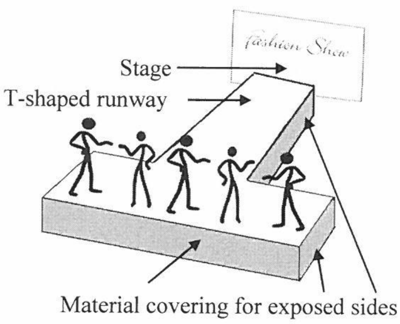
(b) Calculate the total profit to be made if she rents the Castle venue and pays for 250 people, but sells only 194 tickets. (5)

[43]

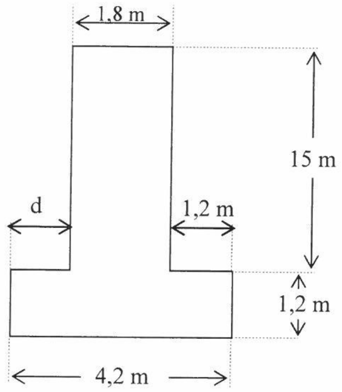
QUESTION 2

2.1 Kataryna is planning a fashion show and intends using the school hall for the event. The hall has a stage and she plans to have a raised T-shaped platform, called a runway, erected in front of the stage, as shown in the diagrams below.

3D diagram of the T-shaped runway



Top view of the T-shaped runway



The SEVEN exposed rectangular sides of the T-shaped runway will be covered with material. The top of the runway will be carpeted. The total length of the runway is equal to $\frac{1}{3}$ of the length of the hall.

[Adapted from www.jerichostage.com]

2.1.1 Calculate:

(a) The missing value **d** (in mm) (3)

(b) The total length (in mm) of the exposed sides of the runway (3)

(c) The area (in m²) of the runway that needs to be covered with carpet

You may use the following formula:

Area of a rectangle = length × width (4)

(d) The length (in m) of the hall (3)

2.1.2 Harry, a British model, wants to know the measurement (in feet) of the front end of the runway.

Convert 4,2 m to feet, rounded off to one decimal place.

NOTE: 1 foot = 0,3048 m (3)

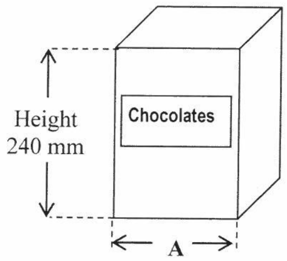
2.2 The organisers of the fashion show decide to hand out chocolates to the audience at the entrance. The pictures and diagrams below show the two different containers in which the chocolates will be packed.

Pictures of different containers

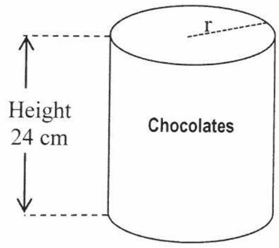
Container with a square base

Cylindrical container

Diagram of different containers



Volume = 3 456 cm^3



Radius (r) = 7 cm

2.2.1 Determine **A**, the length (in cm) of ONE side of the square base.

You may use the following formula:

Volume of box with square base = (side)² × height (4)

2.2.2 The organisers of the fashion show want to use their own label around the outer curved side of the cylindrical container. The label will be 1 cm longer than the circumference of the circular base to allow for an overlap.

Determine the total area (to the nearest cm^2) of all the labels that will be required for 76 cylindrical containers.

You may use the following formula:
Area of one label (in cm^2) = [1 + 2 π × r] × height
using π = 3,142 (4)

2.2.3 Show, with calculations, that the volume of the cylindrical container is 238,99 cm^3 more than the volume of the container with the square base.

You may use the following formula:
Volume of cylinder = π × r² × height using π = 3,142 (3)

2.2.4 State the most appropriate metric unit of measure for the mass of a container of chocolates. (2)

[29]

QUESTION 3

3.1

Rahim's favourite band is performing at an open-air arena. The seating plan of the arena is shown in ANNEXURE B.

Use ANNEXURE B to answer the questions that follow.

3.1.1 Determine the total number of seats available in the middle block. (3)

3.1.2 Give the compass direction from seat E12 towards the stage. (2)

3.1.3 Rahim is seated exactly in the middle of a row in the middle block. The row he is seated in has an odd number of seats and is furthest from the stage.

Name the row and seat number where he is seated. (3)

3.1.4 Mali is seated at D14. She decides to go to the refreshment stand which is directly east of the lighting box.

Give the directions for the route from her seat to the refreshment stand. (4)

3.1.5 Determine the probability of randomly choosing a spectator to join the band on the stage if $87\frac{1}{2}\%$ of all the seats in the arena are occupied. (3)

3.1.6 It is predicted that it is most unlikely that it will rain on the night of the performance. Choose ONE of the values below that best describes this probability:

1,0 $\quad \mathbf{\frac{1}{2}} \quad$ **0,0** $\quad$ **40%** $\quad \mathbf{\frac{3}{5}} \quad$ **0,8** $\quad$ **20%** (2)

3.2 ANNEXURE C shows the assembly diagrams for a floor lamp.

Use ANNEXURE C to answer the questions that follow.

3.2.1 Refer to DIAGRAM 4.

(a) Must the nut be screwed or unscrewed? (2)

(b) Give the direction in which the nut should be turned. (2)

3.2.2 How many screws are needed to assemble the lamp shade? (2)

3.2.3 Which diagram is associated with the instruction: 'Join the stand to the base.'? (2)

3.2.4 The total height of the floor lamp in the picture is 62 mm.

Determine the actual height (in m) of the floor lamp if the scale of the diagram is 1 : 30. (3)
[28]

QUESTION 4

4.1 The motorcycle land-speed record is the fastest speed achieved by a motorcyclist on land.

TABLE 2 below shows the motorcycle land-speed records from 1930 to 2010.

TABLE 2: MOTORCYCLE LAND-SPEED RECORDS IN MILES PER HOUR

YEAR	SPEED	RIDER	YEAR	SPEED	RIDER
1930	137,23	Joseph S Wright	**1956**	214,50	John Allen
1930	137,58	Ernst J Henne	**1962**	224,57	William Johnson
1930	150,65	Joseph S Wright	**1966**	245,67	Robert Leppan
1932	151,77	Ernst J Henne	**1970**	254,84	Cal Rayborn
1934	152,81	Ernst J Henne	**1975**	302,92	Don Vesco
1935	159,01	Ernst J Henne	**1978**	318,60	Don Vesco
1936	168,92	Ernst J Henne	**1990**	322,15	Dave Campos
1937	169,68	Eric Fernihough	**2006**	342,80	Rocky Robinson
1937	170,27	Piero Taruffi	**2006**	350,88	Chris Carr
1937	173,68	Ernst J Henne	**2008**	360,91	Rocky Robinson
1951	180,29	Wilhelm Herz	**2009**	367,38	Chris Carr
1955	184,83	Russell Wright	**2010**	376,36	Rocky Robinson
1956	193,73	John Allen			

[Adapted from Wikipedia/Landspeedrecords]

Use TABLE 2 to answer the questions that follow.

4.1.1 Determine the difference between the highest and lowest land-speed records that were set between 1950 and 2000. (3)

4.1.2 Determine the number of riders that set new land-speed records from 1930 to 2010. (2)

4.1.3 Identify the TWO years during which the land-speed record remained unbroken for the longest time AND also state the number of years the record remained unbroken. (3)

4.1.4 Name the rider that held the land-speed record the most number of times AND also state how many times this rider held the record. (3)

4.1.5 Determine the probability (as a percentage) of randomly selecting a land-speed record in TABLE 2 that was set during the 21st century. (3)

4.2 TABLE 3 below shows the numbers and percentages of children from three age groups who did not attend any South African educational institution from 2002 to 2009.

TABLE 3: NUMBERS AND PERCENTAGES OF CHILDREN NOT ATTENDING ANY SOUTH AFRICAN EDUCATIONAL INSTITUTION FROM 2002 TO 2009

	AGE GROUPS					
	7 to 15		**16 to 18**		**7 to 18**	
Year	**Number of children**	**%**	**Number of children**	**%**	**Number of children**	**%**
2002	345 501	3,7	514 534	17,6	860 035	7,0
2003	265 328	2,8	522 914	17,2	788 242	6,4
2004	216 678	2,3	520 016	17,3	736 694	6,3
2005	209 309	2,2	539 177	17,8	**A**	6,0
2006	227 324	2,4	551 628	17,5	778 951	6,2
2007	200 520	2,1	477 411	14,8	677 931	5,4
2008	194 901	**B**	525 200	16,2	720 101	5,7
2009	142 843	1,5	519 576	16,7	662 419	5,3

[Adapted from www.statssa.co.za]

Use TABLE 3 to answer the questions that follow.

4.2.1 State why the data for the number of children is regarded as discrete data. (2)

4.2.2 Identify the age group where the majority of children did not attend any educational institution. (2)

4.2.3 Give the year during which the age group 16 to 18 showed the best attendance. (2)

4.2.4 Determine the missing value **A**. (2)

4.2.5 Determine the missing value **B**, if the total number of children in that age group was 9 281 000 in 2008. (3)

4.2.6 Draw a broken line graph on ANSWER SHEET 2 to represent the percentage of children in the age group 16 to 18 not attending any educational institution from 2002 to 2009. (5)
[30]

QUESTION 5

One of the ways to compare the purchasing power of one country's currency to another country's currency is to compare the local price of common items that are available in all the countries. The average local price of a Big Mac burger and a 2 ℓ cola as well as the exchange rates are given in TABLE 4 in ANNEXURE D.

Use ANNEXURE D to answer the questions that follow.

5.1 Identify the country that has the strongest currency in comparison to the rand. (2)

5.2 Calculate the price in rand that you will pay for a 2 ℓ cola in the United States of America. (2)

5.3 Determine the missing values:

5.3.1 **A** (2)

5.3.2 **B**, the value of ONE Indian rupee in rand (2)

5.4 Determine the simplified ratio of the Singapore price of a Big Mac Burger to a 2 ℓ cola. (3)

5.5 Identify the TWO countries that have almost similar purchasing power. (2)

5.6 Define the term *median*. (2)

5.7 Use the prices in rand for a Big Mac Burger to do the following:

5.7.1 Arrange the data in descending order (2)

5.7.2 Calculate the mean price (3)
[20]

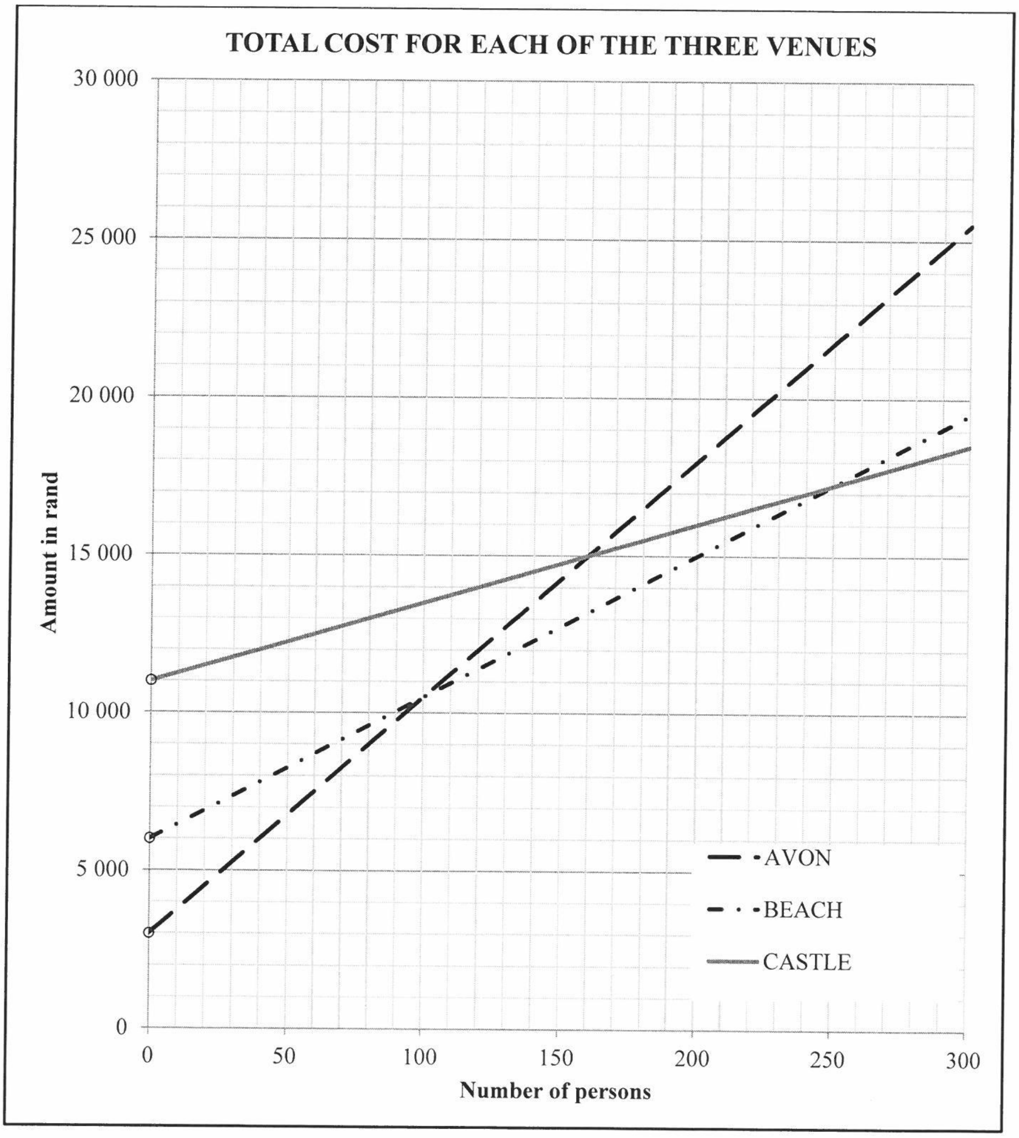
TOTAL: 150

ANSWER SHEET 1

CENTRE NUMBER: □□□□□□□□

EXAMINATION NUMBER: □□□□□□□□□□□□□

QUESTION 1.2.4(a)

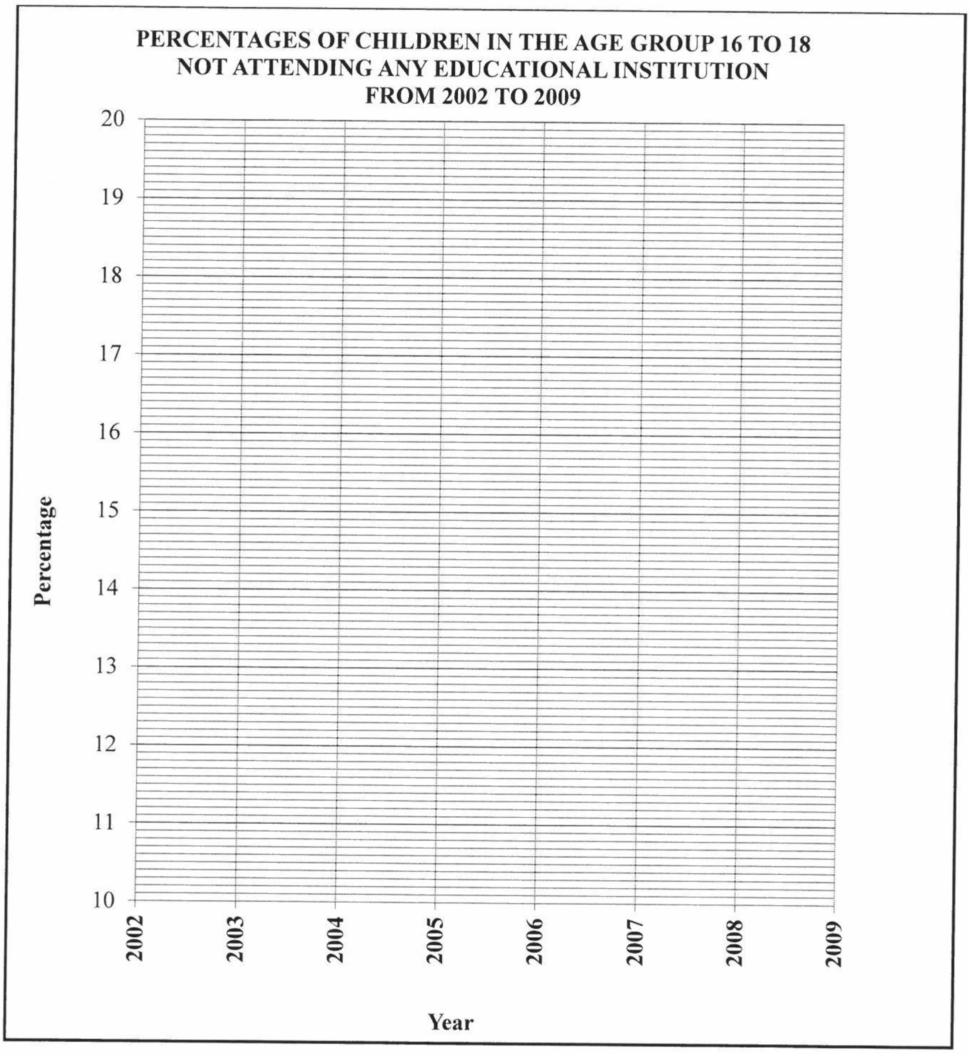


ANSWER SHEET 2

CENTRE NUMBER: | | | | | | | | |

EXAMINATION NUMBER: | | | | | | | | | | | | | |

QUESTION 4.2.6



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICAL LITERACY P2

NOVEMBER 2016

FINAL MARKING GUIDELINE

MARKS: 150

Symbol	**Explanation**
M	Method
MA	Method with accuracy
CA	Consistent accuracy
A	Accuracy
C	Conversion
S	Simplification
RT/RG/RD	Reading from a table/graph/map/diagram
SF	Correct substitution in a formula
O	Opinion/reason/deduction/example

P	Penalty, e.g. for no units, incorrect rounding off, etc.
R	Rounding off
NP	No penalty for rounding
AO	Answer only full marks
J	Justification

This memorandum consists of 19 pages.

 Please turn over

APPENDIX K Mathematical literacy p2 November 2016

QUESTION 1 [36 MARKS]

Ques	Solution	Explanation	T&L
1.1.1	P(even number date) = $\frac{11}{22}$ ✓✓A ✓A	2A numerator 1A denominator AO (3)	P L2

	= $\frac{1}{2}$ or 0,5 or 50%		
1.1.2	• Quality of bank services / security / perks. □□O **OR** • Proximity or accessibility of the bank. □□O **OR** • Marketing/advertising appeal □□O **OR** • Loyalty to bank □□O **OR** □□O • Religious reasons / Economical reasons Any other suitable reason	2O reason (2)	F L4

1.1.3	2014 Fee = R3,50 + 1,1% × R1 000 □SF = R14,50 □CA % change = $\left(\frac{R15,50}{R14,50} - 1\right) \times 100\%$ □SF = $\left(\frac{R1,00}{R14,50}\right) \times 100\%$ □CA = 6,8965517… A ≈ 6,9% □R **OR** □SF % change = $\left(\frac{R15,50}{R3,50 + 0,011 \times R1\,000} - 1\right) \times 100\%$ □SF = $\left(\frac{R15,50}{R14,50} - 1\right) \times 100\%$ □□ CA = 6,8965517… □CA A ≈ 6,9% □R	1SF substituting R1000 1CA 2014 fee 1SF correct values 1CA simplification 1R rounding **OR** 1SF correct values 1SF substituting R1000 1CA 2014 fee 1CA simplification 1R rounding (5)	F L2

Please turn over

Ques	**Solution**	**Explanation**	**T&L**

1.1.4	Withdrawal fee R15 000 at Bank X □SF = R3,95 + 0,013 × R15 000 = R198,95 □CA Fees for 4 withdrawals = R198,95 × 4 = R795,80 □CA Withdrawal fee for R15 000 at Bank Y = R4,00 + R15 000 × 1,15% = R176,50 □CA Fees for 4 withdrawals = 4 × R176,50 = R706,00 □CA Difference in fees = R795,80 – R706,00 = R89,80 □CA □CA It is NOT VALID. □O □ □CA	1SF substituting 1CA weekly charges 1CA fees for 4 withdrawals 1CA charges 1CA fees for 4 withdrawals 1CA difference 1O conclusion **OR**	F L4

	OR		
	Withdrawal fee R15 000 at Bank X	1MA substituting	
	✓MA = R3,95 + 0,013 × R15 000	1CA weekly charges	
	= R198,95 ✓CA		
	Withdrawal fee for R15 000 at Bank Y		
	= R4,00 + R15 000 × 1,15%	1CA charges	
	= R176,50 ✓CA	1CA difference	
	Difference in fees = R198,95 – R176,50 = R22,45	1M fees for 4 withdrawals 1CA October charges	
	✓M Saving on 4 withdrawals = R22,45× 4 = R89,80	1O conclusion	
	It is NOT VALID ✓O	**OR**	
	OR		

Ques	Solution	Explanation	T&L
	Bank X: Fee per R1 000 = R3,95 + R1,30 ÷ 100 × 1 000 □MA = R16,95 □CA Withdrawal fee for R15 000 = R16,95 × 15 = R254,25 For 4 withdrawals : R254,25 × 4 □M = R1 017 Bank Y: Withdrawal fee for 4 times R15 000 = R15,50 × 4 × 15 □CA = R930 □CA Difference in fees = R1 017 – R930 = R87 □CA It is NOT VALID	1MA substituting 1CA weekly charges 1M fees for 4 withdrawals 1CA charges 1CA October charges 1CA difference 1O conclusion (Max of 6 marks for a total withdrawal of R60 000 .) (7)	

1.1.5	Wage for 4 full weeks = R2 142,85 × 4 □A = R8 571,40 Wage for 2 days = $\frac{R2\ 142,85}{5}$ □M ×2 □M = R857,14 Total wage = R8 571,40 + R857,14 = R9 428,54 □CA **OR** Average day wage = $\frac{R2\ 142,85}{5}$ □M **OR** $\frac{R2142,85 \times 4}{20}$ = R428,57 □A Total wage for October = 22 × R428,57 □M = R9 428,54 □CA **OR** 2 days of a five day week = $\frac{2}{5}$ □M of a week	1A 4 weeks wage 1M divide by 5 1M multiply by2 1CA total wage **OR** 1M divide by 5 1A daily wage 1M multiply by 22 1CA total wage **OR** 1M divide by 5 1A number of weeks 1M multiply by weekly wage 1CA total wage **OR**	F L2

	Total number of weeks = $4\frac{2}{5}$ ✓A **OR** 4,4 Total wage for October = $4\frac{2}{5}$ × R2142,85 ✓M = R9 428,54 ✓CA **OR**		

Ques	Solution	Explanation	T&L
	✓M 52 ✓A Monthly wage = R2 142,85 × — 12 ✓MA = R9 285,68 ✓CA	1M multiplying 1A 52 weeks in year 1MA dividing by 12 1CA total wage (4)	

1.2.1	• More small/local companies may have entered the market □□O □□O • The increased use of smartphones, laptops and tablets □□O • Locally produced no need to import. • Cost of transport increased □□O • Economical reasons / factors □□O • Maritime piracy / security □□O • Other means of transport used □□O □□O • Durability - demand for new computers became less Or any other valid factors with reasons	2O factor with reason 2O factor with reason (4)	D L4
1.2.2	Q1 of 2012: □MA (15,7 + 11,7 + 10,1 + 9 + 5,4) million □CA = 51,9 million **or** 51 900 000 Q1 of 2013: = (12 + 11,7 + 9 + 6,2 + 4,4) million □MA = 43,3 million **or** 43 300 000	1MA adding correct values 1CA total shipment in 2012 1MA total shipment in 2013	D L2

	Difference between 2013 and 2012 □CA = 51,9 mil – 43,3 mil = 8,6 million **or** 8 600 000 **OR**	1CA difference in million **OR**	

Ques	Solution	Explanation	T&L
	Differences (in millions) for A = 15,7 – 12,0 = 3,7 □A B = 11,7 – 11,7 = 0 □A C = 10,1 – 9,0 = 1,1 D = 9,0 – 6,2 = 2,8 □M E = 5,4 – 4,4 = 1 Total difference = (3,7 + 1,1 + 2,8 + 1) million □CA = 8,6 million	2A differences in millions 1M adding all differences 1CA total difference in million Penalty if million omitted (4)	

1.2.3	□RT □M 12 000 000 – 15 700 000 % change A = × 100 % ——————————— 15 700 000 = – 23,56687898% □CA □RT 6 200 000 – 9 000 000 % change D = × 100 % □M ——————————— 9 000 000 = – 31,11111111% □CA □M The statement is NOT VALID. □O □M **OR** Percentage of 2012 shipped in 2013: □RT By A: $\frac{12{,}0}{15{,}7}\times 100\%$ = 76,43% □A ∴ Percentage decrease = 100% – 76,43% = 23,57% □RT	1RT correct values 1M calculating % change 1CA % change 1RT correct values 1M calculating % change 1CA % change 1O conclusion **OR** 1RT correct values 1A percentage 1M % change 1RT correct values 1A percentage 1M % change	D L4

	By D: $\frac{6,2}{9} \times 100\%$ $= 68,89\%$ A $\therefore$ Percentage decrease = 100% – 68,89% = 31,11% O D shows the greatest decrease, the statement is NOT VALID	1O conclusion NP (7)	
		[36]	

QUESTION 2 [47 MARKS]			
Ques	**Solution**	**Explanation**	**T&L**

2.1.1 (a)	A Amount × 109,7% = R218,9 billion R218,9 billion Total amount spent = $\frac{\text{R218,9 billion}}{109,7\%}$ M = R199 544 211 500 CA **or** R199,54 billion or R1,9954 × 10^{11}	1A correct value and % 1M dividing by 109,7% 1CA total amount NP (3)	F L2
2.1.1 (b)	A It is more appropriate to round to one decimal place. If a rand value in billions is rounded off to a whole number, the amount that is added or lost is hundreds of millions of rands. O **OR** A It is not appropriate to round to off to a whole number since it has a big financial implication O	1A statement 2O explanation (Note: More appropriate can be implied in the statement) (3)	F L4

2.1.2	✓A ✓A International: 43% of R 218,9 billion = R94,127 billion Number of visitors = 14,3 million or 14 300 000 \\ ✓C Average spent per visitor = $\dfrac{R94\ 127\ 000\ 000}{14\ 300\ 000}$ ✓MA = R6 582,31 ✓CA This is NOT correct. ✓O **OR** ✓A ✓A International: 43% × R 218,9 billion = R94,127 billion ✓C Average spent per visitor = $\dfrac{R94,127 \times 1\ 000 \text{ million}}{14,3\text{million}}$ = R6 582,31 ✓CA This is NOT correct. ✓O **OR** ✓MA	1A percentage 1A amount 1C conversion 1MA average 1CA value 1O conclusion **OR** 1A percentage 1A amount 1C conversion 1MA average 1CA value 1O conclusion **OR**	F L3

Ques	Solution	Explanation	T&L
	Amount spent by the International visitors □MA = R6 580 × 14,3 million □A □C = R94 094 million = R94,094 billion But spent by international tourists is □A □A 43% × R 218,9 billion = R94,127 billion The amount was NOT CORRECT □O	1MA multiplying 1A amount 1C conversion 1A percentage 1A amount 1O conclusion (6)	
2.1.3	□A □A Air transport and road transport	1A for each item (2)	F L2
2.1.4	Payment of tourism levy □□O **OR** □□O Purchase of souvenirs **OR** □□O Entrance fees to tourist attractions **OR** □□O Any other suitable example	2O example (2)	F L4

2.1.5	Growth in 2014 = 2,9% × R103,6 billion □M = R3,0044 billion □M GDP contribution (2014) = (R3,0044 + R103,6) billion = R106,6044 billion □CA Growth in 2015 = 2,9% × R106,6044 billion = R3,0915276 billion GDP contribution (2015) = (R3,0915276 + R106,6044) billion = R109,6959276 billion □CA Growth in 2016 = 2,9% × R109,6959276 billion = R3,1811819 billion GDP contribution (2016) = (R3,1811819 + R109,6959276) bil. = R112,8771095 billion □CA □□R = R112 877 million **or** R112 877 000 000 **or** R112,877 billion **OR**	1M multiplying 1M adding 1CA amount in 2014 1CA amount in 2015 1CA amount in 2016 1R correct rounding **OR**	

Ques	**Solution**	**Explanation**	**T&L**

2.1.5	□A □M GDP contribution (2014) = 102,9% × R103,6 billion = 106,6044 billion □CA GDP contribution 2015 = 102,9% × R106,6044 billion = 109,6959276 billion □CA GDP contribution 2016 = 102,9% × R109,6959276 billion = R112,8771095 billion. □CA = R112 877 million □R **or** R112 877 000 000 **OR** GDP contribution 2016 □M □A □A = R103,6 billion × 102,9% × 102,9% × 102,9% = R112,8771095 billion. □CA = R112,877 billion **or** R112 877 million □C **or** R112 877 000 000 □R	1M multiplying 1A 102,9% 1CA amount in 2014 1CA amount in 2015 1CA amount in 2016 1R correct rounding 1M multiplying 2A 102,9% CA amount in 2016 1C conversion 1R correct rounding (6)	F L3

2.2.1 (a)	RT Stopover times = 5 + 20 + 5 + 2 + 8 + 2 + 2 + 2 + 23 + M 26 + 3 + 17 + 3 + 14 + 3 + 3 CA = 138 minutes **or** 2 hrs and 18 minutes **or** 2,3 hours	3RT correct stopover times 1M adding stopover times 1CA total stopover time Stopover times: One or two errors only 1 mark penalty, Three or four errors 2 mark penalty AO (5)	D L2
2.2.1 (b)	2 and 3 minutes CA	CA From Q2.2.1 (a) 2CA modal time (2)	D L2

Ques	Solution	Explanation	T&L

2.2.1 (c)	Actual train travel time: ✓RT 13:24 (day2) to 17:30 (day1) – stopover time ✓CA = 19 hr 54 min – 2 hr 18 min ✓M = 17 hr 36 min = 17, 6 hr ✓C D = S × T ✓SF 992 km = S × 17hr 36 min $S = \frac{992\ \text{km}}{17{,}6\ \text{hour}}$ ✓S = 56,36 km/h ✓CA **OR** ✓RT ✓CA Total time = 24 hours – 17h30 + 13h24 = 19hr 54 min ✓M 19hr 54 min – 2 hrs 18 min = 17 hrs 36 min = 17,6 hr ✓C D = S × T ✓SF 992 km = S × 17,6 hr $S = \frac{992\ \text{km}}{\phantom{17{,}6}}$ ✓S	CA From Q2.2.1(a) 1RT start and end time 1CA 19 hours 54 min 1M subtracting stopover time 1C conversion 1SF substitution 1S changing subject of formula 1CA simplification **OR** 1RT start and end time 1CA 19 hours 54 min 1M subtracting stopover time 1C conversion 1SF substitution 1S changing subject of formula 1CA simplification	M L3

	17,6 hour ≈ 56 km/h CA **OR** From 17:30 to 00:00 = 6 hrs 30 min RT From 00:00 to 13:24 = 13hrs 24 min CA Time of journey = 19 hrs and 54 minutes M Travel time = 19 hr 54 min – 2 hr 18 min = 17 hr 36 min D = S × T SF 992 km = S × 17,6 hr S Average Speed = $\frac{992 \text{ km}}{17,6 \text{ hour}}$ C = 56,36 km/h CA	**OR** 1RT start and end times 1CA trip time 1M subtracting stopover time 1SF substitution 1S changing subject of formula 1C conversion 1CA simplification	
		NP	

		(7)	

Ques	Solution	Explanation	T&L
2.2.2	**Forward trip in January:** Parents = 2 × R560 = R1 120 □MA □MA Father = R560 – R560 × 25% **OR** R560 × 75% = R420 □CA Children's fare = R560 × 80% = R448 □MA Two children = 2 × R448 = R896 □CA □CA Total fare for family: R1 120 + R420 + R896 = R2 436 **Return trip in February:** □A Parents fare = 2 × R490 = R980 Father = R490 minus R490 × 25% or R490 × 75% = R367,50 □A Two children = 2 × (R490 – R490 × 50%) = R490 □A	1MA two adult price 1MA discounted price for over 55 yrs 1CA father's fare 1MA children fare 1CA total children's fare 1CA Jan total fares 1A adults Feb fare 1A senior citizen fare 1A children Feb fare	Fin L3

	Total fare for return trip = R980 + R490 + R367,50 = R1 837,50 □CA Total cost for both trips = R2 436 + R1 837,50 □CA = R4 273,50 **OR**	1CA total Feb trip's fare 1CA total trip fare (Note: Max of 6 marks if only one trip is calculated ; Max of 9 marks for using the same fare for both trip) **OR**	

Ques	Solution	Explanation	T&L

	□MA □MA Father's fare = (R560 + R490) × 75% □M = R787,50 □CA Parents' fare = 2 ×(R560 + 490) □MA = R2 100 □CA □MA □MA □A Children's fare = (R560 × 80% + R490 × 50%) × 2 = R1 386 □CA Total fare for both trips = R787,50 + R2 100 + R1 386 = R4 273,50 □CA	1MA adding correct values 1MA 75 % 1M % calculation 1CA simplification 1MA adding and multiplying 1CA simplification 1MA 80% 1MA 50% 1A correct values 1CA simplification 1CA total return trip fare (11)	
		[47]	

QUESTION 3 [31 MARKS]			
Ques	**Solution**	**Explanation**	**T&L**

3.1.1	Capacity of section C = 5 m × 1, 2 m × 15 m □SF = 90 m^3 □ CA □SF Capacity of section A = 2 m × 12,5 m × 15 m = 375 m^3 □CA Maximum capacity = 90 m^3 + 375 m^3 + 300 m^3 □ MA = 765 m^3 **OR** Maximum capacity = Capacity of section (A + B + C) □SF □SF = 2 m × 12,5 m × 15 m + 300 m^3 + 5 m × 1, 2 m × 15 m □CA □CA = 375 m^3 + 300 m^3 + 90 m^3 □MA = 765 m^3 **OR** Volume = 30 m × 15 m × 2 m □SF = 900 m^3 □CA Volume beneath C = 5 m × 15 m × 0,8 m = 60 m^3	1SF correct values 1CA capacity section C 1SF correct values 1CA capacity section A 1MA adding capacities in m^3 **OR** 1SF Correct values for A 1SF correct values for C 1CA capacity section A 1CA capacity section C 1MA adding capacities in m^3 **OR** 1SF volume 1CA volume section A 1SF volume beneath B	M L3

	Volume beneath B = $\frac{1}{2}$ × 12,5 m × 15 m × 0,8 m SF $_3$ CA = 75 m Maximum capacity = 900 m^3 – 60 m^3 – 75 m^3 = 765 m^3 MA	1CA volume beneath B 1MA subtracting volume in m^3 (5)	
3.1.2	M 3 3 Volume of water = 94% × 765 m = 719,1 m = 719 100 ℓ C $= \frac{719\ 100 \times 1}{3,785}$ gallons C ≈ 189 986,79 gallons CA	1M calculating % 1C convert to litres 1C convert to gal.	M L3

	OR	1CA simplification **OR**	

Ques	Solution	Explanation	T&L
	Capacity (in litres) = 765 m^3 × 1 000 = 765 000 ℓ ✓C Capacity(in gallons) = $\frac{765\ 000}{3,785}$ ✓C = 202 113,6063 Volume of water = 94% × 202 113,6063✓M = 189 986,79 gallons ✓CA	1C convert to litres 1C convert to gal. 1M calculating % 1CA simplification	
		NP	
		(4)	

3.1.3	In 1 hour 2 350 litres of water will flow. In 1 day: 24 ×2 350 litres □MA = 56 400 litres will flow □CA □M In $2\frac{1}{2}$ days amount of water flowing = $2\frac{1}{2}$ × 56 400 litres = 141 000 litres □CA ∴ Statement is NOT VALID. □O **OR** 135 000□ Time to fill swimming pool = □MA ———— 2 350□/h ≈ 57,4468 hours □CA 57,4468 hrs = 2 days and 9 h 27 min □M Two and a half days = 2 days 12 hours □C ∴ Statement is NOT VALID □O **OR** 135 000□ Time to fill swimming pool = □MA ———— 2 350□/h	1MA using flow rate 1CA water in 1 day 1M multiplying 1CA simplification 1O conclusion **OR** 1MA finding time taken 1CA time 1M splitting calc. hrs 1C converting two and a half days 1O conclusion **OR** 1MA finding time taken 1CA time	

	$\approx 57{,}4468$ hours □CA □MA . Two and a half days = $(2 \times 24 + 12)$ hours = 60 hours □A ∴ Statement is NOT VALID □O **OR**	1MA multiply with 24 and add 12 1A hours 1O conclusion **OR**	
Ques	**Solution**	**Explanation**	**T&L**

3.1.3	$\text{Time to fill swimming pool} = \dfrac{135\ 000\ \ell}{2\ 350\ \ell/h}$ ✓MA ≈ 57,4468 hours ✓CA ✓MA ✓CA 57,4468 hours ÷ 24 hours/day = 2,3936 NOT VALID ✓O **OR** ✓MA ✓A $2\frac{1}{2}$ days × 24 h/d = 60 hours ✓MA Volume of water = 60 hours × 2 350 ℓ/hour = 141 000 ℓ ✓CA This is more than the 135 000 ℓ to be topped up The statement is NOT VALID ✓O	1MA finding time taken 1CA time 1MA dividing by 24 h/d 1CA days 1O conclusion **OR** 1MA multiplying with 24 h/d 1A number of hours 1MA multiplying hours with flow rate 1CA simplification 1O conclusion (5)	M L3

3.2.1	Total = $18 \times 15 = 270$ MA M Difference = 270 – 236 = 34 $x = 34 \div 2$ M = 17 CA **OR** MA Mean = $\frac{2x+236}{18} = 15$ $2x = 270 - 236$ M = 34 $x = \frac{34}{2}$ M CA = 17 **OR**	1MA multiplying 1M subtracting totals 1M dividing by 2 1CA value of x **OR** 1MA adding correct values 1M subtracting totals 1M dividing by 2 1CA value of x **OR**	Data L3

Ques	**Solution**	**Explanation**	**T&L**

	$\checkmark$M Mean = $\frac{2x+236}{18} = \frac{2x}{18} + 13{,}1111$ $\checkmark$M 15 – 13,1111 = 1,8888... $\frac{2x}{18} = 1{,}8888...$ $\checkmark$CA x = 1,888... × 18 ÷ 2 = 17 $\checkmark$CA	1M adding correct values 1M mean concept 1CA manipulating formula 1CA value of x AO (4)	
3.2.2	$\checkmark$RG $Q_1 = 15$ and $Q_3 = 20$ $\checkmark$RG IQR = 20 – 15 $\checkmark$M = 5 $\checkmark$CA	1RG finding Q_1 1RG finding Q_3 1M subtracting 1CA IQR value AO (4)	Data L3
3.2.3	$\checkmark\checkmark$O It is more convenient for them to go in the evening **OR** $\checkmark\checkmark$O During daytime other distractions keep people away. **OR**	2O reason (2)	D L4

	Small groups receive individual attention □□O **OR** Any other sensible reason □□O		
3.2.4	□A P(Day Group full attendance) = $\frac{6}{18}$ × 100% □A ≈ 33% □R	1A numerator 1A denominator 1R whole % AO (3)	P L2
3.2.5	The range of the afternoon group was smaller.□ □O The afternoon group has a higher median. □□O The afternoon group has smaller inter-quartile range.□ □O Minimum of the afternoon group is higher. □□O (Any TWO acceptable reasons)	2O reason 2O reason (4)	D L4
		[31]	

QUESTION 4 [36 marks]			
Ques	**Solution**	**Explanation**	**T&L**

4.1.1	✓MA 0,21875 miles = 385 yards Hence, 1 mile = $\frac{385}{0,21875}$yards ✓MA = 1 760 yards **OR** $\frac{1}{0,21875}$ = 4,571428571 ✓MA ✓MA 385 × 4,571428571 = 1760 yards	1MA recognising equal parts 1MA correct fraction **OR** 1MA conversion factor 1MA multiplying 385 with conversion factor (2)	M L2
4.1.2	Approximately 4,5 miles ✓✓RG (Accept distances in the range 4,3 miles to 4,7 miles)	2RG correct distance. (2)	MP L2
4.1.3	✓RG ✓C ✓CA 700 ft = 700 × 0,3038 m = 212,66 m (Accept heights in the range 700 ft to 710 ft)	1RG correct distance 1C converting to m 1CA max height NP (3)	MP L2
4.1.4	It is uphill. (steep) ✓✓O **OR** This runner found it difficult to run uphill. ✓✓O	2O reason	MP L4

	OR It is easier to run downhill. ✓✓O	(2)	
4.2.1	✓A ✓A 6 + 3 or 9 [Due to the annexure of Limpopo full marks can be awarded if only 6 is given as the number of venues]	2A number of venues (2)	MP L2
4.2.2	Hippo ✓ ✓A	2A correct enclosure (2)	MP L2

Ques	Solution	Explanation	T&L
4.2.3	✓✓A Zoo is 6 times bigger than the elephant exhibit. ✓M ✓CA ∴ $6 \times 4 = 24$ football fields Also accept 5 or 7 as a correct estimation. ANSWER ONLY full marks if 20 to 28 football fields.	2 A estimation 1M multiplying 1CA solution (Max 2 marks for number of football fields for estimated areas of 3,4 ,8 or 9.) (4)	MP L4

4.2.4	The distance on the map = 85 mm □A □A □M Bar scale 20 mm is 200 m Real distance using the bar scale = $\frac{85\text{ mm}}{20\text{mm}} \times 200\text{m}$ □M = 850 m □CA 1,6 km = 1 600 m □C ∴ The scale is NOT correct. □O **OR** □A Bar scale 20 mm is 200 m □M 1,6 km = 1 600 m □C □M Calculated map distance = $\frac{1\,600\text{ m}}{200\text{m}} \times 20\text{mm}$ = 160 mm □CA Measured distance = 85 mm □A ∴ The scale is NOT correct. □O	1A measured distance 1A measured bar 1M relating to bar to measurement 1M using the given scale 1CA simplification 1C conversion 1O conclusion **OR** 1A measured bar 1M relating to bar to measurement 1C conversion 1M using the given scale 1CA simplification 1A measured distance 1O conclusion (7)	MP L4

	(Accept a range from 82 mm to 87 mm for the distance between streets and 18 mm to 22 mm for the bar scale.)		
4.3.1	Saturday □□A	2A correct day (2)	D L2
4.3.2	Monday is NOT reflected on the given graph. □□O	2O reasoning (2)	P L4

Ques	Solution	Explanation	T&L
4.3.3	The number of visitors increase to about 12:00. on weekdays and then decrease again till 16:00. □□O **OR** The number of visitors on weekends is more than visitors on weekdays. □□O **OR** The number of visitors increase to about 13:00 the weekends and then decrease again till 16:00. □□O Any TWO trends relating time and number of visitors. on	2O trend 2O trend (4)	D L4

4.3.4	The number indicated by the height of the column on Saturday is a little more than double the height of the mean number for a Tuesday ✓✓O **OR** People work during the week ✓✓O **OR** ✓✓ Saturdays they go with their families to the zoo. **OR** ✓✓O Cheaper to go during the weekends O	2O reason 2O reason (4)	D L4

	OR More activities at the zoo on Saturday. O		
		[36]	

TOTAL: 150

APPENDIX L Data capturing

School A			
	Gender	Eng	Math
1	M	31	16
2	M	32	48
3	F	40	38
4	F	39	38
5	M	64	41
6	F	48	24
7	M	45	37
8	M	47	35
9	M	42	24
10	M	33	47
11	M	55	59
12	M	45	36
13	F	38	26
14	F	40	41
15	M	42	39
16	M	48	29
17	M	41	25
18	F	40	14
19	M	45	40
20	M	52	61
21	F	63	21
22	F	48	36
23	F	46	35

School B			
	Gender	Eng	Math
1	F	41	24
2	F	41	36
3	M	44	59
4	F	36	36
5	F	52	54
6	M	47	45
7	M	45	26
8	F	43	49
9	M	46	34
10	F	59	44
11	F	63	52
12	M	50	49
13	F	47	37
14	M	37	39
15	F	50	41
16	M	48	51
17	M	51	57
18	M	49	21
19	F	60	52
20	F	50	25
21	F	51	27
22	M	44	38
23	F	56	53

School C			
	Gender	Eng	Math
1	M	58	56
2	M	42	46
3	F	48	36
4	F	57	54
5	M	46	64
6	F	43	45
7	F	43	38
8	F	55	56
9	M	43	36
10	M	49	47
11	F	70	56
12	F	57	61
13	M	47	40
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24	M	60	63
25	F	41	19
26	F	42	22
27	F	38	33
28	M	48	62
29	M	40	22
30	F	52	28
31	M	42	59
32	F	34	28
33	M	39	26
34	F	54	38
35	F	29	20
36	M	48	46
37	F	70	36
38	F	51	51
39	M	36	33
40	M	36	43
41	M	45	33
42	M	50	47
43	F	61	38
44	F	59	41
45	M	48	38
46	F	48	53
47	F	44	53
48	M	45	56
49	F	48	26
50	M	44	38
51	M	41	38

24	F	43	38
25	M	58	33
26	M	41	40
27	F	34	19
28	F	49	40
29	M	43	37
30	M	62	63
31	M	53	63
32	F	63	36
33	F	42	25
34	F	48	35
35	F	26	19
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52	F	51	35
53	F	62	49
54	F	32	11
55	M	52	41
56	F	38	34
57	M	49	44
58	M	50	41
59	F	44	40
60	M	41	33
61	F	61	58
62	M	44	43

School D			
	Gender	Eng	Math
1	F	60	34
2	M	32	31
3	F	50	26
4	M	33	30
5	F	44	22
6	F	74	70
7	M	53	34
8	F	54	44
9	M	49	43
10	M	55	37
11	F	50	36
12	M	45	32
13	F	62	36

School E			
	Gender	Eng	Math
1	M	41	39
2	M	38	58
3	F	34	36
4	M	33	54
5	M	45	42
6	F	45	38
7	F	63	58
8	M	51	52
9	F	55	52
10	F	57	45
11	M	38	54
12	F	56	50
13	M	34	45

SCHOOL F			
	Gender	Eng	Math
1	M	61	56
2	F	47	40
3	M	55	70
4	M	60	60
5	F	50	39
6	M	66	75
7	F	68	47
8	M	35	25
9	M	53	46
10	F	53	41
11	F	57	53
12	F	51	50
13	F	49	38

14	F	53	32
15	F	44	28
16	M	72	51
17	F	37	32
18	F	62	50
19	M	47	15
20	M	49	39
21	F	53	49
22	F	38	41
23	M	39	35
24	F	50	32
25	F	41	21
26	F	48	45
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14	M	42	47
15	F	50	39
16	M	50	46
17	M	43	57
18	M	24	26
19	F	58	50
20	F	47	33
21	M	41	40
22	M	45	42
23			
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14	M	42	32
15	F	65	65
16	F	54	43
17	F	46	39
18	M	44	33
19	F	59	39
20	M	46	30
21	F	42	25
22	M	73	76
23	F	51	51
24	M	60	75
25	F	50	43
26	M	49	38
27	M	60	52
28	M	44	25
29	M	41	28
30	F	59	42
31	M	52	44
32	M	45	32
33	M	54	51
34	M	45	35
35	F	57	53
36	F	52	38
37	F	41	23
38	M	48	41
39	M	43	55
40	F	52	44
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School G			
	Gender	Eng	Math
1	M	46	37
2	M	50	48
3	M	56	51
4	M	31	23
5	M	31	16
6	F	39	36
7	F	37	49
8	F	55	36
9	F	59	60
10	F	58	46
11	F	57	40
12	M	43	12
13	M	53	24
14	F	43	25
15	M	40	18

School H			
	Gender	Eng	Math
1	M	32	16
2	M	50	59
3	M	41	19
4	M	40	40
5	F	47	29
6	M	38	27
7	M	31	25
8	M	36	23
9	M	31	8
10	M	45	23
11	M	48	25
12	M	35	22
13	M	44	36
14	F	41	42
15	M	52	39

School I			
	Gender	Eng	Math
1	F	46	46
2	F	48	32
3	M	44	33
4	F	60	50
5	F	47	40
6	M	38	18
7	M	47	18
8	F	48	28
9	M	32	29
10	F	49	49
11	M	40	29
12	F	56	33
13	M	42	56
14	M	39	33
15	F	46	25

16	M	42	14
17	F	40	14
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16	M	45	47
17	F	36	20
18	F	35	17
19	M	39	17
20	M	38	29
21	M	38	21
22	F	38	19
23	M	37	21
24	M	53	36
25	F	39	39
26	F	53	42
27	F	41	17
28	F	41	35
29	M	33	15
30	F	60	37
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16	F	31	23
17	M	41	40
18	F	56	38
19	F	42	35
20	F	48	34
21	F	38	25
22	F	57	24
23	M	56	41
24	F	50	28
25	F	50	30
26	F	40	21
27	F	48	25
28	F	33	25
29	F	51	42
30	M	49	40
31	M	37	39
32	M	29	19
33	M	40	35
34	M	37	27
35	M	35	26
36	M	38	34
37	F	40	30
38	F	57	46
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School J			
	Gender	Eng	Math
1	M	56	27
2	M	58	42
3	M	39	36
4	F	58	49
5	M	55	45
6	F	44	28
7	M	50	50
8	M	62	56
9	M	41	35
10	M	48	33
11	M	43	51
12	F	58	57
13	F	58	42
14	M	41	27
15	M	49	62
16	M	50	39
17	M	46	43

18	M	40	38
19	F	41	22
20	M	27	22
21	F	47	39
22	M	49	52
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APPENDIX M Ethical clearance certificate

COLLEGE OF EDUCATION RESEARCH ETHICS REVIEW COMMITTEE

19 October 2016

Ref : **2016/10/19/45278113/28/MC**
Student : Mr K Nyandoro
Student Number : 45278113

Dear Mr Nyandoro

Decision: Approved

Researcher: Mr K Nyandoro
Tel: +2778 740 9671
Email: Knyandoro1@yahoo.co.uk

Supervisor: Prof. MG Ngoepe
College of Education
Department of Mathematics Education
Tel: +2712 429 8375
Email: ngoepmg@unisa.ac.za

Proposal: Language as a factor of learning of Mathematical Literacy at grade 12 in Moloto Circuit in Limpopo Province

Qualification: M Ed in Mathematics Education

Thank you for the application for research ethics clearance by the College of Education Research Ethics Review Committee for the above mentioned research. Final approval is granted for the duration of the research.

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the College of Education Research Ethics Review Committee on 19 October 2016.

The proposed research may now commence with the proviso that:

1) *The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
2) *Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the College of Education Ethics Review Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*

3) *The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.*

Note:

The reference number **2016/10/19/45278113/28/MC** *should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the College of Education RERC.*

Kind regards,

M Claassens

Dr M Claassens
CHAIRPERSON: CEDU RERC
mcdtc@netactive.co.za

VI McKay

Prof VI McKay
EXECUTIVE DEAN