UNIVERSITY OF KWAZULU-NATAL

INVESTIGATION OF THE EFFECT OF THE LOW LEARNER PASS RATE IN MATHEMATICS ON UNEMPLOYMENT IN KWAZULU-NATAL SCHOOLS

BY

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A Dissertation Submitted in partial fulfillment of the requirements for the degree of

Master of Business Administration

Graduate School of Business and Leadership

College of Law and Management Studies

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2018

DECLARATION

I hereby confirm that this work is my own unaided work. Any consultation has been acknowledged and other published material has been recorded by means of full references.

Signature: ___________________________

Date:

DEDICATION

This mini-dissertation is dedicated to:

- My wife, Thokozani and our children: Mziwandile, Zamazulu, Mbulelo Lwazi and Zola, for their support throughout the study.
- My late father, SWB, and my elder brother, Siyabonga, who were the source of inspiration in my early life.

ACKNOWLEDGEMENTS

I wish to thank the following persons without whose help this study would not have been a success.

- My supervisor Dr Emmanuel Mutambara who was most gracious and yet thoroughly demanding. His penetrating insight and wide knowledge provided a valuable perspective for my consideration. I thank God for providing me with such a supervisor.
- The Amajuba District for giving me permission to make use of their circuits for the purpose of data collection.
- The District Manager, for allowing me to involve his district in the study, including the Circuit Managers and, the Principals of schools.
- The Rector of Madadeni Technical College for allowing the mathematics lecturers to be involved in the research.
- My late father, Solomon, and my brother, Syabonga, for encouragement.
- Finally, my wife Thokozani, and our children for support and inspiration.

ABSTRACT

Unemployment is very high in South Africa. During the last quarter of 2016, unemployment was more than 25%. At the same time, the failure rate in mathematics in the Grade 12 examinations in South Africa is also very high. The aim of the study is to establish if there is any relationship between the high unemployment rate and the low rate of learner achievement in mathematics. Hence, the topic of the research is “Investigation of the effect of low learner pass rate in mathematics on unemployment in the KwaZulu-Natal schools”. In this study, the researcher employed both quantitative and qualitative analysis to uncover the facts about the problem at hand. In this research, the samples were taken at random and consisted of participants from the Amajuba District, to represent the province. The participants consisted of circuit managers, high school principals, deputy principals, subject heads of departments, teachers of mathematics and commerce and mathematics lecturers at Amajuba Technical College. A total of 156 questionnaires were distributed and 112 were completed and returned. Based on the questionnaire responses and the literature review, unemployment is caused by the lack of skills and the scarcity of mathematics qualifications among the workforce. Accordingly, many students fail mathematics and leave school early. Such students do not possess the skills that are required by the labour market. Hence, they constitute a considerable component of the unemployment rate.It was concluded that the low learner pass rate in mathematics actually contributes to the high unemployment rate in KwaZulu-Natal and in the whole country. The researcher recommends the establishment of a special school that would teach entrepreneurship and simultaneously re-teach mathematics to the out-of-school youth who obtained low symbols in mathematics at the Grade 12 level. The researcher further recommends the founding of an in-service centre for the newly-appointed mathematics teachers and for the teachers whose learner pass rate in mathematics is low.

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LIST OF ACRONYMS AND ABBREVIATIONS

AWM	Association for Women in Mathematics
CAD	Computer-Aided Drawing
GIS	Geographic Information Systems
MAA	Mathematical Association of America
SACE	South African Council of Educators
StatsSA	Statistics South Africa
PTD	
US	United States

CHAPTER 1: INTRODUCTION AND ORIENTATION

1.1 INTRODUCTION

The education in a country largely influences the rate at which that country develops. Education has such an influence on development by ensuring that learners acquires skills and develop the entrepreneurial mind of the workforce. The development of skills is linked to the level of mathematics education which the workforce in the country possesses. Mkhize and Nduna (2010) support this viewpoint and assert that mathematics is the key subject for many professions. The implication here is that students need some mathematics qualifications in order to qualify as medical doctors, engineers, actuaries, economists and accountants among others. However, mathematical skills are also required in trades such as brick-laying, plumbing and auto-mechanics, as well as in office jobs such as bank tellers, service workers and till operators in shops. Hence, employers regard mathematical knowledge as a pillar of country's economic development. Accordingly, mathematics qualifications are vital if education is to contribute to the economic development in a country.

However, there is a scarcity of mathematically-qualified people in the workforce in South Africa. Van de Walle (2007) supports this view as he argues that mathematics-based skills are sparse in the South African labour market. Furthermore, there are many vacant posts that require some knowledge of mathematics (Appendix 5). The workforce needs employment but cannot occupy those vacant positions due to lack of mathematical skills. Kronholz (2004) shares this view and argues that low performance in mathematics by the youth might collapse the economy.

The youth with mathematics qualifications have opportunities to enter mathematics-based careers. Such youth may become professionals like actuaries, engineers, medical doctors, among others, and may even start their mathematics-based businesses. On the other hand, if the participation of the workforce in mathematics and the related careers is low, the economy slows down correspondingly and unemployment booms. This is happening in South Africa at present. This statement is supported by Kreitner and Kinicki (2008) who emphasise the shortage of college graduates in technical fields related to science, mathematics and engineering in South Africa

According to Kreitner and Kinicki (2008), it is the high failure rate in the grade 12 mathematics that prevents students from registering for mathematics-based qualifications at universities and other tertiary institutions. Lawless (2005) echoes this opinion and maintains that for a country to be economically well-developed, there is a need for more engineers and doctors, among others.

The objective of the study is to investigate the effect of students' low achievement in mathematics on unemployment. This involves the identification of the number of students that failed the Grade 12 examinations because of low achievement in mathematics. Such youth often cannot find work thus increasing the unemployment rate in the country.

1.2 BACKGROUND

According to Statistics South Africa (StatsSA) (2015a), about 25% of the workforce is unemployed. Job opportunities and jobs are scarce, particularly for the semi-skilled and the unskilled labour force. Indeed, most of the work seekers in South Africa are semi-skilled and unskilled, and consequently, there is a high rate of unemployment. This is echoed by Nel, Kirsten, Swanepoel, Erasmus, Poisat, Sono and Schultz (2008) who argue that South Africa has a shortage of certain types of skilled workers and an oversupply of unskilled workers.

The problem-solving skills that are developed during the mathematics teaching and learning activity, are essential in developing other skills as well. The skills that are involved in carpentry, building, plumbing, business, and engineering, among others, are based on a knowledge of mathematics. This view is echoed by Lawless (2005) who argues that the mathematics pass rate among the South African students is insufficient to satisfy the needs of science, engineering, technology and the financial professions.

Appendix 5 presents examples of the thousands of vacant mathematics-based jobs in South Africa. However, the majority of work seekers do not qualify for these positions and cannot apply for them. Hence, many work seekers remain unemployed in spite of the availability of mathematics-based jobs. It is through such observations that the researcher feels the lack of mathematics qualifications limits the development of skills among the workforce, and thus contributes to the high level of unemployment.

In line with the above-mentioned challenge is the low pass rate in mathematics in the Grade 12 examinations. For instance, in the year 2014, 225 458 students wrote mathematics at grade 12 level. Only 79 050 students passed, obtaining 40% and above, and 146 408 students got less. It is the 146 408 students that increased the unemployment rate in 2015. Such increase in unemployment, caused by the out-of-school youth happens every year (StatsSA, 2015a).

The researcher wanted to investigate the impact of the students' low achievement in mathematics on unemployment. If low achievement in mathematics actually causes high unemployment rate, the government needs to find some strategy to improve the mathematics pass rate, rather than analysing unemployment in isolation.

At present, there are no mathematics in-service centres to cater for newly-qualified teachers. Such teachers gain experience from the learners. Moreover, teachers whose mathematics classes performed badly in any year, keep on getting the same results in the following years. Hence, there is an accumulation of out-of-school youth without mathematical knowledge and who are thus, unemployable.

It is based on the above assumption that there is a deficiency of mathematicians, scientists, engineers, technologists, medical scientists and others. As a result, South Africa imports qualified mathematics-based professionals from other countries while the unemployment rate of the local population is very high. Furthermore, the number of entrepreneurs who should emerge from mathematics-based education is minimal, and the unemployment rate in South Africa keeps on increasing.

1.3 STATEMENT OF THE PROBLEM

As mentioned above, the unemployment rate in South Africa is very high. The available jobs require qualifications, which the majority of the work seekers do not possess. For instance, some jobs need a background in mathematics, but the work seekers do not possess such qualifications. Intrinsic in the problem is the high failure rate in mathematics at grade 12 level. On the average, from 2011 to 2014, 150 000 students obtained less than 40% in mathematics at grade 12 examinations. Such students may not take up mathematics-based careers like engineering, medicine, among others. They are not easily employable either. This implies that the 150 000 students joined and increased the unemployed workforce from 2011 to 2014 (StatsSA, 2015).

The problem is to find out if the high failure rate in mathematics actually causes the high unemployment rate.

1.4 AIM OF THE STUDY

The aim of the study is to establish the causes of the high unemployment rate, and to ascertain if it is connected to the low achievement in mathematics. All in all, the aim of this discourse is to present an approach and possible solutions to the problem of unemployment in KwaZulu-Natal and South Africa.

1.5 THE STUDY OBJECTIVES

The prime research objectives of the study:

- To analyse the unemployment rate relative to the skills of the labour force.
- To determine the significance of mathematical knowledge and mathematical skills relative to the work situation.
- To compare the employability of work seekers, who possess mathematical knowledge and those who are mathematically illiterate

1.6 RESEARCH QUESTIONS

The following research questions support the stated research objectives:

- What is the connection between the low skills among the South African workforce and the high rate of unemployment?
- What are the rewards relative to the employer, of quality mathematics qualifications among the work seekers, among the employees, among entrepreneurs?
- What is the difference in employability between the workforce members who possess mathematical knowledge and those who are mathematically illiterate?

1.7 DELIMITATION OF THE STUDY

The field is very wide. Hence, the study was limited to the Amajuba Education District in the KwaZulu-Natal province.

1.8 RESEARCH METHODS

1.8.1 Literature Review

This study focuses on the different views and opinions by different authors on:

- Unemployment and the work skills of the South African workforce;
- Significance of mathematics qualifications and employability in the labour market; and
- The extent of employability of the mathematically literate compared to the mathematically illiterate work seeker.

1.8.2 Questionnaire

A questionnaire was developed to collect data which was related to the causes of unemployment and its possible relationship to low achievement in mathematics. The collected data were summarised and analysed. The data was obtained from two circuit offices in Amajuba districts, and 30 high schools were sampled in each. The questionnaire focused on unemployment, the skills of the workforce, the significance of mathematics in the work place and the possibility of establishing a special school for mathematics and entrepreneurship to cater for the out-of-school youth.

1.9 SIGNIFICANCE OF THE STUDY

The study is on the high rate of unemployment in the country. The government tries to create jobs but the attempts are fruitless. In the researcher’s view, there is a possibility that the high failure rate in mathematics causes the high unemployment rate in the country. If that is the case, the problem of unemployment also becomes a problem of determining the best methods and techniques for producing a good mathematics pass rate. Hence, solving the problem of unemployment will focus on mathematics teaching and learning as well, instead of unemployment in isolation.

1.10 CHAPTER OUTLINE

Chapter 1

This chapter presents the background, the statement of the problem, the research questions, the objectives, delimitation, the aim, and the significance of the study and also the research methods. This chapter also provides a frame of reference, which allows the study to be taken with a focal point of reference

Chapter 2

This chapter presents a literature study that has a bearing on the labour force and unemployment, mathematics and its value in the workplace. The study also looks into the unemployment rate in combination with the high failure rate in mathematics. The study also explores the possibilities of a special school for the out-of-school youth.

Chapter 3

This chapter deals with research design, methodology and procedures, which include sampling and description of instrument. It also deals with the data collection using questionnaires. Moreover, the chapter provides the recording and classification of the observation.

Chapter 4

This chapter provides for the interpretation, analysis, and for discussion of the questionnaire responses. The results are then tabulated according to the extent of the responses.

Chapter 5

This chapter gives a summary, conclusion and recommendations according to the findings of the study

1.11 CHAPTER SUMMARY

This chapter deals with a plan to determine if low achievement in mathematic causes high rate of unemployment. The plan comprises the procedure to ascertain the nature of the problem and entails the introduction, the background, the aim and significance of the study among others. Based on the introduction, education is essential for the development of the country, and particularly mathematics education. This is because of many vacant jobs that are mathematics-based, which South Africans cannot take up because they are not qualified for them. The background gives current information concerning unemployment and the achievement in mathematics at Grade 12 level. Over and above the topic of the investigation, the research objectives and questions were formulated. This chapter provided the background and a preliminary literature review, and defined the extent of the investigation. The following chapter provides the literature review that forms a basis for this study.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The chapter explores the literature that is related to unemployment and learner achievement in mathematics at the Grade 12 examination. It then investigates the skills of the South African labour force, including the significance of mathematics in supporting the development of skills. The rest of the chapter is devoted to the extent to which mathematics relates to work programmes in an enterprise.

The researcher briefly discusses mathematics education to unveil the teaching and learning strategy for mathematics. He emphasises constructivism and the problem-solving approaches believing that consistent and insightful application of these teaching strategies would change the situation. Students would start getting good marks in mathematics. Mpofana (1997) asserts that problem-solving strategies enable learners to engage, enjoy and solve problems in class and elsewhere. He further argues that such students will get good marks in mathematics examinations and would be familiar with problem-solving. Then employees, who have gone through mathematics training, solve problems at work as well. Nel, et al. (2008) echo this idea when they assert that teaching methods in mathematics, enable mathematically literate workers to solve problems in the workplace and to be innovative.

In establishing the relationship between Grade 12 mathematics results and the unemployment rate, the researcher starts by discussing the skills of the workforce. Then he discusses the unemployment rate and investigates the power of mathematics and its contribution to the world of work. In identifying the skills of the workforce, he considers mathematics as an essential tool and a skill in the work place. The mathematics qualifications of the unemployed workforce are ascertained. The subject of this discourse is to expose the relationship between the high mathematics failure rate and the high unemployment rate in the country.

2.2 GENERAL BACKGROUND

In South Africa, unemployment is very high at more than 25%. According to StatsSA (2017), the unemployment rate in the third quarter of 2017 was 27,7%. Hence, unemployment is increasing instead of decreasing, as desired. The increase in unemployment may result from the increase in the number of students who fail the Grade 12 examinations each year. In 2017, the average pass rate across all provinces in South Africa was just over 75% (Haden, 2018). This is a problem for the whole country.

Inherent in the problem is a quest for quality education that can meaningfully contribute to the youth's future employment. Many students pass Grade 12 examinations but remain unemployed. The reason for such unemployment, among others, is the quality of education that is offered. It is not necessarily and sufficiently relevant to the work situations. At present, school education does not equip students with the skills that are relevant for employment. Nel et al. (2008) support this statement when they emphasise the importance of education and training in preparing the youth for the work place in general. They state that the youth is tomorrow's workforce and should hence be prepared in terms of education and training.

Nel et al. (2008) further argue that there is an oversupply of an unskilled workforce in South Africa. According to them, the most needed skills are science-based, and mathematics is the foundation of all sciences. Hence, the development of most skills is dependent on achievement in mathematics. Unfortunately, most of the learners do not do well in mathematics. Then the youth are generally unskilled and unemployable, and the country has to import technicians, medical doctors, and actuaries, among others. This does not assist the country to curb unemployment. South Africa has to devise a strategy to develop its own experts in all fields. Mathematics forms the background for such development.

Furthermore, the country has to formulate a strategy to make education relevant for employment and to cater for the out-of-school youth who failed Grade 12 mathematics. However, the researcher desires to establish if the low achievement in mathematics causes high unemployment.

2.3 LABOUR FORCE

According to Schiller (2000), the labour force consists of individuals who are between the ages of 16 years and 65 years and who are either working for pay or actively seeking paid employment. Nel, Werner, Poisat, Sono, Duplessis and Ngalo (2011) concur with the previous statement as they assert that children under the age of 15 years may not be employed. This implies that the labour force comprises both employed and unemployed individuals. However, individuals who are on leave, have labour disputes or bad weather are also part of the workforce and are counted as employed. People who are not in the labour force are those who do not offer labour services. This, according to Schiller (2000) includes persons who are full-time students, young children and elderly people living in retirement and are jobless. However, the students join the labour force when they finish school and search for jobs (Nel et al., 2011).

Horn (2006) concurs with the above explanation and refers to the labour force as the economically-active population. This refers to the population that is actively involved or wants to be involved in economic development. Finally, he argues that those are the individuals who are willing and able to work.

2.3.1 Labour Force Growth

Schiller (2000) maintains that the increase in the labour force results from the population growth. According to him, the population keeps on mounting as more and more children are born. Correspondingly, more and more children reach the workforce age. Hence, the workforce continually increases. The labour force also increases because of more and more people deciding to seek employment. In line with this statement, Horn (2006) asserts that there is an increase number of women joining the labour force. Students who finish tertiary studies and those who fail the Grade 12 examination also join and increase the work force.

In the years from 2004 to 2011, Van Aardt (2012) observed and recorded the statistics for the youth unemployment according to the ages. According to him, the youth unemployment rate reached 97.7 % in 2011. He argues that such high youth unemployment results from, among other things, low education attainment. Students fail at school and join the workforce. This then constitutes a major increase in the labour force.

Based on his study, Van Aardt (2012) categorised the unemployed youth according to age groups. He observed that youth unemployment slowly decreased with an increase in the age of the group. The percentage unemployment is highest in the age group between 15 years and 19 years, followed by the age group from 20 years to 24 years. The age group from 25years to 34 years is still very high but lower than the previous two age groups. Figure 2.1 depicts the unemployment rate for the out-of-school youth. The graph affirms the extent to which the South African youth increases the unemployed labour force, and hence unemployment.

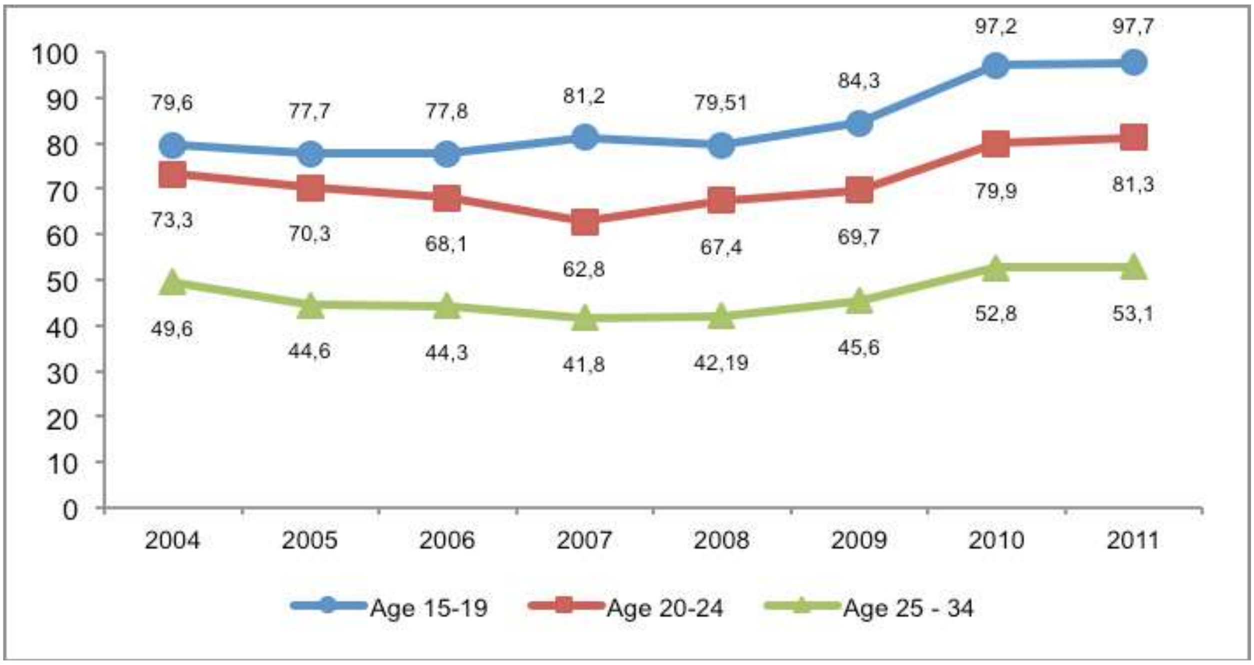

Figure 2.1: Unemployment rates according to age from 2004 to 2011

Source: (Van Aardt, 2012:63)

Furthermore, StatsSA (2015a) verifies the presentation by Van Aardt (2012). Accordingly, between 2011 and 2014, about 600 000 students obtained less than 40% in mathematics at Grade 12 level. On average, the number of such students from 2011 to 2014 per year is 150 000. Students with a low pass in mathematics and who have neither skill nor experience are not attractive to employers. Hence, they greatly increase the youth unemployment rate. Accordingly, it can be concluded that the high youth unemployment rate as depicted by Van Aardt (2012) above, emanates from the students who did not obtain quality mathematics pass rates.

This statement is echoed by Schiller (2000) who refers to it as structural unemployment. Such structural unemployment emanates mostly from students who do not pass the Grade 12 examinations or students who pass grade 12 examinations with subjects other than mathematics and science. In this particular situation, students who leave school increase unemployment rate. Kreitner and Kinicki (2008) concur with this consideration when they cite a mismatch between educational attainment and the knowledge and skills needed by the employers. They further mention the essence of mathematical sciences, as a skill in the work place.

According to Kreitner, and Kinicki (2008), the youth from schools are unemployable due to lack of skills and due to education which is not relevant to the job market. He further argues that the unemployment rate of the youth can be improved if they take up mathematics- and science-related subjects. According to him, this will reduce unemployment by enabling them to enroll for science- and engineering-related qualifications at higher education institutions**.**

2.3.2 Skills of the Labour Force

As the labour force grows, the whole population also grows and hence the need for the country to produce more goods and services increases. According to Schiller (2000), the amount of goods and services that a country can produce is limited to the availability of the factors of production. Factors of production, among others, encompass the labour force and entrepreneurship. Hence the country needs to develop an entrepreneurial spirit and more skills among its workforce. This will expand the economy of the country and reduce unemployment. Schiller (2000) reiterates that the ability of a country to produce goods and services further depends on the employees' technological expertise. Hence, the essence of the labour force is in the relevance of their skills.

Nonetheless, meeting the production demand depends on the education and the creation of skills to use the available technology. On the other hand, technology needs the employees' ability to solve immediate problems. This is in line with Valacich and Wright (2010) who argue that problem-solving is crucial in the work environments. Students and youth with mathematical knowledge possess such ability. Iji (2008) substantiates this statement and describes mathematics as a model for thinking. Hence, there is a demand for an education system that produces good mathematicians and mathematically literate people, to work successfully in enterprises (Schiller, 2000:106).

According to Horn (2006), South Africa has a lack of entrepreneurial skills among the work force. On the other hand, an expanding work force creates a need to establish new enterprises. People who are experts in their fields and who have an entrepreneurial mindset need to create new jobs. There are jobs that have been created in some fields other than in the mathematics-based fields but this limits the extent of job creation. The education system has to produce mathematically-literate people who can initiate new job opportunities (Horn, 2006:113).

According to Horn (2006), South Africa's economy has been undergoing a structural transformation. Accordingly, "the focus has moved away from agriculture and mining towards the more knowledge based secondary and tertiary sectors". He further maintains that the technological platform on which products are produced and services are built is growing in complexity. This implies that new knowledge is constantly being introduced. Different skills are required. According to him, new competencies include proficiency in mathematics, computing, reading, writing and reasoning. However, according to Horn (2006), South Africa has a deficiency of people with skills and quality mathematics ability. Hence there is a mismatch between the needs of the labour market and the South African workforce. Dlamini (2001, cited in Horn, 2006:page) argues that the development clearly requires continuous evaluation as to whether the curricula and content of subjects offered at school are indeed suitable and do equip learners to face the challenges of the workplace, especially in as far as science, engineering and technology skills are concerned.

The majority of enterprises apply the knowledge and the skills of mathematics on their daily operations. Hence, employers in such enterprises require employees who possess some mathematics qualifications. According to Kreitner and Kinicki (2008), employees without mathematical literacy generally lack critical thinking and analytical reasoning. He further mentions the shortage of graduates in technical fields that are related to science, mathematics and engineering. The technical fields mentioned here are all based on mathematics. To do science and engineering, mathematics is at the centre. Hence the lack of mathematics qualifications among the youth is one of the causes for unemployment in countries globally, including South Africa.

Based on the high failure rate of mathematics, more youth from the high school level, leave school as they cannot proceed to do mathematics-based qualifications at tertiary institutions. Hence, the out-of-school youth join the workforce but are mathematically illiterate and are unemployable. Thus, there is a vast annual increase in the unemployment rate in this country.

According to the preceding discussion, an increase in the number of mathematically-literate youth might reduce unemployment (Kreitner & Kinicki, 2008). However, mathematics is a prerequisite for many jobs that are required by the economy. Appendix 4 gives a list of mathematics-based professions. The youth must be encouraged and taught to start new enterprises, but to initiate a mathematics-based enterprise requires a good knowledge of mathematics. This implies that the education department needs to produce more and more matriculants with good passes in mathematics. If that is not the case, jobs will always be minimal. People from other countries keep on creating their jobs in South Africa and occupy senior positions. Unless something is done to increase the number of youth that qualify as mathematics professionals, unemployment will remain high (Bradley & Patton, 2000).

According to Kreitner and Kinicki (2008), skilled labour includes physicians, attorneys, engineers, scientists, builders, architects, among others. They are the specialised part of the labour force with advanced educational qualifications. However, qualifying for each one of these needs a solid foundation in mathematics. Such mathematics qualifications are scarce in South Africa. It is then not easy for most of South Africans to take up these professions. Hence, the unemployment rate is high.

Kreitner and Kinicki (2008) emphasise the shortage of college graduates in technical fields related to science, mathematics and engineering. Fewer students register for mathematics-based qualifications at universities and other tertiary institutions. In such fields, students from other countries rather than from South Africa fill the South African universities. The shortage of South African students is due to the high failure rate in mathematics at Grade 12 level. Hence, few students qualify for the mathematics-based professions some of which are listed in Appendix 4. Mathematics-based professions and jobs remain vacant for quite some time. Appendix 5 shows a list of unoccupied mathematics-based professions and jobs. This shows that there are mathematics-based vacancies, and there are many unemployed members of the South African workforce. Nonetheless, most of these unemployed members of the workforce are unable to fill the vacancies, because they do not possess the mathematics qualifications and skills demanded by the vacant posts.

According to StatsSA (2015a), South Africa has a workforce of more than 18-million people, of whom approximately 13, 5-million are employed. In terms of StatsSA:

- 9,6 million work in the formal sector (non-agricultural);
- 2,2 million work in the informal sector (non-agricultural);
- 685 000 work in agriculture; and
- 1,1 million work in private households.

Accordingly, for the last quarter of 2014, about 4,5 million people were looking for work, of which 3,1 million (or 68%) had been looking for work for a year or longer. According to StatsSA (2015a), 61% of the job seekers passed grade 12. However, they do not necessarily possess the skills that the mathematics-based jobs and the corresponding professions require. Such students need to pass grade 12 mathematics examinations besides their grade 12 subjects. This is in line with Schiller (2000:115) who asserts that the South African labour force needs some mathematics qualification to improve their employability.

According to StatsSA (2015a), the proportion of skilled workers within all race groups increased over the preceding twenty-year period. However, the extent of the increase in skills differs with the racial groups. Accordingly, the white and Indian populations showed a substantial increase in skills. Based on StatsSA, the skilled white workforce increased from 42% in 1994 to 61% in 2014. This is a gain of 19 percentage points. Similarly, the skills of Indians increased from 25% to 51% over the same period, a gain of 26%. The implication here is that the proportion of semi-skilled workers decreased from 55% in 1994 to 36% in 2014. Only 3% of white workers occupied low-skilled occupations in both 1994 and 2014.

According to StatsSA (2015a), the black African workforce moved slowly towards skilled occupations. Accordingly, in 1994, 15% of black African workers occupied skilled jobs and this increased to only 18% in 2014. This implies that, after 20 years, the black African workers, increased their skills only by 3%. This was very low, and is related to the standard of education that was available to the black Africans prior to 1994. Most of their schools did not teach mathematics and science. Even in schools where mathematics and science were taught, it was of a very low standard. Laboratories were scarce, and the teachers who taught mathematics were not qualified to teach it (Mpofana, 1989:206). Even after 1994, teaching and learning were still of a low standard. This is particularly because most of the teachers for mathematics and science in black schools are a product of the apartheid education. They teach according to the methods by which they themselves were taught. This demonstrates the effect of the lack of quality mathematics teaching on the development of skills, which in turn leads to unemployment.

In terms of semi-skilled positions, black Africans moved from 42% to 48% over a period of 20 years. The increase is better here because the demand of the effort is comparatively lower (Southafricainfo, 2018).

The fact that there has been a shift towards skilled workers within the population groups with the exception of the black Africans can be explained relative to the schooling system. Education for the black Africans was substandard. Teaching and learning were inferior, and this was exaggerated in mathematics and science. Problem-solving aptitude was not developed. Even now such aptitude is still developing. That is one of the reasons for a slow shift of skilled black African workers . This demonstrates the effect of good mathematics learning on employment.

In terms of the preceding discussion, young black South Africans need more training. Many of the teachers, who are teaching presently, are a product of substandard Apartheid education. Hence, some other approach is essential to teach mathematics to the out-of-school youth.

2.4 UNEMPLOYMENT RATE

According to StatsSA (2017), there has been an increase in the unemployment rate over many years. The unemployment rate in 2011 was at 24.2%, and in 2017 it increased to 27.7 %. According to Bhorat and Jacobs (2010), there is a structural change in labour demand and that the labour demand trends are shifting towards highly-skilled workers. Consequently, the labour force that possesses low skills remains unemployed. Pauw et al. (2006) share this view and assert that there is minimal demand for low-skilled workers. In their view, the poorly-educated majority of the labour supply remains unemployed. Hence, the high unemployment in South Africa is caused by the lack of skills among the labour force.

According to Barker (2007), very few people are ready to take up mathematics- and science-based careers in South Africa. This is because of the low achievement in mathematics in the Grade 12 examination. Mlatsheni and Rospabé (2005) concur with this viewpoint and argue that most students who matriculate in South Africa are functionally illiterate as they neither possess job skills nor are they mathematically-literate. Hence, the probability of such youth readily obtaining jobs is minimal. Many of the available mathematics-based jobs remain vacant while unemployment is rife in the country.

This is in line with Barker (2007) who emphasises the importance of mathematics and science for many tertiary qualifications. He argues that the skills of the workforce in South African can improve if the country produces a substantial number of learners with good mathematics qualifications. Even though there is an increase in the number of learners who do mathematics at school, the pass percentages are very low.

The country is therefore obliged to import skilled workers for the vacant mathematics-based posts. Furthermore, mathematics-based entrepreneurs are scarce. The president of the country keeps on persuading entrepreneurs from other countries to establish enterprises in South Africa. When they come, they are not necessarily in big numbers and they do not make an impact on the rate of unemployment. A noticeable reduction in unemployment will result if the South Africans themselves in their numbers open up new mathematics-based enterprises. This, however, requires an increase in the number of South Africans who obtain good symbols in mathematics at Grade 12 level and enter tertiary studies in mathematics and science, and who are willing to be entrepreneurs.

The observation, according to Barker (2007), is that the unemployment rate in South Africa is very high relative to other countries. Such high unemployment also coincides with the fact that South African students do badly in international mathematics tests, such as the Trends in International Mathematics and Science Study, which show that South Africa is making little or no progress in mathematics and science results. "The 2016 Global Competitiveness Report ranked South Africa last among 140 countries for maths and science" (Qobo, 2017:n.p.).

Schiller (2000:109) explicates the rate of unemployment with the help of the following mathematical formula:

$$\text{Unemployment rate} = \frac{\text{Number of unemployed people}}{\text{Labour force}}$$

He expresses unemployment rate as a fraction or a percentage. If the number of unemployed people from the work force is large, compared to the labour force, then unemployment rate is high. According to StatsSA (2017), the current rate of unemployment is about 27,7%. This means that for every four members of the workforce, one is unemployed. This is very high (Schiller, 2000).

Typically, teenagers just entering the labour market have the greatest difficulty in finding jobs. This is probably because they have no job experience and relatively few marketable skills. Employers are reluctant to hire them. This is echoed by Schiller (2000) who asserts that teenage unemployment rates are typically three times higher than adult unemployment rates.

Noe, Hollenbeck, Gerhat and Wright (2008) support the previous statement, as they argue that employers normally prefer employees with some standard of mathematics. According to them, employees with a mathematics background, have the potential to become experts in problem-solving and technology. They feel that mathematics is an excellent tool for developing problem-solving skills. Accordingly, mathematically-literate employees with excel in solving mechanical and natural problems at work. This argument is supported by

Kenderov (2006) who asserts that creative problem-solving skills are crucial to being competitive in the global market of mathematics-based careers.

Noe et al. (2008) further argue that education also influences the chances of being unemployed, and graduating from college reduces the probability of being unemployed. Furthermore, the inclusion of mathematics and science in a qualification considerably reduces the chances of unemployment. Advancing technology has put a premium on better-educated workers. Hence, the education department must have a real and complete solution to the problem of unemployment: the solution is ensuring that the schools produce enough mathematicians and scientists. (Noe et al., 2008).

Barker (2007) supports the preceding argument and identifies the basic skills for a person who joins the labour force, and who seeks employment. Among others, he mentions the ability to communicate information through mathematics and science, using technology and scientific systems. He further relates mathematics to problem-solving ability. In his view, mathematics is essential in the workplace. Hence, increasing the number of people in the workforce who possess mathematical knowledge would reduce unemployment.

Parents know that their children need mathematics in order to increase the probability of success at workplace. They want their children to do mathematics at school. However, the failure rate is very high in mathematics at Grade 12 level. Barker (2007) supports the aspiration that more students should enroll for mathematics but he says this ambition is praiseworthy only if it coincides with a quality pass rate. However, the education system causes the majority of the learners to fail mathematics. It is this high failure rate in mathematics which causes many learners to fail the Grade 12 examination. Even if they pass, they pass with low mathematics symbols and the tertiary education institutions do not accept them to do mathematics-based qualifications. Employment chances are also slim. They often do not obtain employment and they remain drop-outs. Year after year, they fail to find employment until some turn to their families, friends, or public welfare for income support and others resort to drugs and crime.

There are different types of unemployment, but for purposes of our discussion, we look at structural unemployment which, according to Schiller (2000), occurs when there is a mismatch between the skills of the job seekers and the requirement of the job market.

- Among others, a mismatch occurs among the youth when they leave school having not obtained the relevant skills. This implies that the youth obtains jobs if the skills they obtained at school match the desired job or profession. Furthermore, the youth that obtained good results in mathematics are usually employable.
- If there is a structural change in consumer demand, technology and trade shrink the markets. This has occurred in the steel, textiles, automobile and other industries (Schiller, 2000).

2.5 MATHEMATICS

2.5.1 The Nature of Mathematics

Devlin (2000) defines mathematics as a science of patterns. According to him, mathematically-literate people observe occurrences as patterns and relate them to existing knowledge. The ability to successfully relate patterns to existing knowledge is associated with the problem-solving ability. Hence, mathematics develops problem-solving ability among students. Valacich and Wright (2010) support this statement and argue that problem-solving is the goal of studying mathematics. According to them, the teaching of mathematics entails the development of methods and strategies for solving problems, among other things.

In line with this, Van de Walle (2007) asserts that mathematics is a science of figuring things out. The implication is that mathematics develops the ability to constitute and to construct new things. Such configuration applies the problem-solving approach of starting from the known to the unknown. Thus, mathematicians have the ability to discover new things. This means that mathematics also develops creativity among the students. This entails the development of the power of imagination and the power to visualise. Kahane (2009) supports this argument and affirms that mathematics is about creative thinking and the development of problem-solving methods. Accordingly, mathematics develops creativity over and above problem-solving. Hence, persons who have mathematical knowledge are creative thinkers and problem-solvers.

According to Iji (2008), mathematics is a model of thought. The implication here is that mathematics develops and extends the thinking skills among the student and mathematicians. During the teaching and learning of mathematics, thinking methods and strategies are developed and applied to problem situations. According to this view, mathematicians start with a problem-based approach and make sense of unfamiliar circumstances. In so doing, mathematicians discover and create new knowledge and also solve problems. Hence, mathematics is the starting point for inventions and discoveries. People who need to invent or discover things need enough mathematical knowledge and ability.

Based on the above views, mathematics advances the thinking ability and capacity for students who do and practise it. This is related to problem-solving ability. Problem-solving ability enables one to learn processes that have not been taught or explained. This argument is supported by Lester and Cai (2010) who define problem-solving as a task that provides intellectual challenges for enhancing students' understanding and development. Furthermore, according to them, a stronger focus on problem-solving contributes to the development of students' higher-order thinking skills.

Imoko and Agwagah (2006) further assert that mathematics forms the bases for observation, reflection and logical reasoning based on a problem and in communicating ideas. They also argue that mathematics is the central intellectual discipline and a vital tool in science, commerce and technology.

2.5.2 The Significance of Mathematics at Work

The patterns that were mentioned by Devlin (2000) above are present everywhere in nature. Hence, they are in the workplace as well. Employees who are mathematicians make sense of those patterns and use them to discover new processes and approaches and to solve immediate problems. Salman (2005) supports this view as he describes mathematics as a precursor of scientific discoveries and invention. Hence, mathematical literacy among the employees is an advantage in any work situation. Such employees have the potential to extend the endeavours of entrepreneurs who started the business by discovering new methods and approaches.

With a mathematical approach, it is easy to formulate rules and methods for computation. This implies that mathematicians observe natural phenomena and formulate rules, formulae, and methods for solving problems. Such rules and procedures improve and simplify the routine operations at work. Devlin (2000) supports this idea and argues that businesses need mathematicians in order to quickly progress and to prosper. Accordingly, business owners appreciate working with mathematically-qualified employees.

Valacich and Wright (2010) argue that problem-solving is the goal of studying mathematics. According to them, the teaching of mathematics entails the development of methods and strategies, for solving problems, among other things. Hence, mathematicians at work, through creativity and problem-solving abilities, extend the ideas of the business founder. This may lead to greater productivity and profitability and may even expand the business. If a business expands, there is a need for more employees. In this way, mathematicians in the world of work have the potential to increase the number of employees. This reduces the rate of unemployment.

Mathematics qualifications stimulate employees in the work place and enable them to discover and to make sense of the patterns and apply them at work. For instance, in the building construction industry, a mathematically-literate work seeker is preferred compared to those without a mathematical background. Such preference is based on the fact that, mathematically-literate people have the potential to carry out measurement processes such as calculations for needed material and establishing easier ways for processing information. Devlin (2000) echoes this observation and asserts that mathematics makes the invisible visible. It is common sense that, without mathematics, the building of structures would be impossible.

Furthermore, mathematically-literate employees are motivated by the ease with which they understand the work at hand and discover alternative and better methods for their duties. This is based on the problem-solving ability and approach as mentioned above. For instance, geography uses calculus as a branch of mathematics to predict tomorrow's weather. This is echoed by Topi et al. (2010) who argue that problem-solving includes analytical skills as well as creativity and the ability to innovate. In further support of the previous statements, Devlin (2000) asserts that market analysts use mathematical theories when they predict the stock market.

During recruitment, the job is analysed in the context of the visualized future of the organization, and in terms of how it (the organisation) is likely to expand. Most organizations presently develop towards technological advancement. Hence, employees with quality mathematics qualifications are preferred. This emanates from the fact that science and mathematics, according to Salman (2005) are precursors of scientific discoveries and technological developments and thus form the foundation of all sciences. This implies that most of the sciences involve some mathematical application. Valacich and Wright (2010) concur with this view when they assert that the development of problem-solving skills is a shared goal in science, engineering, mathematics and technology education.

According to Dossey, McCrone, Giordano, and Weir (2002), mathematics is a tool for solving problems in science, commerce and government affairs. Hence, employers desire to recruit persons with good mathematics background. Nonetheless, people with low marks in Grade 12 mathematics are most likely to remain unemployed (Kreitner & Kinicki, 2008).

All sciences need mathematics, and people who want to do any form of science need a mathematical background. Then, institutions of higher learning can accept them for those qualifications that are science- and mathematics-based. Nonetheless, the supply of such students in South Africa is very low.

The South African universities mostly fill up the above-mentioned faculties with students from other countries rather than from South Africa. Hence, the country lacks such professionals (Appendix 4).

Many mathematics-based vacancies remain unfilled for a long time. This requires the importation of professionals to occupy these vacant posts. This happens while many South Africans remain without jobs for years. Such South Africans cannot occupy these vacant posts because they do not possess the required mathematics qualifications. Hence, the relationship between mathematics pass rate and unemployment exists. Mathematics contributes to economic prosperity as it improves people's thinking and their ability to occupy science- and mathematics-based positions in different industries (Appendix 5). Nonetheless, there is a shortage of young people taking up mathematics-related careers across the world (Engelbrecht & Mwambakana, 2016:175)

For a country to be competitive in the world economy, it needs to use technology. For the best application of technology, employees need some mathematical ability. This implies that mathematics is crucial for economic development. Dossey et al. (2002) argue that mathematical knowledge is the intellectual currency of the technological age. This implies that mathematics is essential in the modern workplace. They further mention that individuals study mathematics to understand, predict and control situations and circumstances. Hence, there is a need for mathematicians in enterprises. According to this argument, the rate at which the workforce acquires mathematics qualification, determines the degree to which the rate of unemployment is reduced.

The Parliamentary Office of Science and Technology (2011) supports the above argument. According to the report, education is essential for future economic success but it stresses the importance of mathematics in this epoch of technology and science. According to the report, mathematics is supreme in the world of work and science because it is the centre of all calculations, logic, reasoning, and problem-solving among other things. All sciences depend on mathematics for their success. Mathematics, according to the report, plays the key role in driving economic growth.

Science, technology and engineering which are so important in economic development are dependent on mathematical principles and reasoning. In other words, mathematics is essential to develop the economy and to curb unemployment in a country. Based on this statement, education without mathematics is not very relevant for economic development and employment. The logical deduction is, therefore, that unemployment can be reduced by decreasing the failure rate in mathematics in the KwaZulu-Natal province and South Africa. However, the majority of the workforce is mathematically illiterate and unskilled.

In these circumstances, it is difficult for the youth who are mathematically illiterate to be employed. However, a person with mathematical knowledge fits comfortably into any work place. Hodgen and Marks (2013) support this statement and refer to mathematics as a critical skill in the work place and elsewhere. According to them, a good pass rate in mathematics at grade 12 level, can be applied in routine work for specialised workplaces. This implies that the probability of being employed is higher with quality mathematics results at Grade 12 level. Furthermore, mathematics professions need specialists with degrees in mathematics for innovation and development. In this case, employment prospect are even higher. In support of this argument, Vorderman, Porkess, Budd, Dunne and Rahman-Hart (2011) maintain that mathematical skills can be applied in almost all industries.

From the discussion, it is clear that the problem of unemployment which KwaZulu-Natal faces can be laid at the door of low achievement in mathematics. The Department of Education thus needs to devise an effective strategy to improve the mathematics pass rate in schools in all grades, with particular attention to Grade 12. A superior education with an emphasis on mathematics is essential as a means to improve mathematics results and reduce unemployment. Vorderman et al. (2011) support this statement and emphasise that mathematics education is of crucial importance for the continued prosperity of the nation. To emphasise this point, they argue that a country would be left behind in terms of economic growth unless mathematics education is improved. KwaZulu-Natal and the whole of South

Africa are probably being left behind in terms of economic development. This is clear from the rate of unemployment.

2.5.3 Mathematics Qualifications for Work Seekers

Most employers know that employees with good mathematics qualifications are more useful in the work situation. The chances of making mistakes are minimal compared to employees who are mathematically illiterate. Employers, therefore, prefer to engage individuals with some mathematical background. In other words, the probability of employment for individuals who are mathematically illiterate is slim. If the majority of the workforce in a country is mathematically illiterate, then the unemployment rate remains high (Van de Walle, 2007).

Norris (2012) maintains that people with mathematics qualifications can understand and apply technology in the enterprise's routine work. According to her, such ability is based on the nature of mathematics as a subject and the methods that are applied in its teaching. Hence, employers are keen to recruit them. Charles and Silver (1990) extend this statement by saying that problem-solving in mathematics is directly related to problem-solving in other parts of life. Employers then prefer persons who possess this problem-solving ability to increase the number of problem-solvers in their enterprises and to reduce the number of mistakes at work. That is one of the reasons that people who have some knowledge of mathematics are normally employable and employed. Barker (2007) echoes this statement and describes mathematics as a core skill for employees, which enables them to contribute substantially to the country's economic prosperity.

Hodgen and Marks (2013) further echo this statement when they argue that most people who are unemployed did not do mathematics or they obtained very low marks in mathematics at Grade 12 level. People in the workplace, according to them, must be able to make sense of mathematics, as this minimises mistakes at the workplace.

2.5.4 Mathematics-Based Businesses

Over and above the previous points made, Van de Walle (2007) mentions examples of the fields that have patterns and order. They are, among others, commerce, science, medicine, manufacturing and sociology. According to him, even art, architecture and music have patterns. It is self-evident then that a person without mathematics qualification is not likely to be employed in these fields.

The majority of the reports address the need for the solution of economic growth, and this also entails the problem of unemployment, among others. Nonetheless, all countries, including South Africa, should build capacity for the economic prosperity. Norris (2012) states that "Science, Technology, Engineering and Mathematics industries are becoming increasingly central to economic competitiveness and growth and will provide many of the jobs of tomorrow for the young people".

Students, who successfully complete mathematics-based qualifications, have the potential to establish businesses that are linked to their professions. For instance, medical doctors may establish one or more surgeries that provide employment thus partly reducing the unemployment rate. Similarly, actuarial scientists, engineers and mathematicians, among others have the potential to establish their own enterprises. Appendix 4 illustrates the range of mathematics-based professions. If there are many people who obtain passes in these qualifications, the probability of establishing related firms is high. This would lead to a tremendous reduction in the unemployment rate.

According to Devlin (2000), insurance companies use mathematics to predict the likelihood of accidents during the following year. They then initiate insurance policies that are linked to the probability of accidents and set premiums accordingly. Hence the insurance companies are dependent on people with mathematical qualifications and their ability to work with statistics and probability. The establishment of such companies contributes to the reduction of unemployment rate in countries.

The person who establishes the insurance company obtains a job, but more important is the fact that many more work seekers may also obtain jobs in the same company. This illustrates the potential of mathematics qualifications to reduce unemployment. The statement is further clarified by Devlin (2000:73) who describes mathematics as the science of logical relationships, apart from order, patterns, and structures.

2.5.5 Performance Trends (2011—2017)

According to the previous discussion, mathematics is essential in the work place. However, the pass rate in the Grade 12 examinations is generally very low. Neither is it improving. This is evident from a year-on-year analysis of results, which the department of examinations calculates at the National Office of Education in Pretoria.

According to a report by the examination department, the number of candidates that passed at the 30% level declined by 5.6 %, and those that passed at the 40% level also declined by 5.4%. Candidates that achieved distinctions over 80% declined marginally from 3.4% to 3.2% of the total number of candidates.

2.5.6 Mathematics Pass Rate Statistics

From 2011 to 2014, the statistics also reveal the youth that are likely to join the workforce and increase the unemployment rate. The youth that obtained less than 40% usually join the workforce. The youth that obtained more than 40% usual proceed to do mathematics-related professions.

Table 2.2:The overall achievement is tabulated as subsequent:

Year	**No. wrote**	**Pass rate <40%**	**% pass rate <40%**	**Pass rate ≥ 40%**	**% Pass rate >40%**
2010	263034	181660	69.1	81374	30.9
2011	224635	157094	69.9	67541	30.1
2012	225 874	145379	64.4	80716	35.6
2013	241 509	143608	59.5	97790	40.5
2014	225 458	120523	53.5	79050	46.5
Total	1180510	748264		406471	
Average	236102	149653		81294	

The workforce in South Africa is 18 450 000 and the unemployed workforce is 4 612 500.

According to the preceding table, the number of matric students who failed grade 12 mathematics and joined the workforce per year, from 2011 to 2014, is approximately 149 653. Such students obtained less than 40% pass rate in mathematics. They leave school and join the workforce. Furthermore, such youth usually remains unemployed for long periods of time, and increase the unemployment rate. The extent of the problem is summarised in Figure 2.2.

Table 2.3: Below and above 40% pass rate

YEAR	2010	2011	2012	2013	2014
< 40%	69.1	69.9	64.4	59.5	53.5
>40%	30.9	30.1	35.6	40.5	46.5

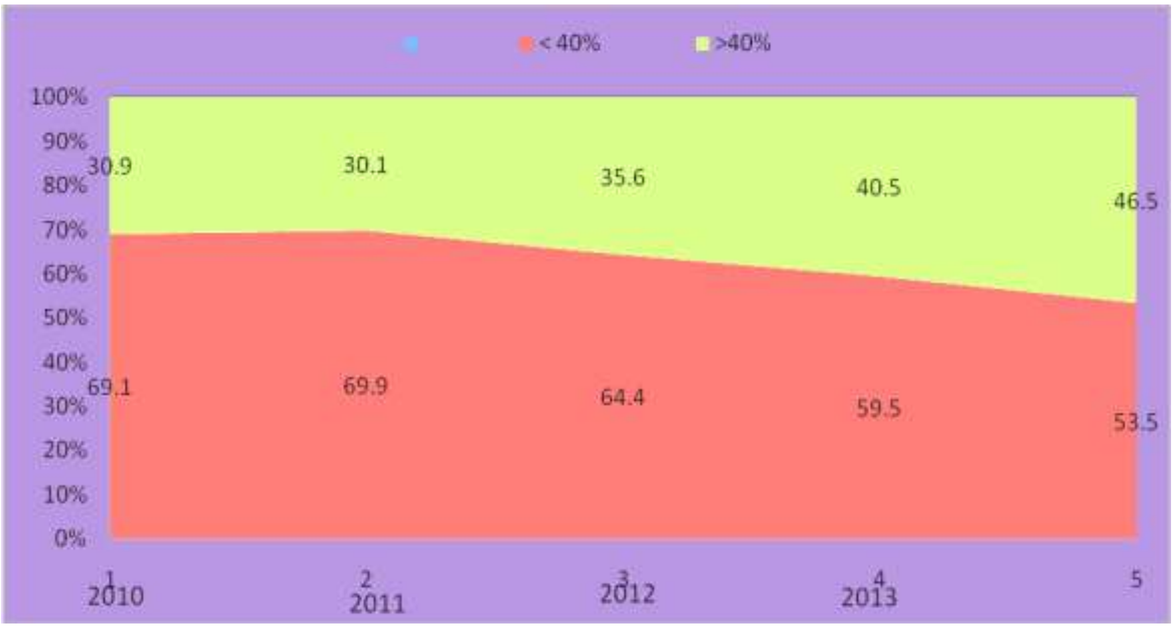

Figure 2.2: Comparison of <40% and >40%

Source: (StatsSA, 2015b)

2.5.7 Coefficient of Determination for the Failure Rate

According to the above table, it is clear that the increase in the unemployed workforce (y) corresponds to the increase in student entrants to the workforce. The Pearson's Correlation Coefficient (r) was calculated from the online calculator at Socscistatistics.com (2018). The value of r is +1.

According to the statistics for 2010 to 2014, the unemployment rate increases when the failure rate of students increases. Since r = 1, the correlation is perfect and the unemployment rate increases proportionately with the increase in the failure rate on mathematics at grade 12 level (Render, Stair & Hanna, 2009:169).

Based on the above statistics, it is apparent that, on the average, about 149 653 learners fail mathematics annually in the Grade 12 examinations. Usually, such students also fail or obtain low pass rates in physical science and hence, they fail the Grade 12 examinations altogether. These learners have no option but to join the labour force, and, unfortunately, many join the ranks of the unemployed. ~~According to this observation, at least 149 653 students increase the unemployment rate per year.~~

2.5.8 Mathematics Education

Van de Walle (2007) asserts that mathematics is a science of making sense of unfamiliar things. Hence, in a mathematics class, learners learn how to solve problems. The implication here is that teaching should be based on problem-solving. Nonetheless, most teachers are not familiar with the problem-solving approach to teaching. Hence, they use teaching approaches that are not conducive to the learning of mathematics. This is in line with Duminy and Steyn (1987, cited in Mpofana, 1997:14) who argue that genuine problem-solving is often neglected in the schools and this contributes to the high failure rate in mathematics.

2.5.9 The Learning Process and Management

The reason for including this section is to illuminate the ease with which the teaching and learning of mathematics may lead to high pass rate. The problem-solving approach used collaboratively with the group discussion approach in the mathematics class is the natural way in which people learn things from infancy.

The newborn baby knows nothing but learns through observing what people do. For instance, the baby observes people moving from one place to another. She observes, thinks, and starts doing what other people do. The baby becomes interested and attempts to move. She ends up crawling, standing, walking and talking, among other things. This is learning in the natural way. However, the parents monitor, control and give support to the baby's movement to ensure that she is eventually and correctly able to move from one place to the other. The parents carefully watch and prevent problems.

This observation concurs with Tewksbury and Macdonald (2005) who assert that learning results from, among other things, observing, listening, thinking, and imitating. These activities by the baby produce fast and correct results if they are managed. Accordingly, teaching should match this learning process. Hence, the importance of observation in teaching should be emphasised. In managing the teaching and learning for mathematics, responsible managers should ensure that observation, thinking and imitation, among other things, are planned for. This kind of learning should be developed and not neglected. However, if the application of these activities is not managed, it may be too slow to reach the expected results or these activities may result in error. Entrepreneurs use more or less the same approach to discover the enterprises they need to establish. Some entrepreneurs did not do mathematics but were still able to discover the kind of enterprises they wanted to establish. Mathematicians should find this discovery of new enterprises easy.

According to Tewksbury and Macdonald (2005), learning is enhanced when a learner sees potential implications, applications, and benefits of the subject matter to the physical world. For instance, teachers of mathematics should strengthen the relationship between learning and out-of-school experiences. They should introduce lessons relevant to out-of-school experiences. The teachers should use teaching methods which link ideas to real-life situations for positive results. This would enhance enthusiasm, motivation, engagement and participation, and result in understanding of the subject matter. Hence, learners would benefit from this discovery approach. Preparations for lessons incorporating this idea challenge the mathematics teachers and they may neglect it if the daily preparation is not properly managed. Managers should ensure that this idea is incorporated in planning for a lesson.

2.6 CHAPTER SUMMARY

The literature review revealed that the students who fail mathematics at Grade 12 level are in the majority. Those students, according to the literature review do not proceed to tertiary institutions but join the labour force. They neither have work skills or mathematical skills. However, employers prefer to recruit work seekers who are mathematically literate. The implication here is that the unemployed labour force includes students who failed mathematics and left school. Apart from mathematical skills, work seekers are generally unskilled.

According to the study, mathematics is the best tool for problem-solving. Further, according to the study, mathematics has the potential to enable the youth to initiate discovery and to construct reality. Hence, the mathematically-literate youth may initiate new businesses. If mathematics is studied concurrently with entrepreneurship, a plethora of new mathematics-based businesses might crop up and many job opportunities might emerge.

Unemployment is caused by the availability of few jobs compared to the available labour force. It is also caused by the mismatch between the labour skills and the skills required by the jobs. With the increase in the number of mathematically-literate youth, the long-standing, vacant, mathematics-based posts will be occupied and unemployment will diminish. The methodology for the study is presented in the following chapter.

CHAPTER 3: RESEARCH DESIGN AND METHOLOGY

3.1 INTRODUCTION

This chapter describes the research design and methodology, which entails the selection of a population and the sample. The research design includes, among others the applied procedures for constructing the questionnaires.

To carry out any research study, information is collected. Moreover, it is important to ensure that the collected information is reliable and valid so that the findings may also be reliable. This view is echoed by Render et al. (2009) who emphasise the importance of the validity and reliability of the collected data. They argue that the validity of the results depends on the reliability and validity of the collected data.

Such information is reliable if it is collected using suitable tools, such as a questionnaire which employs a distinctive way of describing and quantifying the data. The questionnaire is a particularly appropriate source of data, yielding information of a kind and in the form that would be used most effectively. In this study, the researcher used a questionnaire as the data-gathering tool.

Bell (1987) also emphasises the importance of reliability and validity in data collection. He feels that procedures, which are selected for collecting data, should always be examined to assess the extent to which they are reliable and valid. In this study, the researcher applied the Cronbach's alpha coefficient to test for reliability.

3.2 RESEARCH PHILOSOPHY

Research philosophy is a theory or attitude that guides the systemic investigation in order to establish facts and reach new conclusions. This theory, according to Lind, Marchal and Wathen (2010), involves the collection of numerical information and is generally referred to as statistics. Furthermore, they argue that the focus of statistics is more than just the collection of information. They define statistics as a science not only of collecting information but also of organising, presenting, analysing and interpreting data to assist in making more effective decisions. According to them, the first step is to collection information. Hence, the researcher uses the guidance of this theory to investigate the relationship between the high failure rate in mathematics and the high unemployment rate in the province and hence in the country.

In statistics as a science, Lind et al. (2010) describe two variables. They are the quantitative and qualitative variables. Accordingly, these variables make use of quantitative and qualitative data and they maintain that:

- Quantitative data consists of quantities that can be ranked in some way. For instance, the ages of student in a statistics class, the number of children in a family, are examples of quantitative data. The number of responses in a questionnaire is also an example of quantitative data.
- Qualitative data, on the other hand, does not have numerical measurements. For instance, according to Lind et al. (2010), gender, religious affiliation, the eye colours of the students in a statistics class are examples of qualitative data. Larson and Farber (2006) support this statement and define qualitative data as consisting of attributes, labels and non-numeric entries. In this study, the biographical data entails the qualitative attributes.

3.2.1 Quantitative Analysis

Render et al. (2009) maintain that the processing of raw material into meaningful information is the heart of quantitative analysis. Furthermore, they argue that quantity is one of the most important issues in research. For instance, in a factory, the quantitative data based on the raw materials are manipulated into information that is valuable for decision making. Hence, management decides about the amount to be ordered and the time for ordering. This statement is supported by Creswell (2012), who argues that quantitative analysis is a scientific approach that promotes effective managerial decision-making. According to Creswell (2012), quantitative research starts with a problem statement and involves quantitative data analysis, among others

According to them, it uses the quantitative data to uncover the truth about social realities. For instance, researchers draw conclusions concerning the problem by using quantitative analysis.

Render et al. (2009) support this argument when they describe quantitative research as a structured method that combines logical deduction with precise empirical observations to obtain results. According to Leedy and Ormrod (2010), quantitative research can be used to obtain answers to questions in research. According to them, the quantitative research is used to establish, confirm or to validate relationships. The validation of the relationship can then be applied to develop generalisations and to contribute to theory.

3.2.2 Qualitative Analysis

The analysis here uses the qualitative data as mentioned above. The qualitative data is used concurrently with the quantitative data to make decisions. To be precise, the quantitative analysis is prepared on the basis of both the qualitative and quantitative data. Qualitative analysis relates to the validity of the findings and involves matters that are not quantifiable. For instance, the biographic data in research measures the extent of the validity and the reliability of the quantitative data. It is on this basss that Render et al. (2009:22) argue that both qualitative and quantitative data must be considered in decision making.

3.3 RESEARCH DESIGN

A design is a plan that is produced to show the anticipated focus and function of something before it is built or made. The term design has application in many fields including architecture, dressmaking and research, among others. Similarly, the research design is a plan that shows the structure of a study programme before it is complete. Berg (2004:31) argues that the research design is a plan illustrating how the study is conducted. According to him, research design constitutes the outline for the collection, measurement, and analysis of data.

Burns and Grove (2003) support this illustration as they define a research design as a blueprint for conducting a study. According to them, the research design anticipates and exercises maximum control over factors that may interfere with the validity of the findings. Accordingly, the function of a research design is to ensure that the research produces enough evidence to answer the initial questions as unambiguously as possible. Three types of research design are discussed below.

3.3.1 Exploratory Studies

Exploratory research often relies on qualitative approaches such as informal discussions with communities, employees, management. It also relies on the available literature. Polit et al. (2001) maintain that exploratory studies are undertaken when a new area is being investigated or when little is known about the area of interest. In line with this statement, Berg (2004) asserts that the data is collected even before the research question is defined. According to him, an exploratory study is a prelude to the study. In clarifying his explanation, Berg (2004) further argues that this research type is conducted for a problem that has not been defined. Hence, exploratory research is concerned with the confirmation of available knowledge and with the building of new knowledge. Exploratory research applies to the study at hand because the high failure rate in mathematics and the high unemployment rate are discussed by different people at different levels of understanding. The researcher wants to discover the relationship if it exists and so as to develop new approaches to the solution (Berg, 2004).

3.3.2 Causal Studies

Causal research is conducted in order to determine the nature of relationships and also to evaluate the impact of specific changes on the various processes. This is echoed by Williams (2007), who asserts that causal research examines the effect of an independent variable on a dependent variable. The most common quantitative causal model is regression analysis (Render et al., 2009:179).

The current research applies the causal design to find out the impact of increasing the mathematics pass rate on unemployment. Render et al. (2009:179) assert that causal studies incorporate the variables or factors that might influence the quantities being forecast. For example, the pass rate in mathematics is influenced by the teachers' abilities to apply suitable teaching methods in their teaching (Mpofana, 1997). The researcher has to develop the best statistical relationship between the high failure rate in mathematics and the high unemployment rate in the province.

3.3.3 Explanatory Studies

According to Render et al. (2009:138), an explanatory study is used to model the relationship between variables. For instance, the relationship between the level of education and income is an example of a explanatory study. Explanatory research actually explains the reason why things are as they are. In other words, explanatory studies determine the relationship between dependent and the independent variables. The relationship between the low achievement in mathematics and the high unemployment rate in South Africa was conveniently modeled using the explanatory approach. Regression analysis is very valuable in explanatory studies.

3.4. POPULATION

According to Lind et al. (2010), a population is the entire set of individuals or objects of interest. This implies that a population consists of all the possible entries which contain the required information. Accordingly, a population actually comprises everyone who possesses the required information. Keller (2008) echoes this notion as he defines population as a group of all items that are of interest to the researcher. Larson and Farber (2006) summarise the definition of population. They define population as a collection of all possible outcomes, responses, measurements or counts that are of interest.

Burns and Grove (2003) concur with this definition as they argue that a sample consists of all the elements that meet the criteria for inclusion in a study. Accordingly, the population is normally very large and it becomes very difficult to obtain information from each member of the population.

In this study, the population consists of all circuit managers, high school principals, deputy principals, subject heads of mathematics and commercial subjects, lecturers at technical colleges in the education districts of South Africa. The population, in this case, is very large, and it covers 9 provinces and 12 education districts per province. Obviously, this is a very big number. It is, therefore, essential to select a sample. For instance, the researcher limited the research to the Amajuba district in KwaZulu-Natal province.

3.4.1 Sampling

Based on the population as discussed above, it is difficult to measure, survey and to manipulate the whole population. Hence, a small portion is selected to facilitate the research process. This small portion is the sample. In line with this, Lind et al. (2010), define a sample as a portion or part of the population. According to them, any information that is required from the population can be obtained using a sample. According to Polit et al. (2001), a carefully selected sample can reliably provide data representative of the population from which it is taken. This coincides with Burns and Grove (2003) who argue that a sample consists of all the elements that meet the criteria for inclusion in a study.

3.4.2 Selection of Samples

According to Lind et al. (2010), to maintain a high level of confidence, a large but manageable sample should be selected from the specified population. To achieve this, the researcher used participants from the Amajuba Education District, which consists of two districts to represent the province and hence, the country.

It is essential to understand that circuit managers, principals of schools and lecturers in Amajuba Education District and in Durban or Umlazi Education Districts must have similar qualifications, education and responsibilities. Hence, taking a sample from the Amajuba

Education District is no different from taking a sample in Durban or Port Shepstone education districts. This explanation coincides with Keller (2008), who asserts that a random sample is selected in such a way that all samples with the same attributes are equally likely to be selected. Hence, the participants in this study were selected at random, although the study site was delimited to Amajuba Education District. This implies that all the participants in the district had the same probability to be chosen. The sample was large but manageable, and thus, validity and reliability were enhanced.

3.5 PRELIMINARY ARRANGEMENTS

Approval for the use of the above-mentioned departmental officials was obtained from the Head of Department for Education in KwaZulu. A written request was sent to the district manager at Amajuba Education District. The researcher had a short meeting with the district manager concerning time and venues for answering the questionnaires. The district manager then negotiated with the selected officials concerning the questionnaires and the time involved. An agreement was reached and the questionnaires were filled-in.

3.6 RESEARCH INSTRUMENTS

Measuring instruments are useful ways to collect information about whether or not an outcome variable is occurring. A great variety of methods and procedures have been developed to aid in the dependable measuring instruments for the purpose of quantifying the attributes to be studied (Ary et al., 1979). For this study, questionnaires were used for the acquisition of data. In the case of all questionnaires, a structured and open form was designed. The open questions were included to incorporate the qualitative aspects of the study.

The questionnaire entails questions or statements about the objectives of a study. This is in line with the Concise Oxford English Dictionary (2009) which views the questionnaire as a written set of questions or statements that are given to people in order to collect facts or opinions about something. In the study at hand, the researcher used statements in the questionnaire to find out the extent to which the respondents agreed or disagreed with each statement.

Using the questionnaire, the researcher explored what the respondents thought, knew and felt. Tuckman (1987) echoes this statement in asserting that a questionnaire makes it possible to measure the respondents' knowledge, values, preferences, attitudes and beliefs among other things, relating to study. The obtained information was then converted into quantitative data through the rating scale techniques.

Furthermore, there are certain advantages associated with the questionnaire, relative to interviews and other instruments. Such advantages, according to Wragg (1982), can be summarised as follows:

- The questionnaire is extremely effective for many people, and is time-effective;
- The questionnaire assists the obtaining of facts concerning attitudes and opinions;
- This technique ensures neutrality in obtaining responses from the sample in a study.

Behr (1973) accentuates these advantages and regards the questionnaire as the best available instrument for obtaining information from widely spread sources.

3.7 CONSTRUCTION OF THE QUESTIONNAIRE

The research instrument is systematically constructed and consists of two parts. Part 1 entails the biographical data. It is included to obtain information about age, experience, academic qualifications and professional qualifications of the respondents.

Part 2 of the questionnaire consists of sections A, B, and C. Section A relates to the skills of the labour force, Section B investigates the significance of mathematics in the work place while Section C envisions a special mathematics school that also teaches entrepreneurship. The questionnaire is such that all the respondents need to answer the same questions.

The questionnaire requires the respondents to express opinions on Section A, Section B and Section C. The responses were coded from 1 – 5, and range from strong disagreement to strong agreement respectively. The respondents used these codes to identify the extent to which they agreed or disagreed with each statement.

3.8 DATA ANALYSIS

Statistics is the theory and method of studying quantitative data. The data were collected from samples of respondents in order to make decisions to accept or reject stated hypotheses. By using statistical methods, the investigator was able to evaluate data and draw conclusions. Render et al. (2009) concur with this explanation when they assert that quantitative analysis is a scientific approach to managerial decision-making. They maintain that the quantitative analysis approach starts with the collection of data, and that it is used to make decisions.

Statistics aims at condensing opinions, performances and comparisons among others, into summary numbers that can be understood. In this study, the statistics were used to find those numbers which relate to the skills of the unemployed labour force, mathematics-based careers and the relationships between unemployment and mathematics abilities. Based on the assertion by Render et al. (2009), the main purpose of quantitative analysis is to manipulate or process data into information that is valuable to people for making decisions.

In their view, statistics summarise the information and establish the relationships among sets of data. Basic statistical measures are appropriate in describing and analysing data in a meaningful way (Best, 1981). Statistical methods involve the manipulation, description and analysis of data. In this study, data were converted into measures of central tendency, measures of relationship and statistical tests of significance.

3.8.1 Cronbach's Alpha Coefficient (α)

Before the analysis of the collected data, it is essential to establish if the responses are reliable and valid. The results that are derived from data that are not valid will also not be valid. This perception is supported by Render et al. (2009) who argue that the validity of the results depends on the reliability and validity of the collected data.

Cronbach’s alpha coefficient tests the reliability and validity of the responses in a questionnaire. It actually tests the consistency of the responses. The extent of consistency of the Cronbach’s alpha coefficient can be summarized in a tabular form as subsequent:

Table 3.1: Cronbach’s alpha coefficient (α) values

Cronbach’s Alpha	**Internal Consistency**
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.5 \geq \alpha$	Unacceptable

The implication here is that, if the α is less than 0.7, the data is not reliable and is inconsistent. If on the other hand, it is between 0.9 and 1.0, the internal consistency is excellent (Wikipedia, 2018).

3.8.2 Chi- Square (χ^2)

The chi-square was used to test the significance which compares observed frequencies with expected frequencies. Chi-square (χ^2) is used as a test of significance when data are expressed in frequencies and percentages. Larson and Farber (2006) state that χ^2 is used to test whether a frequency distribution fits an expected distribution or not. This is echoed by Fitz-Gibbon and Morris (1978), who assert that χ^2 indicates whether the results from the two measures are about what would be generally expected. This implies that the χ^2 test is used to determine whether or not the observed frequencies differ significantly from the expected frequencies. (Render et al., 2009).

3.8.3 Pearson's Correlation Coefficient (ρ)

Correlation is a statistic that measures the relationship between two variables. According to Devore and Peck (2005), the correlation measures how strongly related to each other are the pairs of data. The strength of the relationship is measured by a common statistic called Pearson's Product Moment correlation (ρ). According to Render et al. (2009), the correlation coefficient also expresses the extent or degree of the linear relationship.

Larson and Farber (2006) assert that correlation measures not only the strength of the relationship but also the direction of the relationship. The value of the correlation can vary from -1, 00 to +1, 00. Accordingly, the correlation is positive and perfect if, ρ is +1 and does not exist if ρ is 0. The correlation is negative if, ρ is negative.

Larson and Farber (2006:461) also give the formula for the product moments as:

$$\rho =. \ \frac{N\Sigma XY-(\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma \Xi''-(\Sigma \Xi)''][N\Sigma \psi''-(\Sigma \psi)'']}}$$

3.9 THE PILOT STUDY

The pilot study is a preliminary study that precedes the actual study or project. According to Bailey (1987), pretesting is the final stage in questionnaire construction, which is checked on a few respondents so that its mistakes can be determined and corrected. Tuckman (1978) suggests that it is essential to do a pilot test on questionnaires. In his view, this is an opportunity to revise the questionnaire based on the results of the pretest.

For this investigation, a pilot study was conducted with the mathematics lecturers of Amajuba Technical College to test questions for clarity and ambiguity. No changes were necessary in this questionnaire.

3.10 ETHICAL CONSIDERATIONS

According to the Oxford English Living Dictionary (2018), ethics relates to moral principles, politeness and good behaviour, among other things. Such politeness is essential in the case of research involving human subjects. It motivates the subjects to be part of the research and to give the information willingly. Furthermore, ethical consideration enables the participants to know exactly what the research is about, including the reason and purpose of the research among other things. Robbins, Judge, Odendaal and Roodt (2009) support this explanation and characterise ethics as being based on values and the value systems. According to them, all researchers should consider ethics during their research.

Hence ethical consideration during research means the researcher must conform to the accepted standards of behaviour while collecting information. Ethical clearance should be sought before any research work is undertaken, including pilot studies and the questionnaire. The participants need to be assured of their safety in contributing to the research.

To address the ethical considerations in this study, a letter was sent to inform the participants about the research. In the letter, the researcher introduced himself to the participants and explained the problem at hand, including the purpose of the research. According to him, the problem was the high rate of unemployment in the country. Inherent to unemployment is the high failure rate in mathematics in the country. Hence, the researcher wanted to establish if there is a relationship between the low pass rate in mathematics and the high rate of unemployment in the KwaZulu-Natal province and the whole country.

The participants were assured of the confidentiality of the information obtained from the questionnaire. It was also explained that the questionnaire consisted of two parts which were the biographical information and the questions which entailed three sections. The three sections were: A. the skills of the labour force and unemployment; B. The significance of mathematics in the work place; and C. The envisioned school of mathematics and entrepreneurship.

3.11 CHAPTER SUMMARY

Research refers to the application of the scientific approach to the study of a problem as a means of acquiring information. Most problems cannot be solved without making use of sampling tools. To collect data from an extraordinarily large population would be time-consuming and would require the services of many investigators. To overcome this, sampling becomes inevitable as it makes it possible to the characteristics of the whole population. It should be realised that larger samples are more likely to provide accurate representations of their populations than are smaller samples. The study at hand was not possible without sampling.

The pilot study was intended to identify weaknesses in the questionnaires of the different groups of respondents and to improve the questionnaire's potential for eliciting relevant information. Necessary changes were then effected.

This chapter explored the composition of the population used in this study and also described the research tools and statistics used in data analysis.

CHAPTER 4: DATA COLLECTION, CLASSIFICATION, RECORDING AND ANALYSIS

4.1 INTRODUCTION

This chapter focuses on classification, recording and analysis of data that was used in the testing of hypotheses as stated in chapter one. It is then concerned with the handling, refining, recording and re-organisation of collected data. According to Tuckman (1987:239), the collected information must be converted into different forms for analysis purposes. Thus the process of analysis and interpretation of collected data, classification and recording was based on Part 1 and Part 2.

In analyzing the findings, attention was paid to the research instrument and the responses.

4.2 RESEARCH INSTRUMENT

4.2.1 Response Rate

The research distributed 156 questionnaires of which 112 were completed and returned as illustrated below:

Table 4.1: Response rate for the population

Total Population	156
Sample	126
Total responses	112
Incomplete responses	4
Non-responses	10
Usable response rate	72%

According to Clarke and Cooke (1992:163), 70% is quite a good response rate. Since the total usable response rate, according to the above tabulation, was 72%, this is an acceptable response rate.

4.2.2 Population and Sample

Table 4.2: Respondents

POTFOLIOS	SAMPLE	RESPONSES	% of Total Sample
District directors	2	0	0
Circuit managers	8	5	4.46
Mathematics advisers	9	7	6.25
College maths lecturers	12	8	7.14
Principals of schools	20	15	13.39
Deputy principals	20	15	13.39

POTFOLIOS	SAMPLE	RESPONSES	% of Total Sample
Heads of mathematics	20	17	15.18
Heads of commercial subjects	20	10	8.93
Mathematics teachers	30	25	22.32
Commercial teachers	15	10	8.93
TOTAL	156	112	100

4.3 RESPONSES BY PARTICIPANTS

This consists of two parts which are structured as follows:

(a) **PART 1**: The biographical data: contains the statistics about the participants, such as gender, age, experience at work and qualification.

(b) **PART 2**: The questionnaire, which comprises:

Section A4: Skills and Unemployment,

Section B4: Mathematics and the workplace, and

Section C4: Mathematics and Entrepreneurship.

4.3.1 Part 1: Biographical Data

4.3.1.1 Gender

The majority of participants in the research were heads of mathematics departments and teachers of mathematics with 62% being men males while 38% were women. This indicates the extent to which both men and women participate and understand the significance of mathematics in curbing unemployment and the economic prosperity of the country at large.

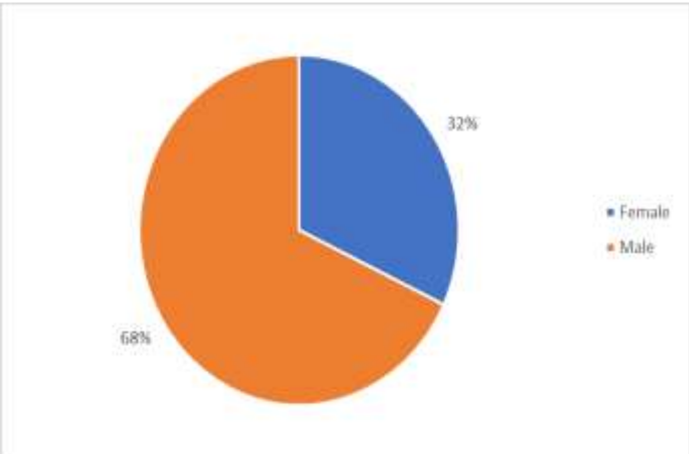

Figure 4.1: Gender

The responses represent the extent of the ability and understanding of mathematics according to gender. This is represented in the school results as well. For instance, in 2011, 32% of female students passed mathematics at grade 12 level and the male students who passed were 68%. Similarly, in 2012, the percentages were respectively 31.2% and 41.1%.

4.3.1.2 Age in years

The respondents here comprise age groups from 21 years to 65 years. This means that all age groups of mathematics and commerce teacher are actually represented. Most of the participants (69%) were mathematics teachers who were above 40 years of age.

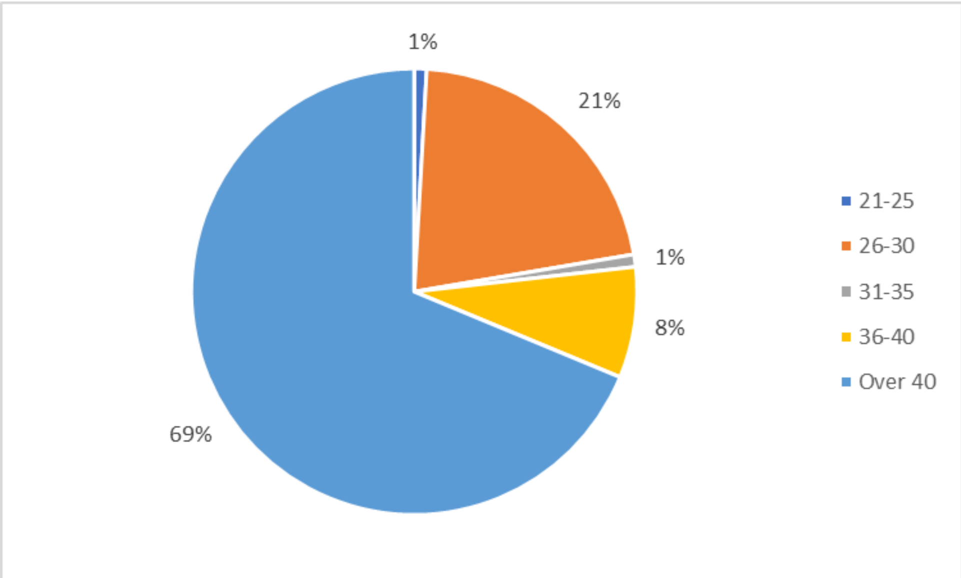

Figure 4.2: Age of the respondents

The thinking and perception of individuals are to some extent influenced by their age group. These are the teachers who have vast experience and knowledge. They have seen more in life, in schools and in the economy. Hence, the responses are reliable.

4.3.1.3 General teaching experience in years

Many of the respondents (27%) have been in the teaching business for at least 20 years. This experience is long enough for the teacher to know a great deal about the product of the education system. This entails the extent to which the education system moulds the youth to participate constructively in the economy of the country. According to Figure 4.3, 28% have been in the field for more than 24 years.

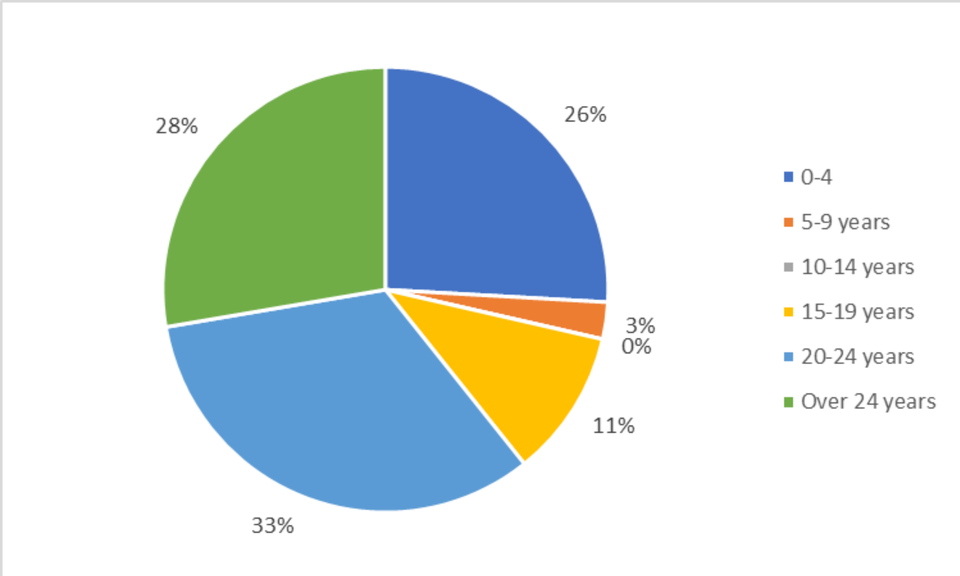

Figure 4.3: General teaching experience

This implies that more than 60% of the respondents have been in the teaching and learning business for more than 20 years. They definitely know what they are talking about. Hence, the responses are trustworthy.

4.3.1.4 Mathematics teaching experience in years

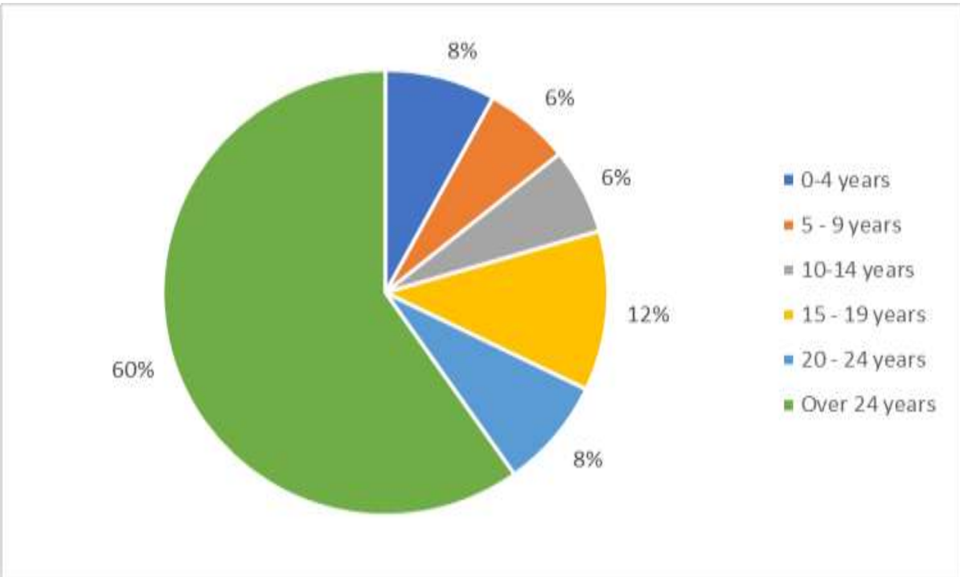

Figure 4.4: Mathematics teaching experience

Most of the respondents (60%) had taught mathematics for more than 24 years. Hence, they already know more than what they were taught at school. They were likely to be presently involved in the nature of mathematics and its significance outside the classroom as well.

They were assumed to be familiar with the statements in the questionnaire, including the creative and problem-solving nature of mathematics, among others. The 8% that have at least 20 years' experience in the teaching and learning of mathematics are also very knowledgeable concerning the nature of mathematics and its effect on the economy. Hence, the responses are assumed to be reliable.

4.3.1.5 Academic qualifications

The majority of the respondents are reasonably learned. This is based on the academic background of the majority of the respondents.

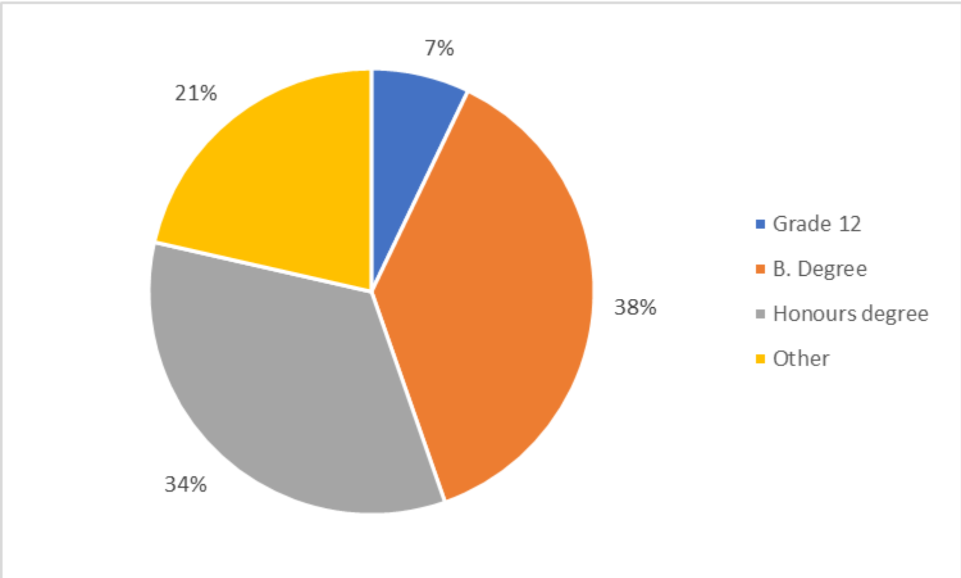

Figure: 4.5: Academic qualifications

For instance, 38% of the respondents have degrees and more importantly, 34% have honours degrees. The implication is that 72% (34%+38%) of respondents are well-educated.

4.3.1.6 Highest academic standard in mathematics

Among the respondents, 27% have mathematics as a major while 20% (13%+7%) have university mathematics.

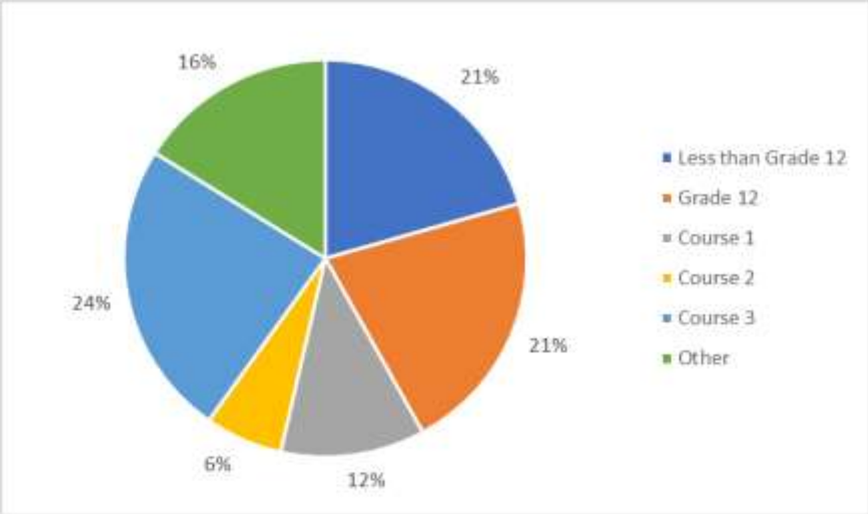

Figure 4.6: Highest academic standard in mathematics

These teachers are well-qualified to teach mathematics. Furthermore, their duty is to develop creativity, problem-solving ability and the critical skills of mathematics. Such teachers are able to explain the significance of mathematics to the learners and the rest of the community. The teachers are also involved in the teaching and learning of mathematics. Teachers normally do research in preparing their lessons.

4.3.1.7 Professional qualification

Figure 4.7 below shows that 29% of teachers hold the Higher Diploma in Education and 23% have Secondary Teachers' Diploma. Such teachers are well-educated and have undertaken professional training. 3% are PTD teachers. They have experience in the teaching and learning.

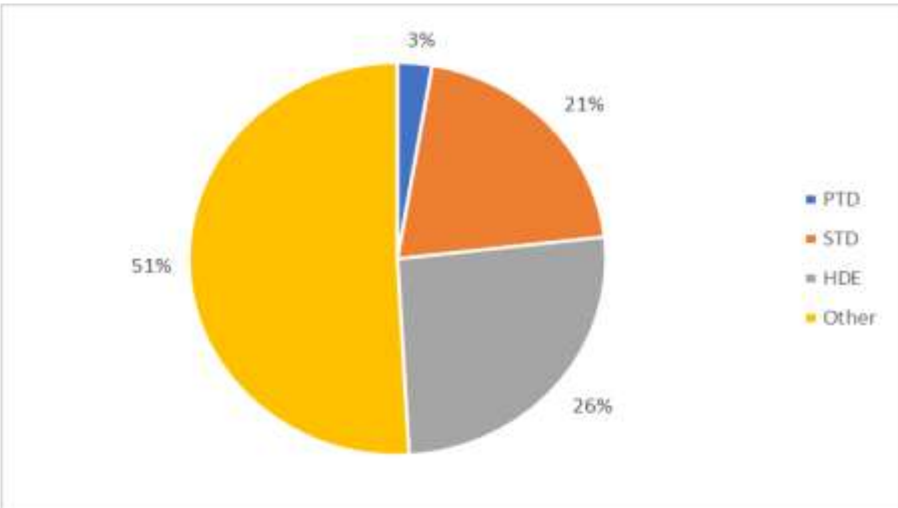

Figure 4.7: Professional qualifications

4.3.2 Part 2: Questionnaire

The collected data for part 2 were tested for validity and reliability, using Cronbach's alpha coefficient; Goodness of fit using the chi-square; and correlation using Pearson's correlation coefficient. These tests are discussed in section 3.8 above, and the results of the tests are shown below each of the section data. The respondents had to choose among five degrees of agreement, which are:

(1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree.

4.3.2.1 Section A: Skills and the workforce

Respondent selections are given in percentage form in the tables below

Table 4.3: Skills of the workforce

NO	STATEMENTS	1	2	3	4	5
1	The unemployment rate is very high in KwaZulu-Natal.	1.79	3.57	14.29	20.54	59.82
2	Lack of skills causes high unemployment in KwaZulu-Natal.	5.37	12.50	18.75	32.14	30.36
3	Unemployment results from the mismatch between the workforce skills and the available jobs skills.	7.14	10.71	21.43	31.25	29.46
4	The majority of youth leaves school without skills and this increases the rate of unemployment.	5.37	14.29	16.07	22.32	41.96
5	Out-of-school youth who leave school with low marks in mathematics forms the major source of unemployment.	7.14	8.9	21.42	32.14	30.36

The results of the test for section A (1-5) data were as follows:

Table 4.4: Cronbach's alpha coefficient

α	N of items
1	5

Cronbach's Alpha test for Section A above is 1. This is much greater than 0.7. Hence Section A of the questionnaire is reliable and excellent (see Table 3.1)

Table 4.5: χ^2 goodness of fit test

N of items	p-Value	χ^2	Significance
5	0.04847	34.3667	0.05

There is enough evidence at 4.8% level to conclude that there is a positive relationship between unemployment and the skills of the workforce.

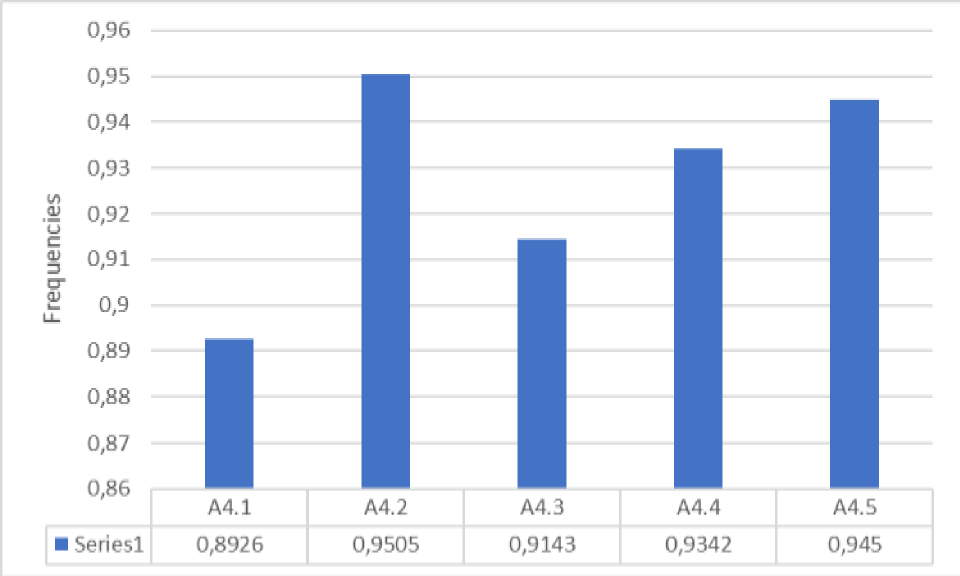

Figure 4.8: Pearson's correlation coefficient (ρ)

The correlation is perfect, positive and hence the frequency of responses increases with the increase in the degree of agreement with each of the statements. Hence, the majority of the participants agreed with the statements on the questionnaire (Section 3.8).

Pearson's correlation coefficient (ρ) is a measure of the strength of a linear association between two variables. Accordingly, the correlation is strong if the ρ is greater than 0.7. If it is less than 0.7, the correlation is weak. The correlation is poor if there are inconsistencies. However, the average ρ for Section A is 0.93. This is much greater than 0.7. Hence there is a string correlation between the variables and there are no inconsistencies.

Table 4.6: χ^2 goodness of fit test

N of items	p-Value	χ^2	Significance
14	0.025955	**28.7115**	**0.05**

The χ^2 result is 28.7115, the p-value is 0.025955. The value is significant at $p<0.05$. Hence there is enough evidence at 2.6% level to conclude that there is positive dependence of unemployment on quality of mathematics qualification.

The ρ for Section B was calculated and the results are shown in Figure B4.0. In almost all the responses, ρ is above 0.8 and is positive. The implication is that the correlation r is perfect.

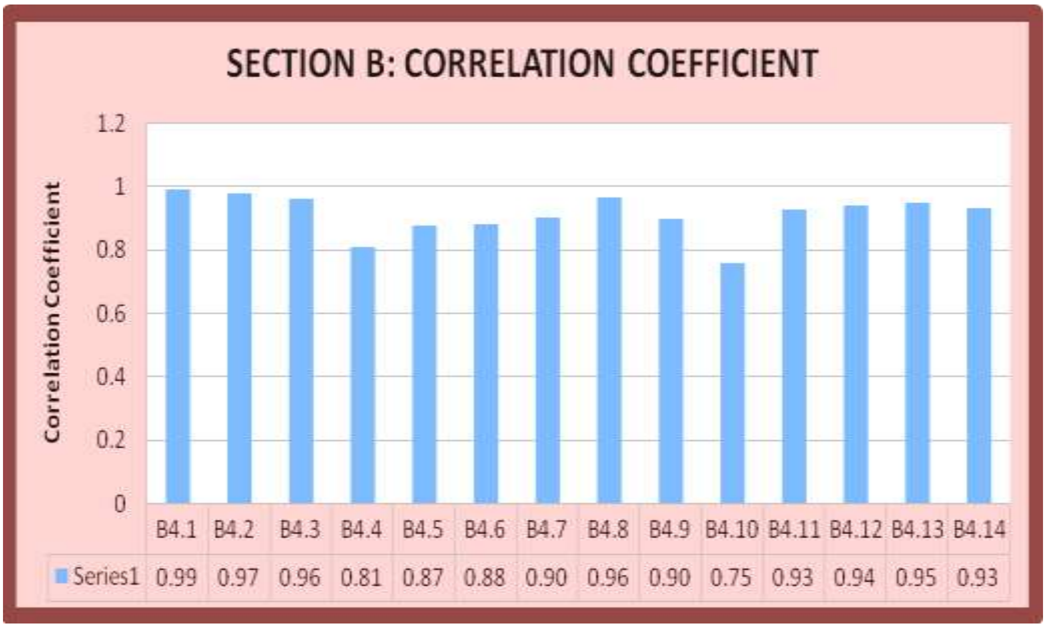

Figure B4.0: Pearson's Correlation Coefficient

That is the respondents agreed with the statements and with one another. A correlation is perfect if the magnitude of ρ is very close to +1 (Larson & Farber, 2006).

4.3.2.2 Section B: Analysis of individual statements

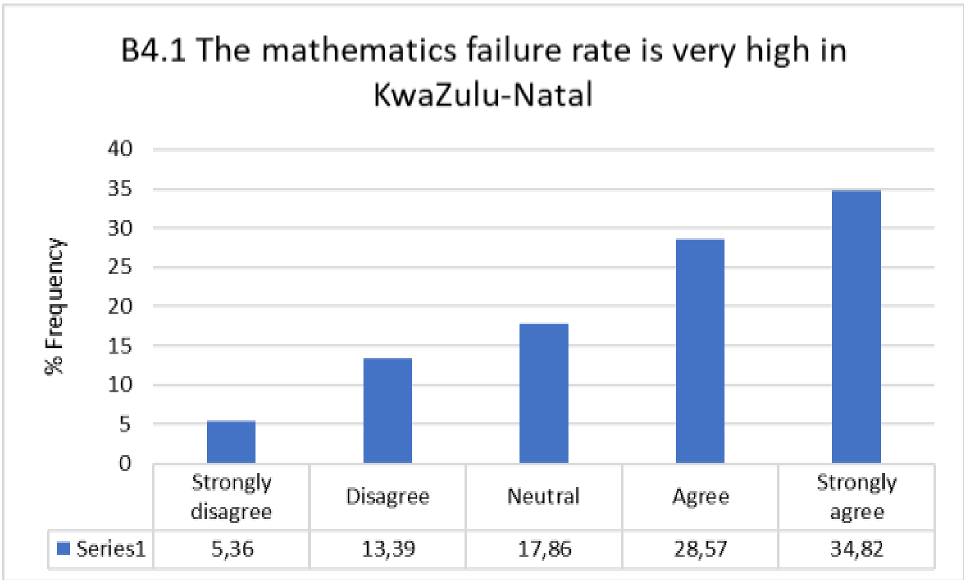

Figure B4.1: Mathematics failure rate in KwaZulu-Natal

The ρ in B4.1 is 0.9937. Hence, the correlation is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of ρ is very close to

+1. This result indicates that the respondents support the statement that “The mathematics failure rate is very high in KwaZulu-Natal”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to Figure B4.1, the percentage of agree and strongly agree together is 63.41 (28.57+34.84**)**, while disagree and strongly disagree combined is 18.75 (5.36+13.39). The participants feel the same as the literature review and the report from the examination Department of Education report.

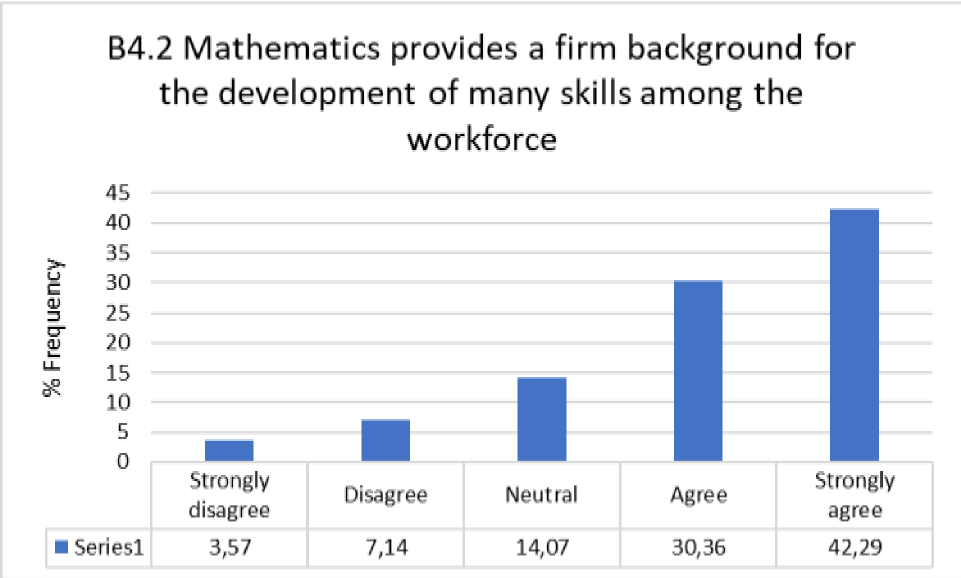

Figure B4.2: Mathematical knowledge and skills development

The ρ in B4.2 is 0.9791. Hence, the correlation is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of ρ is very close to +1. This result indicates that the respondents support the statement that “mathematics provides a firm background for the development of many skills among the workforce”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to Figure B4.2, the percentage of agree and strongly agree together is 72.65 (30.36+42.29**)**, while disagree and strongly disagree together is 10.71 (3.57+7.14).

According to Kreitner, and Kinicki (2008:47), skilled labour includes physicians, plumbers, attorneys, engineers, scientists, builders, architects, among others. They are the specialised part of the labour force with advanced educational qualifications. However, each one of them needs some mathematics qualification.

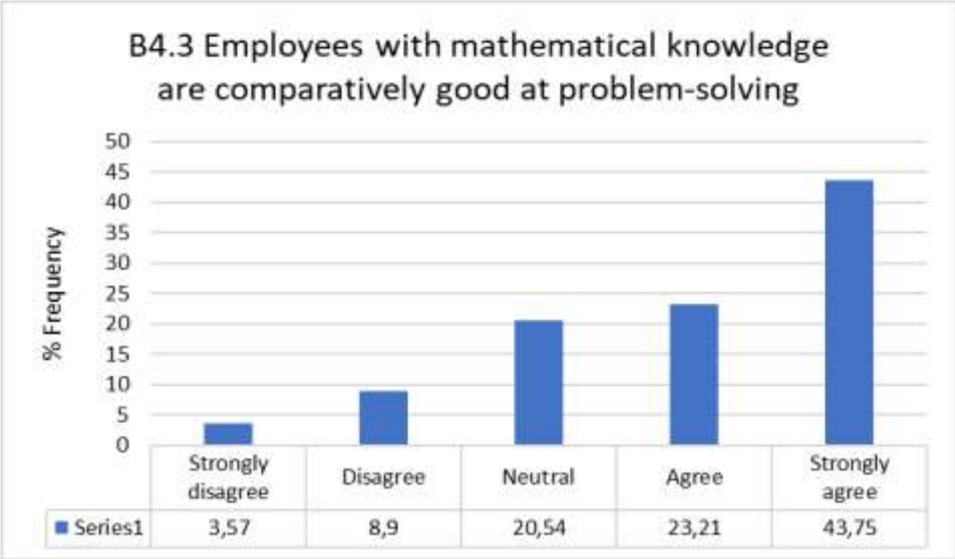

Figure B4.3: Mathematical knowledge and problem-solving at work

The ρ in B4.3 is 0.9791. Hence, the correlation is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of ρ is very close to +1. This result indicates that the respondents support the statement that "Individuals with mathematical knowledge are comparatively good at problem-solving".

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to Figure B4.3, the percentage of agree and strongly agree together is 43.75 (20.54+23.21), while disagree and strongly disagree together is 12.47 (3.57+8.9). Very (1990) shares this view as he argues that mathematics knowledge makes sense of any situation including the workplace content. He, furthermore, asserts that mathematics knowledge enables the workers to solve problems at work and elsewhere. Employers need employees with mathematics thinking.

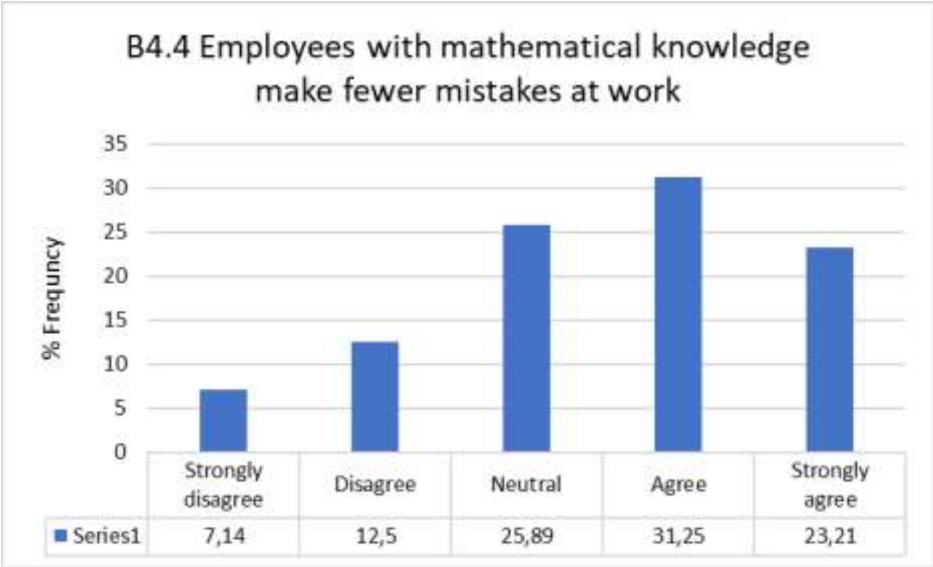

Figure B4.4: Mathematical knowledge and work accuracy

The ρ in B4.4 is 0.8118. Hence, the correlation is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. Furthermore, the correlation is good. This result indicates that the respondents support the statement that "employees with mathematical knowledge make fewer mistakes at work".

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.4, the percentage of agree and strongly agree together is 54.45 (31.25+23.21), while disagree and strongly disagree together is 19.64 (7.14+12.5).

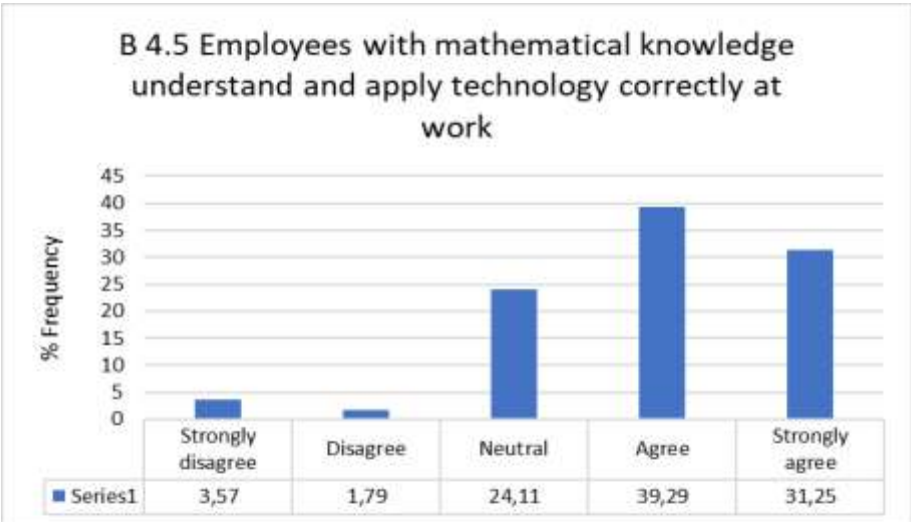

Figure B4.5: Mathematical knowledge and technology

The ρ in B4.5 is 0.0.8779. Hence, the correlation is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. This result indicates that the respondents support the statement that "employees with mathematical knowledge understand and are able to apply technology correctly at work".

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.5, the percentage of agree and strongly agree together is 70.54 (31.25+39.29), while the disagree and strongly disagree together is 5.36 (3.57+1.79).

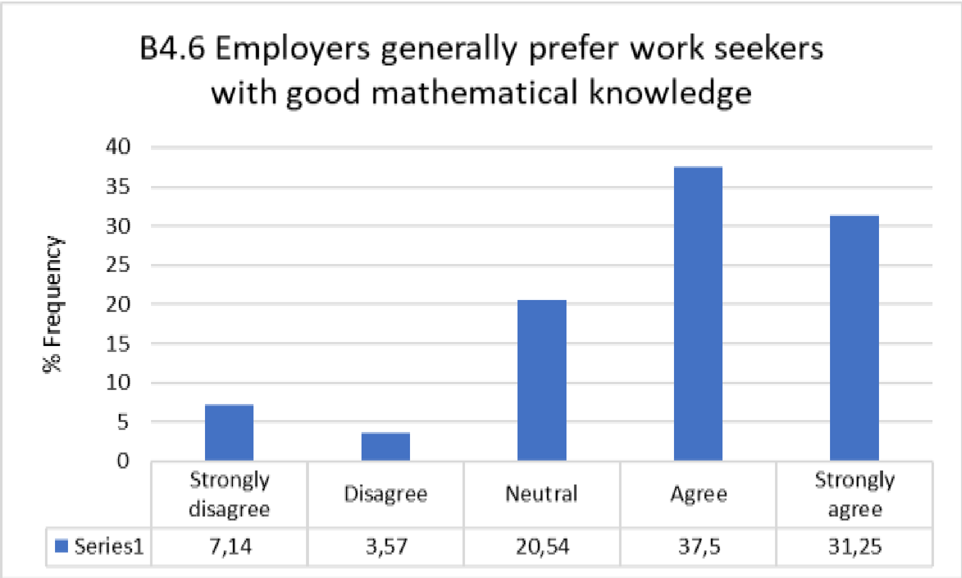

Figure B4.6: Mathematical knowledge and employers

The ρ in B4.6 is 0.0.8815. Hence, the correlation is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. This result indicates that the respondents support the statement that "employers generally prefer work seekers with good mathematical knowledge".

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.6, the percentage of agree and strongly agree together is 68.75 (37.50+31.25), while the disagree and strongly disagree together is 10.71 (7.14+3.57). Furthermore, Noe et al. (2008:713) support these statements as they argue that employers normally prefer employees with some standard of mathematics.

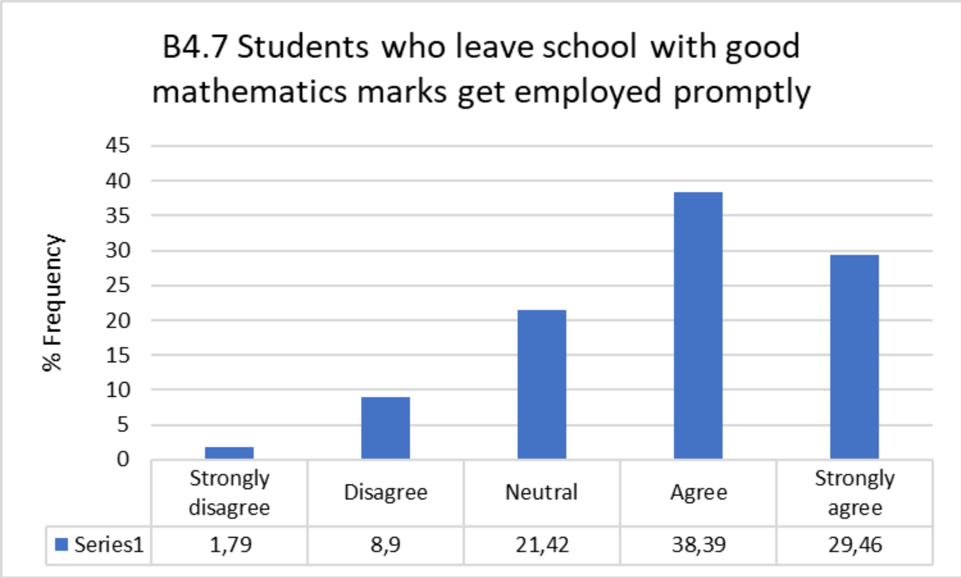

Figure B4.7: Good mathematics marks and employment

The ρ in B4.7 is 0.9689. Hence, the correlation is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of ρ is very close to +1. This result indicates that the respondents support the statement that “students who leave school with good mathematics marks get employed promptly”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.7, the percentage of agree and strongly agree together is 66.08 (38.39+26.79), while the disagree and strongly disagree together is18.75 (3.57+15.18).

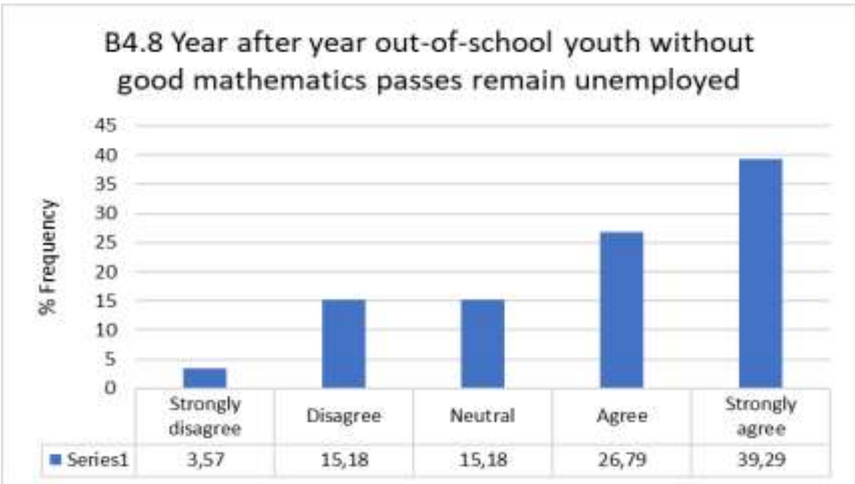

Figure B4.8: Out-of-school youth without good mathematics passes

The ρ in B4.8 is 0.9014. Hence, the correlation is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of ρ is very close to +1. This result indicates that the respondents support the statement in that “Year after year out-of-school youth without good mathematics pass rate remain unemployed”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.8, the percentage of agree and strongly agree together is 75 (41.07+33.93) while the disagree and strongly disagree together is12.5 (.89+11.61)

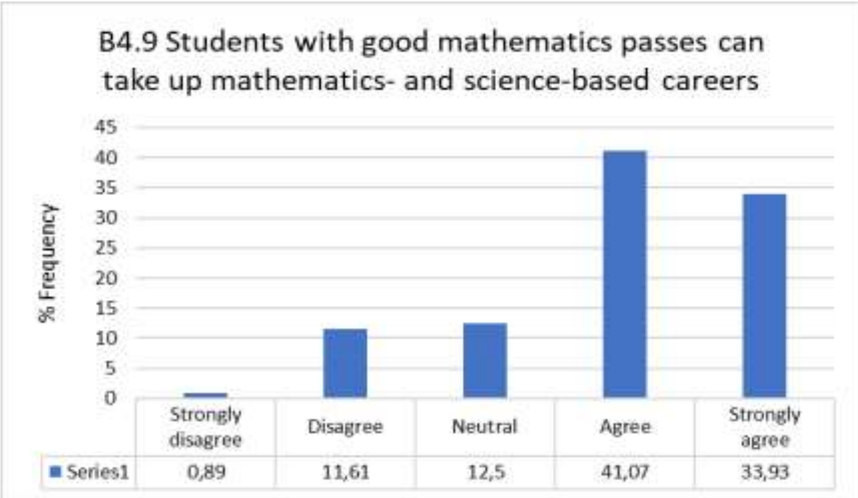

Figure B4.9: Good mathematics passes and mathematics- and science-based careers

The ρ in B4.9 is 0.7592. Hence, the correlation is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. This result indicates that the respondents support the statement that “students with good mathematics passes can take up mathematics- and science-based careers”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.9, the percentage of agree and strongly agree together is 75 (41.07+33.93) while the disagree and strongly disagree together is 12.5 (0.89+11.61).

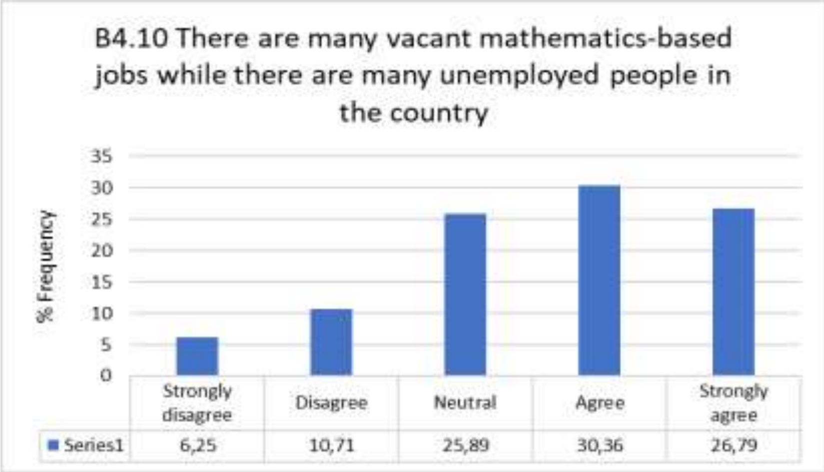

Figure B4.10: Mathematics-based vacant jobs

The ρ in B4.10 is 0.9309. Hence, the correlation r is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of ρ is very close to +1. This result indicates that the respondents support the literature review in that "mathematics failure rate is very high in KwaZulu-Natal".

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.7, the percentage of agree and strongly agree together is 62.50(33.04+29.46) while the disagree and strongly disagree together is 13.40 (3.58+9.82). Furthermore, these results are in line with Appendix 4, concerning the many mathematics-based vacant posts.

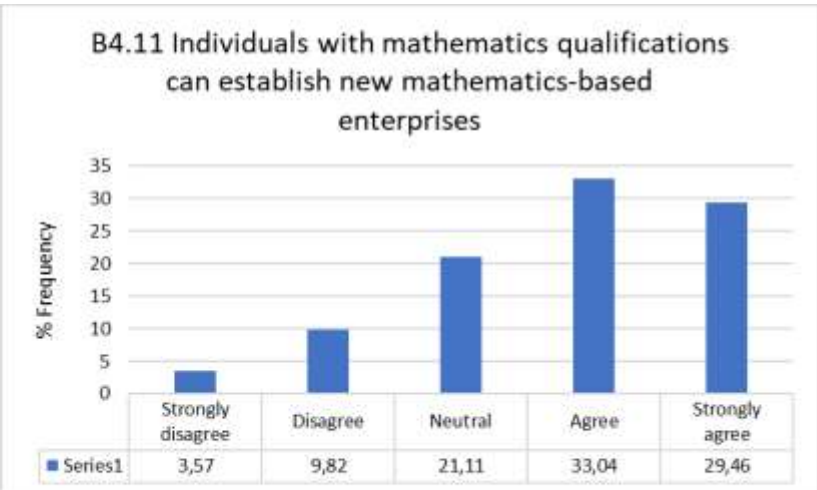

Figure B4.11: Mathematics qualifications and mathematics-based enterprises

The ρ in B4.11 is 0.9412. Hence, the correlation is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of ρ is very close to +1. This result indicates that the respondents support the literature review in that “Individuals with mathematics qualifications can establish mathematics-based enterprises”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.7, the percentage of agree and strongly agree together is 62.50 (33.04+29.46) while the disagree and strongly disagree together is13.40 (3.58+9.82).

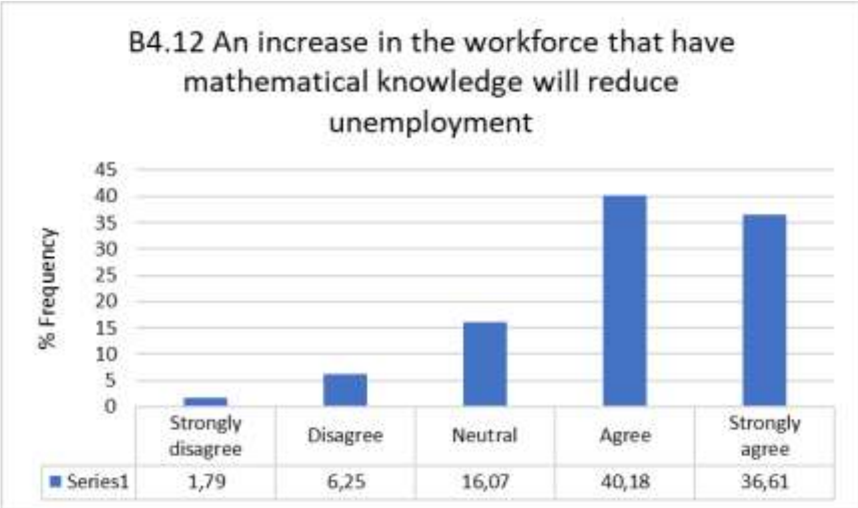

Figure B4.12: Mathematical knowledge reduces the unemployment rate

The ρ is 0.9412. This implies that r is positive, and it also means that the frequencies of respondents' choices increase as the degree of agreement move from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of ρ is very close to +1. This result indicates that the respondents support the literature review in that “mathematical knowledge reduces the unemployment rate”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.12, the percentage of agree and strongly agree together is 76.79 (40.18+36.61) while the disagree and strongly disagree together is8.04 (1.79+5.25).

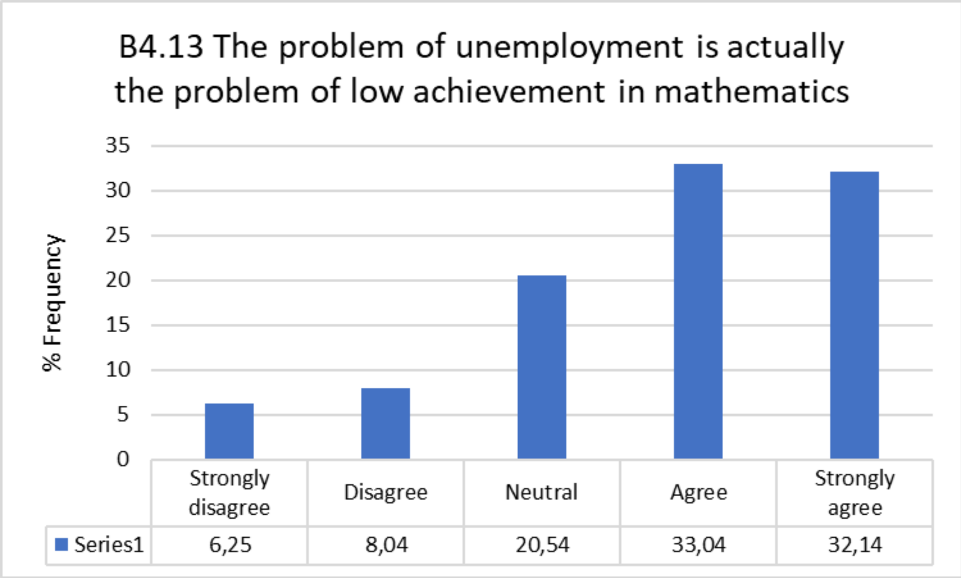

Figure B4.13: Unemployment problem and mathematics failure rate problem**.**

The ρ in B4.13 is 0.0.9524. Hence, the correlation r is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of r is very close to +1. This result indicates that the respondents support the statement that "the problem of unemployment is actually the problem of low achievement in mathematics".

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.13, the percentage of agree and strongly agree together is 65.18 (33.04+32.14) while the disagree and strongly disagree together is 14.29 (6.25+8.04).

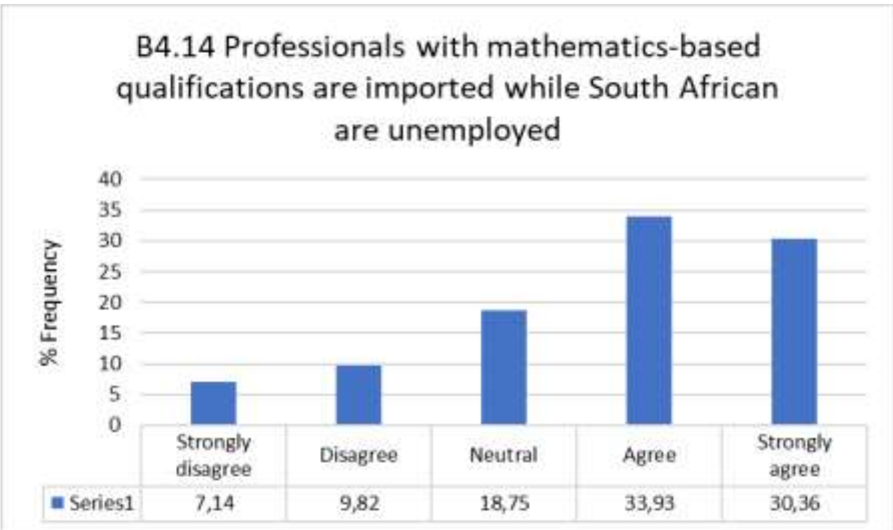

Figure B4.14: Mathematics-based professionals

The ρ in B4.14 is 0.9338. Hence, the correlation r is positive, which shows that the frequencies of respondents' choices increase with the increase in agreement from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of r is very close to +1. This result indicates that the respondents support the statement that “professionals like medical doctors, engineers, actuaries, mathematicians with mathematics-based qualifications are imported while South Africans are unemployed”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph B4.14, the percentage of agree and strongly agree together is 64.29 (33.93+30.36) while the disagree and strongly disagree together is 16.96 (7.14+9.82)

C. Analysis of responses from each statement

4.3.2.3 Section C: A School of Mathematics and Entrepreneurship

- Respondent selections in percentage form

Table 4.7: A school of mathematics and entrepreneurship

N	STATEMENTS	1	2	3	4	5	TOTAL
1	Entrepreneurship provides the youth with skills for initiating their own businesses.	2.68	14.29	19.64	33.93	29	100
2	Entrepreneurship encourages the young people to start new businesses in the country.	1.79	14.79	10.71	30.36	42	100
3	Quality mathematics pass rate enables the youth to complete mathematics-based professions.	1.79	10.89	22.32	35.71	31	102
4	Special teaching approaches like constructivism and problem-solving will enable the learners to pass mathematics with good marks.	5.36	16.07	8.9	38.39	31	100
5	Mathematics together with entrepreneurship would create new jobs and reduce unemployment.	9.82	17.86	12.5	31.25	29	100
6	There is a need for a school to re-teach mathematics and entrepreneurship to students who obtained less than 40% pass rate at the grade 12 examination.	10.71	15.18	16.07	26.79	31	100

- Data testing

Table 4.8: Cronbach’s alpha coefficient

Cronbach’s Alpha	N of items
0.97	6

The Cronbach's Alpha test for Section C above is 0.96707. This is much greater than 0.7. Hence Section C of the questionnaire is reliable and there are no inconsistencies.

The results of the chi-square test are shown below:

Table 4.9: χ^2 for Section C

N of items	p-Value	χ^2	Significance
14	0.025955	**28.7115**	**0.05**

The χ^2 is 26.7527 and the p-value is 0.044315. The value is significant at $p<0.05$. Hence there is enough evidence at 4.4% level to conclude that there is a great need for a school that teaches entrepreneurship together with mathematics for the out-of-school youth.

The following graphical representations illustrates the Pearson's correlation coefficient for each statement of Section C of the questionnaire. According to section 3.8, the responses increase with the increase in degrees of agreement in the questionnaire

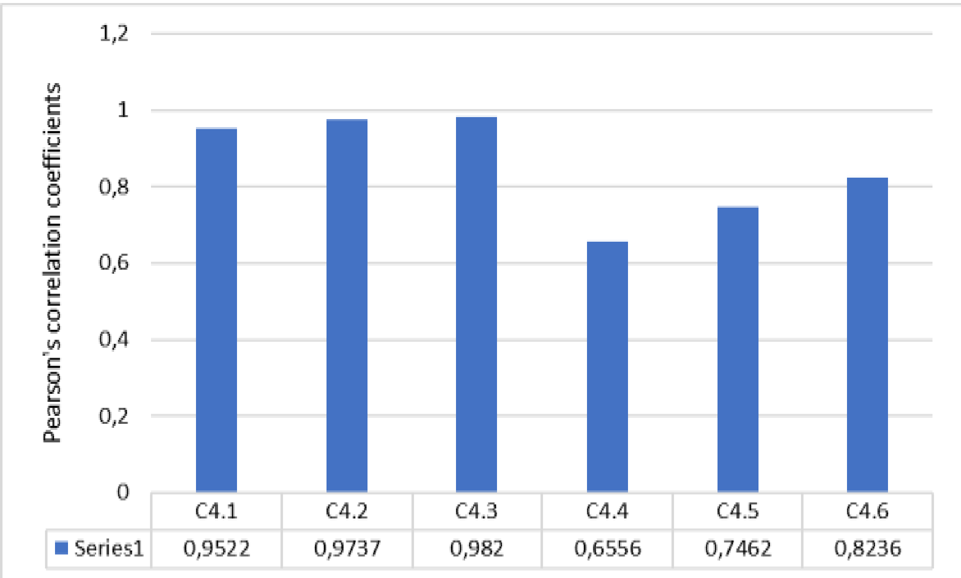

Figure C4.0: Pearson’s correlation coefficients

The correlation is perfect and positive as the frequency of responses increases with the increase in the degree of agreement with each of the statements. Hence, the majority of the participants agrees with the statements on the questionnaire (Section 3.8)

C. ANALYSIS OF INDIVIDUAL STATEMENTS IN SECTION C

Figure C4.1: Entrepreneurship and business skills

The ρ is 0.9522. This implies that r is positive, and it also means that the frequencies of respondents' choices increase as the degree of agreement move from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of ρ is very close to +1. This result indicates that the respondents support the statement that "Entrepreneurship provides the youth with skills to start their own businesses".

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph C4.1, the percentage of agree and strongly agree together is 63.39 (33.93+29.46) while disagree and strongly disagree together is 16.97 (2.68+14.29). Hence, the majority of people in the sample do perceive the need for entrepreneurship in addition to mathematics for the out-of-School youth.

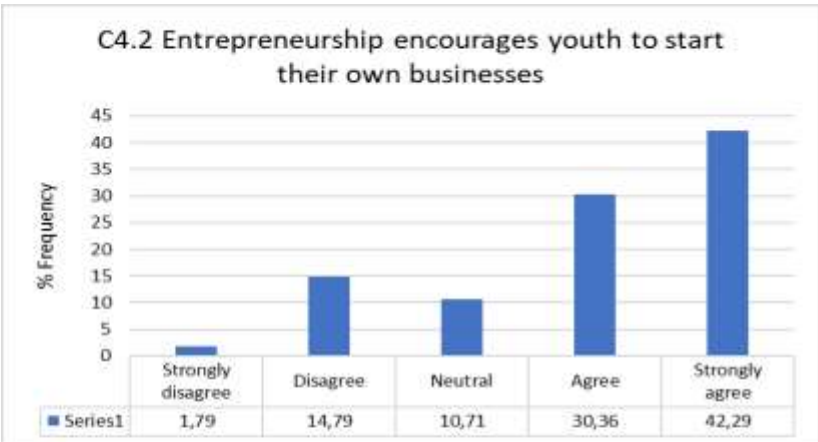

Figure C4.2: Entrepreneurship and initiating enterprises

The ρ is 0.9737. This implies that r is positive, and it also means that the frequencies of respondents' choices increase as the degree of agreement move from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of r is very close to +1. This result indicates that the respondents support the statement that “Entrepreneurship encourages the youth to start their own businesses”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph C4.2, the percentage of agree and strongly agree together is 72.65 (30.36+42.29) while disagree and strongly disagree together is 16.58 (1.79+14.79). The majority of the people in the sample feel that more businesses will be founded if mathematics and entrepreneurship are taught together. This will undoubtedly reduce unemployment in the province and, eventually, the country at large**.**

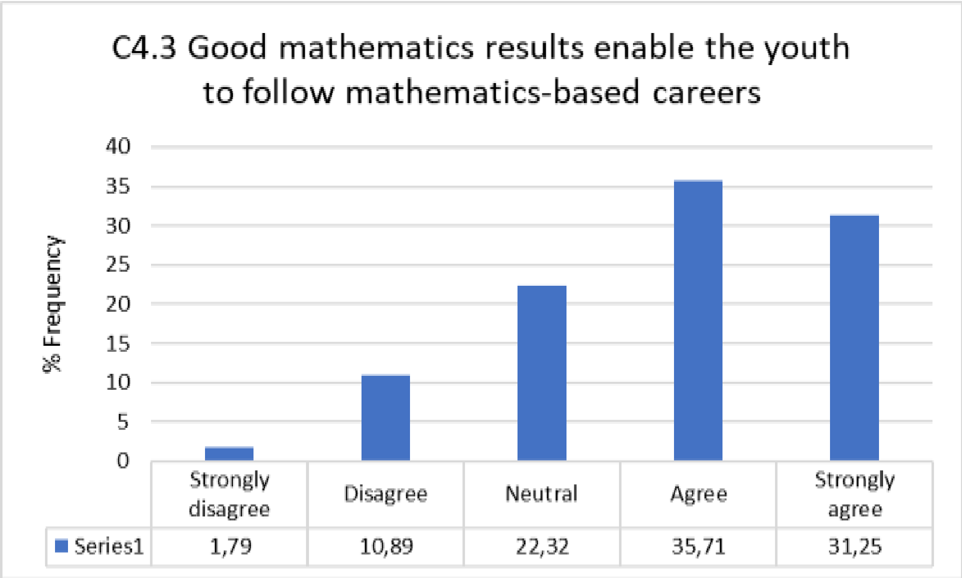

Figure C4.3: Good mathematics results and mathematics-based careers

The ρ is 0.9820. This implies that r is positive, and it also means that the frequencies of respondents' choices increase as the degree of agreement move from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of r is very close to +1. This result indicates that the respondents support the statement that “good mathematics results enables the youth to enter mathematics-based careers”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph C4.3, the percentage of agree and strongly agree together is

66.96(35.71+31.25) while disagree and strongly disagree together is 12.68(1.79+10.89). Most of the people in the sample know that good marks in mathematics are essential for progress in mathematics-based professions and to curb unemployment.

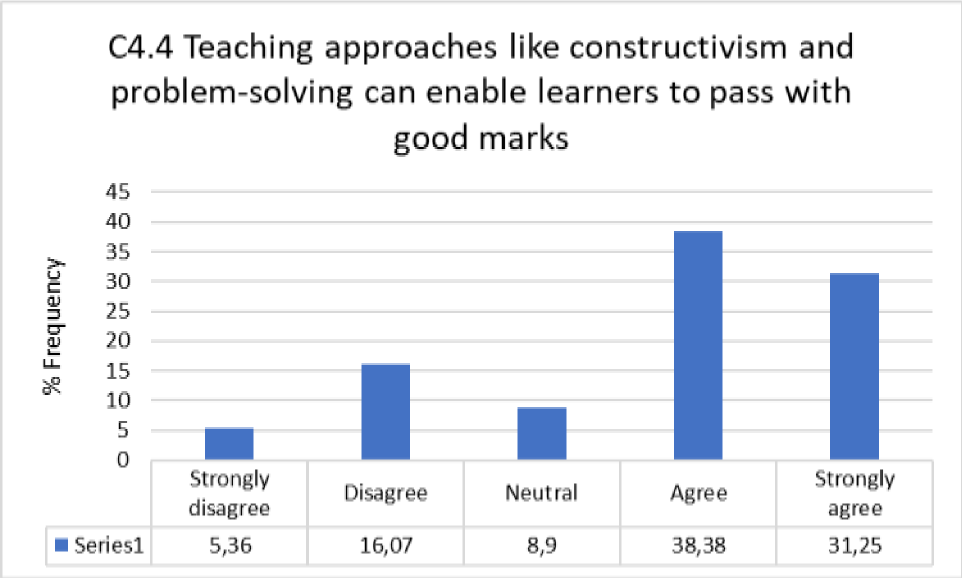

Figure C4.4: Constructivism and problem-solving teaching approach

The ρ is 0.6556. This implies that r is somewhat positive, and it also means that the frequencies of respondents' choices increase as the degree of agreement move from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of r is very close to +1. This result indicates that the respondents support the statement that “special teaching approaches like constructivism and problem-solving will enable learners to pass with good marks”.

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph C4.4, the percentage of agree and strongly agree together is 69.64(38.39+31.25) while the disagree and strongly disagree together is 21.43(5.36+16.07). Most people agree and strongly agree that there are certain methods of teaching which will reduce the high failure rate in mathematics and thus curb unemployment. However, experience is essential in this case.

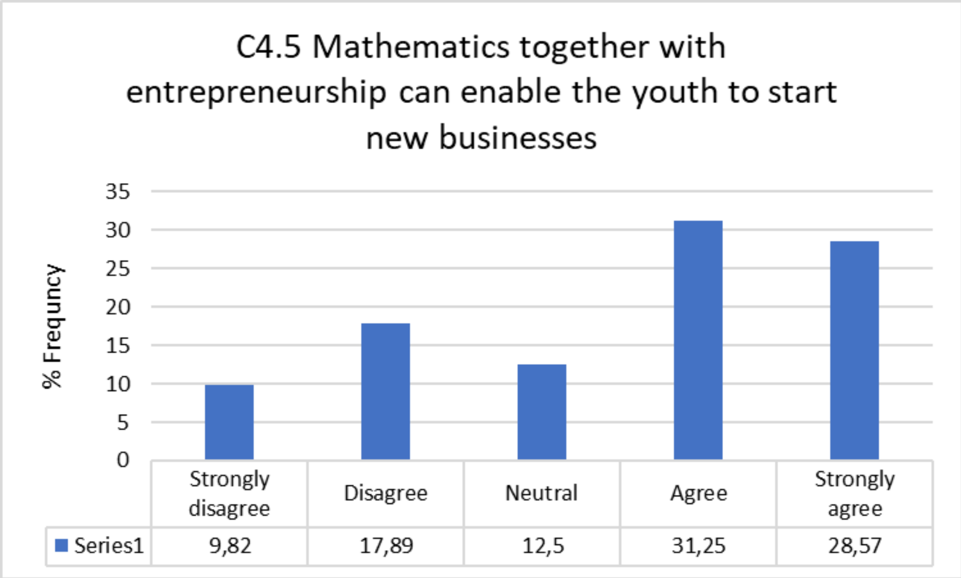

Figure C4.5: Mathematics and entrepreneurship to initiate businesses

The ρ is 0.7462. This implies that the correlation is positive, and it also means that the frequencies of respondents' choices increase as the degree of agreement move from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of r is very close to +1. This result indicates that the respondents support the statement in that "mathematics together with entrepreneurship can enable the youth to start new businesses".

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to graph C4.5, the percentage of agree and strongly agree together is 59.82 (31.25+28.57) while disagree and strongly disagree together is 27.68 (9.82+17.86). It is evident from the frequencies in the choices of people in the education department that the combination of entrepreneurship and mathematics might save KwaZulu-Natal and South Africa from unemployment and poverty.

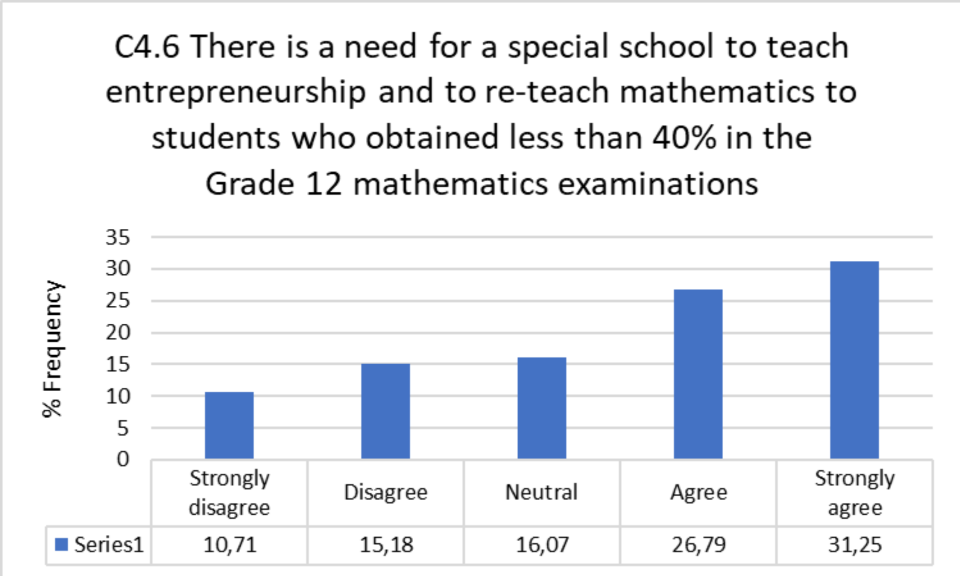

Figure C4.6: Special school for entrepreneurship and re-teach mathematics

The ρ is 0.8236. This implies that the correlation is positive, and it also means that the frequencies of respondents' choices increase as the degree of agreement move from strongly disagree to strongly agree. Furthermore, the correlation is perfect, as the magnitude of r is very close to +1. This result indicates that the respondents support the statement that "There is a need for a special school to teach entrepreneurship and re-teach mathematics to the out-of-school youth who obtained less than 40% in the Grade 12 mathematics examination".

Furthermore, the extent of agreement with the statement is demonstrated by the degree to which the percentages of agree and strongly agree exceeds those of disagree and strongly disagree. According to Figure C4.6, the percentage of agree and strongly agree together is 58.04 (26.79+31.25) while disagree and strongly disagree together is 25.896 (10.71+15.18). The sample is taken from the circuit officials, principals of schools, mathematics advisers, among others. Most of them perceive the need for a special school for the out-of-school youth. The majority of out-of-school youth are children who failed or obtained low marks in mathematics and hence could not proceed to do study at tertiary institutions.

4.4 CHAPTER SUMMARY

In this chapter, the data from the questionnaire and the demographics were collected. The data from the questionnaire were classified as Section A: the skills of the workforce and unemployment, Section B: the significance of mathematics in the workplace, and Section C: the envisioned school of entrepreneurship and mathematics (Appendix 6).

The responses were then recorded and analysed according to the extent of agreement with questionnaire statements. In almost all the sections of the questionnaire, the responses showed a positive correlation with the statements. Accordingly, it is clear that the South African workforce is generally unskilled and that is a cause for unemployment. It also became clear that mathematics as a skill is essential in the work place, and also for the development of other skills. The chapter also revealed the need for a special school for mathematics and entrepreneurship for the out-of-school youth.

On the analysis of the questionnaire responses, it was clear that the failure rate in mathematics actually causes the high rate of unemployment. Almost all the answers from the questionnaire confirmed that lack of skills causes unemployment and that mathematics is essential for employment. The results from the questionnaire also confirmed the importance of the combination of mathematics and entrepreneurship in the establishment of mathematics-based businesses.

The following chapter provides conclusions and recommendations to the Department of Education and the government.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter presents conclusions and recommendations, in order to address the objectives of the study. It is in this chapter that the findings from the literature as well as findings from the primary study are summarised. Conclusions are drawn from the findings and recommendations are made. The chapter also makes recommendations for further research. The objectives that guided the study were as follows:

- To analyse the unemployment rate relative to the skills of the labour force.
- To determine the significance of mathematical knowledge and mathematical skills relative to the work situation.
- To compare the employability of work seekers, who possess mathematical knowledge and those who are mathematically illiterate.

5.2 FINDINGS FROM THE STUDY

The findings from the study are in two parts, and consist of the secondary and the primary research:

5.2.1 Findings from the Literature

5.2.1.1 Skills of the labour force

According to the literature review, the majority of the labour force in South Africa is unskilled. Such lack of skills contributes greatly to the high rate of unemployment. Nel et al. (2008:28) highlight this view as they affirm that South Africa has an oversupply of unskilled labour. Lack of mathematical knowledge, according to the literature review, also contributes to the lack of skills and high rate of unemployment.

5.2.1.2 The value of mathematics in reducing unemployment

According to the literature review, mathematics forms the background upon which most skills and the science-based careers are built. Without mathematics, science-based professions cannot be followed and the extent to which skills are developed is limited.

Based on the literature, mathematics develops problem-solving abilities among the employees. Such problem-solving abilities increase the extent to which employees within an enterprise can discover new methods of production and the new products. Hence, the enterprise expands and employs more workers thus reducing the unemployment rate.

5.2.1.3 Employability based on quality mathematics qualification.

According to the literature review, employers prefer to employ work seekers who have mathematical knowledge. Consequently, work seekers who have mathematical knowledge are more likely to be employed than the ones without such knowledge. Hence, work seekers need to improve their mathematics results in order to advance their chances of employment.

Accordingly, any further step the Department of Education takes to improve the quality of education should be geared towards improving mathematics education and introducing entrepreneurship in every grade level.

5.2.1.4 The establishment of new enterprises and entrepreneurship.

According to the literature review, entrepreneurship enlightens the mathematics students about the businesses that are related to mathematics and science. Moreover, entrepreneurship empowers and encourages the mathematics students to pursue an entrepreneurial career path. Accordingly, on completion of their mathematics-based training, the students can establish mathematics-based businesses. This may open up many job opportunities and thus limit the rate of unemployment.

Nonetheless, the high mathematics failure rate in the country limits access to jobs. The problem of unemployment in South Africa can be partly attributed to the high failure rate in mathematics.

5.2.1.5 The extent to which students who fail mathematics increase unemployment

According to the literature, every year approximately 150 000 teenagers join the unemployed workforce due to low achievement in mathematics. This number is actually more than 150 000 because there are some teenagers who leave school even before reaching the Grade 12 level. The government and, in particular, the Department of Education, need to do all they can to improve the Grade 12 mathematics results. The main problems are:

- High rate of unemployment

The rate of unemployment in South Africa is very high. According to the literature review, and the statistical calculations, the high failure rate in mathematics contributes greatly to the high rate of unemployment. If more members of the workforce obtained quality mathematics qualifications, the unemployment rate would correspondingly decrease. This statement relates to the fact that there are always vacant mathematics-based jobs (Appendix 5). Hence, the problem of unemployment could be partly solved by reducing the failure rate of mathematics at Grade 12 level.

- Out-of-school youth

Out-of-school youth are the children who left school for various reasons before they completed their schooling. Many of them left school because they could not pass mathematics. They could not proceed to do mathematics-based professions at tertiary institutions and they are not qualified for mathematics-based jobs. They join the unemployed workforce and according to the literature review, they form the major component of the unemployed labour force. According to StatsSA (2015), the unemployed youth make up more than 38% of the unemployment rate, with the overall unemployment rate in the country being 25%. Consider this calculation:

Let X represent the unemployment rate for adults in South Africa, then.

$$\text{Average unemployment} = \frac{38\% + X}{2} = 25\%$$

$$X = 50\% - 38\%$$

$$X = 12\%$$

This means that the adult unemployed workforce constitutes 12% and the youth unemployed workforce constitutes 38%. If it were not for the youth entering the labour force, unemployment would be 12%. This further emphasises the impact of the high mathematics failure rate on the unemployment rate.

5.2.2 Findings from the Primary Research

5.2.2.1 Skills of the labour force

The majority of the responses in the questionnaire supported the fact that the labour force generally has low skills. Accordingly:

- The low skills among the workforce cause the unemployment rate to be very high.
- The unskilled labour force keeps on increasing based on the school drop-outs.

- There is a mismatch between the workforce skills and the skills required by the market.

5.2.2.2 The value of mathematics in reducing unemployment

The majority of respondents in the questionnaire felt that mathematics is essential as:

- It provides the background for the learning and development of most skills among workforce members.
- Employees with mathematical knowledge quickly understand and are able to use technological applications.
- Employers generally prefer work seekers with mathematical knowledge.
- Students with quality mathematics qualification can take up science-based professions.

5.2.2.3 Employability of mathematically qualified work seekers.

According to the questionnaire responses, employers prefer to employ work seekers who have mathematical knowledge. Employers generally feel that employees with mathematical knowledge quickly understand the processes and make fewer mistakes.

5.2.2.4 Entrepreneurship and the establishment of new enterprises.

The respondents from the questionnaire agreed that entrepreneurship encouraged the youth to start new businesses in the country. According to them, entrepreneurship would provide the youth with the skills and interest to initiate mathematics-based businesses.

5.2.2.5 Mathematics-qualified professionals can establish mathematics-based businesses.

The respondents generally concurred with the literature review that the combination of mathematics and entrepreneurship can result in the establishment of many mathematics-based enterprises and hence, create more job opportunities.

5.2.2.6 To make recommendations on initiatives that will reduce the unemployed workforce.

The respondents to the questionnaire strongly agreed with the literature review, that the Department of Education needs to establish a school that would teach entrepreneurship and re-teach mathematics to the out-of-school youth. On completion of their mathematics-based training, the youth could start new mathematics-based businesses and reduce unemployment.

5.3 RELATIONSHIP BETWEEN THE FINDINGS FROM THE LITERATURE AND FROM THE PRIMARY STUDY

On average, the responses in the questionnaire coincide with the theoretical assertions from the literature review. Hence, the low pass rate in mathematics actually causes the high rate of unemployment. The implication here is that the problem of unemployment is actually the problem of high failure rate in mathematics. Accordingly, the problem of unemployment should not be treated in isolation. It should be treated together with the high failure rate in mathematics. This further implies that the increase in the pass rate of mathematics in the country will considerably reduce the unemployment rate.

5.4 CONCLUSIONS

The high unemployment rate in South Africa was the driver behind this study. Economists and the government, among others, have endeavoured to reduce unemployment, but none of the efforts have produced any laudable results. In this study, the researcher wanted to establish if the high failure rate of mathematics at grade 12 level had any impact on the unemployment rate in South Africa. This was done through the literature review, the questionnaire responses and the statistical calculations.

During the study, there was an agreement between the literature review and the questionnaire responses that the high unemployment rate, results from the lack of skills among the South African labour force. There was further agreement that the development of most skills is dependent on the acquisition of mathematical knowledge of the workforce. Hence, without mathematical knowledge among the workforce, skills may not develop properly and unemployment may not necessarily decrease. Nel et al. (2008:28) concur with this observation as they assert that South Africa has an oversupply of unskilled workers and a shortage of certain types of skilled workers.

Mathematics-based professions and jobs remain vacant for quite some time because the unemployed workforce does not possess the skills to occupy the vacancies (Appendix 5). The country, therefore, imports skilled professionals with the necessary mathematical qualifications from other countries because such professionals are scarce in South Africa. People from other countries occupy positions such as specialist-medical doctors, engineers, actuaries, mathematics educators, to name a few, while South Africans remain unemployed and in poverty. Such importation of experts is necessary and essential. This is an example of how the high failure rate in mathematics at the Grade 12 examinations impact the unemployment rate.

The study of the literature on mathematics has revealed that mathematics is useful in all enterprises. According to the literature, employees with mathematical knowledge have the ability to solve problems within the organisation. They also have the potential to apply technology effectively and correctly. Furthermore, the literature revealed that the majority of employers prefer to employ job seekers who possess some mathematical knowledge. The implication is that employees with a background in mathematics are employable while the job seekers without this background add to the unemployment rate on a yearly basis. Noe et al. (2008:713) support this idea when they assert that employers normally prefer employees with some level of mathematical knowledge. According to them, employees with a mathematics background have the potential to become experts on their jobs and on technology.

Based on the literature review and the questionnaire responses, lack of mathematical knowledge among the workforce causes the high unemployment rate. Such unemployment rate increases with the increase in the number of youth who leaves school without having passed mathematics. Furthermore, the out-of-school youth that are mathematically illiterate remain unemployed year after year.

According to the literature, South Africa needs more youth who possess mathematics qualifications. The mathematics-qualified youth will obtain jobs and, in turn, initiate businesses that are mathematics-based. Hence, more jobs would be created. The implication is that more South Africans should possess mathematics knowledge to curb unemployment.

5.5 RECOMMENDATIONS

5.5.1 In-service Centre

According to the literature review, echoed by the questionnaire responses, the high failure rate in mathematics contributes to the problem of the high rate of unemployment. The implication here is that if the achievement in mathematics by students improves, the unemployment rate will decrease. The establishment of an in-service centre for mathematics teachers could be one of the strategies to improve the pass rate in mathematics and thus reduce the rate of unemployment.

To this end, an in-service centre would:

- Be staffed with well-experienced teachers who are academically suitable.
- Take care of newly-appointed teachers who have no mathematics teaching experience.
- Provide comprehensive in-service programmes to mathematics teachers whose learners continually obtain low pass rates.
- Emphasise the problem-solving and constructivist strategy for mathematics teaching.

According to the literature review, the questionnaire and the statistics, most of the mathematics teachers are not sufficiently qualified to teach mathematics at Grade 12 level. Hence, they may not apply the essential approaches of constructivism and problem-solving among others (Mpofana, 1997:14). Retired, qualified and experienced teachers may also be used.

5.5.2 Out-of-School Youth

According to StatsSA (2015), from 2011 to 2014, 598 328 students obtained less than 40% pass rate in mathematics at grade 12 level. The Department of Education needs to do something for these drop-outs. One of the strategies to deal with this problem is to establish a special school for them that would introduce entrepreneurship and re-teach mathematics. After completion, the drop-outs would find employment, some would enter mathematics-based professions and might initiate new mathematics-based enterprises. The empowerment of drop-outs would, in turn, create job opportunities and help to reduce the high rate of unemployment in the country.

5.3.3 A special school for mathematics and entrepreneurship

A possible strategy would be that of re-teaching the out-of-school youth in mathematics and to include entrepreneurship in the curriculum. The establishment of a special school for mathematics and science or a special bridging course for mathematics to provide for the out-of-school youth, who are drop-outs, could be considered.

- The education department should establish a school to increase the number of the youth that possess mathematics qualifications. Such schools should be available in every district (Appendix 6).

- Such a school should offer entrepreneurship over and above mathematics at grade 12 level. The youth from the school will transform innovations into services and companies to drive the economic growth and reduce unemployment rate (Timmons & Spinelli, 2009:6).
- Entrepreneurship will inspire and empower mathematics students to be founders of mathematics-based enterprises. If this happens, unemployment will be greatly reduced and the gross domestic product will grow.
- The mathematics qualifications among the youth will decrease the number of the unemployed youth. This is based on the literature review and the questionnaire responses.
- The education department should staff the school with well-qualified, experienced and motivated mathematics teachers.

5.5.4 Staffing for the Mathematics Departments in Schools

The principal should ensure that:

- HODs for mathematics departments have the required qualifications and experience in the teaching of mathematics.
- Mathematics teachers should be well-qualified for the sections of the syllabus that they teach.
- The mathematics teachers should teach by specialising in sections of the syllabus to ensure thorough teaching and learning in each section.

5.6 RECOMMENDATIONS FOR FURTHER RESEARCH

There is considerable scope for further research. For instance, there is a need for a study on the impact of management on learner achievement in mathematics. It is felt that lack of education management in the classroom is one of the causes of the high failure rate of mathematics at all levels including the grade 12 levels. This includes the management of lesson time, the extent of daily preparation, and learner engagement during teaching and learning, among others.

Furthermore, there is a need for a study on the reasons for the high rate of unemployment, the extent to which entrepreneurship is essential as a school subject, in the KwaZulu-Natal province as well as the whole country.

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APPENDICES

APPENDIX 1: RESEARCH INSTRUMENT

You are kindly requested to complete this questionnaire as accurately as possible. The information supplied will be used for research purposes. Please indicate your answers by just putting a cross (x) in the appropriate spaces.

PART ONE: BIOGRAPHICAL DATA

1.1 GENDER

MALE	FEMALE

1.2 AGE IN YEARS

UNDER 21	21-25	26-30	31-35	36-40	OVER 40

1.3 GENERAL TEACHING/WORK EXPERIENCE IN YEARS

0-4	5-9	10-14	15-19	20-24	OVER 24

1.4 MATHEMATICS TEACHING EXPERIENCE IN YEARS

0-4	5-9	10-14	15-19	20-24	OVER 24

1.5 YOUR ACADEMIC QUALIFICATIONS

GRADE 12	B. DEGREE	HON. DEGREE	OTHER

1.6 YOUR HIGHEST ACADEMIC STANDARD IN MATHEMATICS

Less than GRADE 12	GRADE 12	COURSE 1	COURSE 2	COURSE 3	OTHER

1.7 YOUR PROFESSIONAL QUALIFICATION

PTD	STD	UED	OTHER

PART TWO QUESTIONNAIRE

SECTION A: SKILLS AND UNEPLOYMENT

Please choose accordingly

(1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree

O	**STATEMENTS**	**1**	**2**	**3**	**4**	**5**
.4.1	The unemployment rate is very high in KwaZulu-Natal.					
.4.2	Lack of skills causes high unemployment in KwaZulu-Natal.					
.4.3	Unemployment results from the mismatch between the workforce skills and the available jobs skills.					
.4.4	The majority of youth leaves school without skills, and increases the rate of unemployment.					
.4.5	Out-of-school youth who leave school with low marks in mathematics forms the major source of unemployment.					

SECTION B: SIGNIFICANCY OF MATHEMATICS IN A WORK PLACE

(1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree (5) Strongly Agree

lO	STATEMENTS	1	2	3	4	5
B4.1	Mathematics failure rate is very high in KwaZulu-Natal.					
B4.2	Mathematics provides background for the development of most skills.					
B4.3	Employees with quality mathematics qualifications solve problems at work.					
B4.4	Employees with quality mathematics qualifications usually make fewer mistakes at work.					
B4.5	Employees with quality mathematics qualifications understand and apply technology correctly at work.					
B4.6	Employers generally recruit work seekers with quality mathematics qualifications.					
B4.7	Students who leave school with quality grade 12 mathematics qualification get employed promptly.					
B4.8	Year after year, out-of-school youth without mathematics qualification remain unemployed.					
B4.9	Students with quality mathematics qualification can take up mathematics- and science-based careers.					
B4.10	There are many mathematics-based vacant jobs while there are many unemployed people in the country.					
B4.11	Individuals with good mathematics qualification can initiate new mathematics-based enterprises.					
B4.12	An increase in the workforce that has mathematics qualification, will reduce unemployment accordingly.					
B4.13	The problem of unemployment is actually the problem of low achievement in mathematics.					
B4.14	Mathematics-based professionals like medical doctors, engineers, actuaries, mathematicians, etc are imported while South Africans are unemployed.					

SECTION C: MATHEMATICS AND ENTREPRENEURSHIP SCHOOL

(1) Strongly Disagree (3) Neutral Disagree (2) (4) Agree (5) Strongly Agree

NO	STATEMENTS	1	2	3	4	5
C4.1	Entrepreneurship provides the youth with skills for initiating their own businesses.					
C4.2	Entrepreneurship, encourages the young people to start new businesses in the country.					
C4.3	Quality mathematics pass rate enables the youth to complete mathematics-based professions.					
C4.4	Special teaching approaches like constructivism and problem-solving will enable the learners to pass mathematics with good marks.					
C4.5	Mathematics together with entrepreneurship would create new jobs and reduce unemployment.					
C4.6	There is a need for a school to re-teach mathematics and entrepreneurship to students who obtained less than 40% pass rate at the grade 12 examination.					

APPENDIX 2: PARTICIPANT INFORMATION LETTER

Dear Participant

I am a Master's student at the University of KwaZulu-Natal in South Africa. I am conducting research on the relationship between "High failure rate of mathematics and the high unemployment rate in the country".

The government, among others, is trying its best to curb unemployment. Requests have been completed to companies outside South Africa to start businesses in South Africa. Nonetheless, such requests do not satisfy the unemployment needs of the country. Instead unemployment keeps on increasing.

Most students find it difficult to enter mathematics-based professions because they do not possess qualifications with mathematics. Hence, some professionals are imported from other countries to work in South Africa, while more South Africans are unemployed. Furthermore, there are unfilled mathematics-based vacant posts.

Confidentiality

Please note that any individual information obtained in this questionnaire will be kept strictly confidential and will only be aggregated with all other responses for data analysis.

Your participation

There are four parts to the questionnaire which should not take longer than 10 minutes to complete. Your participation is voluntary but will be appreciated.

The deadline for completion is 30 November 2015. For any queries regarding this questionnaire please contact TW Mpofana at thanduxolompofana@gmail.com and 0824173990

Thank you for your valuable time and cooperation in completing this survey.

Yours Sincerely.

______________ __________

T.W. MPOFANA DATE

APPENDIX 3: PERMISSION TO CONDUCT RESEARCH

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Nomangisi Ngubane | Tel: 033 392 1004 | Ref.:2/4/8/594

Mr TW Mpofana
PO Box 20128
NEWCASTLE
2940

Dear Mr Mpofana

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"THE IMPACT OF MATHEMATICS HIGH FAILURE RATE ON UNEMPLOYMENT"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 09 December 2015 to 31 December 2016.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kehologile at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report / dissertation / thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

Amajuba District

[redacted]

Nkosinathi S.P. Sishi, PhD
Head of Department: Education
Date: 09 December 2015

KWAZULU-NATAL DEPARTMENT OF EDUCATION

POSTAL: Private Bag X 9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa ...dedicated to service and performance
PHYSICAL: 247 Burger Street, Anton Lembede House, Pietermaritzburg, 3201. Tel. 033 392 1004 beyond the call of duty
EMAIL ADDRESS: kehologile.connie@kzndoe.gov.za / Nomangisi.Ngubane@kzndoe.gov.za
CALL CENTRE: 0860 596 363; Fax: 033 392 1203 WEBSITE: WWW.kzneducation.gov.za

APPENDIX 4: MATHEMATICS-RELATED PROFESSIONS

While unemployment is rife in the country, there is a great need for the workforce that offers mathematics at different levels. Job seekers with good symbols in mathematics do not remain unemployed for a long time. Industries need them. In mathematics education, students learn methods and strategies to approach situations and solve problems in a more logical manner. Mathematics teaches patience, discipline, and step-by-step problem-solving skills. For those with a substantial background in mathematics, an unlimited number of career opportunities are available. According to *Jobs Rated Almanac,* a 1990 publication of World Almanac Books of New York, NY, careers that require a very strong background in mathematics were listed as the five "best" jobs. They were:

- software engineer
- actuary
- computer systems analyst
- computer programmer
- mathematician

Almost all of the top fifty jobs in this "best" jobs list involved mathematical reasoning and knowledge. This list was the result of the comparison of two hundred and fifty jobs that are classified according to:

- income
- future outlook
- physical demands
- job security
- stress
- work environment

The list that follows briefly describes the work that is associated with some mathematics-related professions:

- **actuary**-- assemble and analyse statistics to calculate probabilities of death, sickness, injury, disability, unemployment, retirement, and property loss; design insurance and pension plans and ensure that they are maintained on a sound financial basis

- **mathematics teacher**-- introduce students to the power and beauty of mathematics in elementary, junior high, or high school mathematics courses

- **operations research analyst**-- assist organizations (manufacturers, airlines, military) in developing the most efficient, cost-effective solutions to organizational operations and problems; this includes strategy, forecasting, resource allocation, facilities layout, inventory control, personnel schedules, and distribution systems

- **statistician**-- collect, analyse, and present numerical data resulting from surveys and experiments

- **physician**-- diagnose patient illnesses, prescribe medication, teach classes, mentor interns, and do clinical research; students with a good mathematics background will find themselves being admitted to the best medical schools and discover that mathematics has prepared them well for the discipline, analysis, and problem- solving required in the field of medicine

- **research scientist**-- model atmospheric conditions to gain insight into the effect of changing emissions from cars, trucks, power plants, and factories; apply these models in the development of alternative fuels

- **computer scientist**-- interface the technology of computers with the underlying mathematical principles of such diverse applications as medical diagnoses, graphics animation, interior design, cryptography, and parallel computers

- **inventory strategist**-- analyse historical sales data, model forecast uncertainty to design contingency plans, and analyse catalogue displays to make them more successful; analyse consumer responses

- **staff systems air traffic control analyst**-- apply probability, statistics, and logistics to air traffic control operations; use simulated aircraft flight to monitor air traffic control computer systems

- **cryptologist**-- design and analyse schemes used to transmit secret information

- **attorney**-- research, comprehend, and apply local, state, and federal laws; a good background in mathematics will help a student get admitted to law school and assist in the understanding of complicated theoretical legal concepts

- **economist**-- interpret and analyse the interrelationships among factors which drive the economics of a particular organization, industry, or country

- **mathematics professor**-- teach mathematics classes, do theoretical research, and advise undergraduate and graduate students at colleges and universities
- **environmental mathematician**-- work as a member of an interdisciplinary team of scientists and professionals studying problems at specific Superfund sites; communicate effectively across many academic disciplines and be able to summarize work in writing
- **robotics engineer**-- combine mathematics, engineering, and computer science in the study and design of robots
- **geophysical mathematician** -- develop the mathematical basis for seismic imaging tools used in the exploration and production of oil and gas reservoirs
- **design** -- use computer graphics and mathematical modeling in the design and construction of physical prototypes; integrate geometric design with cost-effective manufacturing of resulting products
- **ecologist** -- study the interrelationships of organisms and their environments and the underlying mathematical dynamics
- **geodesist** -- study applied science involving the precise measurement of the size and shape of the earth and its gravity field (courtesy of Bruce Hedquist)
- **photogrammetrist** -- study the applied science of multi-spectral image acquisition from terrestrial, aerial and satellite camera platforms, followed up by the image processing, analysis, storage, display, and distribution in various hard-copy and digital format (courtesy of Bruce Hedquist)
- **civil engineer** -- plan, design, and manage the construction of land vehicle, aircraft, water, and energy transport systems; analyse and control systems for land vehicular traffic; analyse and control environmental systems for sewage and water treatment; develop sites for industrial, commercial and residential home use; analyse and control systems for storm water drainage and storage; manage construction of foundations, structures and buildings; analyse construction materials ; and surface soils and subterranean material analysis (courtesy of Bruce Hedquist)
- **geomatics engineer** -- once known as "surveying engineer", includes geodetic surveying: takes into account the size and shape of the earth, in order to determine the precise

horizontal and vertical positions of geodetic reference monuments; cadastral surveying: establishes and reestablishes the reference monuments for the U.S. Public Land Survey System, i.e., township and section corners; topographic surveying: determines the detailed configuration or contour of the natural earth's surface and the position of fixed objects thereon or related thereto; hydrographic surveying: similarly determines underwater contours and features; land surveying: is the location of existing parcel and new land subdivision lines, road and utility rights-of-way and easement lines, and determination of the location of existing and new reference monuments, which mark property lines and parcel corners; land surveying: also involves the preparation of legal descriptions for officially recorded land ownership conveyance deeds and other land title documents; construction surveying: is the determination of the direction and length between and the elevations of reference points for fixed private and public works, as embraced within the definition and practice of civil engineering, and the labeling of reference markers containing critical information for the construction thereof; design, operation and management of advanced Geographic Information Systems (GIS and Land Information Systems [LIS]), as well as other sophisticated computer mapping and Computer-Aided Drawing (CAD) based geospatial applications (courtesy of Bruce Hedquist)

Even if mathematical science is not a choice as a career, studying as much mathematics as possible is a good way to keep your career options open. Mathematics is an excellent foundation for, and is usually a prerequisite to, study in all areas of science and engineering. Students in such areas as anthropology, sociology, and psychology, as well as law, business, and medicine, also benefit from a solid background in mathematics and statistics. It enhances the understanding of science and technology and their effects on our world. This improves the probability of being employed.

The above information is generously provided by The Mathematical Association of America (MAA) and the Association for Women in Mathematics (**AWM**). (adapted from: kouba@math.ucdavis.edu)

APPENDIX 5: SAMPLE OF AVAILABLE POSTS THAT ARE MATHEMATICS-BASED

There were about 3,120 results from www.izito.co.za/wrb?q=mathematics+vacancies:
These examples show that there are jobs available in many fields:

- Mathematics & Physics Teacher Location: Seeking a highly-qualified Mathematics & Physics High School teacher for an international school based in Pretoria...
- Young ladies (23-29) required for Call Centre Administrators. Must have a good matric with high mathematics. Excellent communication skills...
- Seeking a Highly-qualified Mathematics & Physics High School teacher... (Honours or Master Education Degree), specialising in Mathematics & Physics For non-South African applicants, they must have a valid work permit...
- Lecturer in Mathematics or Applied Mathematics. Applications in all areas of Mathematics and Applied Mathematics....
- Opportunity for an Actuarial Analyst to join the leading investments & wealth management Company in South Africa& Africa....
- Statistical Analyst: South African Reserve Bank; Banking Association of South Africa (Informatics) with 3 years relevant experience in statistical analysis.
- Teacher: English, South African, Female (girls school) qualified as a Maths teacher with a South African Council of Educators (SACE) number. Senior Mathematics teacher required for private school in...
- Survey Interviewer: Rustenburg Area: South African citizen or holder of a valid South African work permit. South Africa Attachment: National Senior Certificate (Matric) with a pass in mathematics...
- Quantitative Analyst: You have an understanding of South African markets, particularly in fixed income and equities. You will be required to use financial mathematics to help...
- Employee Benefits Call Centre Consultant with EB Administrat.. Matriculation with Mathematics. Excellent English, African Languages and Afrikaans would be an added advantage)....

APPENDIX 6: ENVISIONED SCHOOL OF ENTREPRENEURSHIP AND MATHEMATICS