THE ZIMBABWE ‘O’ LEVEL MATHEMATICS CURRICULUM AND STUDENTS’ CAREER ASPIRATIONS IN SHURUGWI AND GWERU DISTRICTS, MIDLANDS PROVINCE: A CAUSAL COMPARATIVE ANALYSIS.

BY

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**ABSTRACT**

This study which was conducted in Shurugwi and Gweru districts of the Midlands Province of Zimbabwe, sought through a causal comparative analysis, to analyse the strengths and weaknesses of the ‘O’ level mathematics curriculum and its influence on the career aspirations and employer expectations of school leavers. The mixed methods approach was chosen to guide the methodology of the study because of its pragmatic nature and ability to produce desired, practical, workable and more justifiable results. Fourteen secondary schools in the two districts and eleven employers in Gweru district were visited for the study. The actual study sample consisted of 285 ‘O’ level students, twenty-eight mathematics teachers, twenty-eight parents, two subject education inspectors, two district education officers, and eleven employers (or their representatives) making a total of 356 respondents and informants.

Students were subjected to a standardised mathematics achievement test and a questionnaire while at each school a sub-group of four to nine ‘O’ level mathematics students were involved in the focus group discussions. Parents and employers participated in face to face interviews conducted by the researcher using prepared interview schedules as guides. Teachers, subject education inspectors and district education officers completed different questionnaires. All the questionnaires had both structured questions of the five-point Likert type as well as open-ended questions to supplement the quantitative data. The statistical package SPSS 16.0 was used to analyse data through some t-tests for comparison of means, correlations, analysis of variance (ANOVA), chi-square tests for testing independence/dependence between some variables, and regression analyses to test which curriculum factors or variables could be best explained by the regression models. Qualitative data from interviews, focus group discussions and open-ended sections of the questionnaires were analysed by first noting frequencies of each response, categorising the responses and
then finding the emerging themes from those responses. After the causal comparative analyses and trial tests had been done, the results were triangulated with qualitative data and with previous research findings and secondary statistics cited from Government agencies such as ZimStat.

Results of the study revealed that in general there were more weaknesses than strengths in the current ‘O’ level mathematics curriculum. In particular students and teachers had negative views about the syllabus and national assessment issues while students were concerned with teachers’ attitudes, professionalism and general assessment and lesson delivery styles. Education officers and inspectors were also worried with the issues of resource shortages and teachers’ lack of morale and professionalism. Parents and employers strongly voiced the importance of mathematics in industry and for the country at large and offered suggestions on curriculum changes which they wished to be implemented. Quantitative results confirmed that students performed low in mathematics with an average of 39%, that there were significant gender differences in mathematics achievement with boys performing better than girls, that most students had very high career aspirations with those of girls being slightly higher than those of boys. It was also found that there were significant differences in students’ views towards the syllabus (STD SYLB), teaching styles, assessment methods, and mathematics anxiety with respect to location, type, ownership and level of the school. The linear regression model was a better approximation of the anticipated relationships because it was able to model more equations than the other functions. For example, one linear regression model explained 56.9% of the variability in student achievement (STDACHV) with type of the school, level of the school, teacher’s qualifications, student’s mathematics anxiety (STDMA), and the views of students on assessment techniques (STDASSTECH) and on teaching methods (STDTCHM) as independent variables (F=40.29, p=0.00). Another linear
model explained 54% of the variability in students’ mathematics anxiety ($F=109.822$, $p=0.000$) with STDTCHM, STDASSTECH and STDACHV as independent variables. Also STDACHV, STDSYL and STDMA were found to be significant factors affecting career aspirations, the model accounting for 15.2% of the variance ($F=16.807$, $p=0.000$). The suggestions and opinions which were voiced by the respondents, discussants and interviewees were corroborated with the statistical findings from the quantitative data.

The conclusion of the study was that the current Zimbabwe ‘O’ level mathematics curriculum is too theoretical and not quite relevant for the economic and technological development of the country. It was also concluded that this curriculum does not match with students’ career aspirations and should therefore be reviewed. It is from these conclusions that recommendations for a new ‘O’ level mathematics curriculum, and proposals for a new policy on mathematics education (for all grade/form levels) were made in this study. It is strongly anticipated that if the recommendations are implemented, Zimbabwe can once again become the food or ‘bread basket’ of Southern Africa and also the ‘giant’ of Southern Africa in terms of technological and economic productivity and development.
ACKNOWLEDGEMENTS

Writing a research proposal and the final thesis can be most interesting but also most disturbing events in the life of a PhD candidate. While the content of the thesis is very important, other issues like organisation of work, conference or workshop presentations, working in a team, time management and coping with the supervisor, as articulated by Gosling and Noordam (2006), are very important as they count towards the ‘sinking’ or ‘swimming’ of the candidate. Hence I would like to express my heartfelt gratitude to the following people without whose help and cooperation I would have ‘sunk’ and the thesis would not have been a success.

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8. Selected parents of the ‘O’ level students - who allowed me to interview them and to capture their ‘voices’ concerning their children’s learning of mathematics and what they wished employers and the Government should do for the economic recovery of the country.

9. Last but not least, selected employers in Gweru district – for allowing to share with me their views and suggestions regarding the relationship between mathematics education and the world of work.
DEDICATION

I dedicate this doctoral thesis firstly to God Almighty. May all those who read it and make use of it give all the credits, praises and honour to Him.

Secondly to my late parents, Museka (my father) and Berita (my mother), for sending me forth into the world. I say thanks very much mum and dad.

Thirdly to my lovely wife Charity, our children Nyasha, Kumbirai, Vimbai and Luwiza whose prayers and moral support have kept me going.

Also to my late wife Gaudencia, for the love, kindness and support she gave to me and my whole family before she passed on. I say may her soul and that of my mum rest in eternal peace!
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<td>DAE</td>
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CHAPTER ONE
INTRODUCTION

1.1 Background to the study

Zimbabwe inherited its education system from its colonial master Britain. Educational opportunities and resources were biased in favour of the minority white children while only a few ‘fortunate’ blacks proceeded through the bottleneck system. However, after independence in 1980 and through the leadership of prime minister Robert Mugabe (later president), Zimbabwe’s education system was among the best in Africa, without race or gender bias but with increasing enrolment, infrastructure and literacy rates (Shizha & Kariwo, 2011). During the 1990’s things then took a sharp downward trend. Concerned about the sorry state of education in the country the president set up a commission of enquiry headed by Dr C.T. Nziramasanga. The Nziramasanga Commission (1999, p. 396), pointed out that Zimbabwe was at a level where there was “overwhelming scientific and technological deficiency, apparent inertia or resistance to change, and inability of the economy to move in step with global technological trends.” This Commission of Inquiry was also tasked, among other things, to recommend strategies that ensure a bias towards the study of mathematics, science and technical subjects from the early stages of education (Term Of Reference 2.1.4). This was so because the Government considered that mathematics and science were tools for economic growth and social development and that they should be taken seriously especially at school.

From the researcher’s observations and experiences as a secondary school mathematics teacher and as a teachers’ college lecturer, it seems things have not changed much in the schools. The Nziramasanga Commission (1999)’s recommendations seem not to have been
taken seriously at the implementation level because there is sufficient evidence that mathematics education at all levels is in dire need of change (Nziramasanga Commission, 1999; Chakanyuka, Chung & Stevenson, 2009; Chirume, 2012). There is a possibility that there is still something wrong with the current ‘O’ level mathematics curriculum and that there is need to evaluate it and come up with appropriate recommendations although other causal factors cannot be ruled out. This is probably because many pupils fear it, drop it and the majority of those who write examinations fail [Refer to Tables 1.1 and 1.2].

According to the former Education Minister David Coltart, Zimbabwe’s education sector is facing many challenges which include poor salaries for teachers and shortage of textbooks and needs to be transformed. However, Zimbabwe’s outdated curriculum which was last reviewed in the late 1980’s is frustrating attempts to transform the education sector. Minister Coltart hoped that by mid-2011 the Government would come up with concrete areas for curriculum reform (The Standard, 8 May 2010) and these were not yet in place. [Initial stages of curriculum review have only been started recently, (The Herald, 14 October, 2014)].

A report prepared for UNESCO by the Zimbabwe National Commission for UNESCO and the then two ministries of Education, Sport and Culture and that of Higher Education and Technology (2001, p. 33) pointed out that, “Mathematics and Science subjects will be overhauled and strengthened with a view to establishing a solid technological base.” Chimhowu (2009) recommended that the curriculum at all levels needed renewal because it does not cater for challenges faced by students during and after schooling. These challenges include the prospect of unemployment, dangers of HIV and AIDS and other sexually transmitted diseases and the challenges of, and opportunities for, working in Zimbabwe and the region. Chimhowu (2009) recommends that the state should put in place sound educational policies and strategies that must benefit the poor as well as the rich student. However, up to now there is no sufficient evidence that Mathematics and Science subjects
have been overhauled or that the curricula have been reviewed to the benefit of the poor and rich students. School children probably still drop and fail mathematics in large numbers. Statistics for the Midlands Province in 2009 shown in Table 1.1 reflect this scenario. The situation is not very different from other provinces in Zimbabwe as the national pass rate was 18.4% in 2012 (The Herald, 4 February 2013) and has not been any better in the previous years: [see also Table 1.2].

<table>
<thead>
<tr>
<th>Table 1.1: Mathematics Dropout and Pass Rates (%) in the Midlands Province: 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dropout Rate</strong></td>
</tr>
<tr>
<td>‘O’ Level: Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Overall</td>
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<table>
<thead>
<tr>
<th>Table 1.2: % Pass Rates for all Subjects in the Midlands Province</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level/Year</strong></td>
</tr>
<tr>
<td>Grade 7</td>
</tr>
<tr>
<td>‘O’ Level</td>
</tr>
<tr>
<td>‘A’ Level</td>
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</tbody>
</table>


One could ask why this study is focusing more on mathematics and less on other subjects. The reason probably stems from the way mathematics has been and is still being considered in relation to other subjects. Karl Friedrich Gauss and others have referred to mathematics as the queen of the sciences and servant of the arts (Phillips, 2014; Department of Education, 2003). Thus Mathematics is viewed as a natural human activity which is important as a tool for solving everyday problems and also as a language of communication although many people consider it as difficult, dull and painful. Mathematics skills and thinking form a foundation or pillar for other subject areas. Mathematical learning is empowering but can also
be ‘demanding’ for everyone even if they are good at mathematics (MacGillivray, 2008). Regardless of its importance, it is strongly believed that mathematics has attained an unfortunate “filter status” for the majority of students in Zimbabwe (Ndemo & Mtetwa, 2010, p. 1). Mathematics is generally considered as a barrier to some students’ success in high school and also as a barrier to some students’ admission into post-secondary education (Chan, 2003?). In Zimbabwe today, it is considered that the requirement for five ‘O’ level passes of C or better including English and Mathematics is a barrier to most student’s career aspirations. The researcher believes that both male and female students are almost equally affected by such barriers. Such low pass rates and high drop-out rates (as in Table 1.1), can reduce students’ chances of entering higher and further education institutions and also chances of getting employment.

Similar problems have been observed in the Southern African Development Community (SADC) region and the world at large. For example, in South Africa a subject called Design and Technology was initiated in the schools to try to solve the problems of shortage of materials and underdevelopment of innate talents (Nziramasanga Commission, 1999). This subject is multidisciplinary and borrows from Mathematics, Science, Technical Graphics, Art, Textiles, Metal Craft and Wood Technology. Through the use of locally available materials like wire, scrap metal, waste paper, basketry straws, clay, plastics, strings and so on, and by encouraging originality and innovativeness, new scientists and technologists could be developed from an early age. According to the Department of Education (2003), South Africa now has a policy document for mathematics education, called the National Curriculum Statement Grades 10-12 (General), which values indigenous knowledge systems and outcomes-based education. Whether this policy has been effectively implemented or not is not clear in this study but could still be investigated. The problem of high failure rate in
mathematics has also been observed in Kenya where many pupils perform poorly in national examinations (Githua & Ngeno, 2004).

Mutasa (1994, p. 70) says that Africans and people of African origin have contributed a lot to science and technology but their information is not published in Africa. It is published in ‘western’ books and journals, attributing success to the ‘western’ world. He challenges Africans by pointing out that unless the rich ideas and knowledge that they have become part of the school curriculum and part of examinable knowledge, publishing them in, “…obscure, however well written, books will ensure they remain at the periphery of human culture and will have no part in shaping what is and what will be.” In Africa as a whole, there is absence of reliable statistics in science and technology and a low number of scientists and engineers due to brain drain, politics and other factors and this is cited as cause for concern (Ntim, 1999). Kapfunde (2007) holds similar views when he says that Mathematics and Science teachers should be given special allowances to keep them in their posts and that education in Africa must be able to bring out the Africanness in the African child.

Also in the USA, students were reported not to do well in mathematics (Miller, 2011) despite the fact that the foundation for future success is a well-educated workforce. This fact and the US agenda for competitiveness resulted in the proposal to improve mathematics and science education. On 18 April 2006, the US president signed an executive order mandating the National Mathematics Advisory Panel to gather data and produce a report with recommendations on how the US policy … “to foster greater knowledge of and improve performance in mathematics among American students” could be realised. The report was crafted and published in a document entitled Foundations For Success (National Mathematics Advisory Panel, 2008, p. xiii). There has been debate though on the usefulness of those
recommendations for policy and practice (Cobb & Jackson, 2008). Whether the recommendations were or are being effectively implemented is not clear.

In Zimbabwe, there is no agreement yet on what ‘national’ mathematics to teach and how it should be taught. As a result, mathematics still remains a feared and hence unpopular subject (Nziramasanga Commission, 1999). In several countries in the world, mathematics achievement, mathematics anxiety and the mathematics curriculum as a whole have been shown to have significant influences on students’ choice of major subject, students’ performance in further mathematics studies and in other related subjects such as Economics, and also on their career choices and earnings (Hoag & Ellen, 2010; Chan, 2003; Laney, 2008; Rose & Betts, 2001; Scarpello, 2005; Zakaria & Nordin, 2008). The researcher has not yet come across published literature on how the current Zimbabwean ‘O’ level mathematics curriculum impacts on students’ chances to go for further education and to be gainfully employed. Therefore, the researcher felt that this study should address these and similar issues.

1.2 Statement of the problem

Many ‘O’ level pupils in Zimbabwe continue to perform poorly in mathematics. The school leavers fail to receive further education and employment. For example, the ‘O’ level dropout rate was 92% for boys and 94% for girls in 1995, the transition rate from Form 4 to 5 was 10% in 2007 (UNESCO-IBE, 2010) while unemployment rate for youths (15-24 years) was 11.5% for boys and 19.5% for girls, both being higher than the national unemployment rate of 9.4% in 2004 (Luebker, 2008). The problem is exacerbated by the requirement for five ‘O’ level passes that must include English and Mathematics if one is to get a decent job or to go for further education at most of the tertiary institutions. Unfortunately, at school mathematics
is considered very difficult, boring, painful and ‘too theoretical’ (maybe as a result of the way it is taught) although it is also important and useful for problem solving and critical thinking. The fact that the majority of students fail this subject at ‘O’ level (as depicted in Table 1.1) and by an overall highest pass rate of 23% in 2003 (UNESCO-IBE, 2010) leaves them with less opportunities and hopes of getting employed or employing themselves. Why do students continue to fail this subject of high importance, usefulness and esteem? Thus one is left to question the relevance and implementation of the current ‘O’ level curriculum which apparently fails to meet the needs of individual learners, societal goals and the national and economic challenges facing the country, hence the need for ‘O’ Level Mathematics curriculum review.

1.3 Purpose of the study

In view of the above problem, this study seeks to analyse the ‘O’ level mathematics curriculum and findout whether it relates to career aspirations and employer expectations of students. The study also intends to use the research findings as a basis for the evaluation or review of the ‘O’ level mathematics curriculum.

1.4 Objectives of the study

The study seeks to achieve the following objectives:

- To investigate the weaknesses and strengths of the current ‘O’ level mathematics curriculum by analysing the syllabus, teachers’ instructional and assessment strategies,
- To assess the relationship between ‘O’ level students’ career aspirations and achievement in mathematics,
To examine whether the acquired ‘O’ level mathematics knowledge and skills are applicable in the field of work,

To investigate the need for a career-related national policy on ‘O’ level mathematics in Zimbabwe,

To establish whether there is need for ‘O’ level mathematics curriculum change.

1.5 Research questions

These are the research questions for this study:

- How relevant is the current ‘O’ level mathematics curriculum?
- How do ‘O’ level students’ career aspirations relate with their mathematics achievement?
- How do employers view post-‘O’ level students’ mathematical knowledge and skills in relation to their performance and productivity in the field of work?
- Should the Government come up with a national policy on an ‘O’ level mathematics curriculum that links classroom-gained knowledge with students’ careers?
- What curriculum model would be best suitable for national ‘O’ level mathematics?

1.6 Assumptions of the study

The following are the main assumptions of this study. It is generally believed that:

- Many secondary school students fail mathematics and have negative attitude towards it,
- Mathematics influences students’ choice of career and prospects for employment more than other subjects,
- Parents and employers value mathematics more than other subjects,
- The teaching of mathematics is more problematic than any other subject, and
- There is urgent need to review the Zimbabwe ‘O’ level Mathematics Curriculum.
1.7 Significance of the study

The findings of the study will be beneficial to the following people:

To the researcher: The researcher will benefit by gaining more knowledge on curriculum evaluation, learning theories and research skills. The researcher, as a qualified mathematics teacher and an experienced teacher educator, will also benefit by applying new gained knowledge on curriculum models and curriculum evaluation to enhance effective teaching and learning of mathematics.

To the student: Students are the leaders of tomorrow and we need to equip them with appropriate mathematical knowledge and skills which will enable them to compete favourably with those in other countries. The proposed new mathematics curriculum would benefit students by making them more competitive, employable and self-reliant.

To the parents, teachers and other stakeholders: Parents, teachers and other stakeholders would get joy and sometimes financial benefit when their children no longer fear mathematics, but achieve the necessary credits required for further education and employment.

To the country: The country would also benefit in the areas of technological and economic advancement and may become again the envy of Southern Africa.

Contribution to knowledge gaps: This study seeks to contribute to knowledge gaps in the following areas:

- causes of ‘O’ level students’ mathematics anxiety and how that anxiety is related to mathematics achievement in the Zimbabwean context,
• special ways of preventing and combating Zimbabwean ‘O’ level students’ mathematics anxiety or fear and building their attitudes towards mathematics,

• ways of establishing a new ‘O’ level mathematics curriculum that caters for all students’ abilities and needs since the current one seems to be inadequate, and

• having a “job related” national policy on mathematics education.

1.8 Delimitation of the study

The study is delimited to:

• the Midlands Province of Zimbabwe and its chosen five districts,

• mathematics and sciences education inspectors (MEI and SCEI), district education officers (DEOs), ‘O’ level mathematicspupils and their teachers and parents, and employers in the three selected districts,

• a ‘social constructivist’ and ‘Kirkpatrick-model’ based evaluation of the ‘O’ level mathematics curriculum and its interrelationships with future/expectations of students, and

• an empirical investigation of ‘O’ level students’ career aspirations and employers’ expectations of students.

1.9 Limitations of the study

• The study has come about during a relatively unstable period in the history of the education system in Zimbabwe because of the many changes that are likely to take place as a result of the new constitution introduced after the referendum in 2013, the election in 2013 and results thereof. It is possible that the Government might put in place a new curriculum making recommendations emanating from this study to be
overtaken by events. The philosophy that would guide the curriculum is not so clear. The researcher would constantly refer to Ministry circulars and stakeholders’ views in order for the study to remain relevant and significant.

- The study is limited to Kirkpartrick’s 4-level model of curriculum evaluation and the social constructivist theory of learning. Although they have been used by previous researchers elsewhere, this researcher is yet to come across sufficient literature on how they may work best for the Zimbabwean situation. If not, the researcher would overcome this by using the model and the theory in conjunction with other models or theories (for example, education with production theories).

- Data to trace and link past ‘O’ level students’ mathematics grades and their current employment status and productivity may not be readily available as some employers may not be willing to divulge company information or some ‘productive’ mathematics experts may have sought greener pastures outside the country. This limitation could be overcome by using data from interviews with a few selected post-‘O’ level employees and their employers in this country.

1.10 Ethical and legal considerations

To handle the relevant ethical and legal implications, the researcher will:

(a) apply for the Ministry of Education permit to conduct research in the selected schools,

(b) explain to the respondents the significance of the study and the contributions it would make to the overall education system, before administering the instruments,

(c) ask the respondents to respond willingly, truthfully and objectively and tell them that they are free to withdraw at any given time,

(d) assure the respondents that their rights of confidentiality, anonymity, freedom of choice and expression will be adhered to,

(e) get consent from parents/guardians for pupils under 18 years old.
1.1 Organisation of the study

This study is organised into five chapters with chapter headings and sub divisions which are ordered as follows:

Chapter 1- INTRODUCTION: Background to the study, Statement of the problem, Purpose of the study, Objectives of the study, Research questions, Assumptions of the study, Significance of the study, Delimitations of the study, Limitations of the study, Ethical and legal considerations, Budgetary plans and implications, Definition of terms, Chapter Summary.


Chapter 3- METHODOLOGY: Chapter introduction, Research paradigm, Research design, Population and sample, Research instruments, Pilot study, Validity and reliability of instruments, Trustworthiness and credibility of results, Data collection procedure, Data analysis procedure, Chapter Summary.
Chapter 4- RESULTS: Chapter introduction, Quantitative data, Quantitative data processing, Mathematics achievement test, Quantitative questionnaire data, Data presentation and analysis, Statistical tests and interpretation of findings, Discussion of quantitative results, Qualitative data, Qualitative data processing, Document analysis of the ‘O’ level syllabus, Qualitative questionnaire data, Interview data, Focus-group data, Data presentation and analysis, Discussion of qualitative results, Chapter Summary.

Chapter 5- FINDINGS, CONCLUSION AND RECOMMENDATIONS: Summary of findings, Conclusions and generalisations, Recommendations, Chapter Summary.

1.12 Action and Budgetary Plan

As for the budget, the researcher sourced and set aside a minimum of US$4000.00 to cover transport costs, stationery, food and other logistics during the course of the study.

The researcher drew a plan of action which culminated in the draft time table for 2011-2014 shown below. The researcher closely adhered to this timetable but only changed it because of unforeseen or extenuating circumstances. For example, the pilot study whose purpose was to check on the instruments and the data collection methods was done in June and July 2013. The first three chapters were defended in February 2014, while the actual fieldwork was executed from June to August 2014. Capturing and entering quantitative data onto SPSS 16.0 as well as analysing qualitative data were done from September to November 2014. The final draft of the report was written from November to December 2014. The research assistants only helped to collect data after the pilot study. Data analysis, interpretation and report writing was done by the researcher alone. Table 1.3 shows the original draft time table.
<table>
<thead>
<tr>
<th>Research Topic</th>
<th>Time Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussion with supervisor</td>
<td>January 2011</td>
</tr>
<tr>
<td>Rough draft of proposal</td>
<td>January to April 2011</td>
</tr>
<tr>
<td>Typing and discussion of rough draft</td>
<td>May – June 2011</td>
</tr>
<tr>
<td>Final draft of proposal</td>
<td>July – August 2011</td>
</tr>
<tr>
<td>Write up of chapters 1, 2, 3</td>
<td>September 2011- ongoing</td>
</tr>
<tr>
<td>Presentation/defence of proposal</td>
<td>September 2012</td>
</tr>
<tr>
<td>Drafting research instruments</td>
<td>October-November 2012</td>
</tr>
<tr>
<td>Discussing research instruments</td>
<td>December 2012 -January 2013</td>
</tr>
<tr>
<td>Field work: Pilot study</td>
<td>February 2013</td>
</tr>
<tr>
<td>Discussion of pilot study outcomes</td>
<td>March 2013</td>
</tr>
<tr>
<td>Fieldwork: Data collection</td>
<td></td>
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<tr>
<td>(a) Schools</td>
<td>April – June 2013</td>
</tr>
<tr>
<td>(b) MEI, SCEI and DEOs</td>
<td>July 2013</td>
</tr>
<tr>
<td>(c) Employers</td>
<td>August– September 2013</td>
</tr>
<tr>
<td>Data cleaning</td>
<td>October – November 2013</td>
</tr>
<tr>
<td>Data presentation</td>
<td>December 2013 – January 2014</td>
</tr>
<tr>
<td>Data analysis and interpretation</td>
<td>February – April 2014</td>
</tr>
</tbody>
</table>
1.13 Definition of special terms and expressions

1.13.1 Mathematics

What is mathematics? Why should it be studied? These are important philosophical and educational questions which may raise further questions than answers. There is no consensus, even among professionals, as to what mathematics is (Phillips, 2014; Bishop, Hart, Lerman & Nunes, 1993). There are two basic schools of thought, namely absolutism and fallibilism. The absolutist school of thought (Tuge, 2008; Ernest, 2004) views mathematics as only a language and a series of number or other ‘games’ with rules to be followed (formalism), or a logical way of thinking (logicism), or a subject whose objects are abstract, remote from everyday experiences, real and objective (Platonism). Progressive absolutists who include intuitionists such as L.E.J Brouwer (Ernest, 2004) view mathematics as a creation of the human mind. The fallibilist school of thought (Tuge, 2008) views mathematical knowledge or objects as social or cultural results of the human activity (humanism). Fallibilists, according to Ernest (2004) also say that mathematical knowledge is not discovered but invented to serve the human being together with the society in which he/she lives (social constructivism). This study, therefore, adopted the ‘midway’ stance and defines mathematics as a subject of study involving various inter-related content areas (arithmetic, algebra, geometry, etc.) and skills (recalling, application, construction, problem solving, analysis, interpretation, evaluation, etc.) pursued by the individual(s) for the purposes of personal as well as societal development.

1.13.2 Mathematics curriculum
The philosophy of mathematics influences the content and organisation of the mathematics curriculum (Tuge, 2008; Ernest, 2004). Curriculum may mean different things to different people. Kelly (2009) defines curriculum as either a range of courses from which students choose what subject matters to study or a specific learning programme. In this study the researcher adopted Kelly’s later version whereby the mathematics curriculum refers to a specific mathematics learning programme that includes the content (syllabus topics) to be learnt, the teaching and learning styles or methods, and the assessment materials and strategies.

1.13.3 **Curriculum evaluation**

Evaluation is the process of judging the value or worth of something (Cai, 2010). Curriculum evaluation is a necessary and important aspect of any national education system since it provides the basis for feedback on processes of curriculum implementation, student achievement and curriculum policy decisions (UNESCO-IBE, 2012). This study adopted these views in its attempt to evaluate the ‘O’ level mathematics curriculum in Zimbabwe.

1.13.4 **Fear of mathematics or mathematics anxiety**

Mathematics anxiety has been defined as feelings of tension, hopelessness and inability (Sankowsky, 2008), and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in everyday life and in academic situations (Strawderman, 2011). Mathematics anxiety can cause one to forget and lose one’s self-confidence (Tobias, 1993). It is also an irrational and threatening fear of mathematics. The mathematics classroom is threatening, frightening and leading to failure, guilt, embarrassment or shame (Buxton, 1981). This study adopted Sankowsky (2008) and Strawderman (2011)’s definitions.
1.13.5 Career aspirations

Aspirations are hopes or ambitions. Career aspirations refer to constructs embodying a person’s dreams and desired career goals (Danziger & Eden, 2006 in Smulders, 2009). They may have an attitudinal component representing ideas and dreams (idealistic aspirations) or a behavioural component representing actual actions a person takes in order to fulfil the dream (realistic aspirations) or both. Career aspirations can be assessed using Holland codes (Green, 2010) assessment inventories or questionnaires (Riegle-Crumb, Moore & Ramos-Wada, 2010). These aspirations stimulate individuals to work hard to reach certain goals.

These terms and others which pertain to this study will be discussed and explained in more detail in chapter two.

1.14 Chapter summary

Chapter one has presented the problem and its context. The background to the study and statement of the problem highlighted education stakeholders’ concern for the high failure and drop outs rates in mathematics by secondary school students. The purpose and significance of the study have been discussed. In particular, chapter one has argued for the need to evaluate the Zimbabwe ‘O’ level mathematics curriculum and to find out whether and how it is related to the students’ career aspirations. Research questions, research objectives, assumptions of the study, limitations, delimitations, ethical and legal considerations, and definition of special terms related to the study have been explained. The budget and time frames given are only proposals which can be adjusted according to needs of the research as it progresses. The next chapter (2) is a review of related literature covering, among others, aspects on the conceptual and theoretical frameworks for this study.
CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

A review of related literature helps a researcher to put his/her research into a proper theoretical or conceptual framework. It also helps the researcher to identify what has already been done well, whether the recommendations are being implemented or not, and if it was not done well, what could be the missing gaps and how it could be improved. This chapter explores, in its conceptual framework, the factors affecting mathematics curriculum reform elsewhere in general, and in Zimbabwe in particular. This framework helps to explain the need (or none of it) for evaluation or review of the curriculum. The chapter discusses the various evaluation models and strategies that are in the literature and proposes the one(s) to be used in this study. In the theoretical framework, the chapter discusses social constructivism as a possible philosophy for mathematics education and suggests how teachers and students can use this teaching/learning theory to develop good ‘habits of mind’ (Tuge, 2008) and be useful problem solvers and developers of their societies. An overview of the structure of the
Zimbabwe ‘O’ level mathematics curriculum is given together with its possible strengths and weaknesses. Factors affecting achievement in mathematics are discussed. The aspect of mathematics anxiety is not left out because it is considered to be an important element that affects achievement and inhibits successful implementation of the mathematics curriculum. Students may not see the value of learning subjects such as mathematics if the curriculum is not related to their career aspirations or societal-developmental needs; hence career aspirations are also discussed. Lastly in the chapter, the case for a national policy on mathematics education is proposed.

2.2 Conceptual Framework

2.2.1 Factors affecting curricula reform

Curriculum reform in mathematics or any other subject is not a new area of study. However, in a way it becomes a new area because of the changing factors that affect it. For mathematics education, these factors are the influences from society, the influences of teaching materials (including information and communication technology in recent years), the role of the teacher and the socio-cultural and socio-cognitive contexts of mathematical thinking (Bishop, Hart, Lerman & Nunes, 1993). In their study, Gruber, Moffat, Sondergaard and Zobel (2004) found influential or outspoken individuals, politics and ‘academic fashion’ as major factors of curriculum change. However, Jones (2002) cited in Gruber et al., (2004) says nothing will change in the curriculum unless the conditions of mutual trust among the stakeholders, professional development of teachers, commitment and consistence of leadership, a non-threatening incremental pace of change and use of purposeful incentives are met. Sometimes challenges make it imperative for a country to review its curricula. For example, high failure rates and shortage of scientists and engineers in Zimbabwe (Nziramasanga Commission,
global competitiveness in USA (McKnight, et al., 1987; National Mathematics Advisory Panel, 2008) and healing the divisions of the past in South Africa (Department of Education, 2003) are some of the challenges which have forced countries to consider reviewing their curricula using any of the methods or models that are available.

2.2.2 The need for evaluation of mathematics curricula

Chirume (1998, pp. 2-3) points out that,

In the early 1960’s and late 1950’s in the USA, the problem of students failing and dropping mathematics was so serious that it became a national crisis. In 1957 the USSR launched Sputnik 1, an achievement which left the US government feeling threatened and attributing their apparent lag in the space race to inadequate science and mathematics learning. Thus traditional mathematics was scrapped and the "New Math" put in its place. The British followed suit by implementing the Nuffield Project for primary school mathematics and the SMP for secondary school mathematics, both aimed at improving students' proficiency in mathematics. Unfortunately, the mathematics failure and drop-out rates did not change significantly. What had been changed was simply the content (i.e. new topics) whilst teaching methods and motivational tactics remained the same.

So evaluation of mathematics curricula and programmes have largely stemmed from these ideas and also from the philosophical idea in the Cockcroft Report of 1982 that ‘mathematics counts’ (Ernest, 2004), and therefore students must learn it and by all means perform well.

The need for change of mathematics curricula is to embrace new philosophies (Tuge, 2008). Since evidence from international research reports such as TIMSS and PISA (English & Sriraman, 2005) suggest that most students do not perform well, some educators then view the ultimate goal of programme evaluation as to improve students’ learning of mathematics (Cai, 2010) by analysing the intended curriculum, the implemented curriculum and the attained curriculum. Others hold the view that school mathematics curricula should capture the essence of ‘workplace mathematics’ (English & Sriraman, 2005). However, the main functions of curriculum evaluation according to UNESCO-IBE (2012) are to establish,
- specific strengths and weaknesses of a curriculum and its implementation,
- inputs needed for improved learning and teaching,
- critical information for important changes and policy decisions, and
- indicators for monitoring.

This study is based on the concept that there is need to review the Zimbabwean ‘O’ level mathematics curriculum because students are failing mathematics and are finding challenges getting employed. Although they may fail other subjects, mathematics is usually given more prominence by most employers. Chinhanu (1997, p. 13) used the Tyler Model of curriculum planning and Kolyagin Yu’s eight criteria for content selection to analyse the ‘O’ level mathematics syllabus for Zimbabwe and found out that it did not provide a balance between intuitive thinking and analytic thinking. Some topics were found to have utilitarian value but teachers lacked a correct pedagogical approach like that of marrying theory with practice. Mandebvu (1996) carried out a study to assess the relevance of school education to employment in the city of Harare and concluded that most employers were unhappy with the education system in Zimbabwe. Schools lacked manpower and technology to offer vocational and technical skills to students. The Government and employers were urged to cooperate.

Since the Nziramasanga Commission (1999)’s recommendations and up to now, it seems the ‘O’ level mathematics curriculum still does not adequately cater for students’ needs and has to be reviewed or evaluated.

2.2.3 Evaluation models

The term ‘model’ is viewed as loosely referring to a conception or approach or method of doing something (Johnson, n.d.). Models are ways of describing how and what should be involved in evaluating a curriculum and they help to define the parameters of an evaluation,
what concepts to study and what procedures to be used (Module 7: Evaluating the school curriculum, 2013). There are a lot of evaluation models existing in the literature and a short synopsis of them might help to put this study in its proper context. Stufflebeam (2001) lists twenty-two models which he calls ‘approaches’ but further divides them into four main groups namely,

- pseudo evaluations or approaches that promote invalid or incomplete findings (like opinion polls on politics, consumer satisfaction ratings on company products),
- questions/methods oriented approaches or quasi evaluation studies which emphasize technical quality by asking a few ‘pointed’ questions but narrowing an evaluator’s scope (like Ralph Tyler’s objectives centred model or Elliot Eisner’s connoisseurship model),
- social agenda/advocacy approaches which strive, through programme evaluation, to make a difference in society by advocating affirmative action and being client centred (like Robert Stake’s responsive/countenance model or the constructivist model), and
- improvement/accountability approaches (like Daniel Stufflebeam’s Context- Input - Process- Product (CIPP) model or Michael Scriven’s goal-free model) that fully assess the programme’s merit or worth and help evaluation personnel “… make and defend decisions keyed to meeting beneficiaries’ needs.” (Stufflebeam, 2001, p. 57).

Johnson (n.d.) gives a summary of how David Payne also classifies evaluation models, which he calls ‘metaphors,’ into four groups. These are:

- management models whereby the evaluator’s task is to provide information to management or other decision makers to help them make informed decisions about programmes or products. Examples in this group are Michael Patton’s *Utilization Focused Model* or Stufflebeam’s *CIPP Model*,

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• judicial models which are based on the ‘hearing or court case metaphor’ whereby two or more evaluators present their different cases which are scrutinized by an arbiter who then gives the final verdict,

• anthropological models which rely on the qualitative research paradigm whereby evaluators enter the field to observe and take note of what naturally goes on in the programme. Examples in this group are Guba and Lincoln’s *Naturalistic Evaluation Model* or Robert Stake’s *Responsive Model*, and

• consumer models which are primarily summative and which focus on the merit or worth of a product as judged by the consumer. An example in this group is Michael Scriven’s *Key Evaluation Checklist*.

According to Stufflebeam (2001, p.10), the main advantages in studying alternative programme evaluation approaches are to “...discover their strengths and weaknesses, decide which ones merit substantial use, determine when and how they are best applied...” For this study, Stufflebeam’s model would have been the best but has the weakness of being time consuming and too comprehensive for one evaluator (the researcher in this case). One model which is straightforward and applicable to industrial as well as educational training (variables to be looked at in this study) is Donald Kirkpatrick’s four level model (Owson, n.d.; Kirkpatrick & Kirkpatrick, 2009). Guskey (2000) (in Owson, n.d.), adapted Kirkpatrick’s model for evaluation of teacher professional development programmes while Kirkpatrick himself has recommended using control group comparisons to assess a programme’s effectiveness at the two higher levels. While Kirkpatrick’s model is straightforward, it does not emphasize negotiation with decision makers and does not explore the why and how of results (Olorunlero, 2012). The *Education With Production (EWP)* model or theory (Jones 1999) can be used to supplement and complement Kirkpatrick’s model in an attempt to evaluate the ‘O’ level mathematics curriculum and these two are discussed below.
2.2.4 Donald Kirkpatrick’s model

This study will borrow and use ideas from the Kirkpatrick’s 4-level evaluation model (Kirkpatrick & Kirkpatrick, 2009; Chapman, 2012; Clark, 2012). The model’s four levels of evaluation consist of:

- **Reaction** – how the learners react to the learning process,
- **Learning** – the extent to which learners gain knowledge and skills,
- **Behaviour (or performance)** – the capability to perform the learned skills while on the job, and
- **Results (or impact)** – which includes such items as monetary, efficiency, moral etc.

Level one can be measured by attitude questionnaires asking learners and teachers to rate the programme design or delivery. Level two measures the extent to which participants change attitudes, improve knowledge and increase skill as a result of participating in the learning process. Learner assessments are done through pre-tests and post-tests. These assist the designers to assess the programme but for the learner, they may poorly correlate with the realities of performance on the job (Gilbert, 1998 in Clark, 2012). Level three (performance or behaviour) assures that the learning transfers to the job. Students’ capabilities to perform learned skills while on the job, rather than in the classroom, are tested. This can be done through testing or observation of the production process and of the products. Learners would work ‘on the job’ with supervisors. The final level (4) is concerned with results. It measures the programme’s effectiveness or impact. These ‘impacts’ can include financial benefits, customer or client satisfaction, improvement in quantity and quality of products, new innovations and new knowledge gained.
Kirkpatrick’s model appears linear and upward but to suit our situation we can look at it from top to bottom (Backward Planning) whereby we start by identifying the results or impacts we need, the behaviour or performance that would bring about such results, the learning that lead to such performances and the reaction or motivation that would affect the learning as shown in Fig.1.

![Backward Planning Diagram](image-url)

Backward Planning will help to ensure that there is a circular causality. The learners’ perception of the need to learn should motivate them to learn, which in turn would cause the desired performance that produces results or impacts required by the customers or clients. The results achieved should drive the performers’ perceptions of the need to learn more and perform better in order to achieve even better results. This completes the circular causality model shown in Fig 2.
Fig 2: Circular Causality

Source: Clark (2012)
This study will borrow mathematics curriculum evaluation strategies from Kirkpatrick’s model and frame or rephrase questions to suit the Zimbabwean situation. For example, the critical questions to be asked at each level in this study could be:

Level 1: How do learners react to the ‘O’ level mathematics curriculum and to its delivery strategies? Information for this level could be collected from teachers’ and students’ questionnaires and focus-group discussions.

Level 2: Did the learners learn (or are they learning) anything? Information for this level can be collected from the analysis of the syllabus document, from achievement tests and attitude and anxiety rating scales.

Level 3: Do students use their newly acquired knowledge on the job? Interviews or questionnaires for employers could be the instruments to collect information for this level.

Level 4: What impact to the student, the society and the country at large has the training (schooling) achieved? Information for this level could be collected from interviews with parents, from education officers’ questionnaires and from review of literature such as Ministry of Education reports and government or company publications.

Donald Kirkpatrick himself and Jack Phillips have proposed a possible fifth level which they called Return On Investment (ROI) which compares level 4 of the original model to the overall costs of training, teaching or implementation (Chapman, 2009). Some researchers have suggested that a fifth level should focus on the impact of the organisation or programme to the society and external clients while others believe that ROI is a level 4 type of evaluation (Brewer, 2007). ROI would entail increased profits (in business), higher productivity (in industry), higher yields (in agriculture) or higher pass rates in the case of ‘O’ level mathematics. There is a Revised Evaluation Model which links the programme (or
organisational) goals to each level of the evaluation and becomes a planning and evaluation tool (Clark, 2012) and which also aids the troubleshooting or error/fault finding process. Kirkpatrick Partners (2013) have designed yet another ‘New World Kirkpatrick Model.’ According to Griffin (2013, p. 9) the new world model:

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retains the original four levels (reaction, learning, behaviour and results) but focuses particularly on the transfer of training into the workplace. Other features include:
- strong business partnerships with business leaders as the cornerstones for success
- beginning the training process with targeted, measurable business results
- introducing return on expectations as the ultimate method of demonstrating the value of training
- a packaged or formula method to maximise results.
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Kirkpatrick Partners’ (2013) latest updated model has engagement and relevance as well as the original component of customer satisfaction added in Level 1. Engagement measures the degree to which participants are actively involved in and contributing to the learning experience. Relevance is concerned with the degree to which training participants will have the opportunity to use and apply what they learned in training on the job. Confidence and commitment were added in Level 2 to the original components of knowledge, skill and attitude. A person is confident if he/she says, “I think I can do it on the job” and committed if they say, “I intend to do it on the job” (Kirkpatrick Partners, 2013). In Level 3, a component called ‘Required Drivers’ was added. Required drivers are processes and systems that reinforce, encourage and reward performance of critical behaviours on the job (Kirkpatrick Partners, 2013). Level four has the new component of ‘Leading Indicators’ which are short term observations and measurements to check whether critical behaviours are on track to create positive impact on the desired results (Kirkpatrick Partners, 2013). The four levels together with the newly added components are applicable for assessing and evaluating the teaching and learning of mathematics whether in the classroom, while doing homework or during fieldwork or attachment. I believe that using the New World Kirkpatrick Model helps
to bring up an all-round person who uses all of the cognitive, psychomotor and affective domains. The authors of the New World Kirkpatrick Model believe that by incorporating these new components into training and learning programmes, participants are sure to benefit through return on expectations (ROE). In the case of this study, ROE could be the ultimate value that all the education stakeholders would, together as partners, benefit from the implementation of a new ‘O’ level mathematics curriculum.

Therelevance and practicability of the Kirkpatrick model (standard, revised or ‘new world’) may become clear if it is used in conjunction with tools and methods from other models.

**2.2.5 Education with production model**

In Zimbabwe, education with production (EWP) drew inspiration in the early 1980’s from Marxist concepts of polytechnic education (McGrath, 1993) and Botswana’s blend of pragmatism and ideology under the Foundation for Education with Production (FEF) which had been spearheaded by Patrick Van Rensburg (Kayawe, 2012). EWP seeks to promote learning with a combination of education and productive work which can enable students to produce goods and services beneficial to the school or the community (McGrath, 1993). A non-governmental organisation, the Zimbabwe Foundation for Education with Production (ZIMFEP) was established in 1982 as a model that could respond to the then socialist ideology of the government by replacing the western type of education that seemed to be producing book-educated cadres without any practical skills or knowhow. ZIMFEP lacked decisional power to train, recruit or retain personnel and there was no effective
implementation. It also failed because it had unfair competition with traditional curriculum; teachers, the society and the examination system were not promoting it (Nhundu, 1997).

EWP has however been beneficial to some countries which have established self-sustaining school enterprises (Singh, 1998) and production units (Jones, 1999) while graduates trained in Zimbabwean technical and agricultural colleges which incorporated EWP ideas have found good jobs in Australia and elsewhere (The Herald, 18 October 2011). If the government and curriculum planners can address the reasons why it failed, it can be a good model to incorporate into the mathematics curriculum since mathematical ideas and skills are also learnt better through practical work and problem solving approaches. Valuable ideas of ZIMFEP should be harnessed and the sector strengthened (Chimhowu, 2009). For example, the mathematics that students learn in the classroom can be applied in the making of woodwork, metalwork, clay-work, or basketry items which can be sold to generate income for the students or their communities and thus using the concept of EWP. When evaluating the ‘O’ level mathematics curriculum, the evaluator would want to see whether these practical skills are incorporated and what the missing gaps are.

### 2.2.6 Evaluation strategies

Evaluation strategies are viewed here as being distinct from the evaluation approaches or models. They are ways, techniques or procedures of carrying out the evaluation. According to Sage Publications (2012), the evaluator should first prepare for the evaluation by setting clear goals and indicators, identifying target populations and selecting the best practises and technologies to be used. The evaluator then selects the methods or tools to be used. These can be observations, interviews, tests, or questionnaires (Commonwealth of Learning & Asian Development Bank, 1999), used separately or in combination. Lastly, the evaluator
implements the evaluation design or plan following some steps or phases. For example, the researcher adapted and used the ‘O’ level mathematics curriculum evaluation phases for this study as shown in Table 2.1. The intention was to find out how this curriculum links with school leavers’ aspirations.

Table 2.1: Phases of curriculum evaluation

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<td>1. Aspects of the curriculum to be evaluated</td>
<td>The evaluator determines what is to be evaluated which may be the total school system, a particular district, a particular grade level or a particular subject. The objectives of the evaluation activity are clearly stated.</td>
<td>The researcher would evaluate the ‘O’ level mathematics syllabus, teaching and learning methods and assessment methods and find out how they link with school leavers’ aspirations.</td>
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<td>2. Data collection</td>
<td>Identify the information to be collected and the tools for collecting the data which may involve interviews, giving of questionnaires, tests, collection of documents and so forth. The evaluator also identifies the people from whom data is to be collected.</td>
<td>The researcher would collect students’ Mathematics achievement marks, career aspirations ratings and mathematics anxiety scores. To collect students,’ teachers,’ parents,’ MEI, SCEI and DEO’s and employers’ opinions, ideas, suggestions and recommendations concerning the ‘O’ level mathematics curriculum, the researcher</td>
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would use tests, rating scales, questionnaires, focus-group discussions and interviews.

### 3. Presentation and analysis of information

The data collected is presented and analysed in the form of tables and graphs. Statistical tools are often used to compare significant differences and to establish correlations or relationships between variables.

The researcher would use tables and graphs, percentages, means and standard deviations to present data. T and ANOVA tests, correlation and regression analyses would be done using SPSS version 16.0.

### 4. Reporting and interpretation of data

Reports are written describing the findings and interpretation of the data. Based on the findings, conclusions are made on the effectiveness of curriculum implementation efforts. Recommendations are made to reconsider certain aspects of the curriculum.

As per this study’s write up.

Adapted from Module 7: Evaluating the School Curriculum, p.11. [Last column inserted by the Researcher]

### 2.3 Theoretical Framework

This study will be based on the social constructivist learning theory. According to Somekh and Lewin (2005, p. 344), “Constructivism is the term used to describe a theory of knowledge which stresses the active process involved in building knowledge rather than assuming that knowledge is a set of unchanging propositions which merely need to be understood and memorised.” Knowledge is assumed to exist in the heads of people and the thinking subject constructs it on the basis of their experiences in their social and cultural contexts (von Glasersfeld, 1996). Debate and research on this theory have brought about its two offshoots, namely radical and social constructivism. Radical constructivism has two basic principles which state that:

(a) “Knowledge is not passively received but built up by the cognizing subject;
(b) The function of cognition is adaptive and serves the organisation of the experiential world, not the discovery of ontological reality.” (von Glasersfeld, 1996, p. 18).

Social constructivism on the other hand refers to the process by which knowledge which exists in the social and cultural world is formed, built up and sustained by social structures, relationships and interactions. Phenomena and knowledge in the social world are believed to keep on changing and not to remain as constants that conform to natural laws. The four principles of social constructivism as propounded by Vygotsky in Social Constructivist Theories (2013) are that,

1. Learning and development is a social collaborative activity,
2. The Zone of Proximal Development can serve as a guide for curricula and lesson planning,
3. School learning should occur in a meaningful context and not be separated from learning and knowledge children develop in the real world, and
4. Out-of-school experiences should be related to the child’s school experiences.

The ‘Zone of Proximal Development’ in simple terms is Vygotsky’s idea that students can master concepts which they cannot understand on their own if they get help from adults or students who are more advanced. It would be interesting to find out whether the four social constructivist principles (as indicated above) have been incorporated in the current ‘O’ level mathematics curriculum and whether teachers and students are following them.

Researchers who adopt the social constructivist approach are likely to use mainly qualitative rather than quantitative methods (Somekh & Lewin, 2005) although a mixture of both can be used. Social constructivism as a learning theory can be applied to any school subject including mathematics.
Since mathematics education (unlike pure disciplines) is heavily influenced by cultural, social and political forces, this study will be guided by the social constructivist learning theory as propounded by Paul Ernest, Ludwig Wittgenstein and Lev Vygotsky among others (Ernest, n.d.; Mutekwe, Ndofirepi, Maphosa, Wadesango & Machingambi, 2013). Social constructivism as a philosophy of mathematics explains the obvious usefulness and objectivity of the subject. It views mathematics as a social construction, a cultural product and one that is fallible as opposed to the radical constructivist views. However, social constructivists also believe that personal theories resulting from our experience of the world must fit social and physical reality. This, they believe, can be achieved by a cycle of theory – prediction – test – failure – accommodation – new theory. This cycle gives rise to the socially agreed theories of the world and social patterns and rules of language use. Mathematics is viewed as the theory of form and structure that arises within language. Paul Ernest believes that mathematics education should foster the construction of knowledge through active participation and interaction among students under the guidance and supervision of teachers. The mathematics education gained should contribute to the development of democratic citizens who are able to critically evaluate political, economical and social claims that are based on mathematical arguments.

Ernest (n.d) further recommends a differentiated mathematics curriculum at secondary level. This type of curriculum calls for advanced study in mathematics for “future mathematicians” and general mathematics that would provide, for other groups of students, enquiry based activities and critical thinking skills that would enable them to fit and be involved in social issues (Ernest, n.d.). Similar sentiments were echoed in the Nziramasanga Commission’s (1999) recommendations.

This research was anchored on the theory of social constructivism as a possible philosophy of mathematics education. There is no doubt that the origins of mathematics are social or
cultural, hence mathematics can be viewed as a social construction and a cultural product. Its justification can be tested through quasi-experiments whose results can be right or wrong. The concepts of mathematics can be derived by abstraction from direct experience of the physical world, from reflecting upon those experiences and then generalizing or negotiating meaning with others during discourse (Ernest, n.d.). Mathematics is also a language of communication and children acquire mathematical concepts first through their mother tongue and later through other languages. Social constructivism therefore offers the possibility of a philosophy of mathematics which accounts for the objectivity and utility of the subject as well as its fallibility and culture-boundedness. Teachers and pupils should not view mathematics as too rigid, alien or ‘already discovered.’ Mtetwa (1999) says that there should be a ‘shift in orientation’ in which teachers need familiarisation and understanding of the main characteristics of constructivist thinking. He believes that if teachers’ teaching plans are based on a theoretical framework, they stand a better chance of being improved upon through scrutiny and debate. The researcher also believes that there should be a new way of teaching and learning mathematics in Zimbabwean secondary schools.

The theoretical framework described above was applied by the researcher to find out:

- How ‘O’ level students in Zimbabwe conceptualise mathematics and how they view its relevance for careers,
- If ‘O’ level students are able to construct and use their own mathematical knowledge, and
- What ‘O’ level mathematics curriculum model would students and employers consider most beneficial to the country.
The conceptual and theoretical frameworks highlighted above have revealed the need to evaluate the ‘O’ level mathematics curriculum. They have also shed light on the type of model that could be employed to determine how the curriculum is related to students’ further education and career choices. The next section gives a brief overview of the Zimbabwe education system, particularly as it relates to the mathematics curriculum.

2.4 Structure of the Zimbabwe ‘O’ Level Mathematics Curriculum

Curriculum planning and designing for schools in Zimbabwe is centralised and done at national level by the curriculum development unit (CDU) which is under the Ministry of Education, Sport, Arts and Culture (MOESAC) and which works hand in hand with the Zimbabwe School Examinations Council (ZIMSEC). From the national level, information is then cascaded downwards to the regional/provincial level, to the district level, to the cluster level and then it finally reaches the school level (Commonwealth of Learning, 2000). CDU is responsible for developing syllabi for all levels of education and approves textbooks written to the prescribed syllabus (Chakanyuka, Chung & Stevenson, 2009).

Zimbabwe follows the British system of education. Ordinary (‘O’) level or forms 3 to 4 students are generally of the age of about 15 to 16 years and there is automatic progression from forms 1 to 4 (EFA-NAP, 2005). Students write the ZIMSEC examination at the end of form 4 and those who pass with five C symbols or better can proceed to do advanced (‘A’) level or can join teacher education, nursing education, agricultural education and training, polytechnic education, or industrial training and trade testing.

The ZIMSEC ‘O’ level mathematics syllabus 4028 is for candidates who are not supposed to use a calculator in Paper 1 but may use it in Paper 2 while 4008 is the non-calculator version for both Paper 1 and Paper 2. Most of the candidates, especially those in the rural schools, in farm and mine schools and those whose parents are of low socio-economic status usually
write the non-calculator version but may instead use mathematical tables for Paper 2. However, the syllabus aims, assessment objectives, methodology, content/topics and scheme of assessment are the same. This curriculum will be effective until 2017 (see Appendix A).

2.5 Strengths and weaknesses of the Zimbabwe ‘O’ level mathematics curriculum

After gaining independence in 1980, the Zimbabwe government embarked on a massive campaign to increase the number of secondary schools, teachers and students as indicated by statistics sourced by Chimhowu (2009). This is still being done especially in the newly resettled farms, at newly established mines and in some remote places that had been neglected by the colonial government. At all the old and newly established secondary schools, there is hardly a school that does not offer mathematics as a curriculum subject, and this ensures that no child is denied the opportunities to study mathematics. The curriculum is also strong in the sense that it is the same countrywide and does not discriminate against race or gender as was the case in the colonial era. In fact, mathematics camps for girls are being encouraged in the rural as well as urban areas of Zimbabwe. Chabongora, Chauraya and Mhlolo (2009) found out that pre-service student teachers opted for Mathematics as their main subject because of its necessity for pursuing a future career in the subject area and for vertical progression to university. Chinhanu (1997) observed that most of the ‘O’ level topics in the syllabus had utilitarian value, and since the curriculum has not been changed since then, the researcher believes that the topics still have such strengths. However, these strengths seem to be outnumbered by the weaknesses. The language of instruction at ‘O’ level is English but most of the students are not proficient in it. They have a ‘double jeopardy’ (Garegae, 2011) of trying simultaneously to understand the mathematics itself and also the language in which it is written. The Government through the Ministry of Education does not seem to have a policy on mathematics education as what other countries like USA and South
Africa do. There is no philosophy for mathematics education that the country wishes to follow. Mtetwa (1999) has suggested that there should be a ‘shift in orientation’ from the teacher-centred to the constructivist viewpoints. In Pakistan, Arif (2010) echoes similar sentiments about weaknesses of their secondary school mathematics curriculum when he says,

*Most of the experts were not satisfied with the criteria of content selection. Because according to them, it is not based on our philosophy of life, it have (sic) lack of focus on logical reasoning and scientific thinking as its major focus is on cramming and rote learning and it is not market and job oriented. (Arif, 2010, p. 208).*

In Zimbabwe, students have unhealthy beliefs about examinations (Mtetwa, 1992) maybe because of the way examinations are perceived. Parents insist on passing the examination while teachers usually emphasize on completing the syllabus and practising for the examination instead of emphasizing on problem solving and analytic thinking. In his analysis of the ‘O’ level mathematics syllabus in Zimbabwe, Chinhanu (1997) found out that there was no balance between intuitive thinking and analytic thinking. He also points out that the topic on compound interest is not in the syllabus and yet this is what the banks are charging. In their survey, Dzinotyiweyi and Fleischner (1995) found out that teachers and students had the opinion that the ‘O’ level mathematics syllabus was too long and had difficult topics. Some of the topics which teachers considered to be most difficult for pupils were transformation, probability and statistics, locus and linear programming. The pupils themselves listed seventeen topics they considered to be difficult and some of these were indices and logarithms, geometrical transformations, algebraic functions and graphs, sets and probability. Maybe all this explains why the pass rate in ‘O’ level mathematics at national level has never been more than 23% (UNESCO-IBE, 2010). The researcher has also observed that the term ‘history of mathematics’ does not exist in the syllabus. Mathematics teaching and learning should not be devoid from history of mathematics. The word
‘computer’ does not appear while the word ‘technology’ appears once in the syllabus and is not even related to the use of computers but is mentioned within the objective to “choose and use appropriate formulae, algorithms and strategies to solve a wide variety of problems (e.g. agriculture, technology, science and purely mathematical contexts)” (ZIMSEC, 2012, p. 4). On the methodology aspect, the curriculum does not offer clear guidelines on how teachers should teach or how students should learn mathematics. There are no guidelines for direct application to industry, attachment or career guidance after school. It would be interesting to find out to what extent these ‘O’ level mathematics curriculum weaknesses (and strengths) actually manifest themselves in the Zimbabwean schools nowadays.

2.6 Factors affecting achievement in mathematics

The way the mathematics curriculum is designed affects the way it is perceived and implemented. Poor achievement usually comes as a result of negative attitudes and poor implementation of the curriculum. A weak curriculum then, is usually viewed negatively by both teachers and students. So the factors affecting achievement in mathematics can be seen from different but not so disjoint levels. These can be grouped into

- **syllabus factors**: students are bound to fail mathematics if the syllabus is too long, topics too difficult, poorly sequenced, disintegrated, incoherent, etc.

- **school based factors**: students are bound to fail mathematics if there is lack (and poor usage) of teaching and learning facilities and if the ‘school type’ is not learner-friendly (Mbugua, Kibet, Muthaa & Nkonke, 2012),

- **teacher related factors**: students are bound to fail mathematics if teachers’ academic preparation (content knowledge), years of teaching, attitude, teaching styles, and beliefs are not adequate or positive (Silva, Tadeo, Reyes & Dadigan, 2006),
• socio-economic factors: students are bound to fail mathematics if the education and economic status of their parents are poor, or if the home environment is insecure due to e.g. early marriages, female genital mutilation (Mbugua, Kibet, Muthaa & Nkonke, 2012) or child-headed family,

• student factors: students are bound to fail mathematics if they lack motivation and interest, lack proficiency in the language of instruction (Mji & Makgato, 2006), lack problem solving techniques or proper learning styles, and if their attitudes towards anything related to mathematics is negative.

This study investigates whether and to what extent these factors also affect ‘O’ level mathematics achievement in the Zimbabwean situation. Mathematics anxiety emanating from the teacher or the student is another factor which is discussed separately below.

2.7 Mathematics anxiety

One cannot talk about the mathematics curriculum without talking about mathematics anxiety. Mathematics anxiety has been viewed to be so prevalent that it affects education policy (Sankowsky, 2008) and that includes mathematics education. It has been shown to have a strong negative correlation with performance in mathematics (Bergeson, 2000; Newstead, n.d.) which is the final outcome mostly desired, and a strong negative correlation with motivation (Zakaria & Nordin, 2008). Motivation includes self-concept, attitude and ability-effort attributions. Fennema (as cited in Johnson, 2000) has also shown that a significant positive correlation exists between attitude towards mathematics and mathematics achievement. Although little may be known about the factors responsible for mathematics anxiety or about its onset, it has potential risk factors which include low mathematics
aptitude, low working memory capacity, negative teacher and parent attitudes and vulnerability to public embarrassment (National Mathematics Advisory Panel, 2008). Hence achievement and attitude are important predictors of whether the student will drop mathematics, do further mathematics or choose a mathematics related career. A person with mathematics anxiety may also show physiological symptoms like increase in heart rate, sweating, trembling and nausea, or may depict psychological symptoms like discomfort, anger, low self-esteem, or loss of memory (Sankowsky, 2008).

If people know what mathematics anxiety is and what causes it, they can find ways to prevent or eradicate it. Skemp (1979) distinguishes fear from anxiety. He says that a person experiences fear when moving (or changing) towards an anti-goal state whereas the person is in a state of anxiety when he/she is not able to move away from an anti-goal state. An anti-goal state is referred to as something that is disturbing, uncomfortable or not good for survival. However, Levitt (1980) believes that there is no clear-cut distinction between anxiety and fear but that anxiety can be a state or a trait (e.g. a person being in an anxious state but the anxiety may later on vanish or a person whose personality or trait is to be always anxious). When anxiety is linked to mathematics, it is known as ‘mathephobia,’ a term that was coined by Lazarus (Buxton, 1981). Warren (n.d., p. 1) defines math anxiety as “... either an aversion or a fear of working with numbers or equations for purposes of understanding the mathematical theories behind them or simply using mathematics to solve practical problems in everyday life.” Strawderman (2011) has similar views. Sankowsky (2008) defines it as feelings of tension, hopelessness and inability while Buxton (1981) says it is an irrational and threatening fear of mathematics. The mathematics classroom is threatening, frightening and leading to guilt, embarrassment or shame. Whichever way it is defined, Warren (n.d.) says it is one of the most serious limitations to education.
2.7.1 Possible causes of mathematics anxiety

There are many contributing factors to mathematics anxiety since it can be viewed from different domains and researchers have attempted to come up with math anxiety models to explain its history, nature, effects and interrelationships with other variables, the major one being achievement or success in mathematics (Strawderman, 2011; Sankowsky, 2008). Strawderman (2011) proposes a math anxiety model with three interrelated domains. The model has the social/motivational domain where the family, peers and society are the forces that act upon an individual to produce ‘behaviours and attitudes’ continuum with pursuit on one end and avoidance on the other. The intellectual/educational domain consists of the knowledge and skills an individual has. Its continuum is achievement with success on one end and failure on the other. The psychological/emotional domain comprises the individual’s emotional history, reactions to stimuli and arousal states. Its continuum is ‘feelings’ with confidence on one end and anxiety on the other. Within this anxiety model, learning takes place and this can be ‘rote learning’ on one end of the continuum and ‘learning for understanding’ on the other end. All these variables are interlinked so that one does not produce results in isolation from the others.

Sankowsky (2008, p. 4) proposes a longitudinal model which he labels CCPP. He says anxiety results from poor performance “coupled with crucial concealed correctable contributors to that performance.” He identifies the instructor or teacher, the student and the discipline (the mathematics subject itself) as interrelated and dynamic contributors to that anxiety. He proposes a flow chart with paths from source to contributor to concealment to performance to attributions and finally to the anxiety. This anxiety has four levels, namely, the pre anxious, the math averse, the math anxious and the super anxious. This model seems to be weaker than that of Strawderman (2011) because it does not include the student’s past experiences and relationships with family, peers and the society at large.
From these two models and maybe others, the possible causes of math anxiety become clear. Students’ math anxiety may be caused by teachers who are themselves anxious about their mathematical abilities and who may pass on unpleasant math experiences (Russell, 2011). The way mathematics is sometimes taught as a right or wrong only subject with right/wrong only answers or the rote learning way may cause anxiety. In a study with adult respondents, Marchewka (2010) identified several factors leading to anxiety. These were communication and language barriers, uncaring attitude of the instructor, quality of instruction, evaluation of instruction, instructor’s dislike of the level of the class, gender bias and age discrimination. Curtain-Phillips (2010) believes anxiety comes from pressure of timed tests, risk of public embarrassment and imposed authority. Hadfield and Trujillo (1999) in Sankowsky (2008) view anxiety as emanating from environmental factors (previous difficult classroom interactions, pressure from parents, bad teachers in early schooling, and perception of the discipline as a set of rigid rules), intellectual factors (learning styles, low self-confidence, dismissing mathematics as irrelevant) and personality factors (shyness, low self-esteem, gender). An awareness and thorough analysis of these possible causes may help educators to find ways of preventing or eradicating the anxiety.

2.7.2 Possible mathematics anxiety preventions and remedies

Perhaps the best preventive action is ‘do not let anxiety develop in the first place.’ To be able to do that, the teacher must have a firm grasp of the content of his/her subject. He/she must be qualified and interested in teaching the subject, must have adequate resources to use (including text books and other teaching/learning aids), and must have professional subject matter pedagogy (teaching/learning styles, humour, history of mathematics and applications of mathematics). Tobias (1991) believes that there is a math anxiety cure which involves changing learners’ and teachers’ attitudes at the same time. Below is a short (historical)
comparison of what different scholars or sources say are the teachers’ and students’
techniques of preventing and overcoming mathematics anxiety:

**Tobias (1991)**

Sheila Tobias proposed several mathematics anxiety reduction techniques, five of the major ones being consciousness raising, the math autobiography, group de tox, divided page exercise and assertiveness training.

*Consciousness Raising:*

"Consciousness Raising" is a technique used to persuade students that they can do mathematics and that they can be helped to reduce their math anxiety. Tobias and her team of counsellors and math instructors used the technique first by distributing booklets of mathematical symbols of different types and then requesting students to visit their “math clinic” (or a math laboratory in our case) to learn more about those symbols. It is claimed that the majority of the students went to that clinic (and were "treated"). Apart from local advertisements, public speeches were also delivered and books written on the subject but with greater emphasis on countering current mathematics myths such as the belief that there is a "mathematical mind", or "mathematics is a (white) male area of study" and so forth.

*Math Autobiography:*

In the first session of the mathematics anxiety reduction programme, a counsellor would kindly ask the student to write or tell his/her mathematics autobiography. The counsellor would ask the student to say more about such things as mother's fear, father pressure, teachers' and peers' attitudes, responses from the opposite sex and so on. Discussing these issues either privately or in groups is believed to reduce some mathematics related pressure and relax the mind of the student.
Group "De-Tox":

‘De-toxing’ is removing toxins (poisonous substances in the body) which are believed to have been caused by anxiety, fatigue or stress. During “de-toxing” students are encouraged to discuss and share their personal mathematics experiences with their peers. The group also watches films or videos on aspects of mathematics anxiety and discuss their observations. It is hoped that after the discussions, the students will not believe that they are ‘alone’ as those affected by the fear of mathematics do. The "Group De-Tox" technique can then end with the teacher teaching those topics and aspects the students would have reported having had difficulty with.

Divided-Page Exercise:

Students are asked to divide a page of their mathematics exercise book into two columns. In the left-hand column labelled "My feelings/thoughts," students would record their feelings and thoughts while doing their mathematics in the right column labelled "My work." Students would be asking themselves questions like "What am I feeling?" "Why is this problem difficult?" and "What can I do?" and then answer these questions in the left-hand column. At the end of the lesson participants would volunteer to read aloud their left-hand side notes, thus prompting a discussion to ensue.

Assertiveness Training:

This is a form of therapy intended to give students the training they would need to survive in the next (real) mathematics classes. An interesting example is the "Math Anxiety Bill of Rights" designed by Sandra L Davies (in Tobias 1991). It is meant to give students courage to speak clearly and fearlessly about any aspect of mathematics that they so wish to speak about. That bill of rights has 14 statements some of which are: “I have the right to dislike math. I have the right to be slow. I have the right not to understand." (Tobias, 1991, p. 93).
Tobias (1991) claims that of all the 600 students who passed through her clinic at her university in the 1970's and 1980's, there was a hundred percent pass rate in the calculus course. Assertiveness training can also be used by teachers and school counsellors in Zimbabwe to motivate ‘O’ level students to have positive attitudes and beliefs towards mathematics.


Wieschenberg spells out several techniques that can be used to inculcate positive attitudes in pupils. For example, self-motivation and desire on the part of the student are very important. Teachers should be discouraged from telling students that mathematics is very difficult or other negative statements. They should instead change the "pessimistic explanatory style” of the students to "optimistic explanatory style." In brief, the pessimistic-explanatory-style student looks at mathematics, the mathematics classroom and him/herself negatively. He/she attributes success to mere luck and failure to inability. If such students' beliefs and attitudes are allowed to stay put, they could probably generate fear of mathematics and helplessness in the classroom. Like Tobias (1991), Wieschenberg advocates group discussions and group learning. He also suggests that attitudes and beliefs can be built up through teaching students different problem solving strategies and giving credits to partial solutions of problems. Here the teacher has many options, some of which include using humour and cartoons to solve mathematics or statistics problems (Schacht & Stewart, 1990), brain teasers (in the form of games or puzzles) to create interest, telling stories that involve mathematics (or history of mathematics) and so on.

**NCTM (1989, 1995b) cited in Das and Das (2013)**
National Council of Teachers of Mathematics (NCTM, 1989, 1995b) give several useful suggestions for teachers who may want to prevent students’ mathematics anxiety. For instance, they propose that teachers should:

- accommodate different learning styles,
- create a variety of testing environments,
- design positive experiences in math classes,
- refrain from tying self-esteem to success with math,
- emphasize that everyone makes mistakes in math,
- make math relevant,
- let students have input in their own evaluations,
- allow for different social approaches to learning math, and
- emphasize importance of original quality thinking rather than rote manipulation of formulas.

The use of mathematics therapies like coaching and counselling may also help. However, coaching by having extra lessons (usually taught by most teachers charging a fee) may leave those students who cannot afford the extra fees more vulnerable and anxious. Only teachers who are more dedicated to duty and who would want their students to excel in mathematics may coach for free. It is therefore suggested that there are missing gaps in the current ‘O’ level mathematics curriculum which need to be filled in by inculcating in both teachers and students good ‘habits of mind’ or ways of thinking about mathematics that are rich, problem-posing, problem-solving, not selfish but useful to everyone. Students should not shun to use mathematical knowledge and skills to do any productive practical work.

**Salsa Mission College (2009)**
Salsa Mission College (2009) gives seven suggestions to help students overcome mathematics anxiety. They say students who want to overcome anxiety and succeed in mathematics should:

1. do math everyday,
2. study smart,
3. attend class,
4. get organised,
5. continually test themselves,
6. replace negative self-talk with positive self-talk, and
7. utilise all their resources.

These seemingly good ideas can work depending on the attitudes, beliefs, character, and self-discipline of the student and how he/she interacts with peers and teachers. The school should provide material resources and teachers should give intellectual support while peers should provide motivational and social support.

**Zyl and Lohr (1994), Marchewka (2010)**

Teachers can reduce mathematics anxiety by applying *Systematic Desensitization* (Zyl & Lohr, 1994) or simply *Desensitization* (Marchewka, 2010) technique. To use this technique, the student should first practise some muscle relaxation exercises and then think of scenes of previously uncomfortable math-related situations while in the relaxed state. Tense muscles would translate into the mind as "failure messages." The student, aware of the tension, would be guided (e.g. by a suitable audio-taped programme) to counter condition the psychological discomforts or to minimise their effect on the task being done. Zyl and Lohr (1994) call such
a method "systematic desensitization" and claim that it overcomes mathematics anxiety and builds confidence and positive attitude to mathematics.

**Freedman (2010)**

Professor Ellen Freedman gives ten ways students should use to reduce mathematics anxiety, some which are similar to those of Salsa Mission College (2009). She says students should, overcome negative self-talk, ask questions, consider math a foreign language and always practice it, not rely on memorization to study mathematics, READ their math text, study math according to ‘YOUR’ LEARNING STYLE,’ get help the same day they don’t understand, be relaxed and comfortable while studying math, ‘TALK’ mathematics, and develop responsibility for their own successes and failures.

Freedman also recommends the use of cartoons and puzzles to arouse interest and encourage creativity in mathematics teaching and learning.

**Curtain-Phillips (2010)**

Curtain-Phillips believes that teachers should make classrooms conducive for mathematics. This can be done by presenting lessons in different special ways which he calls visual/spatial, logical/mathematics, musical, body/kinesthetic, verbal/linguistic, interpersonal and intrapersonal. This implies that teachers should make mathematics relevant to everyday lives. They should teach mathematics with applications, for example, by linking it with cooking, sewing, sports, home repairs, hobbies, games and technology. Mathematics should be made fun and interesting using humour, jokes and cartoons. Students should be encouraged to do cooperative group work. Teachers should teach and develop problem solving skills in students.
Russell (2011)

Russell (2011) offers six strategies students may use to overcome mathematics anxiety. She believes that they should,

- have a positive attitude,
- ask questions to understand math,
- practice regularly,
- hire a good math tutor or work with peers,
- do the mathematics instead of just reading over their notes, and
- be persistent even if they make mistakes.

There are many similarities and probably few differences in the techniques described above, the purpose of including them being to conscientise and challenge ‘O’ level teachers and students to use them. Some would call for costly resources; others for time and commitment. However, they can be adopted with some modifications to suit the Zimbabwean situation.

2.8 Career aspirations and employer expectations of students

Aspirations are hopes or ambitions. Career aspirations refer to constructs embodying a person’s dreams and desired career goals (Danziger & Eden, 2006 in Smulders, 2009). Two types, namely, realistic and idealistic aspirations were identified by Linda Gottfredson (Smulders, 2009). Career aspirations may have an attitudinal component representing ideas and dreams (idealistic aspirations) or a behavioural component representing actual actions a person takes in order to fulfil the dream (realistic aspirations) or both. Career aspirations can be assessed using Holland codes (Green, 2010), assessment inventories or questionnaires (Riegle-Crumb, Moore & Ramos-Wada, 2010). These aspirations stimulate individuals to work hard to reach certain goals.
According to Holland’s theory (Green, 2010; University of Missouri, 2010), people can be described or characterised according to what they do. They can fit into two or more of six types of careers or environments. These types which were coded as RIASEC are:

1. **REALISTIC** – crafts or technical, these are the doers who want to work with tools or animals. They tend to be practical and down to earth,
2. **INVESTIGATIVE** – thinkers or scientific, these people like activities involving mathematics, physics, biology or medical fields. They tend to be independent, curious or studious,
3. **ARTISTIC** – these like creative activities such as art, music or drama. They tend to be unrestricted or free thinkers,
4. **SOCIAL** – these are people who want to work with other people, often helping, enlightening, curing or informing them. These people tend to be friendly,
5. **ENTERPRISING** – these are business minded people. They tend to persuade or influence others, and
6. **CONVENTIONAL** – these are the ‘organisers’ or ‘followers’ who want to work with data or a set of instructions. They tend to be dependable, responsible and detailed.

Holland also theorises that individuals acquire these codes hereditary (from birth) but they are strengthened or weakened though the environment (ie. home, school or community). An individual would be satisfied and more productive if he/she gets the career that they really want and are capable of doing. Thus it is the duty of the teacher to find the direction(s) through which a student’s career aspirations are poised and to try to strengthen those aspirations.
According to the Social Cognitive Career Theory (SCCT), career choice behaviour is shaped by outcome expectations, career interests and career self-efficacy (Tang, Pan & Newmeyer, 2008). Career self-efficacy may be influenced by gender, race/ethnicity, family background and learning experiences from teachers, peers, or role models. Mathematics anxiety has been shown to also influence career aspirations although there is little research in this area (Scarpello, 2005) while mathematics achievement has been shown to have an effect on students’ career aspirations between grades 11 and 12 (Chan, 2003?).

If teachers understand students’ career aspirations, they can relate their teaching activities according to the students’ interests (Ismail, Kadir & Pihie, 2011) and such aspirations might highly predict subsequent educational and occupational attainment (Riegle-Crumb, Moore & Ramos-Wada, 2010). It is pathetic that mathematics has been a critical filter for 70% of career choices at the university level (Chan, 2003?) and this provides a challenge to teachers. While students continue to have an aversion for mathematics, society cannot meet its needs for a mathematically literate workforce. Hence the need for intervention programmes by teachers and Ministry officials. These programmes could be in the form of designing and implementing new curricula, reducing mathematics anxiety, creating a ‘math and technology’ oriented student and improving students’ career aspirations through attachments or EWP.

Employers too, have their own expectations of students. Some employers in Thailand stated that graduates had weaknesses in both theory and practice (Chantara, Kaewkuekool & Koul, 2011) prompting educators to seek better curriculum and career opportunity programmes to overcome the challenges interfering with students’ aspirations. Employers are distressed by the weak mathematical and quantitative skills of high school graduates (Steen, n.d.) because there is no strong tally between the mathematics that the students do at school and the mathematics required at the workplace. Apart from linking a ‘good’ mathematics curriculum
with higher earnings (Rose & Betts, 2001), employers also expect students they employ to dress properly, behave well and have the will to learn new things at the workplace. They must also have the right attitude and employability skills (Australian Government’s Department of Science and Training, 2005) such as self-management, initiative, enterprise, communication, teamwork, planning and organisation, problem solving and technology. It would be interesting to find out whether and to what extent the Zimbabwean ‘O’ level mathematics curriculum (or any other country’s math curriculum) reflects these skills.

In a study in Perth, Australia, high school students viewed mathematics as a subject with much prestige in the eyes of the community, especially employers (Frid, 1994). Students elsewhere may also realise that a good background in mathematics could prepare them well for employment (Piotrowski & Hemasinha, 2001). In Zimbabwe, most employers demand at least five ‘O’ level subject passes of C symbol or better. Most of the job advertisements have the extra condition ‘including English and Mathematics.’ Such employer expectations may also have an influence on students’ aspirations, achievement in and attitude to mathematics. While these seem to be good student aspirations and employer expectations, it is unfortunate that most students do not meet them. For these to be met, the employers should provide assistance in the form of vacancies for student attachments, on the job training, free career fairs for students, visiting schools to talk as role models and sharing job experiences, and having EWP partnerships with schools.

2.9 Towards a national policy for mathematics education

A national education policy constitutes the laws and rules governing the operations of education systems within the country. The fundamental principles may be set out in the
Constitution or in primary, secondary or tertiary education legislation. For example, the preamble to the new constitution of Zimbabwe adopted through a referendum in March (COPAC, 2013), states that the people of Zimbabwe are committed to build a united, just, and prosperous nation founded on values of equality, fairness, freedom, transparency, honesty and the dignity of hard work. The Minister of Education can formulate specific policies that govern his/her departments and such policies should be passed through an Act of Parliament to become enforceable. For example, in South Africa, the Department of Education (2003) has a National Curriculum Statement or policy that explains, guides and enforces how Grade 10-12 (General) Mathematics should be taught, learnt and assessed. The policy is guided by the principles of social transformation, outcome based education, human rights, indigenous knowledge systems and environmental and social justice, among others.

According to Sierpinska (2003), many of the mathematics education research papers she reviewed focused on teaching and learning, few on assessment and less on mathematics policy. Government policy was considered to be an intervening variable between the factors affecting achievement in mathematics and performance in mathematics (Mbugua, Kibet, Muthaa & Nkonke, 2012). In his recommendations for the future of Zimbabwe, Chimhowu (2009, p.79) points out that, “Given the drastic changes which have taken place nationally, regionally and globally, there is an urgent need to re-examine educational policies and strategies,” and that education and training should be linked more closely to economic development. Considering the above mentioned points and values as enshrined in the new Zimbabwe constitution and the fact that many ‘O’ level students need a lot of support and motivation to do well in mathematics for the nation to prosper, it is high time a new national policy on mathematics education is formulated and implemented. The basis for that policy also emanates from findings and recommendations of the Nziramasanga Commission (1999),
UNESCO-IBE (2001) and Chimhowu (2009), and from personal observations and experiences.

The Zimbabwe national policy for mathematics education should be guided by the country’s history, philosophy, social, cultural and economic conditions. It should clearly spell out its mission, vision, core values, aims/goals, objectives, content to be covered, materials to be used, activities to be carried out by each of the stakeholders, teaching and learning processes and procedures, assessment and evaluation strategies, stages and steps. As contents of that policy, and also borrowing from recommendations of Chirume (1998), it is proposed that:

- There should be more time for teachers and students to use social constructivism as a philosophy guiding the teaching and learning of mathematics. Students should study and construct their own mathematical knowledge under the supervision of willing and motivated teachers. Ethno-mathematics and indigenous knowledge systems should be incorporated into the mathematics curriculum.

- The mathematics that students learn should be relevant, useful, enjoyable and applicable to their real-life situations and in their local communities. Arithmetic, algebra, geometry, trigonometry, statistics and probability should form the common core content areas at ‘O’ level.

- Resource materials like calculators, computers, textbooks and other learning media should be increased and their quality improved to cater not only for examination needs, but also for the daily-learning needs of the students,

- The primary mathematics syllabus and examination should be modified and related to the secondary ones,

- It should be a national priority to take adult basic education seriously. The adult basic education curriculum should include relevant and useful mathematics. For example, numeracy, measurement, making recipes and application of fertilizer, as topics, would
help the peasant farmers in the rural areas learn how to increase their crop yields or to bake bread for sale and those in urban areas how to budget their time and money and operate small businesses. If parents see and appreciate the value of mathematics, they surely would impart positive mathematics attitudes and beliefs to their children. They would also instil in children the idea that mathematics should not be and is not a male dominated discipline. Then all children regardless of gender would receive equal opportunities of studying mathematics at home.

- At the school level, the curriculum should include Guidance and Counselling as a subject so that pupils are taught the value of education, self-discipline, study skills, overcoming anxiety and stress, among others.

- Mathematics should not be seen as a dead or deadly subject. It should be "humanized." Short historical and philosophical accounts of mathematics should be taught as well as the use of cartoons, jokes and funny stories to make students attentive, active, participatory and interested throughout the lesson. More textbooks involving local as well as foreign historical achievements in mathematics (suitable for specific student grade-levels) need to be published.

- Assessment needs to be a continuous process that encompasses final tests, coursework, fieldwork or project work and linked to the concept of EWP.

- Conditions of service for teachers should be improved, including favourable salary adjustments and activities that boost their morale. Pre-service and in-service training of teachers should be an ongoing process that focuses thoroughly both on mathematics content and methodology areas. This could also reduce the math anxiety of the teachers and help them to inculcate positive attitudes in their students.

According to the Association for the Development of African Education (DAE, 1996) policy formulation is not a simple step by step process but can be messy and fluid. Change in
education requires public consensus and political acceptability. A coherent and sustainable policy framework for mathematics education in Zimbabwe can be assembled by establishing priorities and choosing between policy options, treating symptoms and tackling the root causes of persistent issues (DAE, 1996). This can be done by removing all bureaucratic bottlenecks, and by advocacy and lobbying (Odukoya, 2009) by interested stakeholders.

2.10 Chapter summary

This chapter has highlighted the conceptual and theoretical frameworks of this study. In particular, the need for evaluating the Zimbabwe ‘O’ level mathematics curriculum and evaluation strategies have been discussed. Donald Kirkpatrick’s evaluation model and the EWP model can be used in conjunction to bring about a coherent and effective mathematics curriculum for Zimbabwe. Suggestions for a national mathematics education policy anchored on the social constructivist paradigm, on preventing and reducing mathematics anxiety among teachers and students and on enhancing achievement and promoting the spirit of scientific and technological advancement were recommended. The need for a curriculum that embraces students’ career aspirations and real world of work experiences was envisaged. Chapter 3 discusses the research methodology and design.
RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

In Chapter 2 the theoretical and conceptual frameworks for this research were discussed. The researcher argued for a possible philosophy for mathematics education for the Zimbabwean context called social constructivism because it enables learners through the guidance of dedicated and patriotic teachers to develop good mathematical habits of mind and construct mathematical knowledge useful to themselves and to the society or country at large. The conceptual framework highlighted the idea or concept that in order to use social constructivism in the mathematics classroom, first the existing curriculum needed to be critically analysed and evaluated using Kirkpatrick’s and EWP models. These views made the researcher decide to use a combination of quantitative and qualitative methods to gather data that could be generalisable to the whole country (quantitative) but being also of the worthiness and depth (qualitative) that encourage students, teachers and other stakeholders to have a new mindshift or philosophy of what mathematics is and what it should do to the individual.

In this chapter the researcher’s chosen methodology and design are outlined. The procedure that was followed to do documentary analysis of the ‘O’ level mathematics syllabus is discussed. The researcher then explains the sampling process that was used to select the people to be included in the study. A discussion of the construction of research instruments (guided by the research questions stated in Section 1.5) follows. The researcher used both self-constructed and standardized instruments but there was need to pilot test the self-constructed ones in order to check on their validity and reliability, and this is discussed in Section 3.4. The actual data collection procedure that was followed in the selected schools, offices and places of employment is also discussed. The data presentation and analysis
procedures are then explained followed by, last but not least, the ethical and legal considerations to ensure voluntary and parental consent, confidentiality, and anonymity.

3.2 Research paradigm

Researchers may understand a paradigm differently. Morgan (2007) gives four versions or definitions of paradigms, namely a worldview, an epistemological stance, shared beliefs in a research field or a model example or pattern. This study adopted the fourth version whereby a research paradigm is viewed as a model or framework of shared set of assumptions about how people perceive the processes and procedures of research done in order to answer pertinent questions.

This research followed the mixed methods approach in which the quantitative paradigm dominated over the qualitative one. This was done because in the quantitative approach the study sought to quantify, describe, analyse and interpret relationships between variables (Hopkins, 2008) that affect the ‘O’ level mathematics curriculum and career aspirations of students. However, qualitative approaches and methods were also used to get in-depth understanding of those variables and to provide sound recommendations for improvement and policy formulation, if needed. Mwirira and Wamahi (1995, p. 110) point out that, “...education, as a truly human phenomenon, cannot possibly be captured in its totality by a single paradigm.” Mixed methods are also believed to generate better understanding than studies bounded by a single method (Greene, Kreider & Mayer, 2005; Cresswell, Klassen, Plano Clark & Smith, 2011). The philosophy guiding this ‘mixing of methods’ is called pragmatism which draws on employing “what works,” using diverse approaches, giving primary importance to the research problem and question, and valuing both objective and subjective knowledge (Cresswell, 2006; Morgan, 2007). These pragmatist views are also supported by Hannula (2009, p. 16) who says, “Mathematics education research uses more
elaborate methods and combines often qualitative and quantitative methods. There seems to be also a trend of increasing connectivity, researchers explicating how their research framework relates to other frameworks.” This is the paradigm or philosophical approach that this study followed.

3.3 Research design

The design of a study involves determining how the chosen method(s) will be applied to answer the research question(s). Research design is an overall plan or blueprint that explains how the research is done and how it will be accomplished (Lee, 2013). This study adopted the survey (by questionnaires and interviews) and quasi-experimental (by tests) designs in which mixed methods (quantitative and qualitative) were used to gather and analyse data. The quantitative techniques were conveniently chosen to dominate over the qualitative ones. The relationships between the variables affecting the ‘O’ level mathematics curriculum were analysed quantitatively by means of statistical tests (t and chi-square tests, correlations, regression analyses and ANOVA).

Sometimes qualitative data is difficult to justify with statistical tests, and so the quantitative data gathered from tests and rating scales were used to verify and corroborate data gathered from opinions, beliefs and suggestions of the respondents (through interviews, open ended questionnaires and focus-group discussions). Data gathered from Official Statistics and from the review of related literature (secondary data), were used to cater for the issue of triangulation in order to overcome threats to validity and reliability of the instruments (Bless & Higson Smith, 1995; Mhlanga & Ncube, 2003). It was hoped that such a design would produce authentic, valid, generalisable and reliable information relating to the mathematics curriculum and the future careers of students. Another purpose for choosing this design was
to integrate the two (quantitative and qualitative) data sources and try to provide more convincing evidence on which policymakers can base their educational choices.

3.3.1 Population

Two districts in the Midlands Province of Zimbabwe, namely Gweru and Shurugwi, were chosen for this study using convenience sampling. The population comprised mathematics teachers and pupils, parents/guardians, the mathematics education inspector (MEI), the education inspector for sciences (SCEI), District Education Officers (DEOs) in the two districts and employers in Gweru District. These are the key stakeholders in any education system although the list is not exhaustive. Midlands Province was chosen mainly because of its centrality to the country. The province has an area of 49166 square kilometres and had a population of 1.62 million in 2012, being the third largest populated province after Harare and Manicaland (ZimStat, 2012). In it we find different types of schools and pupils and parents from different ethnic, political, social and economic backgrounds.

Statistics provided by the ZIMSEC Regional Manager in Gweru show a total of 239 secondary schools in the Midlands province in 2012. In the same year, 11227 female and 9646 male students registered for ‘O’ level mathematics in the whole province. Out of these, 708 female and 802 male students passed the non-calculator version while 1313 female and 1548 male students passed the calculator version of the examination paper. In the schools we find teachers from different language backgrounds, and of different qualifications and experiences. The recommended teacher to pupil ratio at ‘O’ level is 1 to 30 (Masuko, 2003) although it is likely to be above that in most schools. Employers comprised the Government, non-governmental, parastatals, indigenous businesspeople as well as those from other countries. The advantage is that data was collected from quite a heterogeneous population that fairly represents the entire population of the country, making it possible to generalise the
results. Moreover, the education system in Zimbabwe is centralised again making it possible to generalise results from the districts to Midlands Province or to any other province in the country.

3.3.2 Sampling techniques, procedures and final sample sizes

3.3.2.1 Sampling techniques

Four sampling techniques were used in this study. These were convenience, simple random, stratified, and purposive or judgemental sampling. Convenience sampling is inexpensive because the researcher can easily and quickly select items that are readily available (Dhliwayo & Keogh, 2002). The researcher conveniently chose to carry out this study in Gweru and Shurugwi Districts in the Midlands Province (Zimbabwe) where he has worked as a secondary school teacher, teachers’ college lecturer and university programme coordinator. Since the aspect of researcher bias cannot be overruled in convenience sampling, this disadvantage was minimised using a variety of data collection methods and instruments (triangulation). Simple random sampling ensures that each unit of a population has an equal chance of being selected for inclusion in the study sample. This technique was used to select the ‘O’ level mathematics teachers at the selected schools, the students for the focus-group discussion as well as the parents of selected ‘O’ level students.

In stratified sampling the population is first divided into groups or layers called strata. The items to be selected are such that they are as heterogeneous as possible between strata and as homogeneous as possible within strata. Stratified random sampling was used to select the schools and the ‘O’ level students because schools are naturally stratified into private/government, rural/urban, day/boarding categories while students are naturally grouped in terms of high, medium and low ability. Judgmental sampling was used by each school’s mathematics head of department (HOD). The HOD is the supervisor of teachers in
his/her department and has expert knowledge of how the students perform within their different classes. To select the employers, the researcher used a combination of purposive and stratified sampling. This was done in order to get as much needed, authentic and qualitative data as possible (purposive) from a wide range of employer categories (stratified). The mathematics and sciences education inspectors are responsible for all the districts in the Midlands Province while each district education officer is responsible for his/her district and these were ‘automatically’ sampled.

3.3.2.2 Sampling procedures and sample sizes

The original plan was to use stratified random sampling with proportional allocation to select eight districts in the Midlands province involving ‘O’ level schools, rural and urban schools, government and private/mission schools, and day and boarding schools. Stratified random sampling with proportional allocation ensures that every subject in the different categories (strata) has got an equal chance of being selected (Dhliwayo & Keogh, 2002). However, due to time, logistical and resource constraints, a representative sample of secondary schools from only two districts (Gweru and Shurugwi) was chosen.

The final sample included nine schools from Gweru and five schools from Shurugwi. Furthermore, natural stratification of the schools was considered when choosing them to avoid getting the same type of school all the time. From each of the chosen 14 secondary schools twenty or more ‘O’ level students were chosen. Students of varying backgrounds and abilities were preferred to students of a particular background or ability class to avoid getting the same or ‘class-biased’ information. So the researcher, with the help of each school’s mathematics HOD identified 7 high achieving, 7 low achieving and 6 average students. The students were asked to give their perceptions, concerns and suggestions about the mathematics curriculum and their mathematics performance and anxiety levels were tested.
and rated. About 6 to 12 of these students at each school were randomly chosen and asked to participate in the focus-group discussion. At least two randomly selected ‘O’ level mathematics teachers per school were asked to complete questionnaires about the mathematics curriculum. At least two randomly selected parents/guardians per school were interviewed. These were parents/guardians of the ‘O’ level students.

District education officers in the two chosen districts were given questionnaires to complete. The mathematics and sciences education inspectors were given the same questionnaires as for the DEOs. [Education inspectors are subject specialists while DEOs are responsible for the teaching and learning of all subjects in their districts]. Eleven purposively selected employers in Gwerudistrict were categorized into government, parastatal, indigenous, and private/foreign employment sectors, and were visited and interviewed. Gweru district was also chosen for the reason that the majority of employers resided in it. So all in all, there were 285 students, 28 teachers, 28 parents, 2 subject education inspectors, 2 DEOs, and 11 employers making a total of 356 respondents and informants in the actual study sample.

3.3.3 Research instruments

A total of seven data collection instruments and one official document were used in this study. The first instrument was the official and current ‘O’ level mathematics syllabus which was critically analysed and evaluated to see if it met expectations of the stakeholders such as students and employers. Then questionnaires, interviews, ZIMSEC standardised mathematics test and mathematics anxiety rating scales were used to collect data from the stakeholders who included pupils, teachers, parents, mathematics education officers and employers. Questionnaires were used because they have the advantage that they are relatively quick, responses are gathered in a standardised way and information is collected from a large group (Milne, 1999). Rating scales of a 5-point Likert type (from strongly agree to strongly
disagree) were incorporated in the questionnaire items. Interviews and focus-group discussions were used to supplement and/or verify the questionnaire data and data from achievement tests. Focus groups are advantageous in that they have high face validity, the researcher can explore and probe the respondents for a range of views, and agreeable solutions are arrived at (Heading, 2005). Data collected using these instruments were analysed together with secondary data collected from Official Statistics such as pass rates, and employment figures.

3.3.3.1 ‘O’ level mathematics syllabus

A critical analysis of the ‘O’ level mathematics syllabus was made. This syllabus is the ZIMSEC approved syllabus for Zimbabwe General Certificate of Education (ZGCE) for examinations in November 2012-2017 coded 4008/4028. This syllabus prohibits the use of mathematical tables and electronic calculators in 4008/1 and 4028/1. “However, the efficient use of mathematical tables is expected in 4008/2 and the efficient use of electronic calculators is expected in 4028/2. In 4028/2 mathematical tables may be used to supplement the use of the calculator” (ZIMSEC, 2012, p.1). Mathematical tables are provided in the examination while candidates bring their own mathematical instruments (excluding flexi curves) and non-programmable scientific calculators. The preamble to the syllabus stipulates that it caters for those students who intend to study mathematics and/or related subjects up to and beyond ‘O’ level and for the mathematical requirements of a wide range of professions. This study sought to determine whether the syllabus met these obligations. [See Appendix A for the full syllabus].

3.3.3.2 Mathematics achievement test
This study used the ZIMSEC standardised (validity and reliability checked) ‘O’ level mathematics national examination Paper 1 (4008/1 equivalent to 4028/1) written in November 2012 to measure students’ achievement in mathematics. The mathematics achievement scores were used for investigating relationships (or correlations) with students’ mathematics anxiety and career aspirations. The ZIMSEC paper has 27 short answer questions each with two or more sub items which cover the whole syllabus and which should be completed in 2½ hours. Problems set in the test cover a wide variety of mathematical situations encompassing Arithmetic, Geometry, Algebra and Trigonometry, all of which are in the national "O" level syllabus. Students were also tested on their ability to recall and apply formulae, comprehend, measure, construct, interpret graphs, solve equations and evaluate expressions, among other skills. The researcher, the research assistants and the mathematics HOD invigilated the mathematics test. Candidates were not told in advance the nature or structure of the questions in the paper that they were asked to write, so having seen or practised the paper beforehand would have little or no impact on the results. It would be similar to having revised any other past exam paper which is the practise most ‘O’ level students normally do. The full mathematics test paper that was used can be found in Appendix K.

3.3.3.3 ‘O’ Level students’ questionnaire

The ‘O’ Level students’ questionnaire constructed by the researcher had three sections. Section A asked for the student’s bio-data including mother and father’s occupation. Section B asked for perceptions and opinions about the mathematics curriculum. Specifically, it asked for information concerning the syllabus, teaching methods, learning styles, and assessment techniques. Section C asked about mathematics anxiety and career aspirations of students. The questionnaire had structured questions of a 5-point Likert type (strongly agree to strongly
disagree) where respondents had to put a circle on their choice as well as open ended items where they would write their opinions and suggestions about mathematics teaching and learning and about their career aspirations. The students’ questionnaire can be found in Appendix B.

3.3.3.4 ‘O’ level teachers’ questionnaire

The ‘O’ level teachers’ questionnaire had Section A asking about biographical data such as gender, age, and qualifications. Section B asked about teachers’ views concerning the mathematics curriculum, especially issues to do with the syllabus, instructional methods, assessment methods, and factors affecting achievement. Like on the students’ questionnaire, the teachers were asked to circle their choice on the given list of responses from strongly agree to strongly disagree. They also wrote their opinions, perceptions and suggestions as regards aspects of the ‘O’ level mathematics curriculum on the open ended sections of the questionnaire. The teachers’ questionnaire can be found in Appendix C.

3.3.3.5 Mathematics and Sciences Education Inspectors and DEO’s questionnaire

The MEI is responsible for the monitoring, supervision and assessment of all mathematics resources, teaching, learning and staffing that take place in all districts in the Province. During the period of this study, the science education inspector was the one responsible for all science subjects (including Maths) before the new mathematics education inspector was recruited in July 2014 and therefore both had to be given the same questionnaire at different times. The district education officers had to be given the same questionnaire as for the MEI because they may not be mathematics subject specialists, but they are in charge of the supervision of all the schools (and hence the general teaching and learning of all subjects) in their districts. DEOs get their reports from school heads and often visit schools in their
districts to get first-hand information. This questionnaire for the MEI, SCEI and DEO had Section A asking for biographical data (gender, age, marital status, qualifications). Section B asked for respondent’s views about the ‘O’ level mathematics curriculum, especially the syllabus, perceptions about teachers’ instructional and assessment methods, and factors affecting achievement in mathematics. There were also open ended sections where the respondent wrote his/her general views and recommendations pertaining to the overall mathematics curriculum. This questionnaire is given in Appendix D.

3.3.3.6 ‘O’ level students’ focus-group discussions

Focus-group discussions used were of the nature where discussants could debate an issue and reach a reliable compromise. After students had filled in the questionnaire, the researcher asked them whether to have the focus-group discussions on the same day or on another day. Most students agreed that the focus-group discussions had to be conducted on the same day. On the day of the discussions, the researcher introduced himself and told discussants the purpose of the meeting. The researcher assured the discussants that the information they would provide as a group would be confidential and their names would not be recorded. The researcher and the group agreed on simple ‘house’ rules of the meeting. Students were to respect each other’s views and no answer would be treated as wrong. Questions that were asked pertained to their like/dislike of mathematics and reasons thereof, their views on how teachers were teaching them, challenges they were facing in the learning process, their feelings about employers’ requirements for passes in Mathematics, and what the government should do about mathematics teaching, learning and assessment policies. The discussions lasted between 15 and 20 minutes. The group sizes ranged from 6 to 12 discussants. A sample of questions asked in the focus-group discussions is given in Appendix E.
### 3.3.3.7 Interview schedule for parents of ‘O’ level students

Parents or guardians of the ‘O’ level students are important stakeholders in the education system because they provide financial, material and emotional support to the student. Some parents/guardians might also provide limited educational support in terms of checking and correcting homework done or arranging and paying for extra tutorials with experienced teachers. This study sought to find out, through interviews, the views of parents or guardians of the ‘O’ level students concerning why students fail mathematics, the importance of mathematics in real life and in the companies and industries. It also sought to establish parents’/guardians’ views about employers’ and government’s policies regarding ‘O’ level subject passes. Parents/guardians were also asked what they thought were the aspects to include or not to include in the curriculum and how they could assist their children to do well in mathematics. The interview schedule for parents given in Appendix F guided the researcher to explore and probe more for these issues.

### 3.3.3.8 Interview schedule for employers

Employers were included in this study to provide information to answer the second part in the research title: “How does it (the ‘O’ level mathematics curriculum) relate to the students’ career aspirations?” Eleven employers purposively selected in Gwerudistrict were visited and interviewed. The interviewer asked them to provide information with explanations on questions such as:

- how often they recruit their employees and what qualifications are considered when recruiting them,
- how many of their employees have 5 ‘O’ level passes, how many have mathematics and how many do not have mathematics,
- whether they consider the math pass to be important or not,
- whether their employees use the math knowledge in doing their jobs,
- whether employees with math passes produce more goods/services than those without math and,
- what they consider to be reasons why students fail mathematics and how companies and industries can assist.

These and other items for the employers’ interview are found in Appendix G. The relationship between students’ career aspirations and the mathematics that they do at school was inferred from the answers provided by the employers.

3.4 Triangulation, validity and reliability of instruments

This section gives brief definitions of these terms as they apply in this research and in section 3.5 the researcher discusses how triangulation was achieved and how validity and reliability of instruments were tested.

3.4.1 Triangulation

The term triangulation probably comes from the word triangle. A triangle is a plane shape with three straight sides and three angles. Therefore, this would mean using multiple (not necessarily three) sources to collect the same type of data or different types of data that answer the same research question. The same or different instruments can be used to collect these data. Describing triangulation, Bazeley (2004, pp. 3-4) says,

> It was initially conceived as the conduct of parallel (otherwise duplicated) studies using different methods to achieve the same purpose, with a view to providing corroborating evidence for the conclusions drawn, i.e. as a technique of validation (drawn from the concept of triangulation in surveying).

Triangulation can also occur at the presentation or analysis stage where multiple presentation or analysis methods are used. The main purpose of triangulation is to check on the validity,
reliability and generalisability of the data. In this study triangulation was catered for by collecting both quantitative and qualitative data from the syllabus document, students, teachers, parents, subject education inspectors, district education officers and employers. The data were presented and analysed using different methods.

3.4.2 Validity

According to Tavakol and Dennick (2011, p. 53), “Validity is concerned with the extent to which an instrument measures what it is intended to measure.” Valid data can be collected if one uses a standardized instrument or if the instrument is firstly checked for validity by an expert or a team of peers and then pilot tested with a few respondents. This ensures internal validity of the instrument. “Generalization is a matter of external validity in that it determines to what populations the study results are likely to apply.” (Confrey & Stohl, 2004, p. 132). In this study valid instruments were used because some of them (‘O’ level syllabus document and ZIMSEC examination paper) were standardised while those constructed by the researcher (questionnaires, interview schedules and focus-group schedules) were firstly peer-checked and then pilot-tested with a few respondents.

3.4.3 Reliability

An instrument is reliable if it produces consistent results when administered to the same people at different times or when used at the same time to different people. Reliability implies validity but validity does not necessarily imply reliability (Tavakol & Dennick, 2011). Reliability can be objectively measured using any of the different methods (formulae) in the literature. This study used Cronbach’s alpha (Tavakol & Dennick, 2011) to calculate the research instruments’ reliability coefficients.
How validity and reliability of instruments were tested

A pilot study to check on the validity and reliability of the research instruments was conducted in a few randomly selected schools in Gweru district. It was carried out in the second week of June 2013 and not in February 2013 as had been proposed because the researcher as a full time employee and student did not find time due to other work demands. Six secondary schools comprising government, mission/private, boarding, day, urban and rural categories in Gweru district were visited and from each of these schools six students (2 high achieving, 2 average and 2 low achieving in mathematics) and at least two teachers were selected and asked to complete the given questionnaires. The mathematics education officer for Gweru was also sampled for the pilot test. For each questionnaire the coding was as follows: male 1, female 2, age (integer as indicated), and 1 to 5 for the responses strongly disagree to strongly agree. Occupation or desired job was coded in ascending order from 0 for not employed to 12 for scientist/physicist. These figures were entered into the Statistical Package For Social Sciences (SPSS) version 16.0 and the reliability coefficient Cronbach’s alpha (α) was computed. When testing for reliability of questionnaire items in a survey, any coefficient α such that 0.7 ≤ α ≤ 1 is accepted as a good reliability indicator (Tavakol & Dennick, 2011).

The reliability correlation coefficients for the ‘O’ level students’ questionnaire were based on the mathematics anxiety, career aspirations, opinion on the syllabus, teaching and learning styles, and assessment techniques sub items. For the teachers’ questionnaire, reliability correlation coefficients were based on views on the syllabus, teachers’ instructional methods, and assessment methods sub items. For the mathematics education officer’s questionnaire, the correlations were based on their views about the syllabus, their perceptions about teachers’ instructional methods and views on assessment methods sub items.
For the ‘O’ level students’ questionnaire, Cronbach’s alpha for all the 34 items and 36 cases was initially $\alpha = 0.6452$. When the variables AGE (age of student) and CADTPA (I would not want to proceed studying math at ‘A’ level) were removed, $\alpha$ became 0.718 which is above the satisfactory minimum value of 0.7. Age would be removed in the final questionnaire since all ‘O’ level students are almost of the same age (around 16 years) while CADTPA would be rephrased.

For the teachers’ questionnaire with 12 cases and 24 items, Cronbach’s alpha was 0.6435. When TRMARRY (teacher’s marital status) and IMMESOL (math is an easy subject at ‘O’ level) were removed from the model, alpha became 0.7226 which is above the accepted level of 0.7. This meant that TRMARRY would be removed from the final teachers’ questionnaire or could just remain as one of the slack variables that can only help to identify or categorise the teacher while IMMESOL, an important variable to determine the attitude or perception of the teacher, would be rephrased or adjusted. For the MEI and SCEI, Cronbach’s alpha was 0.8090 for 2 cases and 29 items and the questionnaire would be adopted as it is.

After checking the reliability of the questionnaire items, the validity and reliability of the interview items (for parents and employers) and focus-group items (for ‘O’ level students) were then analysed and tested during discussions with colleagues and other mathematics teachers and finally checked by the research supervisor. These reviewers agreed that the instruments were effective in measuring what they were supposed to measure. The students also agreed that the questionnaire was clear, readable, and understandable. All reliability correlation coefficients were large and positive (>0.7). On the whole, all the research instruments were considered to be generally reliable and valid and the data collection process could commence.

3.6 Trustworthiness and credibility of results
Gray (2009, p.194) says that some researchers believe truthfulness or ‘trustworthiness’ to be “...more important than concerns over the validity or reliability checks....” This might relate more to qualitative than quantitative research. Flick (2006) considers credibility as referring to accurateness, reliability and freedom from distortion. Credibility again might be a criterion of qualitative research more than it is considered in quantitative research. Since this study employed the mixed methods approach, it might be prudent also to discuss the procedures that were made to increase the credibility and trustworthiness of the results.

The researcher increased credibility through the following ways:

1. There was persistent engagement with the respondents, interviewees and participants during the administration of the questionnaires, interviews and focus group discussions. The researcher explained some terms on the questionnaire items which the respondents could not understand. During the interviews the researcher probed for further explanations on issues which were not very clear. The researcher also used triangulation of different methods and research instruments. Two research assistants helped the researcher to collect data which the researcher cross-checked.

2. Peer-debriefing- This was achieved through regular electronic mail and face-to-face communication with the research supervisor. The researcher also held some informal meetings with workmates who were not directly involved in the research. During these meetings research instruments were scrutinized while all stages of the research as well as the actual data collected were discussed. This was done in order to disclose any blindspots of the researcher.

3. The researcher analysed negative cases as well as positive cases in all the collected data so as to come up with holistic answers to the research questions.

Trustworthiness of the results was addressed through:
Transferability - where the researcher used purposive sampling to make sure that the collected information would correlate with or ‘fit’ the respondents who had given the data and generalization to a similar wider population would be possible.

Dependability - The researcher used and kept audit trails (in soft and hard copy format) for all the data collected. The audit trails are accessible from the researcher upon request.

Confirmability - In this write up, the researcher tried to show connections between the data and his own interpretations. The steps of this study can be confirmed or replicated.

3.7 Data collection procedure

Firstly, the researcher collected data during the pilot study and used it to test validity and reliability of the instruments and cross-checked these using expertise and input from the supervisor. The researcher then solicited help from two assistants who would help in the administration of the tests, distribution and collection of the questionnaires and conducting the interviews and focus-group discussions. These assistants were qualified mathematics teachers who were somehow familiar with the research problem or topic. Focus-group discussions were carried out with a few randomly selected “O” level students after they had completed the questionnaires. Face to face interviews were separately carried out with parents and employers and the data were video-taped and also transcribed by hand to take care of any inaudible or non-verbal responses. Statistical information on previous figures was collected from the regional centre in Gweru.

3.8 Data presentation, analysis and interpretation procedures
Qualitative data from interviews and questionnaires were analysed question by question. Similarities or differences between different questions were noted and emerging themes or ideas identified and noted. Findings were compared with those from any previous similar research and from Review of Related Literature. For quantitative data, SPSS version 16.0 was used to perform t-tests, chi-square tests, correlations, regression analyses and ANOVA. Data found from tests (measuring students’ performance) and questionnaires and rating scales (measuring mathematics anxiety, attitudes and perceptions about the curriculum) were compared with data from previous statistics (e.g. pass rates, employment figures etc.). The ‘O’ level mathematics curriculum (e.g. syllabus document) was critically examined and their relationships with or impact on the field of work critically analysed. The advantage of using such a methodology was that unclear or questionable figures or opinions would be verified by data from other sources within the same study. Quantitative data also had the advantage that hypotheses could be statistically tested and results could be generalised to a wider population (Johnson & Onwuegbuzie, 2004).

For the analysis of focus-group data, Green (2006) says:

Reliability (consistency of findings) and validity (accuracy of information) are important factors to consider in the process of data analysis. Two of the most useful tools for addressing them when analyzing focus-group data are:

1) Coding Teams – researchers code the same data and discuss their findings. Similarities and differences between results are assessed.

2) Participant Validation – researchers take findings and analysis back to the participants and ask them to review the work and provide feedback.

The most important element of analyzing qualitative data, including data obtained from focus groups, is to THINK! (Green, 2006, slide No 7)

In this study, Green’s item 2 as indicated above was not carried out because the researcher did not consider it necessary and prudent to go back to ‘disturb’ the students; an event which
could likely take more of their study time and cause them some examination anxiety. Thus after careful “THINKING” analysis was done basing on item 1 as indicated above.

3.9 Handling of ethical and legal issues

The researcher handled the relevant ethical and legal implications in the following ways:

(a) The researcher visited the offices of the Ministry of Education, Sport, Arts and Culture (now Ministry of Primary and Secondary Education) in the Midlands province in February 2013 and discussed with the Education Officer for Professional Administration and Legal Services, the purpose and objectives of the research. He agreed to assist by providing the schools list, ‘O’ level enrolment figures and pass rates. Through the ZOU Midlands Regional Director, a formal application for the Ministry of Education permit to conduct research in the selected schools was made and addressed to the Provincial Education Director. This application letter stated that the researcher was a lecturer employed by Zimbabwe Open University and was also a DPhil candidate conducting research on the ...(research topic) and that he needed cooperation and assistance. The application for the permit to conduct research in the selected schools and district offices was granted by the Midlands Provincial Education Director on 15 May 2013 (see Appendix H for the terms and conditions of the permit),

(b) The researcher explained to the respondents the significance of the study and contributions it would make to the overall education system, before administering the instruments,

(c) The researcher asked the respondents to respond willingly, truthfully and objectively and told them that they were free to withdraw at any given time,
(d) The researcher assured the respondents that their rights of confidentiality, anonymity, freedom of choice and expression would be adhered to,

(e) The researcher got consent from parents/guardians for pupils under 18 years old from the school authorities who were acting in loco parentis,

(f) The researcher also got another letter from his employer on 4 July 2013 confirming “to whom it may concern” that he was a ZOU DPhil candidate who was conducting research on the ...(research topic) and that he needed their cooperation and assistance. The researcher used this letter to get entrance into the premises of the sampled companies/employers. The researcher would like to thank the employers/company representatives for willingly supplying the required information during the interview process. Their names, unfortunately, cannot be revealed here because of the agreement that was made not to reveal confidential company information or their names (see Appendix I).

3.10 Chapter summary
Research methodology is what shapes research and it is guided by the researcher’s model example or philosophical worldview. This model allows the researcher to follow a specific pattern or ‘mix patterns’ in an attempt to find the best solution(s) to the research problem(s). Although there is debate on whether Mixed Methods can be called a research paradigm or a methodology, this study employed this approach because of its strengths which are to develop a complementary picture, to compare results (Cresswell et al., 2011), to combine depth with breadth and validate data through triangulation (World Bank Institute, 2007). The design of this study was to combine and integrate both quantitative and qualitative data gathering techniques and analysis procedures in an effort to try and find valid and reliable evidence for
or against mathematics curriculum review, its relationships with career aspirations of students and possible mathematics policy formulation. Open ended and structured questionnaires, rating scales, tests, interviews and focus-group discussions were used to gather data for comparison, triangulation and testing assumptions. Statistical software package SPSS version 16.0 was used for quantitative data analysis while video/audio media and hand transcription methods were used to capture qualitative data which would be analysed using question by question, theme generation, and documentary analysis methods.

This chapter has described and explained the research paradigm and methodology for this study. The design or plan of the procedures and processes used were articulated. A total of 6 data gathering instruments constructed and used by the researcher were explained and their validity and reliability discussed. The seventh instrument used to test students’ achievement in ‘O’ level mathematics was the standardised ZIMSEC past examination paper for the year 2012. The ‘O’ level mathematics syllabus currently in use in the schools was discussed and this would be qualitatively analysed. The researcher was guided by Kirkpatrick’s 4 level evaluation model and the EWP model as the critical analysis of the ‘O’ level mathematics curriculum and its interrelationships with students’ career aspirations were carried out. The researcher took cognisance of the limitations of the study and was cautious of them when making recommendations. The next chapter (4) presents, analyses and discusses the data and the emanating results.
CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, AND INTERPRETATION

4.1 Introduction

The major objectives of this study were to find out whether and to what extent the ‘O’ level mathematics curriculum relates to the students’ career aspirations and also to investigate the strengths and weaknesses of this curriculum. Data obtained would lead to recommendations on how to review the ‘O’ level mathematics curriculum. Cobb and Jackson (2008) have highlighted the consequences of relying on research conducted using a single methodology when developing recommendations for policy and practice, namely that it negatively affects the quality and usefulness of the recommendations. To overcome such negative effects, data were collected using both quantitative and qualitative approaches as
was explained in chapter 3. A total of eight instruments were used, viz, one (‘O’ Level Mathematics Achievement Test) was used to collect quantitative data, four (syllabus document, two interview guides and a focus group-discussion guide) were used to collect qualitative data and three (students’, teachers’ and MEI’s questionnaires) were used to collect a mixture of quantitative and qualitative data, although much of the data was quantitative.

In this chapter, data from these various data gathering procedures are presented, analysed and interpreted. The following section (4.2) will discuss the presentation, processing, analysis and interpretation of quantitative data, the next section (4.3) will focus on qualitative data and the last section (4.4) will give a synopsis of the two data types and how they link with secondary data collected from a review of related literature and from official (government) statistical agents such as the Zimbabwe National Statistics Agency (ZimStat).

4.2 Quantitative data

4.2.1 Quantitative data processing

The data processing method that was used during the pilot survey, a study whose results have been published in a research journal (Chirume & Chika, 2014) was employed again with slight variations during the main study.

From the students’, teachers’, the MEI, SCEI and DEO’s questionnaires, 51 variables were created, coded and entered onto SPSS 16.0 as follows:

1. DISTRICT (district in which school is located): Gweru 1, Shurugwi 2,
2. LOCATION (geographical location of the school): Urban 1, Rural 2,
3. OWNER (ownership of the school): Government 1, Mission/Private 2,
4. SCHTYP (type of the school): Boarding 1, Day 2,
5. LEVEL (level of the school by having both ‘O’ and ‘A’ levels or up to ‘O’ level only): 6th form 1, No 6th form 2, [The variable LEVEL was created because it was observed that there seemed to be a difference in terms of quality of resources (eg textbooks) and teacher's qualifications and experiences between schools having forms 1 to 4 classes and those having forms 1 to 6 classes. Here the code 2 for "no 6th form" meant those schools with classes ending at form 4 level],

6. STDSEX (gender of the student): Male 1, Female 2,

7. STDAGE (age of the student in years): exact numerical value was entered,

8. FROCC (father’s occupation): occupations were coded in ascending order of prestige, esteem or remuneration from passed away/not entered (0), unemployed (1), self-employed (2), factory worker (3) right up to scientist/physicist (13),

9. MROCC (mother’s occupation): similarly coded as of father’s occupation,

10. STDSYLB (students’ views on the mathematics syllabus): most favourable (4-9), mixed (10-15), least favourable (16-20),

11. STDTCCHM (student’s views about teaching and learning styles): positive (7-16), mixed (17-26), negative (27-35),

12. STDASSTECH (student’s views about assessment techniques): most favourable (5-11), mixed (12-18), least favourable (19-25),

13. STDMA(student’s mathematics anxiety): low anxiety (9-21), moderate anxiety (22-33), high anxiety (34-45),

14. STDCASP (student’s career aspirations): low (4-9), moderate (10-15), high (16-20),

15. STDJOBALS (student’s desired job after leaving school): the same coding as
used for FROCC and MROCC,

16. STDACHV (student’s mathematics achievement score): Low (0-40 marks), Average (41-60 marks) and High (61-100 marks).

17. TRSEX (gender of the teacher): Male 1, Female 2,

18. TRAGE (age range of the teacher in years): Below 20 (1), 20-30 (2), 31-40(3), 41-50 (4), 51-60 (5), Above 60 (6),

19. TRQUAL (teacher’s qualifications): “O” level only (1), “A” level (2), Diploma/Certificate (3), Bachelors’ degree (4), Masters’ degree (5), Any other higher qualification (6),

20. TRMARRY (teacher’s marital status): Single 1, Married 2, Widowed 3, Divorced 4, Separated 5,

21. TRSYLB (teacher’s views about the syllabus): positive (10-18), mixed (19-29), negative (30-40),

22. TRINMTDS (teacher’s views about instructional methods): positive (7-16), mixed (17-26), negative (27-35),

23. TRASSMTDS (teacher’s views about assessment methods): positive (5-11), mixed (12-18), negative (19-25).

[There were 7 teacher variables assigned for the first teacher (TR1) and the second teacher (TR2) bringing the total number of variables to 30].

31. MEISEX (gender of the mathematics education inspector): Male 1, Female 2,

32. MEIAGE (age range of the MEI in years): Below 20 (1), 20-30 (2), 31-40 (3), 41-50 (4), 51-60 (5), Above 60 (6),

33. MEIQUAL (MEI’s qualifications): “O” level only (1), “A” level (2), Diploma/Certificate (3), Bachelors’ degree (4), Masters’ degree (5), Any other higher qualification (6),

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34. MEIMARRY (MEI’s marital status): Single 1, Married 2, Widowed 3, Divorced 4, Separated 5,

35. MEIVSYLB (mathematics education inspector’s views about the syllabus): positive (11-26), mixed (27-42), negative (43-55),

36. MEIVTRINMTDS (mathematics education inspector’s views about the teacher’s instructional methods): positive (8-18), mixed (19-29), negative (30-40),

37. MEIVASSMTDS (mathematics education inspector’s views about assessment methods): positive (6-14), mixed (15-22), negative (23-30).

Seven variables similar to those of the MEI were coded for the SCEI and the DEOs, making a sub total of 14 variables and a grand total of 51 variables. No formula was used to come up with the categories of ratings such as 6-14, 15-22 etc. The researcher used his discretion and borrowed ideas from Quilter and Harper (1988, p.124) who say that, ”There is, however, no theory which can provide the `upper boundary' of this score below which one might conjecture `negative attitude’.”

4.2.2 Quantitative data presentation and analysis

Table 4.1 gives the frequencies and percentages of students in the various categories.

Table 4.1: Frequencies and percentages of students by gender and school categories (% rounded off)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISTRICT:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gweru: 1</td>
<td>83 (29.1)48 (16.9)131 (46.0)</td>
<td>107(37.5)47 (16.5)154 (54.0)</td>
<td>190 (66.6)95 (33.4)285 (100)</td>
</tr>
<tr>
<td>Shurugwi: 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>190 (66.6)95 (33.4)285 (100)</td>
<td>190 (66.6)95 (33.4)285 (100)</td>
<td></td>
</tr>
<tr>
<td>LOCATION:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban: 1</td>
<td>57 (20.0)74 (26.0)131 (46.0)</td>
<td>67 (23.5)87 (30.5)154 (54.0)</td>
<td>124 (43.5)161 (56.5)285 (100)</td>
</tr>
<tr>
<td>Rural: 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>124 (43.5)161 (56.5)285 (100)</td>
<td>124 (43.5)161 (56.5)285 (100)</td>
<td></td>
</tr>
<tr>
<td>OWNER:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government: 1</td>
<td>121 (42.5)10 (3.5)131 (46.0)</td>
<td>115 (40.3)39 (13.7)154 (54.0)</td>
<td>236 (82.8)49 (17.2)285 (100)</td>
</tr>
<tr>
<td>Mission: 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.1 shows that there were more female than male students in all of the categories except in Shurugwi district and at the “No 6th form” level where the numbers of male and female were more or less the same. The majority of the secondary schools in both districts are owned by the Government which has endeavoured to upgrade most of the schools in the rural areas to 6th form status. The researcher got responses from nine schools in Gweru and five in Shurugwi districts. Eighteen male and 10 female mathematics teachers responded to the questionnaires.

Table 4.2 gives further statistics for the demographical data for the teachers.

| Table 4.1: Gender distribution of school students |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| SCHTYP: Boarding: Day: 2 Total  | 53 (18.6)78 (27.4)131 (46.0) | 72 (25.2)82 (28.8)154 (54.0) | 125 (43.8)160 (56.2)285 (100) |
| LEVEL: 6th Form: 1 No 6th Form: 2 Total | 102 (35.8)29 (10.2)131 (46.0) | 127 (44.5)27 (9.5)154 (54.0) | 229 (80.3)56 (19.7)285 (100) |

| Table 4.2: Showing mean, standard deviation and skewness (SK) for teachers’ bio-data |
|--------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| TR1QUAL | TR2QUAL | TR1AGE | TR2AGE | TR1MARRY | TR2MARRY |
| Mean     | 3.9825 | 3.5614 | 2.9404 | 3.1754 | 1.9474 | 1.8596 |
| Std. Dev | 0.39767 | 0.49709 | 0.71203 | 0.94053 | 0.47549 | 0.34796 |
| SK       | -0.144 | -0.249 | 0.087 | 0.154 | -0.159 | -2.082 |

The teacher qualification mean ratings of 3.9825 and 3.5614 show that the majority of teachers (71.5%) had a bachelor’s degree, few (25%) had Diploma/Certificate in education only, one (TR1) had a masters’ degree(3.5%) while none had ‘O’ or ‘A’ levels only. The majority of TR1 respondents were in the age range 31-40 years while the TR2 respondents’ age range was 41-50 years. The marital ratings (1.947 and 1.8596) show that most of the
teachers were married (82.2\%) and a few (14.3\%) were single. None indicated that they were divorced or separated while one (TR1) indicated that she was widowed (3.5\%). The age and qualifications may help to show the maturity and expertise of the teachers while divorced and separated teachers may depict certain marital problems which they may carry with them to the classrooms. However, no teacher indicted that their marital status was affecting their teaching in any way. Negative skewness shows that most scores were concentrated to the left of the mean while positive skewness indicates that the majority of the scores were concentrated to the right of the mean.

Table 4.3 gives the descriptive statistics for some variables for the students, teachers, parents’ occupations and the education officers (MEI, SCEI and DEO).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>STDAGE</td>
<td>16.5822</td>
<td>1.0722</td>
</tr>
<tr>
<td>FROCC</td>
<td>4.0702</td>
<td>3.1737</td>
</tr>
<tr>
<td>MROCC</td>
<td>3.3053</td>
<td>2.7924</td>
</tr>
<tr>
<td>STDSYLB</td>
<td>12.1053</td>
<td>3.5697</td>
</tr>
<tr>
<td>STDTCMH</td>
<td>16.6807</td>
<td>3.8902</td>
</tr>
<tr>
<td>STDASSTECH</td>
<td>13.3579</td>
<td>3.7536</td>
</tr>
<tr>
<td>STDCASP</td>
<td>16.5579</td>
<td>2.9790</td>
</tr>
<tr>
<td>STDJOBALS</td>
<td>8.5158</td>
<td>2.8304</td>
</tr>
<tr>
<td>TR1SYLB</td>
<td>26.4211</td>
<td>4.2470</td>
</tr>
<tr>
<td>TR2SYLB</td>
<td>25.9614</td>
<td>4.6500</td>
</tr>
<tr>
<td>TR1INMTDS</td>
<td>19.6842</td>
<td>93.9857</td>
</tr>
<tr>
<td>TR2INMTDS</td>
<td>18.0702</td>
<td>3.0570</td>
</tr>
<tr>
<td>TR1ASSMTDS</td>
<td>18.2456</td>
<td>2.7016</td>
</tr>
<tr>
<td>TR2ASSMTDS</td>
<td>16.4386</td>
<td>2.4825</td>
</tr>
<tr>
<td>MEI/SCEI/DEO/VSYLB</td>
<td>32.2500</td>
<td>11.3200</td>
</tr>
<tr>
<td>MEI/SCEI/DEO/VTRINMTDS</td>
<td>27.7500</td>
<td>6.5511</td>
</tr>
<tr>
<td>MEI/SCEI/DEO/VASSMTDS</td>
<td>21.7500</td>
<td>6.7515</td>
</tr>
</tbody>
</table>
Table 4.3 shows that the average age of the students was 16.5822 years. It is interesting also to note that the youngest student was 14 years old, the oldest was 21 years old and the majority of older students were learning in rural schools while the majority of younger ones were in urban schools. The average ‘father’s occupation’ for the students was 4 (SPSS output 4.0702 and slightly above the categories of driver, typist, secretary, but below nurse, senior clerk, agricultural officer), while the average ‘mother’s occupation’ was 3 (SPSS output 3.3053 and at factory worker, rural/peasant farmer, security guard level). Only two students had the highest ‘father’s occupation’ level of 12 (doctor) while 10 students indicated the highest ‘mother’s occupation’ level of 9 (lecturer, businessman, director). It is interesting to note that the majority of the students themselves did not like their parents’ current jobs since they indicated an average ‘job after leaving school’ (STDJOBALS) level of slightly above 8 (i.e., they would like to be managers, accountants, economists, etc.), and they also had very high career aspirations (16-20 category). Low levels of parents’ occupation as depicted in Table 4.3 can negatively affect the student’s motivational level or career aspiration (Wairimu, 2012), and hence students’ mathematics achievement may also be affected.

Most students had mixed to favourable views about the syllabus, mixed to negative views about teaching and learning styles and mixed to least favourable views about assessment techniques. These negative views concerning assessment issues are a pointer to the authorities suggesting the need for a new and complete assessment system in the light of the recent ZIMSEC mathematics examination paper leakages and the fact that students were to re-sit the papers (The Herald, 12 November 2014), a situation that could lead to psychological and financial stress, anxiety and more failure.
The teachers on one hand, had mixed to negative views about the syllabus, mixed views about the teacher’s instructional methods and mixed to negative views about assessment methods with TR1 being more dissatisfied than TR2. None had favourable views. On the other hand, the MEI, SCEI and DEOs also had mixed views about the syllabus, mixed to negative views about teachers’ instructional methods and mixed to negative views about the assessment methods. None of these education officers had favourable views about the mathematics curriculum. In comparison, the teachers’ and education officers’ ratings which ranged from ‘mixed’ to ‘negative’ were somehow equivalent. One could therefore infer that the mathematics syllabus, the assessment techniques and the general teaching and learning of mathematics are somehow amiss and need to be rectified.

It may be interesting to compare the students’ career aspirations, mathematics achievement scores, anxiety scores, views on the syllabus, views on teaching and styles and views on assessment techniques by district, gender, location, school type, ownership and level. Table 4.4 gives descriptive statistics for career aspirations, mathematics achievement and mathematics anxiety.

Table 4.4: Showing students’ career aspirations, mathematics achievement and anxiety scores by gender of student and teacher and by school categories

<table>
<thead>
<tr>
<th></th>
<th>STDCASP: For Entire Sample, min=5, max=20</th>
<th>STDACHV: For Entire Sample, min=0, max=90</th>
<th>STDMA: For Entire Sample, min=9, max=40</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean SD</td>
<td>Mean SD</td>
<td>Mean SD</td>
</tr>
<tr>
<td>Female Student: 2</td>
<td>16.3053 2.8740</td>
<td>40.3130 23.4774</td>
<td>22.7176 6.1710</td>
</tr>
<tr>
<td>Male TR1: 1</td>
<td>16.6354 3.0258</td>
<td>36.7293 2.3626</td>
<td>23.0939 6.5275</td>
</tr>
<tr>
<td>Female TR1: 2</td>
<td>16.4231 2.9053</td>
<td>45.1058 2.2652</td>
<td>22.9712 5.8084</td>
</tr>
<tr>
<td>Male TR2: 1</td>
<td>17.1618 2.7316</td>
<td>41.2197 2.1645</td>
<td>22.4566 6.6415</td>
</tr>
<tr>
<td></td>
<td>15.6250 3.1139</td>
<td>37.5714 2.6248</td>
<td>23.9643 5.5376</td>
</tr>
</tbody>
</table>
The average mathematics achievement score out of 100 was 39.7860 with a lowest mark of 0 (scored by 7 students), a highest mark of 90 (scored by one student) and a modal mark of 3 (scored by 8 students). Of the students, 48.8% performed in the low achievement range of 0-40 marks, 27% were in the ‘average achievement’ range of 41-60 marks while 24.2% were high achievers in the mark range of 61-90 marks. These figures agree with the statistics of high failure rate (cited in the literature and in Table 1.1). Table 4.4 also shows that male students performed better than their female counterparts in the mathematics test and were less mathematically anxious agreeing with the generally held belief that mathematics is a male domain in African countries (Ottevanger, van de Feiter & de Akker, 2007) and elsewhere (Sankowsky, 2008). Boarders were also better performers than day scholars but ironically suffered more from mathematics anxiety. Urban students out-performed rural students and mission/private school students performed better than government school students despite being more mathematically anxious. Students at a 6th form school performed better than those at a school without 6th form while Gweru district students performed better than those in Shurugwi district. Table 4.4 also shows that all students had high career aspirations ranging from a low of 15.1964 (for students at schools without 6th form level) to a high of 17.7340
(for students at mission or private schools). Girls had slightly higher career aspirations than boys. These results imply that there may be need for those students at the less privileged or disadvantaged schools to be guided by career counsellors so that their aspirations are raised. It could also be that students at schools with 6th form level and those at mission schools might be having better ‘career role models’ to copy or envy. But whether these differences were statistically significant or not will be discussed later in the t-tests and ANOVA tests.

Table 4.5 gives descriptive statistics for students’ views on the syllabus, teaching and learning styles and assessment techniques by gender of the student, and by type, location, ownership and level of the school.

Table 4.5 Showing students’ views on the syllabus, teaching and learning styles and assessment techniques by gender of student and by school categories

<table>
<thead>
<tr>
<th></th>
<th>STDSYLB: For Entire Sample, min=4, max=20</th>
<th>STDTCHM: For Entire Sample, min=6, max=29</th>
<th>STDASSTECH: For Entire Sample, min=5, max=25</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean SD</td>
<td>Mean SD</td>
<td>Mean SD</td>
</tr>
<tr>
<td>Male Student: 1</td>
<td>12.4580</td>
<td>3.7729</td>
<td>16.3130</td>
</tr>
<tr>
<td>Female Student: 2</td>
<td>11.8052</td>
<td>3.3705</td>
<td>16.9935</td>
</tr>
<tr>
<td>Male TR1: 1</td>
<td>11.7459</td>
<td>3.6334</td>
<td>16.8674</td>
</tr>
<tr>
<td>Female TR1: 2</td>
<td>12.7308</td>
<td>3.3825</td>
<td>16.3558</td>
</tr>
<tr>
<td>Male TR2: 1</td>
<td>11.6936</td>
<td>3.6717</td>
<td>16.4624</td>
</tr>
</tbody>
</table>
Table 4.5 shows that although all students had mixed views about the syllabus, those at schools without 6th form level had the highest score of 13.4286 (having more negative or unfavourable views) while those in urban schools had the least score of 11.5403 (implying somewhat more favourable views than those scoring 13.4286). Perhaps teachers in urban schools interpret the syllabus with their children more often than teachers in rural schools most of which do not have 6th form levels. Similarly, students at ‘no 6th form’ rural schools had more negative views about teaching and learning styles ascompared to their counterparts in urban schools. However, students at mission schools topped the list for having the most negative or unfavourable views about assessment techniques (with a score of 15.0102) while those at day schools could be viewed to have less negative views about assessment techniques (a score of 12.5312). Thus one may infer that assessment of students’ work is lax or is not being done well at the private/mission schools while teaching and learning techniques need to be improved at the rural and day schools. Nevertheless, the reasons why these differences and patterns emerged in the distribution of the mean scores could not be established from the quantitative data in this study but one can only infer them from the qualitative data from the questionnaires, interviews and focus group discussions.
4.2.3 Some Statistical tests and interpretation of findings

Pearson’s product moment correlation coefficients were computed using SPSS 16.0 to find out if there were any significant relationships between student, teacher, and the education officers’ variables and how they could help to explain students’ mathematics anxiety, mathematics achievement and career aspirations. Table 4.6 gives a summary of only the significant correlations (at \( \alpha \leq 0.05 \)).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Correlation (r)</th>
<th>2 tailed sig. level (p ( \leq \alpha ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>STDACHV and STDMA</td>
<td>-0.401</td>
<td>0.000</td>
</tr>
<tr>
<td>STDACHV and STDCASP</td>
<td>0.316</td>
<td>0.000</td>
</tr>
<tr>
<td>STDACHV and STDJOBALS</td>
<td>0.356</td>
<td>0.000</td>
</tr>
<tr>
<td>STDACHV and STDSYLB</td>
<td>-0.283</td>
<td>0.000</td>
</tr>
<tr>
<td>STDACHV and STDTCCHM</td>
<td>-0.343</td>
<td>0.000</td>
</tr>
<tr>
<td>STDACHV and FROCC</td>
<td>0.248</td>
<td>0.000</td>
</tr>
<tr>
<td>STDACHV and MROCC</td>
<td>0.189</td>
<td>0.001</td>
</tr>
<tr>
<td>STDACHV and TR1QUAL</td>
<td>-0.386</td>
<td>0.000</td>
</tr>
<tr>
<td>STDACHV and TR2QUAL</td>
<td>0.230</td>
<td>0.000</td>
</tr>
<tr>
<td>STDACHV and TR2INMTDS</td>
<td>0.289</td>
<td>0.000</td>
</tr>
<tr>
<td>STDMA and STDSYLB</td>
<td>0.415</td>
<td>0.000</td>
</tr>
<tr>
<td>STDMA and STDTCCHM</td>
<td>0.550</td>
<td>0.000</td>
</tr>
<tr>
<td>STDMA and STDCASP</td>
<td>-0.294</td>
<td>0.000</td>
</tr>
<tr>
<td>STDMA and STDASSSTTECH</td>
<td>0.620</td>
<td>0.000</td>
</tr>
<tr>
<td>STDMA and TR1ASSMTDS</td>
<td>0.137</td>
<td>0.021</td>
</tr>
<tr>
<td>Variable Combination</td>
<td>Correlation</td>
<td>Significance</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------</td>
<td>--------------</td>
</tr>
<tr>
<td>STDJOBALS and TR1ASSMTDS</td>
<td>-0.336</td>
<td>0.000</td>
</tr>
<tr>
<td>STDCASP and TR2ASSMTDS</td>
<td>-0.116</td>
<td>0.050</td>
</tr>
<tr>
<td>STDJOBALS and TR2INMTDS</td>
<td>0.199</td>
<td>0.001</td>
</tr>
<tr>
<td>STDSYLB and STDTCHM</td>
<td>0.429</td>
<td>0.000</td>
</tr>
<tr>
<td>DISTRICT and STDSYLB</td>
<td>0.169</td>
<td>0.004</td>
</tr>
<tr>
<td>OWNER and STDCASP</td>
<td>0.180</td>
<td>0.002</td>
</tr>
<tr>
<td>LEVEL and STDCASP</td>
<td>-0.226</td>
<td>0.000</td>
</tr>
<tr>
<td>LEVEL and STDJOBALS</td>
<td>-0.297</td>
<td>0.000</td>
</tr>
<tr>
<td>STDMA and DEOVSYLB</td>
<td>0.229</td>
<td>0.000</td>
</tr>
<tr>
<td>STDACHV and DEOVSYLB</td>
<td>-0.546</td>
<td>0.000</td>
</tr>
<tr>
<td>STDSYLB and DEOSYLB</td>
<td>0.177</td>
<td>0.003</td>
</tr>
<tr>
<td>STDSYLB and TR2SYLB</td>
<td>-0.122</td>
<td>0.039</td>
</tr>
<tr>
<td>TR1SYLB and DEOVSYLB</td>
<td>-0.162</td>
<td>0.006</td>
</tr>
<tr>
<td>TR2SYLB and DEOVSYLB</td>
<td>0.172</td>
<td>0.004</td>
</tr>
<tr>
<td>TR1ASSMTDS and DEOVASSMTDS</td>
<td>0.486</td>
<td>0.000</td>
</tr>
<tr>
<td>TR1INMTDS and DEOVTRINMTDS</td>
<td>0.124</td>
<td>0.037</td>
</tr>
</tbody>
</table>

The other remaining variables were not significantly correlated and were therefore not entered in the table for analysis. It can be noted from Table 4.6 that there was a moderate to large positive correlation coefficient of $r=0.620$ between STDMA (students’ mathematics anxiety) and STDASSTECH (students’ views on assessment techniques), and $r=0.550$ between STDMA and STDTCHM (students’ views on teaching methods), meaning that as the students’ views on assessment techniques and teaching methods become more negative or unfavourable, their mathematics anxiety also increases. The more their mathematics anxiety, the less their mathematics achievement as indicated by $r=-0.401$. As the students’ mathematics achievement increases or improves, so becomes their career aspirations and the level of the job they would like to do after leaving school ($r=0.316$ and $r=0.356$ respectively).

As the teacher improves his/her qualifications, it is expected that his/her students would also improve their performance as indicated by the positive correlation of $r=0.230$ between TR2QUAL and STDACHV. Although the teachers coded TR1 had less qualifications than those coded TR2, there was an unexpected negative correlation of $r=-0.386$ between TR1QUAL and STDACHV. There should have been a positive correlation since it is expected that the higher or better the teacher’s qualifications, the better should be his/her
students’ performance.

Further analysis revealed that students in Shurugwi district had less favourable views about the syllabus than those in Gweru district \((r=0.169)\) implying that perhaps teachers in Shurugwi (where there were more rural and day schools) rarely have time for syllabus interpretation with their students. Students at mission schools had higher career aspirations than those at government schools \((r=0.180)\). Students at 6th form schools also had higher career aspiration and STDJOBALS scores than those at schools with “O” level only \((r=-0.226\) and \(r=-0.297\) respectively). Hence there could be need for a career guidance counsellor to be stationed at the poorly resourced schools where the students are low achievers and the teachers are less qualified.

The values for MEI and SCEI variables were constant since these officers work for all the districts in the province. Hence no correlations between the MEI and SCEI variables and the other variables could be computed. However, for the two district education officers, their views on the syllabus negatively correlated with STDACHV \((r=-0.546, p=0.000)\) and positively correlated with STDMA \((r=0.229, p=0.000)\). There were significant positive correlations between the district education officers and the first teachers’ (TR1) views regarding instructional and assessment methods \((r=0.124, p=0.037\) and \(r=0.486, p=0.000\) respectively). However, the DEOs’ views on the syllabus positively correlated with those of TR2 \((r=0.172, p=0.004)\) but surprisingly negatively correlated with those of TR1 \((r= -0.162, p=0.006)\). Views of students about the syllabus were positively correlated with views of the DEOs \((r=0.173)\) but surprisingly negatively correlated with those of TR2 \((r=-0.122)\). This means that different teachers and education officers may view the same syllabus differently. DEOs may be excused since they are not necessarily mathematics subject specialist but as for the teachers, the researcher suggests that they should undergo some training so that they
would interpret the syllabus in the same way. The way teachers interpret the syllabus may have an effect on the way their students understand and accept that syllabus as “their syllabus” to be implemented.

In order to examine the variability in achievement, mathematics anxiety, career aspirations and students’ views on the curriculum (syllabus, teaching/learning methods and assessment methods), and possibly to come up with a mathematical model that could best fit the data, both linear and non-linear regression analyses (and ANOVA) were carried out one by one. Since there is no clear evidence as to whether attitude towards mathematics (which includes anxiety and unfavourable views) is a cause or effect of achievement (Ma, 1997; Hensel & Stephens, 1997), the researcher can decide which can become the dependent and which may become the independent variables. Tables 4.7 to 4.11 show the B, Beta, T and levels of significance (Sig T) when all variables had been entered in the multiple linear regression equation(s) with STDACHV, STDMA, STDSYLB, STDCASP, and STDJOBALS as the dependent variables. [Variables with significant levels of α > 0.05 were removed from the models]. The B values are the coefficients of the variables in the equation whereas the Beta values represent the standardized slopes or coefficients. T is the significance test statistic. For example, the Betacoefficient for STDMA (-0.275) means that if anxiety is reduced by one unit, then achievement would be increased by 0.275 units or about 27.5% provided other variables are held constant.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>B</th>
<th>Beta</th>
<th>T</th>
<th>Sig T</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHTYP</td>
<td>18.221</td>
<td>0.384</td>
<td>7.198</td>
<td>0.000</td>
</tr>
<tr>
<td>LEVEL</td>
<td>-50.424</td>
<td>-0.852</td>
<td>-13.087</td>
<td>0.000</td>
</tr>
<tr>
<td>STDTCHM</td>
<td>-0.805</td>
<td>-0.133</td>
<td>-2.669</td>
<td>0.008</td>
</tr>
<tr>
<td>STDASSTTECH</td>
<td>1.023</td>
<td>0.163</td>
<td>2.963</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Table 4.7: Multiple linear regression analysis with STDACHV as dependent variable
Table 4.7 shows that there were three levels of variables or factors affecting students’ achievement. These were the school variables (level and type of school), the teacher variables (age, qualifications and marital status) and the student variables (mathematics anxiety, career aspirations, views on assessment techniques and views on teaching and learning methods). The model explained 56.9% of the variability in achievement (F=40.29, p=0.00). District, location, ownership of the school and gender (either of teacher or student) were not significant predictors in this model.

Students’ mathematics anxiety (STDMA) was entered as the dependent variable resulting in Table 4.8.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>B</th>
<th>Beta</th>
<th>T</th>
<th>Sig T</th>
</tr>
</thead>
<tbody>
<tr>
<td>STDTCHM</td>
<td>0.39</td>
<td>0.242</td>
<td>5.048</td>
<td>0.000</td>
</tr>
<tr>
<td>STDASSTECH</td>
<td>0.807</td>
<td>0.483</td>
<td>10.665</td>
<td>0.000</td>
</tr>
<tr>
<td>STDACHV</td>
<td>-0.071</td>
<td>-0.267</td>
<td>-6.186</td>
<td>0.000</td>
</tr>
<tr>
<td>Constant</td>
<td>8.586</td>
<td>0.000</td>
<td>5.862</td>
<td>0.000</td>
</tr>
</tbody>
</table>
In Table 4.8 it can be observed that there were student related factors only. This model accounted for 54% of the variability in students’ mathematics anxiety (F=109.822, p=0.000). Although the school environment, teachers and other factors can contribute to a student having fear and dislike of mathematics, they were not significant factors in this model.

The syllabus is a very important aspect of the curriculum. Beliefs, views and attitudes towards the syllabus can significantly affect mathematics achievement and can lower or raise students’ career aspirations. The influence of some of these variables on students’ views on the syllabus was modelled and the results are shown in Table 4.9.

Table 4.9: Multiple linear regression analysis with STDSYLB as dependent variable

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>B</th>
<th>Beta</th>
<th>T</th>
<th>Sig T</th>
</tr>
</thead>
<tbody>
<tr>
<td>STDMA</td>
<td>0.124</td>
<td>0.218</td>
<td>2.890</td>
<td>0.004</td>
</tr>
<tr>
<td>STDACHV</td>
<td>-0.020</td>
<td>-0.134</td>
<td>-2.217</td>
<td>0.027</td>
</tr>
<tr>
<td>STDCASP</td>
<td>-0.170</td>
<td>-0.142</td>
<td>-2.505</td>
<td>0.013</td>
</tr>
<tr>
<td>STDASSTTECH</td>
<td>0.157</td>
<td>0.165</td>
<td>2.403</td>
<td>0.017</td>
</tr>
<tr>
<td>Constant</td>
<td>10.775</td>
<td>0.000</td>
<td>6.972</td>
<td>0.000</td>
</tr>
</tbody>
</table>

In Table 4.9, STDACHV and STDCASP were negative predictors of students’ views on the syllabus while STDMA and STDASSTTECH were positive predictors. This means that as the STDSYLB scores increased numerically (from favourable to least favourable), the students would have low career aspirations and low achievement and vice versa. This model accounted for 22.2% of the variance (F=19.94, p=0.000).

The job a student would want to do after leaving school (STDJOBALS), father’s occupation (FROCC) and mother’s occupation (MROCC) were asked from students because they were considered to be some measurement of career aspirations (STDCASP). However, the trial models failed to produce significant regression equations when these variables were entered.
In Table 4.9, only STDACHV and SCHTYP were significant predictors of STDJOBALS, accounting for 16.2% of the variance (F=27.179, p=0.000). In another model STDACH, STDGYLB and STDMA were found to be significant factors affecting career aspirations, the model accounting for 15.2% of the variance (F=16.807, p=0.000). Tables 4.10 and 4.11 reflect STDJOBALS and STDCASP as dependent variables.

Table 4.10: Multiple linear regression analysis with STDJOBALS as dependent variable

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>B</th>
<th>Beta</th>
<th>T</th>
<th>Sig T</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHTYP</td>
<td>-1.074</td>
<td>-0.189</td>
<td>-3.431</td>
<td>0.001</td>
</tr>
<tr>
<td>STDACHV</td>
<td>0.040</td>
<td>0.331</td>
<td>6.027</td>
<td>0.000</td>
</tr>
<tr>
<td>Constant</td>
<td>8.611</td>
<td>0.000</td>
<td>14.255</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 4.11: Multiple linear regression analysis with STDCASP as dependent variable

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>B</th>
<th>Beta</th>
<th>T</th>
<th>Sig T</th>
</tr>
</thead>
<tbody>
<tr>
<td>STDACHV</td>
<td>0.027</td>
<td>0.215</td>
<td>3.555</td>
<td>0.000</td>
</tr>
<tr>
<td>STDGYLB</td>
<td>-0.126</td>
<td>-0.151</td>
<td>-2.48</td>
<td>0.014</td>
</tr>
<tr>
<td>STDMA</td>
<td>-0.069</td>
<td>-0.146</td>
<td>-2.281</td>
<td>0.023</td>
</tr>
<tr>
<td>Constant</td>
<td>18.599</td>
<td>0.000</td>
<td>19.795</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The low variability figures (16.2% and 15.2%) accounted for in Tables 4.10 and 4.11 respectively, means that STDCASP and STDJOBALS could be explained better by other variables or it could be a result of sampling errors or bias of students as they were filling in the rating scales. That is why several variables were tried in the various models as a means to arrive at more meaningful and useful results in the causal comparative analysis.

When linear models had been tried and exhausted, the "curve-estimation" regression analysis was also carried out in order to find the mathematical curve that could "best" fit the data. The
researcher interchanged some variables to become either the dependant or the independent variables. Table 4.12 shows the amount of variability explained by each model.

Table 4.12: Variance described by different models

<table>
<thead>
<tr>
<th>Dep. Var and Indep. Var</th>
<th>Lin</th>
<th>Log</th>
<th>Inv</th>
<th>Quadr</th>
<th>Cubic</th>
<th>Expon</th>
</tr>
</thead>
<tbody>
<tr>
<td>STDACHV and STDMA</td>
<td>16%</td>
<td>16.3%</td>
<td>15.4%</td>
<td>#</td>
<td>#</td>
<td>*</td>
</tr>
<tr>
<td>STDMA and STDACHV</td>
<td>16%</td>
<td>*</td>
<td>*</td>
<td>17.1%</td>
<td>18%</td>
<td>16.3%</td>
</tr>
<tr>
<td>STDACHV and STDPSYLB</td>
<td>8%</td>
<td>8.6%</td>
<td>8.5%</td>
<td>#</td>
<td>#</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>STDACHVand STDTCHM</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>--------------------------</td>
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<tr>
<td></td>
<td>11.8%</td>
<td>11.6%</td>
<td>10.5%</td>
<td>#</td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>STDACHV and STDASSTECH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>#</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STDACHV and STDCASP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9.2%</td>
<td>7.2%</td>
</tr>
<tr>
<td></td>
<td>#</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STDACHV and STDJOBALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.7%</td>
<td></td>
<td></td>
<td>15.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STDACHV and TR1SYLB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>#</td>
<td></td>
<td></td>
<td>#</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STDACHV and TR2SYLB</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>#</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>STDACHV and TR1ASSMTDS</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15.3%</td>
<td>13.3%</td>
<td>*</td>
<td>#</td>
<td>19.9%</td>
<td></td>
</tr>
<tr>
<td>STDACHV and TR2ASSMTDS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>#</td>
<td></td>
<td></td>
<td>1.6%</td>
<td>6.2%</td>
<td>6.2%</td>
</tr>
<tr>
<td>STDACHV and TR1INMTDS</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>5.9%</td>
<td>6.3%</td>
<td>#</td>
<td>7.9%</td>
<td>8.1%</td>
<td></td>
</tr>
<tr>
<td>STDACHV and TR2INMTDS</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>#</td>
<td></td>
<td>7.9%</td>
<td>7.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STDJOBALS and MROCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.1%</td>
<td></td>
<td></td>
<td>#</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STDJOBALS and FROCC</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.9%</td>
<td></td>
<td></td>
<td></td>
<td>#</td>
<td></td>
</tr>
<tr>
<td>STDCASP and STDACHV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td></td>
<td></td>
<td>#</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STDCASP and STDJOBALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>2.7%</td>
<td></td>
<td></td>
<td></td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>STDJOBALS and STDACHV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.7%</td>
<td></td>
<td></td>
<td>14.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STDSYLB and STDACHV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8%</td>
<td></td>
<td></td>
<td>#</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STDSYLB and STDMA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17.2%</td>
<td>17.5%</td>
<td>16.3%</td>
<td>#</td>
<td>#</td>
<td>17.0%</td>
</tr>
</tbody>
</table>

Key: # means the estimated equation was not significant at \( \alpha \leq 0.05 \). * means tolerance limits were reached; so some independent variables were not entered. Lin=linear, Log=logarithmic, Inv=inverse, Quadr=quadratic, Expon=exponential.

As can be noted in Table 4.12, not all the curve estimation functions were able to contribute to the variability in the dependent variable as accounted for by the independent variable. Students’ views about the syllabus (STDSYLB) were dependent on students’ mathematics anxiety (STDMA) with each curve estimation model accounting for over 16% of the variability. Also STDMA and achievement (STDACHV) were significantly dependent on each other. The linear function was a better approximation of the anticipated relationships.
because it was able to model more equations than the other functions. However, there were no significant curve estimation models to explain relationship between STDACHV and both teachers’ views on the syllabus (TR1SYLB and TR2SYLB). There were also no significant curve estimation relationships between STDACHV and STDASSTECH. Surprisingly, students’ career aspirations were not dependent on father’s or mother’s occupation and were not entered in Table 4.12. However, the student’s desired job after leaving school (STDJOBALS) was linearly dependent on father’s occupation and also on mother’s occupation. Thus parents can contribute significantly to the employment opportunities of their children. They should assist their children to choose what they will do in life according to their talents and career aspirations.

The mathematics and science education inspectors and the district education officers are not directly involved in the teaching and learning of mathematics at the classroom level and so the researcher decided not to run any regression equations connecting their variables with students’ mathematics achievement, career aspirations or mathematics anxiety.

Independent samples t-tests were done to find out if there were any significant differences in the means of STDACHV, STDMA, STDCASP, STDJOBALS, STDSYLB, STDTCHM, and STDASSTECH between the groups categorised by DISTRICT, LOCATION, SCHTYP, OWNER, LEVEL STDSEX, TR1SEX and TR2SEX. It was found that there were significant differences in STDACHV (t=10.799, p=0.000), STDMA (t= -4.087, p=0.000), STDJOBALS (t=3.203, p=0.002), STDSYLB (t= -2.888, p=0.0040 and STDTCHM (t= -3.093, p=0.002) between Gweru and Shurugwi districts. There were no significant mean differences in STDASSTECH and STDCASP between the two districts. Similar results were found for significant mean differences in the student variables between urban and rural locations except for STDCASP and STDJOBALS. With respect to ownership of the school, there were
significant differences in the means of STDASSTECH ($t= -3.651, p=0.000$), STDCASP ($t=-3.084, p=0.002$), STDJOBALS ($t=-4.452, p=0.000$) and STDACHV ($t=-2.283, p=0.023$) between government and mission schools and no significant differences in the means of the other variables. There were significant mean differences in STDACHV ($t=2.195, p=0.029$), STDJOBALS ($t=4.004, p=0.000$) and STDASSTECH ($t=4.336, p=0.000$) between boarding and day schools. Regarding LEVEL, significant mean differences were found in STDSYLB ($t=-3.143, p=0.002$), STDTCHM ($t=-4.09, p=0.000$), STDMA ($t=-3.475, p=0.001$), STDCASP ($t=3.91, p=0.000$), STDJOBALS ($t=5.224, p=0.000$) and STDACHV ($t=11.743, p=0.000$) between ‘no 6th form’ schools and those schools having 6th form classes. Surprisingly, the t-tests failed to produce significant differences in the means of the variables under investigation between male and female students. However, with respect to the gender of the first teacher (TR1), there were significant mean differences only for STDSYLB ($t= -2.258, p=0.025$) and STDACHV ($t= -2.925, p=0.004$). For TR2, the results seemed quite opposite as there were significant mean differences for all the variables except for STDACHV and STDTCHM. Why these differences emerged could only be explained directly by what the concerned students and teachers pointed out in the questionnaires and focus group discussions and perhaps also by the ‘voices’ echoed by parents, education officers and employers when qualitative data were collected.

Non parametric Chi-square tests were also run to find out whether STDACHV, STDMA, STDCASP and STDSYLB were dependent or not on DISTRICT, LOCATION, SCHTYP, OWNER, LEVEL STDSEX, TR1SEX and TR2SEX. Results showed that there was an association between students’ mathematics achievement and the district they came from ($\chi^2=1.419, p=0.000$), ownership of the school ($\chi^2 =1.058, p=0.02$), type of the school ($\chi^2 =1.066, p=0.017$) and level of the school ($\chi^2 =1.701, p=0.000$). There was an association between students’ mathematics anxiety and LOCATION ($\chi^2=46.505, p=0.028$) and between
students’ mathematics anxiety and LEVEL ($\chi^2=58.064$, p=0.002). Students’ career aspirations were dependent on OWNER ($\chi^2 = 24.699$, p=0.016), on LEVEL ($\chi^2 = 30.521$, p=0.002), and on sex of second teacher ($\chi^2 = 37.122$, p=0.000). Other combinations failed to produce significant results.

### 4.2.4 Discussion of quantitative results

Quantitative data that were analysed in 4.2.2 and 4.2.3 produced interesting results. The results have confirmed the hypothesis that ‘O’ level students in the Midlands province perform poorly in mathematics (scoring on average 39.79%). This is corroborated by Nkoma, Zirima, Chimunhu and Nyanga (2013) who found out that there was a performance lag in ‘O’ level mathematics in Manicaland Province (Zimbabwe) in the years 2007 to 2008, and Chagwiza, Mutambara, Tatira and Nyaumwe (2013) who found out that although most secondary school students had positive attitudes towards mathematics, their achievement score was as low as 47%. In this study, most students had high career aspirations but ‘moderate’ mathematics anxiety. Students also viewed the syllabus, teaching and learning styles and assessment methods differently, some with mixed to unfavourable views about them. This suggests that the mathematics curriculum should be looked into as articulated by Nziramasanga Commission (1999) and in this regard, the Zimbabwe Ministry of Primary and Secondary Education has already embarked on the whole school curriculum review process (UNICEF Zimbabwe Media Centre, 2014; The Herald, 14 October 2014). However, it will be interesting to find out what the stakeholders will say about mathematics education and whether it will tally with the findings of this study.

Significant variances in student achievement, mathematics anxiety and career aspirations between the two districts, between urban and rural schools and between boarding and day schools were also found and these show that gaps still exist in how teachers deliver
instruction and how student gain mathematical skills and concepts. Results from Section 4.2.3 also revealed that mathematics achievement, anxiety, career aspirations and students’ views on curriculum issues could be modelled by regression equations. The linear equations explained more variance than the curve estimations, with several variables accounting for 56% of STDACHV. Hence it should be noted that mathematics teaching and learning are complex tasks that cannot possibly be explained by single variables. A thorough analysis of the curriculum has also shown that a good number of factors come into play (Arif, 2010; Mbugua, Kibet, Muthaa & Nkonke, 2012). Thus a good teacher must take all of them into consideration since what goes on in the classroom should be more of the teacher’s responsibility than anyone else. For example, the teacher can use career-related instruction. According to O’kwu and Anyagh (2010, p. 206), “Career-related instruction in mathematics is the teaching of mathematics topics by purposely and explicitly illustrating the practical utility of each topic indifferent career areas.” O’kwu and Anyagh (2010) found out that students taught using career related instruction performed better in a mathematics achievement test than those taught using the conventional method. Chi-square and t tests which were carried out in this study helped to confirm that associations and significant differences existed between some variables and categories. A good teacher should also consider such differences and relationships when planning and delivering instruction. This is not to say that students, parents and education officers should not play their part.

Qualitative data were also collected in order to authenticate or verify the quantitative data and the results are presented in the next section.

4.3 Qualitative data
Qualitative data were collected from students, teachers, MEI, SCEI and DEO’s questionnaires. Interviews with parents and employers, focus group discussions with students as well as documentary analysis of the ‘O’ level syllabus also gave rise to qualitative data.

4.3.1 Document analysis- The Zimbabwe ‘O’ level mathematics syllabus

Document analysis is the process of locating, coding and analysing information in any type of document (Mhlolo, 2011) for the purpose of making recommendations on official policy and practice. The syllabus is an important component of the curriculum and syllabus document analysis is carried out in this research to put the reader in the picture of the nature and characteristics of the curriculum under investigation and also to collect data for making recommendations on curriculum issues pertinent to this study. The Zimbabwe ‘O’ level mathematics syllabus currently being implemented in the schools is a 14-paged document divided into eight sections which are the preamble, aims, assessment objectives, general notes on tables, calculators and mathematical instruments, methodology, content/topics and their objectives and scheme of assessment.

The preamble states that this syllabus (4008/4028) caters for people who wish to study mathematics and related subjects up to and beyond ‘O’ level and for the mathematical requirements of a wide variety of professions (p. 1). The preamble lacks in that it does not give examples of the related subjects nor the professions which the ‘O’ level graduates can choose from. The syllabus assumes themastery of the Z.J.C. mathematics syllabus (for Forms 1 to 2) and therefore its completion period is two years (Forms 3 and 4). The next component (Section 2) gives ten syllabus aims. Aim 2.3 seeks to enable pupils to appreciate the important role of mathematics in national development and in the country’s socialist ideology. This means that mathematics learned by pupils should help them to develop their country whose guiding philosophy or ideology is that of socialism. In socialism, the means of production
should be in the hands of all the people (the masses), EWP being one of its tenets. The concept of EWP is however not mentioned in this syllabus but is indirectly implied in aim 2.4 which stipulates that pupils should acquire a firm mathematical foundation for further studies and for vocational training. How this ‘vocational training’ is to be assessed is not clearly explained. The last aim (2.10) seeks to enable pupils to appreciate the process of discovery and historical development of mathematics. There is unfortunately no stipulated content for the ‘history’ of mathematics. The issue of technological development through the use and applications of computers is again silent in the syllabus aims.

There are ten assessment objectives in the syllabus document but all are silent on the use of technology despite the fact that calculators, computers or even cell phones are now readily available to the majority of people in both urban and rural areas. There is no assessment objective that clearly and directly links mathematics with history or with EWP. Hence one can conclude that the curriculum planners had in mind the noble ideas of national development and socialism but could not spell out (at least in the aims and objectives) how these were to be attained.

Section 4 is an informative section which stipulates that electronic calculators should be used in Paper 4028/2 only while mathematical tables and instruments may be used for Paper 4008/2 or Paper 4028/2. No mathematical instruments or calculators are allowed in Paper 1. The section also gives some examples of recommended SI units and notation. Maybe the section on NOTES should have come in the preamble or should have provided a scope-and-sequence chart. A scope-and-sequence chart for the concepts, skills and attitudes to be attained at each level facilitates understanding and use of the objectives (Sage Publications, 2012).
Section 5 is about methodology but seems to be teacher-centred rather than pupil-centred. Only item 5.2 out of the nine items relates to the pupils who should ‘learn mathematics through activity based and/or guided discovery.’ Guided discovery is a good approach but it may have its own disadvantages in that the teachers may restrict pupils from being independent and creative. Free discovery should have been allowed to some extent because some pupils work better when the teacher is ‘not looking at them’ or not always directing them. Item 5.9 gives ‘project work’ as an example of an approach that teachers may be free to use and not as a mandatory approach which should be assessed. It is the researcher’s view that there cannot be national development without mandatory fieldwork or project work.

Section 6 gives the content or topics to be taught and the content objectives. There is a total of 11 topics which cover the major areas of mathematics such as arithmetic, algebra, geometry, trigonometry, statistics and probability. The topics are well sequenced and ordered from simple to complex, they are well integrated and they neatly cohere. However, I feel that some topics on computers and their applications, on sequences and series, and on the history of mathematics could have been included.

The last section outlines the scheme of assessment. The examination consists of two papers of the same weighting (50% each) and same time allocation (2½ hours each). Candidates answer approximately thirty short questions in Paper 1, and in Paper 2 they answer 6 compulsory structured questions in Section A and any 3 out of 6 questions in Section B. The scheme of assessment is silent on continuous assessment or on coursework, field work or project work. The syllabus designers could have included a section on skills weighting or a test blueprint (specification grid) for each paper. There is also no mention of recommended textbooks or guides for teachers and learners or suggested teaching/learning aids to be sourced or to be made by teachers and students. Different schools can use different textbooks.
or learning aids for the same topic and if the textbook has a lot of errors, it might be a disadvantage to the students who have no choice but to use it. An integrated textbook that incorporates a holistic mathematics curriculum (Mcnaught, 2009) could have been recommended. The syllabus could have incorporated aspects of a ‘supported curriculum’ (Sage publications, 2012) by providing guides on time allocation, materials and media, and information on staff development programmes.

A curriculum based on learning outcomes rather than on aims/objectives may have potential advantages. Learning outcomes address higher order skills, address the personal development needs of students, provide more concrete details about student performance for parents and ensure quality in education provision (Education, Audiovisual and Culture Executive Agency, 2011). Learning outcomes also encourage a learner centred and activity based approach to education (Department of Education, 2003). The ‘O’ level mathematics syllabus does not have any stipulated learning outcomes. Nevertheless, the syllabus document incorporates the socialist ideology of the nation and encourages good ‘habits of mind’ (syllabus aim 2.9) but seems not to emphasize the socialist principles of valuing human labour (through EWP). Pupils are bound to react negatively to Kirkpatrick’s evaluation level 1 (Reaction) because their mathematics learning (level 2) has weaknesses in methodology and is not complete in content. Level 3 (use of acquired knowledge while on the job) would be difficult to measure if project work or EWP are not emphasized as assessment methods. Level 4 (impact on the society) would also be difficult to gauge because there would be little or no national development, contradicting Aim 2.3. The Nziramasanga Commission (1999) has proposed a similar mathematics syllabus or curriculum that is pupil-centred and geared towards national scientific and technological development but that curriculum has not been designed and implemented up to now (2014). The problem could be that people do not want to change their original ways of thinking and embrace new philosophies or ‘habits of mind.’
Maybe students are not exposed to the reasons and justifications why they need to learn mathematics. A lot of lobbying and consciousness raising would have to be undertaken.

4.3.2 Questionnaire data

4.3.2.1 Processing of qualitative data from questionnaires

Students, teachers, MEI, SCEI and DEOs completed different questionnaires which had both structured and open-ended questions. The purpose of including the open-ended questions was to tap the students’, teachers’, and education officers’ perceptions, views and suggestions regarding aspects of the mathematics curriculum such as the syllabus, teaching and learning styles, assessment methods and factors affecting achievement. Questions on mathematics anxiety and career aspirations were also asked from the students. The data were analysed by first looking at frequencies of each response, categorising the responses and then finding the emerging themes from those responses. The qualitative results would also supplement and/or corroborate the quantitative data obtained from the other sections.

4.3.2.2 Students’ questionnaire data

Of the 285 students in the study sample, some left the open-ended sections of the questionnaires blank. For the section asking about perceptions and views on the syllabus, 215 students responded resulting in a response rate of 75.4%. Here are the views of the students about the syllabus:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... topics in syllabus are too difficult</td>
<td>58 (27.0%)</td>
</tr>
<tr>
<td>.... syllabus is too long and tiresome</td>
<td>50 (23.3%)</td>
</tr>
</tbody>
</table>
From the sentiments given by the students, one observes that the negative points outweigh the positive ones. Some students suggested that since the syllabus is too long, time to complete it should be increased. They also said holiday lessons had been banned and had to be reinstated. The topics considered to be irrelevant were logarithms, matrices, surds and quadratic equations. For instance, one female student at a mission school commented:

_Some things are not even necessary for life out there. Who needs quadratic equations or surds? It’s just silly. What we do in school should be applicable in the real world. This is why we have a lot of educated people with no jobs and unlearned people like Bill Gates being the richest people._

This student could be just one out of thousands with similar ideas but one wonders whether quadratic equations are really irrelevant and inapplicable in the real world. Perhaps it is the way teachers teach these topics that make them appear to be ‘silly’.

The topics mentioned as most difficult were transformations, probability, mensuration, circle geometry and vectors. It is interesting to note that transformations, probability and circle geometry were also found to be difficult by students and teachers in a study carried out in
Zimbabwe some 20 years ago by Dzinotyiweyi and Fleischner (1995). The students who did not respond to the questionnaires in this study may have had no access to the syllabus. Hence teachers should give students copies of the syllabus or make them aware of it through syllabus interpretation during the beginning of each school term.

Of the 285 students in the study sample, 185 responded to the section asking about views on teaching methods and learning styles. Their responses are summarised below:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... teacher is harsh and lacks good teaching styles</td>
<td>28 (15.1%)</td>
</tr>
<tr>
<td>... teachers should have more time with poor performers</td>
<td>28 (15.1%)</td>
</tr>
<tr>
<td>... teacher is friendly and his/her methods are easy to understand</td>
<td>27 (14.6%)</td>
</tr>
<tr>
<td>... teacher to use ‘cheap’ and understandable methods to solve problems</td>
<td>26 (14.1%)</td>
</tr>
<tr>
<td>... maths needs more attention and revision</td>
<td>20 (10.8%)</td>
</tr>
<tr>
<td>... more resources and textbooks with clear examples needed</td>
<td>13 (7.0%)</td>
</tr>
<tr>
<td>... teacher to use practical methods, jokes and easy language when teaching</td>
<td>10 (5.4%)</td>
</tr>
<tr>
<td>... teacher must improve his/her qualifications and language of instruction</td>
<td>9 (4.9%)</td>
</tr>
<tr>
<td>... students to attend all maths sessions and ask questions</td>
<td>8 (4.3%)</td>
</tr>
<tr>
<td>... our teacher is not good, does not come for lessons</td>
<td>5 (2.7%)</td>
</tr>
<tr>
<td>... introduce e-learning, we can learn better through it</td>
<td>4 (2.2%)</td>
</tr>
<tr>
<td>... we should have seminars with other schools</td>
<td>3 (1.6%)</td>
</tr>
<tr>
<td>... teachers are overworked and unmotivated because of low salaries</td>
<td>2 (1.1%)</td>
</tr>
<tr>
<td>... we learn more and better through group work</td>
<td>2 (1.1%)</td>
</tr>
</tbody>
</table>

The above sentiments indicate that most of the students were blaming teachers for their lack of understanding and resultant poor performance. It seems that most teachers’ methods of instruction and students’ learning styles are not in tandem. Suggestions for improvement
were put forward and these include supplying more learning resources and textbooks with clearly worked out examples, improvement of one’s qualifications and delivery strategies and language on the part of teachers and the use of e-learning for the students. In support of e-learning National Curriculum Board (2008, p. 14) opines that, “...effective use of digital technologies can enhance the relevance of the content and processes for learning.” Seminars with other schools were also mentioned as these would allow sharing of ideas and techniques between and within students of different school environments.

Of the 285 students, 144 responded to the section asking about assessment methods. Their responses are summarised below.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... I panic and am nervous when writing exams and exercises</td>
<td>24 (16.7%)</td>
</tr>
<tr>
<td>... students must be given daily exercises and homework</td>
<td>24 (16.7%)</td>
</tr>
<tr>
<td>... assessment methods should be improved</td>
<td>16 (11.1%)</td>
</tr>
<tr>
<td>... assessment methods are good at my school</td>
<td>15 (10.4%)</td>
</tr>
<tr>
<td>... I need counselling before exams, self-control and time management</td>
<td>15 (10.4%)</td>
</tr>
<tr>
<td>... assessment time is not enough (esp. for Paper II)</td>
<td>14 (9.7%)</td>
</tr>
<tr>
<td>... I enjoy maths exercises</td>
<td>14 (9.7%)</td>
</tr>
<tr>
<td>... exams (e.g. Paper II) are hard and rarely cover topics done at school</td>
<td>12 (8.3%)</td>
</tr>
<tr>
<td>... many students have difficulties in maths and they fail</td>
<td>8 (5.6%)</td>
</tr>
<tr>
<td>... allow use of calculators in Paper I</td>
<td>2 (1.4%)</td>
</tr>
</tbody>
</table>

The opinions and suggestions of the students indicated above imply that most students were in agreement that the current assessment methods are not good enough and should be improved (79.9% being against and 20.1% being in favour). Similar negative views on assessment were echoed by teachers during a study on Grade 7 Mathematics curriculum
which was carried out in Namibia (National Institute for education Development, 1998). The teachers in Namibia pointed out that there were no clear guidelines on how to carry out continuous assessment in the classrooms. But during a study in Sweden by Andersson (2010, p. 7) and a co-teacher, they designed mathematical projects to make sure that, “assessment and grading issues became transparent for all participating actors in the mathematics education network.” The researcher therefore suggests that daily exercises, tests and examinations are not meant for students to sweat and panic but should be treated as learning tools and not as the ‘end all’ assessment tools.

On attitudes towards mathematics and mathematics anxiety, 194 of the 285 students’ comments are shown below.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>… working maths problems is fun and one’s mind gets jerked up</td>
<td>37 (19.1%)</td>
</tr>
<tr>
<td>… maths needs more revision and hard work but with interest and hope</td>
<td>29 (14.9%)</td>
</tr>
<tr>
<td>… I panic and worry about maths, its involved in my career</td>
<td>27 (13.9%)</td>
</tr>
<tr>
<td>… maths is too hard and I don’t like it</td>
<td>23 (11.9%)</td>
</tr>
<tr>
<td>… I like maths, there is always an answer to a problem</td>
<td>21 (10.8%)</td>
</tr>
<tr>
<td>… maths is relevant in life, it makes you get a job after school</td>
<td>15 (7.7%)</td>
</tr>
<tr>
<td>… I feel relieved when I pass maths</td>
<td>10 (5.2%)</td>
</tr>
<tr>
<td>… I feel angry and worried when I fail to solve maths problems</td>
<td>9 (4.6%)</td>
</tr>
<tr>
<td>… need to like maths and to like the teacher in order to pass maths</td>
<td>9 (4.6%)</td>
</tr>
<tr>
<td>… I feel that am not good at maths</td>
<td>6 (3.1%)</td>
</tr>
<tr>
<td>… teachers are harsh; they must be patient when teaching maths</td>
<td>5 (2.6%)</td>
</tr>
<tr>
<td>… maths is easy and understandable</td>
<td>3 (1.6%)</td>
</tr>
</tbody>
</table>
Responses given above indicate that most of the students (58.2%) had positive attitude towards mathematics but a few (22.2%) were anxious about it while some (19.6%) had mixed feelings. These findings seem to agree with the quantitative result of an average score of 23.049 (showing moderate anxiety) which was recorded in Table 4.4. Some students echoed strong sentiments about mathematics and about the teaching system and learning environment. They said:

[Maths] is there to make people different, it screens them and puts them into hostile groups.

(Male student at a rural government school), and

I like maths but the environment and teaching system makes me get confused and also fear makes it difficult.

(Male student at a rural mission school).

In light of the above, Chirume and Chikasha (2014, p. 201), have recommended that, “...teachers should make mathematics anxiety and negative attitude to mathematics discussion topics in every mathematics classroom and use researched strategies to deal with them.”

Students also commented about their career aspirations on the last section in their questionnaire. Quantitative results (Table 4.3) showed that most students had high career aspirations and most indicated jobs of high prestige or high remuneration which they would like to do after leaving school. However, when asked to state the daily activities of a person engaged in their chosen career, 163 (57.2%) had an exact or correct answer, 55 (19.3%) had an indirect answer (such as ‘busy all time’ or ‘reads a newspaper daily’) while 67 (23.5%) had an incorrect answer or left the space blank. Students were also asked to write what they knew, thought or felt about their career aspirations. Below are the comments of 206 out of 285 students who responded.
The above comments show that although students had varied perceptions and ideas about their choice of career, the greatest number (23.8%) believed that mathematics was necessary in their career and they had to pass mathematics to get a job. One male student at an urban school commented, “Mathematics is the master key to all life opportunities.” However, one female student at a boarding school had this to say:
Of course Maths is necessary, but I feel I would be fine with Physics and Computer Science. Unfortunately, this country has made it clear that without Maths, one is as good as a foetus, so I’m obliged to love Maths, while at one mission school in the rural areas, one student with very strong words said, “I think the maths thing must be removed in my career.”

The above responses and comments can also be classified into Holland’s RIASEC codes (Green, 2010; University of Missouri, 2010). For example, in this study there were REALISTIC students (e.g. those who wanted to be engineers and software programmers), INVESTIGATIVE (several wanted to be lawyers and police officers), ARTISTIC (the one who believed his/her career needed ‘thinking out of the box’), SOCIAL (several wanted to become nurses), ENTERPRISING (‘I would like to earn a lot of money every month’) and CONVENTIONAL (e.g. the hardworking accountants, the careers needing focused and organised people). Holland’s theory and the RIASEC codes can help to assure teachers and students that although mathematics is important in life, even those without it can be useful and productive in society as there are good jobs which need only minimal knowledge of mathematics.

### 4.3.2.3 Teachers’ Questionnaire data

Twenty-eight teachers from the 14 different schools responded to the open-ended sections of the teachers’ questionnaire. The respondents were asked to provide information on the syllabus, the teacher’s instructional methods, assessment methods and lastly on factors affecting achievement in mathematics. Concerning the syllabus, the teachers responded thus:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... some syllabus topics are not very relevant in real life</td>
<td>5 (17.9%)</td>
</tr>
</tbody>
</table>
... split maths syllabus into two components, for weaker and stronger pupils 5 (17.9%)
... syllabus is too long, combine topics or give it more time 4 (14.3%)
... syllabus is good as it is 4 (14.3%)
... pupils should be made aware of the syllabus 1 (3.6%)
.... [no comment, left blank] 9 (32.0%)

Some similarities can be observed from these responses and those given by the students. For the example, the views that the syllabus is too long and that it should be changed (since it does not cater for both strong and weak pupils). In agreement with students’ views, the topic on logarithm tables was also identified by the teachers to be not very relevant in life.

Views on the teacher’s instructional methods were as follows:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... teachers need to integrate modern teaching methods</td>
<td>7 (25.0%)</td>
</tr>
<tr>
<td>... most pupils have poor language, do not understand abstract concepts</td>
<td>5 (17.9%)</td>
</tr>
<tr>
<td>... too large classes and lack of resources make good teaching impossible</td>
<td>4 (14.3%)</td>
</tr>
<tr>
<td>... pupils have negative attitude towards mathematics lessons</td>
<td>2 (7.1%)</td>
</tr>
<tr>
<td>... [no comment, left blank]</td>
<td>10 (35.7%)</td>
</tr>
</tbody>
</table>

Although most pupils were believed to have poor language and negative attitude towards mathematics resulting in their lack of understanding of mathematical concepts, teachers also attributed the blame to themselves. They believed that their lack of knowledge in the use of modern teaching methods or approaches had a negative effect on their instruction, hence the need to capacitate them on new pedagogies.
Concerning assessment methods, the teachers’ views were as follows:

**Responses** | **Frequency (%)**
--- | ---
... assessment methods too theoretical, include coursework and projects | 9 (32.1%)  
... need different exams for slow/fast learners, paper 3 for drawings/constructions | 4 (14.3%)  
... exam topics are too wide from form 1 to form 4 | 2 (7.1%)  
... re-introduce ZJC exams | 1 (3.6%)  
... [no comment, left blank] | 12 (42.9%)  

The responses recorded above show that while 12 (42.9%) of the teachers did not comment, the remainder (57.1%) were not in favour of the current assessment systems. This compares well with 79.9% of the students who were against the current methods (c/o Section 4.3.2.2). If follows that if the syllabus and instructional methods and learning styles are to change, as being suggested, then the assessment methods should change as well.

The last section on the teachers’ questionnaire asked about factors affecting achievement in mathematics. All the 28 teachers responded with more than one giving several different responses as the factors. So all in all there were 10 different answers accounting for 40 single responses as summarised below:

**Responses** | **Frequency (%)**
--- | ---
... pupils’ negative attitude towards maths, anxiety, lack of motivation | 14 (35%)  
... limited resources (e.g. textbooks), large classes and poverty | 7 (17.5%)  
... maths is very difficult and most pupils have weak/poor background | 6 (15%)  
... syllabus is too long; all topics cannot be finished before exams | 3 (7.5%)  
... school environment not conducive | 2 (5%)  

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... parental influence is negative 2 (5%)
... assessment systems are not good enough 2 (5%)
... teachers are harsh, have negative attitude and use poor teaching methods 2 (5%)
... peer pressure is too much 1 (2.5%)
... pupils have different abilities but are given the same paper 1 (2.5%)

It can be noted from the above responses that although teachers held different beliefs and opinions on the factors affecting their students’ achievement, the majority (35%) attributed the problem to pupils’ negative attitude while a minority (5%) attributed the problem to their own counterparts who are harsh or less motivated and qualified to teach mathematics. Students also had similar sentiments (c/o: students’ Section 4.3.2.2 on teaching/learning styles and mathematics anxiety). The teachers’ ideas that mathematics is difficult and pupils have weak or poor mathematical backgrounds could also be a result of poor teaching in the early grades since it is the duty of the teacher to demystify the ‘myth’ that mathematics is indeed very difficult. Some teachers also attributed the problem of failure to peer related factors, parent related factors and school factors (including school environment and teaching or learning resources). These factors were also identified in previous studies (e.g. Chirume & Chikasha, 2014, Nkoma et al., 2013).

4.3.2.4 MEI, SCEI and DEO’s questionnaire data

The mathematics education inspector, science education inspector and two district education officers responded to the same questionnaire which had open-ended sections soliciting views on the syllabus, teachers’ instructional methods, assessment methods, and on factors affecting mathematics achievement. On views about the syllabus, the SCEI commented that some topics are not relevant to pupils’ lives but did not give a list of such topics. The Gweru DEO
thought the syllabus was suitably appropriate but could be enhanced by adding topics but again did not give examples of the topics. The Shurugwi DEO believed that the syllabus had to be changed maybe by having two components to cater for both the academic and practical oriented students. The MEI did not comment.

Concerning their views on teachers’ instructional methods, the SCEI thought that the teachers’ methodological skills needed to be enhanced, the Gweru DEO suggested that mathematics teachers needed to be staff developed while the Shurugwi DEO also believed that mathematics teachers had to be retrained to improve methodological and content skills. The MEI did not comment.

On assessment methods, the MEI believed that oral assessment should be considered as well while the Gweru DEO thought that summative evaluation was most appropriate for credibility of results. The Shurugwi DEO commented that assessment methods needed to be practical oriented. The SCEI did not comment.

On factors affecting achievement, the SCEI indicated that it was because the methodology in the teaching of mathematics did not have enough resources to support it. The MEI believed that team teaching could enhance achievement and that teachers should have a passion for mathematics and should love their students. The Shurugwi DEO commented that pupils fail because they have negative attitude to mathematics and lack practice, and also that teachers lack content and methodology skills and have low morale. The Gweru DEO had just two phrases, ‘teacher quality’ and ‘motivation levels of students.’
A lot of similarities and few differences could be noted from the views given by teachers, students and the education officers. Similar factors affecting the mathematics curriculum have been recorded elsewhere (e.g. Chirume & Chikasha, 2014; Mbugua et al., 2012; Nkoma et al., 2013; Tshabalala & Ncube 2013). For example, Tshabalala and Ncube (2013) found that pupils in Matebeleland North Province (Zimbabwe) attributed their failure of ‘O’ level mathematics to lack of resources, poor teaching methods, fear of mathematics and poor mathematical background from lower levels. Serious in-service training of mathematics teachers and guidance and counselling to develop positive attitudes towards mathematics were some of the recommendations by Tshabalala and Ncube (2013). This study adopts those recommendations but goes deeper to look at the broader perspective of the whole mathematics curriculum.

4.3.3. Focus group discussion and Interview data

4.3.3.1 Focus group discussion with students

In the focus group discussions, the students were supposed to speak in English but after finding out that only a few were willing to talk, the researcher allowed them to speak in their mother tongue (which was mostly Shona) and to mix Shona and English. The researcher audio-recorded and video-recorded the discussions and also transcribed on paper and in English the major points raised in the discussions. The researcher allowed the students to digress but then managed to shift their focus onto the main points since there were pre-written questions (see Appendix E) to guide the discussions. The focus group discussions also helped the researcher to check on the credibility, truthfulness and trustworthiness of the data provided by the same students in the open-ended sections of the questionnaires. The discussions were held in June and July 2014.
The researcher managed to carry out the focus group discussions at each of the 14 schools in the two districts which were visited. Thus there were 14 different focus groups. Question 1 required the biographical data of the discussants. The researcher noted that the smallest group at one school had two boys and two girls who were available and willing to participate in the discussions while the largest group of four boys and five girls was recorded at another school. On average, 3 boys and 4 girls constituted the discussants in the focus groups. The discussions lasted from 20 to 30 minutes.

In Question 2 the researcher wanted to find out whether the discussants liked the way in which their teachers taught them mathematics. Similar or equivalent views or opinions from different focus groups were merged into single phrases or sentences. Nine of the groups said they liked and enjoyed how they were being taught mathematics while the remaining five groups did not agree. When asked to explain further why they enjoyed their teachers’ lessons, the groups that enjoyed the lessons gave the following reasons. [The frequencies indicate the number of groups that raised the particular response. The responses have been summarised]:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... he explains to us in a way we understand and he allows us to ask questions</td>
<td>6 (42.86%)</td>
</tr>
<tr>
<td>... he/she is not late for lessons</td>
<td>1 (7.14%)</td>
</tr>
<tr>
<td>... he/she understands our problems</td>
<td>1 (7.14%)</td>
</tr>
<tr>
<td>... he brings the whole subject to life</td>
<td>1 (7.14%)</td>
</tr>
</tbody>
</table>

The groups which did not like how they were being taught had the following reasons.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... he is too fast, not considerate and assumes that we already know everything</td>
<td>1 (7.14%)</td>
</tr>
<tr>
<td>... his/her language is not good, is rude and says “wrong answer!”</td>
<td>1 (7.14%)</td>
</tr>
</tbody>
</table>
Although the above reasons given by the discussants indicate (on average) that the students liked the way they were being taught mathematics, the achievement test results indicated failure and views in the open-ended sections of the questionnaires indicated that the majority of the students were against how they were being taught. It could be that in the questionnaires the students were anonymous and free to air the views while in the focus group discussions they could not ‘sell out’ on their teachers to a visitor and they were also aware that their voices were being recorded.

In Question 3 the researcher wanted to find out whether the discussants were interested in learning mathematics and what could be their reasons. Only 3 students in one group said they were not interested in learning mathematics, the reason being that they were not able to solve most of the mathematics problems. The discussants in all the other focus groups said they were interested in learning mathematics and pointed out the following reasons:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... maths refreshes the mind and no job is without maths</td>
<td>9 (42.8%)</td>
</tr>
<tr>
<td>... maths is applied in day to day life e.g. buying and selling</td>
<td>4 (19.0%)</td>
</tr>
<tr>
<td>... it is an interesting subject which is good for Engineering and Actuarial Sciences</td>
<td>3 (14.3%)</td>
</tr>
<tr>
<td>... it is good for further studies and we want to do Sciences at ‘A’ level</td>
<td>3 (14.3%)</td>
</tr>
<tr>
<td>... maths is good for problem solving</td>
<td>1 (4.8%)</td>
</tr>
<tr>
<td>... maths helps in calculations (e.g. calculating measurements)</td>
<td>1 (4.8%)</td>
</tr>
</tbody>
</table>
The above sentiments seem to point to fact that most students view mathematics as very important for employment, for use in daily life situations and for further studies despite the fact that many still drop and fail the subject. Perhaps it could be the way mathematics is being viewed and taught that leads to such dislike and failure. The researcher noted an interesting point emanating from the views in the following conversation with a discussant in one of the focus groups: “Mathematics is good for my ‘A’ level combinations. I would like to do Diesel Plant Fitting.” When asked further what kind of mathematics (or the topic) was needed for one to do Diesel Plant Fitting, this student had no answer. The other discussants in the group also did not have an answer. Thus students might know that mathematics is needed in companies and industries but might not know what or how the mathematics is to be applied.

It is the duty of the teachers to teach students not just theory but the real applications of mathematics.

In Question 4 the researcher wanted to find out from the students themselves the reasons why many pupils fail mathematics at ‘O’ level; in other words, the factors affecting mathematics achievement as viewed by the discussants. These were the responses of the different groups:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... negative attitude and fear, thinks maths is difficult then relaxes and loses focus</td>
<td>10 (30.3%)</td>
</tr>
<tr>
<td>... lack of practice</td>
<td>8 (24.3%)</td>
</tr>
<tr>
<td>... lack of knowledge and understanding</td>
<td>3 (9.1%)</td>
</tr>
<tr>
<td>... time to catch up (also exam time) is too little</td>
<td>3 (9.1%)</td>
</tr>
<tr>
<td>... pupils are naturally dull and lazy</td>
<td>3 (9.1%)</td>
</tr>
<tr>
<td>... teachers are too fast yet rate of student understanding is low</td>
<td>2 (6.1%)</td>
</tr>
<tr>
<td>... many teachers are harsh and not patient</td>
<td>1 (3.0%)</td>
</tr>
<tr>
<td>... pupils lack motivation and interest</td>
<td>1 (3.0%)</td>
</tr>
</tbody>
</table>
... maths has too many rules and formulas 1 (3.0%)
... pupils fear the teacher 1 (3.0%)

The majority of the focus groups pointed out negative attitude and fear of the subject as the main contributor to poor performance and similar views were also raised by the students who filled in the questionnaires, the teachers, the parents, the education officers, and some of the employers. The reasons given above by the discussants can be grouped into categories of teacher methodology and teacher characteristics, students’ attitude and characteristics, and nature of mathematics. The topics which most groups believed to be difficult are probability and transformations. Although shortage of resources like textbooks, parental influence, teacher qualifications and the school environment were not mentioned during the discussions, they were raised elsewhere (e.g. in the teacher questionnaires and interviews with parents and employers).

In Question 5, the researcher wanted to probe the learning challenges faced by students in mathematics. These challenges could also be considered as factors affecting achievement in mathematics and can be easily compared with those given in Question 4 above: The learning challenges mentioned by the discussants were as follows:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... shortage of lesson and study time</td>
<td>5 (17.2%)</td>
</tr>
<tr>
<td>... New General Mathematics book does not show clear examples</td>
<td>5 (17.2%)</td>
</tr>
<tr>
<td>... sharing of textbooks because of shortages</td>
<td>4 (13.8%)</td>
</tr>
<tr>
<td>... no computers, shortage of calculators, maths instruments and graph paper</td>
<td>4 (13.8%)</td>
</tr>
<tr>
<td>... constant change (transfer) and shortage of teachers</td>
<td>3 (10.3%)</td>
</tr>
<tr>
<td>... teachers favour only the capable and refuse to explain</td>
<td>2 (6.9%)</td>
</tr>
</tbody>
</table>
... no challenges 2 (6.9%)
... difficult topics: circle geometry, mensuration, bearing; many formulas to master 2 (6.9%)
... teachers do not attend lessons regularly 1 (3.5%)
... our school is poor, no electricity 1 (3.5%)

The above mentioned challenges can be grouped into factors relating to resources, teacher attitude and characteristics, school or Ministry administration, school environment, and the nature of the subject of Mathematics. The fact that most schools in the rural areas are poor, do not have electricity and cannot afford to buy generators imply that the use of computers for learning mathematics might only be a dream to most of the students. Some of the challenges are financially related and can be overcome once money becomes available while other challenges imply an overhaul of the mathematics curriculum and an effective professional development for teachers. Textbooks like the current New General Mathematics (NGM) series also need to be reviewed as the discussants mentioned that they do not show clear examples. In one of the focus groups some students mentioned that some of their mathematics teachers would resist being asked for an explanation of a ‘difficult’ concept and would answer back saying, “Ndezvako izvi, ndezvambuya vako,” meaning “It’s your own fault, it’s your own business.” In contradiction to the above sentiments, it is interesting to note that two groups mentioned that they do not have learning challenges. Whether this was true or false could not be ascertained.

In Question 6 the researcher asked the discussants what they believed could be done to overcome the challenges mentioned in Question 5. The following points were raised:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responses</td>
<td>Frequency (%)</td>
</tr>
<tr>
<td>... no challenges</td>
<td>2 (6.9%)</td>
</tr>
<tr>
<td>... difficult topics: circle geometry, mensuration, bearing; many formulas to master</td>
<td>2 (6.9%)</td>
</tr>
<tr>
<td>... teachers do not attend lessons regularly</td>
<td>1 (3.5%)</td>
</tr>
<tr>
<td>... our school is poor, no electricity</td>
<td>1 (3.5%)</td>
</tr>
</tbody>
</table>
The points raised above mean that students are important stakeholders in curriculum reform and they do have good ideas which should be taken seriously by curriculum reviewers and designers. However, the suggestions that parents should have interest in mathematics and help children with homework could be difficult to implement since some of the parents might not have mathematical knowledge themselves.

Some of the ideas mentioned above in Question 6 were similar to the ones given for Question 7 which asked the discussants to mention the improvements they thought should be made in the mathematics curriculum. Here are the points raised in answer for Question 7:
... increase time for maths syllabus completion and put more emphasis on homework and revision

8 (30.7%)

... removed difficult topics e.g. probability, vectors, logarithms, transformations, circle geometry, mensuration of solid shapes

5 (19.2%)

... improve textbooks (locus and probability should be explained well) and introduce small booklets for each topic

4 (15.4%)

... do not change or transfer teachers continuously

2 (7.7%)

... government to provide resources e.g. computers to all schools and allow all students to use computers and calculators

2 (7.7%)

... no improvements needed, the curriculum is alright as it is

2 (7.7%)

... remove irrelevant topics (surds, factorization)

1 (3.8%)

... examiners to make sure that what comes in the exam is what the students have actually covered (e.g. Consumer Arithmetic always comes but we do not cover it)

1 (3.8%)

... employ only patient and knowledgeable teachers of mathematics who can demonstrate to children the importance of mathematics

1 (3.8%)

Twelve focus groups agreed that some improvements had to be done to the mathematics curriculum while two groups thought the curriculum was alright as it is and no improvements were necessary. Some of the points mentioned by the discussants in twelve of the groups were quite good and relevant. However, some still could be debatable. For instance, instead of suggesting a complete removal of difficult topics from the syllabus, perhaps the discussants should have said the topics should be made simpler and understandable in the textbooks and during the teacher’s lesson delivery. Topics like Logarithms and Surds are not very difficult or irrelevant as such but could still be taught using calculators rather than log tables. A challenge however, is that many students in the rural areas still do not have calculators. Those
with cell phones are not allowed to use them during lessons as they might disrupt the smooth flow of the teachers’ lessons. The concept of factorization is not irrelevant as it is a way of simplifying long and difficult expressions and can be applied in many topics in further studies of mathematics. It is the researcher’s opinion that the discussants held these views because of the way teachers taught them and because mathematics is generally viewed as a challenging subject. Something has to be done concerning how students view the ‘nature’ of mathematics and to the way mathematics should be taught.

Question 8 (similar to Question 3 in the parents’ interview guide and Question 7 in the employers’ interview guide) asked the discussants whether they considered mathematics to be important for their daily lives. The views of the discussants are summarised below:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... maths is important, we need it for budgeting at home and calculating change</td>
<td>8 (32%)</td>
</tr>
<tr>
<td>... maths is important, it is needed in most jobs</td>
<td>7 (28%)</td>
</tr>
<tr>
<td>... maths is important for further studies (e.g. needed at ‘A’ level)</td>
<td>3 (12%)</td>
</tr>
<tr>
<td>... maths is important as it sharpens our mind</td>
<td>3 (12%)</td>
</tr>
<tr>
<td>... maths is important as it enables us to solve our problems</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>... yes it’s important but it is also very difficult</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>... it is not of that much importance but only for people’s pride and prestige</td>
<td>1 (4%)</td>
</tr>
</tbody>
</table>

The responses given above indicate that the majority of students consider mathematics to be important but for various reasons, topping the list being the use of mathematics in the home and for employment purposes. However, some students (in one of the focus groups) considered mathematics to be not important except for people’s pride or prestige. In another
group one discussant pointed out that she wanted to be a police officer but did not know how or where mathematics would be applied in that job.

In Question 9 the researcher wanted the discussants to air their opinions and feelings about employers’ job requirements that a school leaver must have five ‘O’ level passes including Mathematics. The responses were as follows:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... yes, 5 subjects is a fair minimum, 6 or 7 are too many</td>
<td>13 (37.1%)</td>
</tr>
<tr>
<td>... companies need maths for running businesses, budgeting and money issues</td>
<td>6 (17.1%)</td>
</tr>
<tr>
<td>... maths should be included because it is a major subject found everywhere and is needed in daily life</td>
<td>5 (14.3%)</td>
</tr>
<tr>
<td>... because maths improves brain performance, is necessary for logical reasoning</td>
<td>5 (14.3%)</td>
</tr>
<tr>
<td>... 3 or 4 subjects NO because it will cause many people to be lazy and to compete for the same job</td>
<td>2 (5.7%)</td>
</tr>
<tr>
<td>... companies use maths for screening</td>
<td>2 (5.7%)</td>
</tr>
<tr>
<td>... companies need maths but the maths must be related to the job</td>
<td>1 (2.9%)</td>
</tr>
<tr>
<td>... what is needed at work is skill and talent, number of subjects can be reduced to 4 and then let the students supplement</td>
<td>1 (2.9%)</td>
</tr>
</tbody>
</table>

The responses above support the view that a pass in Mathematics is necessary and should be included in the requirements for a job. A minimum number of five ‘O’ level subjectswas also supported by the majority (13 out of 14) of the focus-groups.
The last question (Question 10) asked discussants what they thought should be the Government’s policy about teaching and learning of mathematics. Their responses were as follows:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... Government must allow extra and holiday lessons to be held</td>
<td>9 (25.7%)</td>
</tr>
<tr>
<td>... Government to employ qualified teachers with a passion for maths</td>
<td>9 (25.7%)</td>
</tr>
<tr>
<td>... Government to simplify the syllabus or review it</td>
<td>4 (11.4%)</td>
</tr>
<tr>
<td>... Government to provide enough resources like books</td>
<td>3 (8.6%)</td>
</tr>
<tr>
<td>... Government to improve teachers’ working conditions to boost their morale</td>
<td>3 (8.6%)</td>
</tr>
<tr>
<td>... Government to emphasize e-learning in all schools, or maths lessons even on TV</td>
<td>3 (8.6%)</td>
</tr>
<tr>
<td>... Government should make maths compulsory at ‘O’ level</td>
<td>2 (5.7%)</td>
</tr>
<tr>
<td>... Exam techniques should be tackled during maths lessons</td>
<td>1 (2.85%)</td>
</tr>
<tr>
<td>... Government to allow teachers to punish kids by beating them</td>
<td>1 (2.85%)</td>
</tr>
</tbody>
</table>

The discussants’ responses to Question 10 touched on many aspects which include teacher qualifications, teacher methodology (including e-learning), time factors, material resources, student discipline and the need to review the syllabus. These ideas all point to the need for a new policy on the mathematics curriculum.

4.3.3.2 Interview with parents

The researcher managed to randomly select for a separate private interview, any two willing parents or guardians of the ‘O’ level mathematics students at each of the 14 schools which were visited. The researcher was guided by some six pre-written questions (see Appendix F) but could rephrase and translate them into the local Shona language for ease of
communication with parents who could not understand English. Parents’ voices were audi-taped but the researcher transcribed on paper and in English the important points of what they were saying. Below is the question by question analysis of the data.

Question 1: The researcher recorded the gender of the interviewees. There were 20 male and 8 female parents who consented to being interviewed.

Question 2 was on reasons why pupils fail mathematics at ‘O’ level. The following reasons and their frequency of appearance are given below:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... pupils fail due to negative attitude to and fear of mathematics</td>
<td>15 (50%)</td>
</tr>
<tr>
<td>... inefficient and unmotivated teachers</td>
<td>6 (20%)</td>
</tr>
<tr>
<td>... pupils lack practice, have poor language and weak primary background</td>
<td>4 (13.3%)</td>
</tr>
<tr>
<td>... maths is naturally difficult</td>
<td>2 (6.7%)</td>
</tr>
<tr>
<td>... shortage of time and resources (e.g. textbooks)</td>
<td>2 (6.7%)</td>
</tr>
<tr>
<td>... lack of motivation by parents and negative peer pressure</td>
<td>1 (3.3%)</td>
</tr>
</tbody>
</table>

The reasons given can be grouped into pupil related factors (attitude, lack of practice), teacher related factors (lack of motivation and morale, inefficiency), material related factors (shortage of textbooks) and parent and peer factors (lack of motivation, insufficient help and negative pressure). The factor of fear of mathematics (or anxiety and negative attitude) topped the list, and was mentioned to a lesser extent by students themselves (Section 4.3.2.2) but to a greater extent by the teachers (Section 4.3.2.3), education officers (Section 4.3.2.4), employers (c/o Section 4.3.3.3 below) and parents. Interestingly, the parents did not mention the issue of overcrowded classrooms or exorbitant fees which might have a negative
influence on their children’s learning. The parents who believe that mathematics is naturally difficult might have failed it at school and no doubt such parents might not have the zeal to motivate their children to like mathematics. Parents also blamed the teachers for students’ poor mathematics achievement.

In Question 3, the researcher wanted to find out how parents viewed the importance (or lack of it) of mathematics in pupils’ daily lives. A breakdown of their reasons is given below:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... mathematics is used in daily life activities and calculations</td>
<td>12 (42.9%)</td>
</tr>
<tr>
<td>... maths is very important for budgeting in the home</td>
<td>3 (10.7%)</td>
</tr>
<tr>
<td>... maths develops logical thinking and helps problem solving</td>
<td>3 (10.7%)</td>
</tr>
<tr>
<td>... many courses involve maths, e.g. teaching, nursing, technicians</td>
<td>3 (10.7%)</td>
</tr>
<tr>
<td>... maths is used for counting (herd of cattle), and measuring</td>
<td>2 (7.1%)</td>
</tr>
<tr>
<td>... we live in a world of technology and technology is all about maths</td>
<td>1 (3.6%)</td>
</tr>
<tr>
<td>... maths is not very important, it depends with what one is doing</td>
<td>1 (3.6%)</td>
</tr>
<tr>
<td>... [did not comment, did not know]</td>
<td>3 (10.7%)</td>
</tr>
</tbody>
</table>

The majority (85.7%) of parents said mathematics is very important, 10.7% said they didn’t know and one (3.6%) said mathematics is not important. Probed further to explain why this particular parent thought mathematics is not important, she said it depends with what one is doing but could not elaborate.

The researcher asked the interviewees to elaborate on the importance of mathematics especially for companies and the country at large. This is what they said in respect of companies:
<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... companies need maths for stock take and cash balances</td>
<td>10 (35.7%)</td>
</tr>
<tr>
<td>... companies need maths for counting, calculating and budgeting their resources</td>
<td>7 (25%)</td>
</tr>
<tr>
<td>... maths is needed to increase company productivity and profit</td>
<td>5 (17.9%)</td>
</tr>
<tr>
<td>... companies need maths for record making and keeping (e.g. tables, graphs)</td>
<td>2 (7.1%)</td>
</tr>
<tr>
<td>... maths promotes creative thinking and planning in the company</td>
<td>2 (7.1%)</td>
</tr>
<tr>
<td>... with maths knowledge workers get organised</td>
<td>1 (3.6%)</td>
</tr>
<tr>
<td>... companies screen employees on basis of maths pass</td>
<td>1 (3.6%)</td>
</tr>
</tbody>
</table>

The above information given by the interviewees suggest that all parents were in agreement that mathematics is important in the companies and industries, the major importance (78.6%) being attached to money related issues (cash balances, budgeting resources, profit etc). Some parents (10.7%) also recognised that mathematics promotes creative thinking and good behaviour (‘being organised’) in the companies. These attributes of good behaviour and creativity are important and should also be nurtured starting in the home and then being re-emphasized at school level.

This is what the interviewees said in respect of the importance of mathematics for the country at large:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... maths is important for national budgeting</td>
<td>10 (35.7%)</td>
</tr>
<tr>
<td>... maths is important for country’s productivity and economic growth</td>
<td>7 (25%)</td>
</tr>
<tr>
<td>... maths is important for country’s technological development and innovation</td>
<td>4 (14.3%)</td>
</tr>
<tr>
<td>... maths produces citizens who are logical thinkers</td>
<td>3 (10.7%)</td>
</tr>
<tr>
<td>... maths knowledge is used in national statistics (e.g. census)</td>
<td>3 (10.7%)</td>
</tr>
</tbody>
</table>
... maths is used to offer services to the country (e.g. teaching) 1 (3.6%)

The reasons given above again suggest that all parents viewed mathematics as being important for the country at large, with most of them thinking in terms of the country’s productivity, economic and technological development. Similar sentiments were echoed in the Nziramasanga Commission (1999)’s recommendations. Thus the new mathematics curriculum, if it is to be designed and implemented, should include technological development, productivity, logical thinking and economic growth as some if its broad outcomes.

Question 4 asked parents to explain whether they thought employers’ job requirements for 5 or more ‘O’ level passes including English and Mathematics were justified. Thirteen of the parents (43.3%) were of the view that English had to be included because it is an international language and an official language for communication hence many jobs require it. With respect to Mathematics, 43.3% explained that it is a core subject for most disciplines and is used for everyday calculations and occupations and that is why many employers require it. One parent (3.4%) believed that mathematics was very necessary and expressed that, “without Mathematics or English, someone cannot operate even a machine.” Others (10%) were of the idea that the requirement for mathematics could be left out since “mathematics is situational,” meaning that while some employers required it, others could do without it.

The interviewees justified the number of required ‘O’ level subjects by saying: five is ok in order for pupils to have a balanced mind and perform basic skills of reading and counting (46.4%), most pupils write ten subjects and ‘five’ was set by government as a minimum
requirement (10.7%), five is too strict, maybe 3 or 4 subject passes are alright (14.3%). The remaining eight parents (28.6%) had no idea why five subjects were needed. It could not be established in this study whether it was the government or employers themselves who had set five subjects as the minimum requirement. From the opinions given by the parents, it seems that a minimum of five ‘O’ level subjects is a good standard but as the Ministry of Primary and Secondary Education has now embarked on the review of the curriculum, people would want to know what the employers (or the government)’s new minimum standards for employment would be.

The interviewer asked the parent-interviewees to explain what the government’s policy about the teaching and learning of mathematics should be (Question 5). The parents’ suggestions were summarised as follows:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... provide resources, make maths compulsory from primary to secondary school</td>
<td>11 (39.29%)</td>
</tr>
<tr>
<td>... employ dedicated and qualified maths teachers, give them good incentives</td>
<td>10 (35.72%)</td>
</tr>
<tr>
<td>... allow the teaching of maths in mother tongue</td>
<td>2 (7.14%)</td>
</tr>
<tr>
<td>... review maths syllabus and make it more likeable by pupils</td>
<td>2 (7.14%)</td>
</tr>
<tr>
<td>... stabilize economy, allow use of modern technology in maths teaching/learning</td>
<td>2 (7.14%)</td>
</tr>
<tr>
<td>... allow (maths) teachers to discipline the pupils, even to beat them</td>
<td>1 (3.57%)</td>
</tr>
</tbody>
</table>

The above suggestions given by the interviewees can be grouped into factors related to issues of language, teacher development, resources and nature of the subject Mathematics. The issue of the government having to provide requisite teaching and learning resources topped the list with teacher development (qualifications and professionalism) following. The issue of pupil discipline in mathematics learning should not be ignored as an undisciplined child will make
the teacher’s work more difficult. It will be interesting to find out how the issue of discipline will be incorporated in the new curriculum.

The last thing the researcher wanted to find out from the parents was how they viewed their roles in assisting their children to do well in mathematics (Question 6). Although the different viewpoints amounted to 34, the researcher merged those that appeared to be similar resulting in 6 categories of viewpoints which are summarised below:

<table>
<thead>
<tr>
<th>Responses</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>... I can help by giving my child enough time and extra lessons</td>
<td>8 (23.52%)</td>
</tr>
<tr>
<td>... I can assist by discussing importance of maths with my kids</td>
<td>6 (17.64%)</td>
</tr>
<tr>
<td>... I can help by providing books and the needed resources</td>
<td>5 (14.71%)</td>
</tr>
<tr>
<td>... I can assist with homework and checking their exercise books regularly</td>
<td>5 (14.71%)</td>
</tr>
<tr>
<td>... I should encourage my kids to be self-reliant and to learn hard</td>
<td>5 (14.71%)</td>
</tr>
<tr>
<td>... I can assist by motivating them, teaching Christianity and showing them love</td>
<td>5 (14.71%)</td>
</tr>
</tbody>
</table>

The suggestions which the parents gave imply that they were concerned with the education of their children and wanted to help by all means. These suggestions can also be viewed as factors affecting achievement in mathematics and can be grouped into anxiety/attitude factors, resources (including time) factors, and motivation and religious factors. The parents did not mention teacher or school related factors. However, on the issue of providing enough time for pupils to learn mathematics, one parent had this to say: “If the Ministry does not reconsider its policies about extra lessons, the pass rate in maths will still drop.”

4.3.3.3 Interview with employers
Face to face interviews were held on different days from March to May 2014 with 11 employers (or their representatives) in Gweru district. The researcher had prepared 12 questions (see Appendix G) to guide the flow of the interview. The researcher however noted with concern that most of the employers were not willing to avail statistics for their employees, in particular, previous mathematics pass grades. The researcher needed such data to trace and link past ‘O’ level students’ mathematics grades and their current employment status and productivity. Nevertheless, the researcher made use of the interview data provided by the employers and secondary data from the review of related literature (c/o Section 4.4).

Some of the employers spoke in Shona, others in English but the researcher transcribed their ‘voices’ on paper using English. Questions 1 to 4 and 6 asked for some company statistics and in some instances the researcher could just observe and take notes without asking. For example, there were 9 male and 2 female employers/company representatives, holding positions ranging from managers to directors or Chief Executive Officers. The composition of the companies was as follows: 4 large private, 3 parastatals, 3 indigenous, 1 NGO, and 0 Government as no government employer consented to be interviewed. However, some officers in the Ministry of Primary and Secondary Education, which is one of the largest government employers, provided similar information by filling in questionnaires (see Appendix D). The companies/organisations interviewed dealt with activities ranging from banking, hairdressing, insurance, retailing, manufacturing, consultancy and TV repairs and sales. The company representatives had served in periods ranging from 3 to 25 years with a ‘service’ average of 11.27 years. The number of employees per company ranged from 5 to 114 with an average of 37.54. All of the employers said they recruited employees as need arises.
Question 5 asked for qualifications considered for employment. Seven (63.6%) of the employers said they required a minimum of 5 ‘O’ level passes including English and Mathematics. A degree or diploma would be an added advantage. Two (18.2%) of the employers said they considered experience, 1 (9.1%) said they considered a degree and 1 (9.1%) said they considered any relevant post ‘O’ level qualification. When asked about the academic qualifications of their current employees, the employers provided data that showed that the majority had 5 or more ‘O’ level passes, of which 80.9% had Mathematics, 16.5% had no Mathematics and 2.6% had less than 5 ‘O’ level passes and no Mathematics.

Question 7 asked whether the mathematics qualification was important for employment. Of the employers, 54.5% were very positive, 27.3% were very negative while 18.2% had mixed opinions. Those with positive responses gave the reasons that the mathematics pass was important for the growth and development of the person. The pass in mathematics was also needed for correct calculation of instalments, interests, profit, and for cost effective running of the business. One manager echoed that, “[maths] dzinokosheswa nokuti ndipo pane mari. Pasina mathshapana mari (mathematics is considered important because it is accompanied with money. Where there is no mathematics, there is no money).” The ones who had mixed feelings believed that a person can fail mathematics but can be able to work with numbers, do basic calculations and still be productive. Those who gave no for an answer believed that mathematics was not important because not many calculations were done in their field of work and yet their business was doing well. They said that if someone has done ‘O’ level even without passing mathematics, he/she was good enough to work. Another one (a male hairdresser) emphatically denied using maths in their salon. Perhaps this employer had a different definition of mathematics because in hairdressing quite a lot of mathematics may be
used in the form of budgeting for chemicals and equipment, making symmetrical patterns and styles of hair cut or weave and time management.

Question 8 asked whether the employees used mathematics knowledge, concepts and skills when doing their job. Seven (63.6%) of the employers answered in favour, 2 (18.2%) of them were against and the other 2 (18.2%) had mixed opinions. Those in favour had the idea that mathematics is used on daily basis to make decisions, offer services promptly, receive and take stock and to calculate interests and deposits. Those ‘against’ said they required their employers only to have practical experience. They said most of their workers did not have ‘O’ level mathematics but were doing a great job. Those with mixed feelings said that they needed only basic skills and not much of mathematics.

Question 9 asked whether employees with the mathematics pass or qualification produced more goods or services than those without. Three (27.3%) said it was difficult to tell, 2 (18.1%) said that there was no huge difference but one with mathematics was better when it comes to cost saving. Three others (27.3%) who said ‘yes’ were of the idea that employees with a pass in mathematics make reasonable decisions and the margin of error is less. The remaining 3 (27.3%) who said ‘no’ were of the idea that only experience and hardworking counts since not all jobs need mathematics. What was important to them was the need for the employee to understand what they were required to do. However, understanding what one is required to do and following instructions are mathematical skills in the broader sense.

Question 10 asked employers to give their reasons why students fail mathematics at ‘O’ level. Most employers attributed the failure to negative attitude and ‘mathephobia’ (46.1%), lack of practice and the teacher not giving enough homework (15.4%), poor coaching or teaching
methods (7.7%), peer pressure and negative parental attitude and influence (7.7%), the natural difficulty of the subject (15.4%) and the idea that our children lack practical skills and are not involved in our businesses most of which use mathematics (7.7%). Similar reasons why students fail mathematics were also raised by the teachers and the education officers.

The researcher followed up (Question 11) asking how the employers could help to boost pupils’ performance in mathematics. It was interesting to note that most of the employers were of the view that children’s education in Zimbabwe should improve and that companies or industries were important education stakeholders. Several suggestions were raised some of which were: forming partnerships with schools and giving practical attachments, career guidance and practical skills in order to entice children to like mathematics (27.3%), donating resources to the needy and those in remote areas and giving awards to excelling mathematics students (27.3%), giving incentives to teachers to increase their morale (18.2%), recruiting employees with Mathematics as a motivational tactic (18.2%) and involving employers in curriculum designing (9%). These are worthwhile suggestions but it only needs time, resources and commitment to make them effective.

The researcher wanted to find out (in Question 12) the justification why employers require job seekers to have 5 ‘O’ levels including mathematics. Most employers (33.3%) were of the view that a person with 5 ‘O’ levels thinks better than one with less and that mathematics improves the employee’s reasoning, 25% said that since business is into profit making, any business person needs appreciation of mathematics because ‘with mathematics, one makes big business.’ One employer (8.3%) thought 5 ‘O’ levels was just a benchmark which people were using since the requirement used to be 4 subjects. Another employer (8.3%) said it was
not justifiable to insist on 5 ‘O’ levels. Against these views, it needs to be seen what the new national curriculum policy will stipulate as the requirements for employment after ‘O’ level.

4.3.4 Discussion of qualitative results

From the data collected from students, teachers, parents, education officers and employers on the perceptions and views concerning the mathematics curriculum and the importance of mathematics in careers, some interesting themes emerged and these are summarised in Table 4.13.

Table 4.13: Factors affecting the ‘O’ Level Mathematics curriculum according to themes and at student, teacher, parent, MEI, SCEI, DEO and employer levels

<table>
<thead>
<tr>
<th>LEVEL/THEME</th>
<th>Students’ Math Anxiety and Attitude</th>
<th>Math Syllabus</th>
<th>Teaching /Learning Styles</th>
<th>Assessme nt Methods</th>
<th>Students’ Career Aspirations</th>
<th>Lack of resources, school environm ent</th>
<th>Need for New Maths Curriculum Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>Moderate factor</td>
<td>Many negative points about it, hence should be changed</td>
<td>Teachers must have knowledge, good methods and passion for maths</td>
<td>ZIMSEC to improve on assessment, deal with exam panic</td>
<td>Very high career aspirations, maths considered very important for jobs</td>
<td>Teachers have negative attitude and are not motivated to teach</td>
<td>Yes, very strong point</td>
</tr>
<tr>
<td>Teacher</td>
<td>Yes, very important factor according to teachers</td>
<td>Moderate factor</td>
<td>Teachers to integrate modern teaching approaches</td>
<td>Assessments should not be too theoretical</td>
<td>Not mentioned</td>
<td>Low morale due to heavy loads</td>
<td>Yes, moderate point</td>
</tr>
<tr>
<td>Parent</td>
<td>Strong factor, Pupils are scared of teachers and not motivate d</td>
<td>Not mentioned, except the point that many pupils do not like maths</td>
<td>Inefficient and unmotivated teachers</td>
<td>Not mentioned</td>
<td>Maths is very important for students’ careers</td>
<td>Government to provide resources and increase morale and salaries of teachers</td>
<td>Yes, teachers to emphasize on importance of maths for employment</td>
</tr>
<tr>
<td>MEI, SCEI &amp; DEO</td>
<td>Attitude of most students is</td>
<td>Moderate factor</td>
<td>Teachers lack content</td>
<td>Assessments also to be</td>
<td>Not mentioned</td>
<td>Moderate factor, Resources</td>
<td>Yes, need to review maths</td>
</tr>
</tbody>
</table>
From the thematic presentation given in Table 4.13 one’s analysis may conclude that the students’ mathematics anxiety/attitude factor emerged strongly from the teachers, parents, education officers and employers and was a moderate factor from the students’ point of view. Thus teachers and students are challenged to find ways of building positive mathematics attitudes and beliefs and overcoming mathematics anxiety to make it easier to implement the mathematics curriculum. The mathematics syllabus was a strong factor to the students and a moderate one to the teachers, education officers and employers. Since most parents could not be expected to be conversant with the ‘O’ level mathematics syllabus they said little apart from raising the point that most of their children do not like mathematics. Teaching/learning styles emerged as a strong theme from all categories of respondents. This justifies the point that teachers who lack content and pedagogical skills contribute to poor performance of the students. Assessment methods were also considered to be a strong curriculum variable by all respondents except the parents. Parents, employers and students considered career aspirations to be a strong curriculum factor and surprisingly teachers did not mention it. Lack of resources and a school environment which is not conducive were strong factors from parents, teachers and students’ point of view and moderate factors as considered by employers and education officers. Although the themes presented in Table 4.13 are not intended to be
exhaustive, the views from all respondents supported the idea that there is need for a reviewed mathematics curriculum.

Factors affecting mathematics achievement were also raised from different respondent or interviewee levels. They were grouped according to emerging themes and are summarised in Table 4.14.

**Table 4.14: Factors affecting mathematics achievement according to themes and at student, teacher, parent, MEI, SCEI, DEO and employer levels**

<table>
<thead>
<tr>
<th>LEVEL/THEME</th>
<th>Math anxiety and attitude</th>
<th>Lack of resources, school environment</th>
<th>Teacher lack of content and methodology</th>
<th>Peer or parental pressure</th>
<th>Poor curriculm</th>
<th>Low teacher morale/ heavy loads/low salaries</th>
<th>Unfair ZIMSEC practices/poor assessment techniques or strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student</strong></td>
<td>Yes, moderate factor, some students like maths but still find it difficult</td>
<td>Yes, moderate factor</td>
<td>Yes, strong factor, some teachers are not qualified to teach maths</td>
<td>Not mentioned</td>
<td>Syllabus too long, some topics are very difficult and not useful</td>
<td>Teachers are impatient, have negative attitude and are not motivated to teach</td>
<td>Exam shocks students, teachers give corrections without explanation</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>Yes, very important factor according to teachers, many students fear maths and have negative attitude</td>
<td>Moderate factor, no textbooks, large classes, poverty</td>
<td>Factor of little significance according to teachers</td>
<td>To some extent</td>
<td>Syllabus too long, maths difficult to most pupils whose background is weak</td>
<td>Low morale due to heavy loads</td>
<td>Moderate factor, assessment systems not good enough</td>
</tr>
<tr>
<td><strong>Parent</strong></td>
<td>Strong factor, pupils fail due to negative attitude</td>
<td>Moderate factor, shortage of time and relevant textbooks</td>
<td>Inefficient teachers</td>
<td>To a less extent</td>
<td>Maths (syllabus) not likeable by pupils</td>
<td>Teachers have low salaries</td>
<td>Parents are very willing to assist but somelack maths knowledge and skills,</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>MEI, SCEI &amp; DEO</th>
<th>Attitude of most students is negative</th>
<th>Resources not enough to support teaching methodologies</th>
<th>Teachers lack content and methodology skills</th>
<th>Not mentioned</th>
<th>Yes, moderate factor</th>
<th>Teachers to have passion for maths</th>
<th>Exam does not assess practical skills</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Employer</strong></td>
<td>Negative attitude and fear of subject (strong factor)</td>
<td>Not mentioned</td>
<td>Poor coaching technique by teachers</td>
<td>Yes, moderate factor</td>
<td>Pupils lack real life skills</td>
<td>No incentives for teachers</td>
<td>Not mentioned</td>
</tr>
</tbody>
</table>

From the thematic presentation in Table 4.14 it can be observed that mathematics anxiety and attitude were mentioned by all the respondents as factors affecting achievement. Lack of resources emerged as a moderate factor mentioned by all respondents except the employers. Teachers’ lack of content and methodology emerged as an important and strong theme which was mentioned by the students, education officers and employers and emerged as a moderate factor from parents’ point of view. Surprisingly it was a factor of little significance to the teachers implying that they did not want to place the blame of students’ failure onto themselves. Students also did not mention peer pressure as a significant factor affecting their achievement, neither was it mentioned by the education officers. The factor of poor mathematics curriculum emerged as a strong theme from the students, teachers, parents and employers while education officers considered it to be a moderate factor. The issues of low teacher morale, heavy teaching loads and low salaries were raised by all categories of the respondents. Hence the Government should seriously consider uplifting teachers’ conditions of service and increasing their salaries as a way of boosting their efficiency and effectiveness which could also lead to improving students’ performance. Assessment strategies and ZIMSEC systems should also be looked at since teachers, students and education officers raised some concern over them. The themes presented in Table 4.14 may help teachers and students to critique and reflect, respectively, on their teaching and learning since they are the
ones directly concerned with students’ achievement. The themes are not intended to be exhausted and it is suggested that all other stakeholders should actively play their roles.

4.4 Comparison with secondary data

Kothari (2004, p. 95) defines secondary data as “... those which have already been collected by someone else and which have already been passed through the statistical process.” Such data must be reliable, suitable, adequate and precise for the study for which they are to be used (Kothari 2004). This research uses ‘official’ secondary data that are considered to possess Kothari’s characteristics and such data can be found from Zimbabwe Central Statistical Office (now ZimStat), UNICEF, the World Bank, Ministry of Primary and Secondary Education and from articles published in refereed journals. This section gives a brief comparison of such secondary data with the primary data collected by the researcher and presented in this thesis. The purpose for this comparison is to establish whether the two data types correlate and support each other and hence to ‘triangulate’ the results of this study before making recommendations. Some of the issues chosen for comparison and discussion include: student enrolment and pass rates in mathematics, staffing and class sizes, teacher professionalism, resources allocation, the need for mathematics for employment, employers and parents’ roles, and support for the review of the mathematics curriculum.

Staffing, class size, student enrolment and pass rates

Secondary school student enrolment, despite shortage of resources especially in rural areas, has been on the increase. For example, in the Midlands Province the number of secondary schools increased from 237 in 2009 to 238 in 2010 and Form 3 enrolment increased from 185265 in 2009 to 198335 in 2010 while Form 4 enrolment increased from 142440 in 2009 to 179693 in 2010 (ZimStat, 2013a). The number of secondary school teachers in the same
province decreased from 4763 in 2009 to 4706 in 2010. These figures give a pupil to teacher ratio of an average of 1 to 69 in 2009 and 1 to 80 in 2010 for Form 3 and 4 respectively. However, Zimbabwe was facing economic hardships during the period 2007 to 2010. The situation seems to be improving since in Gweru District alone the secondary school enrolment figures for 2014 were 21237 with a staffing establishment of 989 (sourced from the Gweru District Office), making a teacher to pupil ratio of 1 to 22. This is in agreement with the teacher to pupil ratio of 1 to 22 in 2010 for the whole country (ZimStat 2013a). However, in most rural schools (and in some few urban schools), large class sizes of 45 to 50 could be observed. Whether the enrolment or staffing figures are low or high the pass rates in ‘O’ level mathematics have remained low. Examples are 28% for the year 2001 in Zimbabwe (Ottenvanger, van de Akker &de Feiter, 2007), 15% in 2003 in Manicaland Province of Zimbabwe (Nkoma et. al, 2013) and about 13.9% in 2012 as given by ZIMSEC (The Herald, 4 February, 2013). These low pass rates in ‘O’ level mathematics agree with the findings in this study and the problem is exacerbated by the concept of automatic promotion from one Grade/Form to the next (Ottenvanger, van de Akker &de Feiter, 2007, Tshabalala & Ncube, 2013).

**Teacher qualifications and professionalism**

According to Chiwanga cited in Mukeredzi (2013), there were 12713 professionally unqualified teachers in Zimbabwe out of a total of 98446 giving an ‘unqualified teacher’ rate of 12.9%. This seems to be a low rate but most of the teachers, although possessing the academic qualifications for teaching, lack the relevant pedagogy and professionalism to teach mathematics. Some of the teachers, having themselves passed ‘O’ level with C or better still struggle to teach the mathematics content. For example, the topics like transformations and indices and logarithms which some teachers found to be difficult for their pupils
(Dzinotyiweyi & Fleischner, 1995) could also be difficult to the teachers themselves. In this study, some students pointed out that their teachers were harsh and rude and failed to explain concepts well. Such teachers may lack professionalism and if it is coupled with lack of mathematics content and methodology, the teachers become very ineffective. Although workshops are normally run in schools to develop the teachers, they are less effective if those teachers lack morale which is the ‘magic behind teacher performance’ (Uma Devi & Mani, 2010), and the proper philosophical mindset or good habits of mind (Tuge, 2008).

**Mathematics for employment, employers’ and parents’ roles**

Viewing mathematics as very difficult and yet very important and necessary for employment may worsen the situation for the student. In their study Tshabalala and Ncube (2013) found out that most students in rural secondary schools in Nkayi (Zimbabwe) would not do mathematics if it was not a compulsory requirement for employment. The unemployment rate for people of 15 years and above in 2011 was 24% for the Midlands province and 30% for Zimbabwe as a whole (ZimStat, 2013b). However according to Government of Zimbabwe’s ZimAsset (2013) unemployment in Zimbabwe remains high at 50%. Looking at economic production, the student population has the highest percentage of economically inactive people (comparing with the retired, sick or old and the homemaker) of which 57.9% was for males and 36.4% for females with those in the urban areas being more economically inactive than their counterparts in the rural areas (ZimStat, 2013b). The researcher considers this as a waste of human capital.

Student learning should not be divorced from students’ practical work which should in turn bring about financial and economic benefit to the student, his/her parents and the community at large. Hence in mathematics learning, students can produce ‘mathematical artefacts and equipment’ or even ‘ideas’ for sale or for employment creation in the communities. Most
employers in this study pointed out the link between mathematics and money and mathematics and productivity and these should not be divorced from one another. They suggested giving prizes for bright mathematics students, giving incentives to teachers and working together and forming partnerships with schools. In this study parents considered mathematics as very important for use in daily lives, for employment purposes and for the development of the country at large. The parents suggested how they could help their children to do well in mathematics and said the Government should also provide the necessary time and resources and also employ qualified and dedicated teachers. Thus parents have a role to play in the education of their children and should not be left out in any curriculum review process.

Resource allocation

Poor achievement in mathematics seems to be a continuous phenomenon considering that most of the schools in Zimbabwe are poor and that poverty has been a penalty for most students and has impacted negatively on their achievement (Vurayai, 2012). However, people should be optimistic and find a way out. Since every new innovation can be costly and the resources are already scarce, careful planning and optimal utilization of those resources should be on the agenda for the achievement of empowerment and employment creation (Government of Zimbabwe, 2013). Many teachers and students in this study mentioned the issue of shortage of resources for teaching and learning but as suggested in Government of Zimbabwe’s ZimAsset (2013), the problems can be solved and Zimbabwe can forge ahead again. In mathematics teaching and learning careful planning, creativity, innovation and optimal resource use and allocation should also be done.

The need for a new mathematics curriculum
From the assessment point of view, Ottenvanger, van de Akker and de Feiter (2007) allude to the report given on Zimbabwe that absence of a practical examination for science students can lead to theorizing of practical work and lack of hands-on practical activities. However, ZimStat (2013a) says that the idea of education with production is incorporated in all subjects in the secondary school curriculum as a way of offering the students opportunities to develop their skills and talents for the benefit of themselves and their communities. Whether schools are actually implementing the concept of EWP, how and to what extent is not yet clear. In this research, the majority of respondents and interviewees pointed out the mismatch between theory and practice in mathematics assessment systems and in mathematics teaching and learning. Some students pass examinations but cannot apply the mathematics skills and concepts in the field of work and would need to be trained again. This scenario cannot be good for the economic, scientific and technological development of the country as the Nziramasanga Commission (1999) have also observed. According to Government of Zimbabwe’s ZimAsset (2013), capacity utilization in the manufacturing sector in Zimbabwe has declined from an average of 57% in 2011 to 44% in 2012 and 39% in 2013. The country’s gross domestic product (GDP) has also declined from 11.9% in 2011 to 10.6% in 2012 and 3.4% in 2013 (Government of Zimbabwe, 2013). Thus Government intends to fund public utilities in schools, hospitals and other social amenities with the idea of creating employment for the youth (Government of Zimbabwe, 2013). In this regard the concept of EWP and linking theory with practice in all school subjects including mathematics will also help create employment for the youth and increase the country’s economic production. The current secondary mathematics curriculum does not seem to support the practical implementation of these ideas, hence the need for a new policy on secondary mathematics education.

4.5 Chapter summary
Since the mixed methods approach was used in this study, data were presented, analysed and interpreted from both the quantitative and qualitative perspectives. The quantitative data were collected from students, teachers, MEI, SCEI, and the DEOs from the two districts which were sampled, namely Shurugwi and Gweru. These quantitative data were in the form of ‘O’ level students’ mathematics achievement scores, ‘O’ level students’ questionnaire rating scores, ‘O’ level mathematics teachers’ questionnaire rating scores and also rating scores calculated from the MEI, SCEI and DEO’s questionnaire instruments. The items which were rated were the views on the syllabus, teaching and learning methods, assessment methods, students’ mathematics anxiety and students’ career aspirations. These data types were subjected to statistical analyses using SPSS version 16.0. Means and standard deviations of subgroups were calculated and analysed and t-tests, chi square tests, ANOVA and regression trials were also run.

A causal comparative analysis that was done produced results which confirmed the research assumptions that ‘O’ level students’ mathematics achievement was low, that mathematics is very important for the country’s development and for students’ recruitment to careers. The results also revealed that the mathematics syllabus, teaching and learning approaches and assessment techniques were negatively viewed. Qualitative data were collected from various sources such as the ‘O’ level mathematics syllabus document, open ended sections in the ‘O’ level students’, the teachers’ and the education officers’ questionnaire instruments, from focus group discussions with students, from interviews with parents and from interviews with employers. These qualitative data types were presented in point form with percentages for each point raised and in narrative and tabular forms. Analysis of the qualitative data was done by searching for common points from the different groups of respondents and discussants, by looking for points with highest percentage ratings and by considering the given ideas and opinions as emerging themes (c/o Tables 4.13 and 4.14). Relevant secondary data were
collected from ‘official’ sources such as Ministry of Primary and Secondary Education, ZimStat, UNICEF, and the World Bank.

A critical analysis and triangulation of results from the quantitative, qualitative and secondary data led to the interpretation that the majority of the respondents were in favour of a review of the whole mathematics curriculum. Although there was a general consensus to change the syllabus, textbooks, teaching and learning methods and assessment methods, there was no clarity on the exact ‘nitty-gritties’ to include in this new curriculum. The Ministry of Primary and Secondary Education has now initiated a review of curricula for all subjects but again the final document is not yet out and teachers and students are still using the old curricula. It would be interesting to find out what the Ministry of Primary and Secondary Education’s position would be regarding the mathematics curriculum and whether it would incorporate the suggestions proposed in this study. The next chapter concludes this thesis by giving a summary of the findings, recommendations and proposals on the new mathematics curriculum and new policy on mathematics education.
CHAPTER FIVE
SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Chapter 5 is the last chapter in this thesis. It firstly gives an overview or summary of the whole thesis or ‘journey’ of this research. Major findings from both quantitative and qualitative data which were collected are then given followed by the conclusions and recommendations. The recommendations are gleaned from the suggestions given by the education stakeholders and such stakeholders for this study were the students, teachers, parents, district education officers, subject education inspectors and employers. The chapter then ends with specific recommendations and proposals on the new ‘O’ level mathematics curriculum and the new policy on mathematics education.

5.2 Thesis summary

In the background to the study in Chapter 1, the researcher pointed out the weaknesses of the current ‘O’ level mathematics curriculum by giving examples such as low pass rates and high
unemployment rates. From the initial proposal of this research, it was the researcher’s desire to use evaluation research techniques to explore these weaknesses and find appropriate solutions. Rossi and Freeman (1993, p.3) define evaluation research as “... a robust arena of activity directed at collecting, analysing, and interpreting information on the need for, implementation of, and effectiveness and efficiency of intervention efforts to better the lot of human kind.” Thus the researcher became interested in embarking on this research using the pragmatist perspectives or mixed methods approaches as ways of contributing to missing gaps in the mathematics curriculum and also as a way to contribute to methodological social science knowledge (Rossi & Freeman, 1993).

The original working title of the thesis was “An evaluation of the Zimbabwe ‘O’ Level Mathematics curriculum: How does it relate to the students’ career aspirations?” but was later changed to the current title: “The Zimbabwe ‘O’ Level Mathematics Curriculum and Students’ Career Aspirations in Shurugwi and Gweru Districts, Midlands Province: A Causal Comparative Analysis.” However, there were minor changes to the research questions and objectives which aimed at addressing, among other things, why students continued to fail this subject of high importance, usefulness and esteem. The research questions and objectives also aimed at addressing whether the teaching and learning techniques were appropriate, relevant and effective. The thesis objectives went on to look at how the ‘O’ level mathematics curriculum could meet the needs of individual learners, societal goals and the national and economic challenges facing the country. Using causal comparative analysis, it was intended therefore, to establish whether there was a link or not between the mathematics curriculum and students’ career aspirations. The complex nature of the research problem resulted in focusing on some ‘expertly’ selected important stakeholders in the education system, namely students, teachers, parents, education officers/inspectors and employers in
Gweru and Shurugwi districts of the Midlands Province. The research also focused at using a variety of data gathering instruments and procedures.

In chapter 2 several evaluation models were discussed but Kirkpatrick’s four-level model and the EWP model were chosen to provide a conceptual framework for this research. Social constructivism was also chosen as the theoretical framework for the research because it helps people to generate or construct their own mathematical knowledge, be it subjective knowledge or objective knowledge. This mathematical knowledge which is created should help in the development and well-being of the individual and the society at large. According to Ernest (2004, p.42), social constructivism also “... takes from quasi-empiricisms fallibilist epistemology, including the view that mathematical knowledge and concepts develop and change.”Review of related literature also included factors affecting achievement, mathematics anxiety, career aspirations and employer expectations of students. Chapter 3 discussed the research methodology and justified why the mixed methods approach was used. Within the mixed methods approach, the quasi-experimental design was also used. Issues of sampling, choice and design of instruments, reliability, validity, and ethical and legal considerations were also explained.

Chapter 4 presented the quantitative and qualitative data that were collected. Quantitative data were analysed using means and standard deviations, t-tests, chi square tests, ANOVA and regression analyses models. Qualitative data were analysed both quantitatively and qualitatively by calculating percentage ratings of respondents’ views or suggestions and by grouping the ideas into themes which were then tabulated. Secondary data were also compared or triangulated with the quantitative and qualitative data types.

Chapter 5 then discussed the findings, conclusions and recommendations.
5.3 Summary of findings
As mentioned earlier, results of this study emanated from various sources such as students, teachers, parents, education officers and inspectors in Shurugwi and Gweru districts of the Midlands province, and employers sampled from Gweru district. Questionnaires, test, interviews, focus group discussions and documentary analysis were used to collect relevant data. The data were used to establish and explain correlations and associations (causal comparative analysis) and possible cause and effect relationships (regression analysis).

The results did confirm the assumptions of the study which were that:

- Many secondary school students fail mathematics and have negative attitude towards it,
- Mathematics influences students’ choice of career and prospects for employment more than other subjects,
- Parents and employers value mathematics more than other subjects,
- The teaching of mathematics is more problematic than any other subject, and
- There is urgent need to review the Zimbabwe ‘O’ level mathematics curriculum.

The first assumption was confirmed more from responses given by teachers, parents and education officers and less by the students themselves as verified by the moderate mathematics anxiety rating scores of the students. So the high failure rate could not be attributed to attitude and anxiety factors only although they do play a major role. The assumption that students fail mathematics in large numbers was also confirmed with boys averaging 40.3% and girls 39.3% in the test. Poor performance was witnessed more in the rural, day, government, and ‘non 6th form’ schools than in the other categories of schools. Most of the mathematics teachers in the sample were highly qualified (71.5% having a bachelors’ degree) and of a relatively young age (31-40 years). Hence it should be noted that
it is not only how well the teacher is academically qualified that leads to better student performance but it could also be due to other teacher characteristics such as attitude, morale, professionalism and methodological skills.

On the issue of careers and occupations it was discovered that the majority of the students’ parents were of medium to low income and of low social economic status. Many students would not choose their parents’ or guardians’ occupations since there was a large variance between the average occupations of the parents (average rating of 4.0 for father and 3.3 for mother) and the jobs the students would want to do after leaving school (average rating of 8.5). The students had high career aspirations with some aspiring to become managers, accountants, economists, scientists and doctors. The students also believed mathematics to be very important and useful for their ‘dream job’ more than other subjects. For example, one student wrote on his questionnaire, “I think maths is the most[sic] subject needed for jobs,” and another wrote, “without maths one is as good as a foetus.” These sentiments should not be taken lightly as they reflect not only the views of the students but possibly those of their teachers and the society at large.

The parents and employers proved to be important and concerned stakeholders because they voiced their concerns about students having too much book knowledge but little hands-on experience necessary for the world of work. Parents believed mathematics to be very important for the country’s development and for the companies’ productivity. They gave suggestions on how they could assist their children to do well in mathematics and also suggested that the government had a larger role to play in terms of teacher training and provision of resources. Employers had the same sentiments as those of the parents; some suggesting forming partnerships with schools, offering attachments and prizes to students and incentives to teachers. Some of the employers attributed the question of requiring five or
more ‘O’ level passes before recruitment to Government policy while others considered it as a company screening exercise. In general, the assumption that parents and employers value mathematics more than other subjects was also confirmed.

The ‘O’ Level Mathematics syllabus was viewed with mixed feelings by the education inspectors and officers, with mixed to negative feelings by the teachers and with strong negative feelings by the students. Among other weaknesses, the syllabus was considered to be too long, to have too difficult topics, to have some irrelevant topics and not to cater for both the weaker and the stronger student. Suggestions to put in place proper assessment systems were echoed and this is supported by the case of 2014 ZIMSEC mathematics examination paper leakages as cited in this study (e.g. *The Herald*, November 12, 2014). Teachers, education officers and inspectors also had views suggesting that the mathematics curriculum was somehow amiss. Students, parents and employers pointed weaknesses of the mathematics curriculum such as mismatch between theory and practice, teachers’ lack of appropriate content knowledge, pedagogic knowledge and professionalism. Thus the teaching of mathematics seemed to be more problematic than other subjects and the fourth assumption of this study was confirmed.

Students in poorer performing schools (ie. in rural areas, day, government and ‘no 6th form’ schools vis-a-vis urban, boarding, mission, and 6th form schools) generally had higher mathematics anxiety and lower career aspirations than their counterparts. There was also a significant moderate correlation between STDMA and STDASSTECH (r=0.62) suggesting that if the issues of anxiety and assessment are not addressed, students might continue to fail and drop mathematics in large numbers. Students in the less privileged circumstances should therefore receive more career guidance and counselling and more resource allocation than their counterparts. T-tests, chi-square tests and linear regression models which were tried also
confirmed the significant differences and relations between the chosen variables (c/o Tables 4.7 to 4.12).

On documentary analysis of the ‘O’ level syllabus it was observed that the philosophy of socialism was chosen (item 2.3 under Syllabus Aims) but how this could be achieved was not clear. Assessment was not linked to the concept of EWP. Thus if Donald Kirkpatrick’s four-level model or New World Model of evaluation (Kirkpatrick Partners, 2013), is used as a checklist, the mathematics curriculum fails to meet the features of transfer of training, strong business partnerships, and maximising results and productivity. The history of mathematics was left out and the use of computers was also not clearly specified in the mathematics syllabus document.

Focus group discussions were carried out with ‘O’ level students in the various schools which where visited. The students voiced their concerns and these generally tallied with what they gave in the open ended sections of the questionnaires. For example, the need for teacher professional development or ‘capacitation’ cropped up in both the FGD and the questionnaires. It was also observed that the Holland Code (Green, 2010, University of Missouri, 2010) was a useful guide to explore further the career aspirations of the students. The students wrote the jobs they would want to do after leaving school and the results were coded and analysed. It was found that all the students fitted well into each of the REALISTIC, INVESTIGATIVE, ARTISTIC, SOCIAL, ENTERPRISING and CONVENTIONAL categories. However, these were just the ‘dream jobs’ and career aspirations of the students. The actual mathematics curriculum in use did not seem to support these ‘dream jobs’ and career aspirations. Thus there is urgent need to review the Zimbabwe ‘O’ level mathematics curriculum and the fifth assumption was confirmed.

The following research questions were also asked in this study:
1. How relevant is the current ‘O’ level mathematics curriculum?

2. How do ‘O’ level students’ career aspirations relate with their mathematics achievement?

3. How do employers view post-‘O’ level students’ mathematical knowledge and skills in relation to their performance and productivity in the field of work?

4. Should the Government come up with a national policy on an ‘O’ level mathematics curriculum that links classroom-gained knowledge with students’ careers?

5. What curriculum model would be best suitable for national ‘O’ level mathematics?

In short, the following are provided as answers to these research questions:

1. The relevance of a curriculum can be assessed by analysing its strengths and weaknesses. The strengths of the ‘O’ level mathematics curriculum are that every child is given the opportunity to learn mathematics as evidenced by growing enrolment and an increase in the number of schools and teachers. Mathematics is offered in all ‘O’ level schools as a curriculum subject and there is no discrimination according to gender, race, tribe, district or geographical location. As investigated by Chinhanu (1997) most of the topics had utilitarian value and this is still the case as the curriculum content has not been reviewed since then. However, these strengths were outnumbered by the weaknesses as alluded to in Chapter 2 (Section 2.5) and by evidence from the statistics and views given in Chapter 4. Hence it was found that the current ‘O’ level mathematics curriculum is not relevant for Zimbabwean students.

2. ‘O’ level students view mathematics as very important in life situations and for their careers. However, there are many barriers to their achievement, among them being the
shortage of time and resources, incompetent and unprofessional teachers and the question of perceived difficulty of the subject resulting in fear and negative attitude to it. Employers too impose their restrictions and screening criteria on the ‘O’ level school leavers. Most students’ chances of entry into the job market are therefore weakened. Students have very high career aspirations but their mathematics achievement is too low. Most students perform below the 40% score.

3. Employers view post-‘O’ level students’ mathematical knowledge and skills as very critical to their performance and productivity in the work place. The employers consider people with passes in Mathematics to be critical and creative thinkers, problem solvers and business minded people. Employers relate mathematics to money, profit and economic development. Therefore most employers would consider recruiting post-‘O’ level students with good passes in mathematics rather than those without.

4. The Government should come up with a national policy on an ‘O’ level mathematics curriculum that links classroom-gained knowledge with students’ careers because it will lead to economic, scientific and technological development of the country.

5. The curriculum model that would be best suitable for national ‘O’ level mathematics is the one linked to the concept of education with production whereby students construct their own mathematical knowledge and practically apply that knowledge to solve real life challenges faced in their communities. The proposed curriculum model and components of a national policy on the ‘O’ level mathematics curriculum are outlined in the recommendations of this study.
Having addressed the assumptions and providing answers to the research questions, the following general conclusions are made.

5.4 Conclusions

The word curriculum has different meanings to different education stakeholders. To some it means syllabus, to others topics or content while to yet others it has a wider meaning. In this research “the ‘O’ level mathematics curriculum’ meant everything that is associated directly or indirectly with the teaching and learning of mathematics at Form 3 and Form 4 levels of the Zimbabwe education system. The study was however restricted mainly to Form 4 students, their teachers, parents, education officers and inspectors in two chosen districts in the Midlands province. Employers were also involved since they count a lot regarding students’ hand-on skills or attachments, career aspirations and employability after leaving school. The study concluded the following:

5.4.1. The current mathematics curriculum is outdated and not relevant to the needs of society and Zimbabwe’s current studentship. It does not tally with the country’s vision and philosophy.

5.4.2. A curriculum that only ‘ends’ at school level and has no direct link with the future of the students is not the best one. It is necessary to come up with a new ‘O’ level mathematics curriculum model.

5.4.3. The Government of Zimbabwe does not have a policy on mathematics education and yet the study of mathematics in schools is necessary for the economic and technological development of the country.
5.4.4. Although this study was conducted in two districts in the Midlands province of Zimbabwe, it is concluded that the data could be comparable and generalisable to other similar districts and to the country at large.

Evidence from the ‘causal comparative analysis’ and from the findings in this study is necessary to help in the formulation of recommendations to address significant differences which were observed. It is against the findings and conclusions of this study that the following recommendations are made.

5.5 Recommendations

5.5.1 Proposed new ‘O’ level mathematics curriculum

It is hereby recommended that the Zimbabwe Ministry of Primary and Secondary Education should design a new ‘O’ level mathematics curriculum document in consultation with major education stakeholders such as students, teachers, parents, employers, education officials and textbook writers. This curriculum document should be more than just a list of topics in the syllabus. It should include components such as the following:

5.5.1.1 A short description of the philosophy of mathematics education and the country’s educational vision, mission statement and core values. Mathematics education in Zimbabwe should be based on principles of constructivism and ‘ubuntuism’ - belonging, sharing rights and responsibilities, participation and solidarity, love and friendship, individuals as part of groups/communities, culture, communication and spirituality (Zimbabwe Sector Plan, 2013).

5.5.1.2 Mathematics content: The current topics are alright as they are but they should be shortened, well sequenced, and not repeated unnecessarily. In short the topics should be coherent, have adequate depth and emphasis on proficiency (National Mathematics
Advisory Panel, 2008). In the current list of topics should be included a brief history of mathematics (appropriate for each topic and Grade/Form level) and use of computers and calculators (and even the cell phone) to model and solve problems.

5.5.1.3 Considering that students have different abilities and interests, the syllabus should be split into two components: Core Mathematics for the average performers and Extended Mathematics for the more talented students. Students should also be allowed to choose the kind of mathematics learning outcomes that relate to their career aspirations. For example, Munikwa (2011, p. 25) citing Mahere (2006) and also borrowing from the Nziramasanga Commission (1999), proposes the two path-way system whereby, “the student is expected to pursue one of the following options at Form 3 level:

**Option 1:** General/Academic Core Subjects (Business/Commercial as a **major** (at least two subjects) and one subject (**elective**) from Technical-Vocational).

**Option 2:** General/Academic Core subjects (Technical-Vocational as a **major** (atleast two subjects) and one subject (**elective**) from Business/Commercial) while also in forms 3 and 4, all students are expected to do a course in Computer Studies.”

5.5.1.4 Learning outcomes: These should be derived from the objectives as enshrined in the constitution of Zimbabwe. For example, the learning outcomes should be related to aspects of good governance, national unity, peace and stability, national development, national culture, empowerment and employment creation (COPAC, 2013).

5.5.1.5 Material resources and time frames: Types and quality of textbooks, computers, calculators, teaching/learning media and time to complete different topics and/or the whole syllabus should be clearly stipulated.

5.5.1.6 Teaching and learning methodologies: These should include student and teacher interpretations of the syllabus, group work and team teaching, active participation and
reflection. Indigenous knowledge systems should be explored and referred to as much as possible. There should be open dialogue on how to reduce mathematics anxiety and build positive attitude towards mathematics. Several techniques to that effect have been documented in this study (Section 2.7.2). Both students and teachers should document their learning and teaching in official documents (pupils’ exercise books and teachers’ schemes of work) as well as in private reflective journals.

5.5.1.7 Assessment methodologies. These should be theoretical as well as practical oriented. Both summative and continuous assessment should be used to arrive at an average score. Assessment techniques should include individual class work, group work, homework, project work and field work. Students’ project work and field work should result in goods and services that can generate income for the student, the school and the society at large. Here employers are key stakeholders and should work together with the teachers involved in students’ attachment and then assessment thereof. This would be in line with constructivist and education with production principles.

Mathematicians and mathematics education experts should be called in to add ‘flavour’ to this ‘O’ level mathematics curriculum framework and then produce a document for public scrutiny, review and possible implementation.

5.5.2 Proposed new policy on mathematics education

The above recommendations (Section 5.5.1) relate only to ‘O’ level mathematics. The Government, through the Ministry of Primary and Secondary Education should design and make a mandatory policy on mathematics education available in all the public schools and private institutions offering mathematics education to Zimbabweans. This policy should have the following characteristics and components:
5.5.2.1 The preamble: This should briefly articulate Zimbabwe’s history and culture and the chosen philosophy which guides the country’s vision, mission and long term goals. As explained before, a blend of social constructivism, education with production and ‘ubuntuism’ could be the chosen philosophy for mathematics education in Zimbabwe.

5.5.2.2 The national curriculum statement on mathematics education. This should be in line with the national objectives as stipulated in the Constitution of the country.

5.5.2.3 The subject nature, importance and relevance of mathematics should be well articulated in the policy document.

5.5.2.4 The content and learning outcomes appropriate at each Grade and Form level should be clearly broken down and specified.

5.5.2.5 Assessment standards appropriate for each Grade and Form level should be clearly outlined. The question of automatic promotion should be adequately addressed by making clear policy guidelines on promotion, repetition, transfer and learning support (National Institute for Education Development, 2011) and on grading.

5.5.2.6 Use of resources including textbooks, textbook selection, teaching and learning media appropriate for each Grade and Form level should be clearly explained. Experts should be tasked to write the relevant and appropriate textbooks and to prepare other teaching and learning materials.

5.5.2.7 The language policy: There should be clear guidelines on the language of instruction and the language of learning. It is proposed that there should be no strict restrictions on the use of English as the sole language of instruction and learning. It is recommended that the local language/mother tongue be used in the writing of mathematics textbooks and gradually become the language of instruction and the language of learning and assessment. [This may take time since people have been ‘addicted’ to English for quite a long time].
5.5.2.8 Teacher expectations and professional development: The students and the society at large expect teachers to deliver the best services without fear or favour. The teachers are human beings too and their conditions of service should be addressed so as to boost their morale. It is recommended that all practising mathematics teachers should undergo regular in-service training which would focus on patriotism, dedication to duty, delighting stakeholders, adherence to highest levels of ethical standards and professionalism and acquisition of further mathematics content knowledge and pedagogic knowledge. Those enrolling in teacher training colleges and universities should be exposed to similar courses. Best performers in teacher professionalism should be rewarded and those found to be performing below minimum standards should be given warnings after which they may be asked to leave the profession. The lost high status of the teacher in society should be reinstated.

5.5.2.9 Student expectations and roles: There should be clear policies on how to deal with student indiscipline and negative attitude to school work. It is recommended that qualified school counsellors or career guides should be employed to professionally deal with student-related issues such as overcoming mathematics anxiety, study skills and making good career choices. As the saying “spare the rod and spoil the child” goes, the issue of caning school children who misbehave should not be completely done away with but should be re-examined and made into a policy that benefits both the student and the teacher.

5.5.2.10 Expectations and roles of other stakeholders: Expectations and roles of parents, employers and other education authorities should also be clearly stipulated in this policy document.
The proposed ‘O’ level mathematics curriculum content and proposed national policy on mathematics education as outlined above may be summarised as a model in the diagram below:

Fig 3: Researcher’s Proposed ‘O’ level Mathematics Curriculum Model
5.6 Chapter summary

This chapter has given a brief summary of the whole thesis by explaining what prompted the researcher to embark on this study. Choices of the appropriate methodology and instruments were made and justified and these are explained in the relevant chapters of the thesis. Data were presented and analysed in chapter four and major findings were again highlighted in chapter 5. The assumptions of the study were confirmed. For example, the respondents and interviewees in the study agreed that the ‘O’ level mathematics curriculum needed review and recommendations on how to do it were presented in this study. Objectives of this research were also achieved but it should be noted, as they say in Shona language that, “chara chimwe hachitswanyi inda.” Literally it means one finger alone cannot kill a louse. With reference to this research it means that it needs all stakeholders to work together with the same spirit, energy, zeal and ‘habit of mind’ to make things work. As the Ministry of Primary and Secondary Education has already spearheaded initial stages to review the whole school
curricula, findings and recommendations of this study could also be of great benefit to them. It will need further research to find out what the contents of this ‘new school curricula’ would be and also how it would be implemented. This thesis has contributed a foundation on which comparisons between the Ministry’s ‘new’ mathematics curriculum and the researcher’s ‘new’ mathematics curriculum could be made. This thesis has also contributed to new knowledge on any missing gaps and relationships regarding challenges of curriculum design and implementation and further research in these areas are recommended. Zimbabwe can once again become the food or ‘bread basket’ of Southern Africa and also the ‘giant’ of Southern Africa in terms of technological and economic productivity and development. Education (including Mathematics) is the weapon to achieve this.
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APPENDICES

Appendix A: The ‘O’ Level Mathematics Syllabus

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL (ZIMSEC)
ZIMBABWE GENERAL CERTIFICATE OF EDUCATION (ZGCE)
For Examination in November 2012 – 2017
O Level Syllabus
MATHEMATICS (4008/4028)

Subjects 4008/4028 MATHEMATICS
4008. This version is for candidates not using calculators
4028. This version is for candidates using calculators in Paper 2

1.0 PREAMBLE
This syllabus caters for those who intend to study mathematics and/or related subjects up to and beyond ‘O’ level and for the mathematical requirements of a wide range of professions. The syllabus assumes the mastery of the Z.J.C. mathematics syllabus. The syllabus is in two versions 4008 and 4028. Syllabus 4008 is the non-calculator version and syllabus 4028 is the calculator version.

2.0 THE SYLLABUS AIMS
To enable pupils to:
2.1 understand, interpret and communicate mathematical information in everyday life;
2.2 acquire mathematical skills for use in their everyday lives and in national development;
2.3 appreciate the crucial role of mathematics in national development and in the country's socialist ideology;
2.4 acquire a firm mathematical foundation for further studies and/or vocational training;
2.5 develop the ability to apply mathematics in other subjects;
2.6 develop the ability to reason and present arguments logically;
2.7 develop the ability to apply mathematical knowledge and techniques in a wide variety of situations, both familiar and unfamiliar;
2.8 find joy and self-fulfilment in mathematics and related activities, and appreciate the beauty of mathematics;
2.9 develop good habits such as thoroughness and neatness, and positive attitudes such as an enquiring spirit, open-mindedness, self-reliance, resourcefulness, critical and creative thinking, cooperation and persistence;
2.10 appreciate the process of discovery and the historical development of mathematics as an integral part of human culture.

3.0 ASSESSMENT OBJECTIVES
Students will be assessed on their ability to:
3.1 recall, recognise and use mathematical symbols, terms and definitions;
3.2 carry out calculations and algebraic and geometric manipulations accurately; check the correctness of solutions;
3.3 estimate, approximate and use appropriate degrees of accuracy;
3.4 read, interpret and use tables, charts and graphs accurately;
3.5 draw graphs, diagrams and constructions to given appropriate specifications and measure to a suitable degree of accuracy;
3.6 translate mathematical information from one form into another (e.g. from a verbal form to a symbolic or diagrammatic form);
3.7 predict, draw inferences, make generalisations and establish mathematical relationships from provided data;
3.8 give steps and/or information necessary to solve a problem;
3.9 choose and use appropriate formulae, algorithms and strategies to solve a wide variety of problems (e.g. agriculture, technology, science and purely mathematical contexts);
3.10 apply and interpret mathematics in daily life situations.

4.0 NOTES
4.1 MATHEMATICAL TABLES AND ELECTRONIC CALCULATORS
Mathematical tables and electronic calculators are prohibited in 4008/1 and 4028/1. However, the efficient use of mathematical tables is expected in 4008/2 and the efficient use of electronic calculators is expected in 4028/2. In 4028/2 mathematical tables may be used to supplement the use of the calculator. Mathematical tables will be provided in the examination. A scientific calculator with trigonometric functions is strongly recommended.

4.2 MATHEMATICAL INSTRUMENTS
Candidates are expected to bring their own mathematical instruments to the examination. Flexicurves are not allowed.

UNITs
4.3.1. SI units will be used in questions involving mass and measures; the use of the centimetre will continue.
4.3.2. The time of day may be quoted by using either the 12-hour or the 24-hour clock, e.g. quarter past three in the morning may be stated as either 3.15 a.m. or 03 15; quarter past three in the afternoon may be stated as either 3.15 p.m. or 15 15.
4.3.3. Candidates will be expected to be familiar with the solidus notation for the expression of compound units e.g. 5 cm/s for 5 centimetres per second, 13/g cm$^3$ for 13 grams per cubic centimetre.

5.0 METHODOLOGY
In this syllabus, teaching approaches in which mathematics is seen as a process and which build an interest and confidence in tackling problems both in familiar and unfamiliar contexts are recommended. It is suggested that:
5.1 concepts be developed starting from concrete situations (in the immediate environment) and moving to abstract ones;
5.2 principles be based on sound understanding of related concepts; and whenever possible, be learnt through activity based and/or guided discovery;
5.3 skills be learnt only after relevant concepts and principles have been mastered;
5.4 the human element in the process of mathematical discoveries be emphasised;
5.5 an effort be made to reinforce relevant skills taught in other subjects;
5.6 pupils be taught to check and criticise their own and one another's work;
5.7 group work be organised regularly;
5.8 a deliberate attempt be made to teach problem-solving as a skill, with pupils being exposed to nonroutine problem solving situations;
5.9 pupils be taught to identify problems in their environment, put them in a mathematical form and solve them e.g. through project work.
6.0 CONTENT/TEACHING OBJECTIVES

TOPIC OBJECTIVES
All pupils should be able to:

6.1 NUMBER
6.1.1. Number concepts and operations, number types (including: directed numbers, fractions and percentages)
- demonstrate familiarity with the notion of odd, even, prime, natural, integer, rational and irrational numbers, including surds,
- use of the number line;
- recognise equivalence between common/decimal fractions and percentages, convert from one to the other and use these three forms in appropriate contexts;
- use directed numbers in practical situations (e.g. temperature, financial loss/gain);
Factors, multiples, HCF, LCM
- find and use common factors/multiples, HCFs and LCMs of given natural numbers;
The four operations (+, -, ×, ÷)
- apply the four operations and rules of precedence on natural numbers, common/decimal fractions, percentages, integers, surds and directed numbers (including use of brackets);

6.1.2. Approximations and estimates
- use the approximation sign (\(\approx\), \(\cong\), \(\approx\)) appropriately
- make estimates of numbers and quantities, and of results in calculations;
- give approximations to a specified number of significant figures and decimal places;
- round off to a given accuracy;
- round off to a reasonable accuracy in the context of a given problem;

6.1.3. Limits of accuracy
- obtain appropriate upper and lower bounds to solutions of simple problems given data to a specified accuracy (e.g. calculation of area of a rectangle).

6.1.4. Standard form
- express in, and use the standard form \(A \times 10^n\) where \(n\) is an integer (including zero) and \(1 < A < 10\);

6.1.5. Number bases, do the following:
Bases 2, 3, 4, 5, 6, 7, 8, 9 and 10,
- state and use place value;
- add and subtract;
- convert from one base to another;

6.1.6. Ratio, proportion and rates
- use ratio, direct and inverse proportion (including use of unitary method) and rates (e.g. speed, cost per unit area);

6.1.7. Scales and simple map problems
- find scales from given information;
- use given scales to calculate distances and areas;

6.2 SETS
6.2.1. Language and notation
Definition of a set
- define sets by listing and describing e.g., \( V = \{a, e, i, o, u\} \) or \( V = \{\text{vowels}\} \);
- define sets using the set builder notation e.g. \( A = \{x: x \text{ is a natural number}\}, B = \{(x, y): y = mx + c\} \), 
  \( C = \{x: a < x < b\} \)

Notation, correctly use symbols as follows:
- is an element of, \( \in \),
- is not an element of, \( \notin \),
- number of elements in set A, \( n(A) \),
- complement of set A, \( A^\prime \),
- the universal set, \( \xi \),
- the null set, \( \{\} \) or \( \emptyset \).
- A is a proper subset of B, \( A \subset B \),
- A is contained in B, \( A \subseteq B \),
- B contains A, \( B \supseteq A \)
- A is a subset of A, \( A \subseteq A \),
- is a subset of A, \( B \subseteq A \),
- union of A and B, \( A \cup B \)
- intersection of A and B, \( A \cap B \)
- use the idea of complement of a union or an intersection;
- use the following symbols, \( \subseteq, \supseteq, \notin, \text{ and } \emptyset \),
- use sets and Venn diagrams to solve problems involving no more than three sets and the universal set;

6.3 CONSUMER ARITHMETIC
6.3.1.
- interpret data (including data on real life documents like water/electricity bills, bank statements, mortgages and information in the media);
- solve problems on budgets (e.g. household, cooperative and state budgets), rates (including foreign exchange and household rates), insurance premiums, wages, simple interest, discount, commission, depreciation, sales/income tax, hire purchase and bank accounts (savings and current accounts);
- read, interpret and use data presented in charts, tables, maps and graphs (e.g. ready reckoners, road maps, charts and graphs in newspapers);

6.4 MEASURES AND MENSURATION
6.4.1. Measures
Time - read time on both the 12 and 24 hour clock (e.g. 7.35 p.m or 19:35).
SI units - use SI units of mass, temperature in degrees celsius, length/distance, area, volume/capacity and density in practical situations,
- express quantities in terms of larger or smaller units;

6.4.2. Mensuration
- carry out calculations involving:
  perimeter - the perimeter and area of a rectangle, triangle, parallelogram and trapezium;
  the circumference of a circle and the length of a circular arc;
  density – density
  area - the area of a (circle including sector and segment); rectangle, triangle, parallelogram and trapezium.
volume/capacity - the surface area and volume of a cylinder, cuboid, prism of uniform cross-section, pyramid, cone and sphere; (formulae for surface areas and volumes of pyramid, cone and sphere will be provided); (units of area to include the hectare);

6.5 GRAPHS AND VARIATION
6.5.1. Coordinates - use Cartesian coordinates in two dimensions to interpret and infer from graphs and to draw graphs from given data;

6.5.2. Kinematics
travel graphs, distance/displacement, acceleration
- draw and interpret displacement-time and velocity-time graphs and solve problems involving acceleration, velocity and distance.

6.5.3. Variation
direct, inverse, joint, partial variation;
- express direct, inverse, joint and partial variation in inverse algebraic terms and hence solve problems in variation;
- draw and interpret graphs showing direct, inverse and partial variation

6.5.4. Functional graphs
- construct tables of values, draw and interpret given functions which include graphs of the form \( ax^2 + bx + c = 0 \), \( y = mx + c \), \( y = ax^2 + bx + c \) and \( y = ax^n \) where \( n = -2, -1, 0, 1, 2 \), and 3 and simple sums of these;
- use the \( f(x) \) notation;
Solution of equations
- solve linear simultaneous equations graphically;
- solve equations using points of intersection of graphs (e.g. drawing \( y = \frac{1}{x} \) and \( y = 2x + 3 \) to solve \( 2x^2 + 3x - 1 = 0 \));
Gradients and rates of change
- estimate gradients of curves by drawing tangents and hence estimate rates of change (e.g. speed, acceleration);
- find turning points (maxima and minima) of graphs (calculus methods not required);
- calculate the gradient of a straight line from the coordinates of points on it, interpret and obtain the equation of a straight line in the form \( y = mx + c \);
- identify parallel straight lines using gradients;
Area under a curve
- estimate area under a curve by counting squares and by dividing into trapezia (trapezium rule not to be used);

6.6 ALGEBRAIC CONCEPTS AND TECHNIQUES
6.6.1. Symbolic expression - express basic arithmetic processes in letter symbols;
formulæ - substitute numbers for words and letters in algebraic expressions (including formulœ);
change of subject - change the subject of a formula and substitute in formulœ including those from other subjects (e.g. science);

6.6.2. Algebraic manipulation
Operations - use the four operations and rules of precedence to manipulate: - directed numbers, monomials (including use of like and unlike terms), simple algebraic fractions;
Factors, multiples, HCF, LCM - find and use common factors, common multiples, HCF and
LCM;
Expansion - expand expressions of the forms a(x + y), (ax + by)(cx + d), (ax + by)(cx + dy);
etc where a, b, c and d are rational numbers;
Factors - factorise expressions of the form ax + bx, ax + bx + ay + by, ka² - kb², ax² + bx + c;
where a, b, c and k are integers

6.6.3. Indices
Laws of indices - use the following laws of indices (where m and n are rational other than zero):
\[ a^m \cdot a^n = a^{m+n}, \quad a^m \div a^n = a^{m-n}, \quad a^0 = 1, \quad (a^m)^n = a^{mn}, \quad a^{1/n} = \sqrt[n]{a}, \quad a^{-n} = \frac{1}{a^n}, \quad a^{m/n} = \left(\sqrt[n]{a}\right)^m \]
Squares/square roots, cubes, cube roots - calculate squares and use factors to find roots and cube roots;

6.6.4. Equations - solve the following:
linear equations - simple linear equations (including those involving algebraic fractions);
simultaneous equations - simple linear simultaneous equations (by graphs, by substitution and by elimination);
quadratic equations - quadratic equations of the form ax² + bx + c = 0 (by factorisation by graphs and by formula);

6.6.5. Logarithms
- use the following basic ideas of the theory of logarithms:
\[ \log_b MN = \log_b M + \log_b N, \quad \log_b (M/N) = \log_b M - \log_b N \quad \text{and} \quad \log_b M^p = p \log_b M \] where b and p are rational numbers and M and N are greater than zero.
- use common logarithms in calculations (including finding powers and roots);

6.6.6. Inequalities
Signs - use the following in appropriate situations:
\[ =, >, <, \geq, \leq, \neq \]
Linear inequalities - solve linear inequalities e.g. of the form ax + b > c, ax + b < cx < dx, ax + b < cx + d < ex + f, c < ax + b < d etc where a, b, c, d, e and f are rational;
Linear programming
- represent inequalities and their solutions on a number line;
- use simple linear programming methods to solve problems (unwanted regions to be shaded, with inequality boundaries shown by broken lines);

6.7 GEOMETRIC CONCEPTS AND TECHNIQUES
6.7.1. Points, lines and angles - identify interpret and apply the following concepts: point, line, parallel, perpendicular;
types of angles - right angle, acute, obtuse, reflex, complementary, supplementary, vertically opposite angles, angles at a point, angles on a straight line;
parallel lines - transversal, allied or co-interior angles, corresponding angles, interior opposite or alternative angles;
angles of elevation and depression - angles of elevation and depression;

6.7.2. Bearings - interpret and use three-figure bearings measured clockwise from north, (i.e. from 000° to 360°) and compass bearings (e.g. N 47° E or 47°E of N);
6.7.3. Polygons
triangles, quadrilaterals - use properties of: triangles (including isosceles and equilateral), quadrilaterals (including kites, parallelograms, rectangles, rhombi, squares, trapezia); n-sided polygons - regular and irregular n-sided polygons,
- state the special names of n-sided polygons (up to n=10), parallel lines and area - use the area property of triangle and parallelograms between the same parallels;

6.7.4. Circles - use the properties:
- radius
- diameter
- chord
- tangent
- cyclic quadrilateral
- use the following circle theorems:
- angle subtended at the centre and on the circumference
- angle in a semi-circle
- angles in the same segment
- angle in the alternate segment;

6.7.5. Similarity and Congruency
- identify similar and congruent figures and solve problems on similar and congruent triangles;
- solve problems on:-
  - areas of similar plane figures,
  - volumes and masses of similar solids;

6.7.6. Constructions - construct the following using ruler and compasses only:
- angle bisector, perpendicular bisector, angles of 30°, 45°, 60°; and 90°; and single combination of these;
- construct a perpendicular:
  - from a given point to a given line
  - through a given point on a given line;
triangles, parallelograms, regular polygons
- construct triangles, parallelograms and simple n-sided polygons (protractors may be used where necessary);
scale drawings - produce scale drawings using an appropriate/given scale;

6.7.7. Loci - construct and use the locus (in two-dimensions) of a point
- equidistant from- two given points,
  - two intersecting lines,
- at a given distance from- a fixed point,
  - a given straight line;

6.7.8. Symmetry - identify line symmetry in two dimensions;
line symmetry - balance properties of isosceles triangles, equilateral triangles, regular polygons, parallelograms and circles directly related to their symmetries;
identify symmetry - identify rotational symmetry (including order of rotational symmetry) in two dimensions;
6.8 TRIGONOMETRY

6.8.1. Pythagoras theorem and trigonometrical ratios - apply Pythagoras theorem, sine, cosine and tangent for acute angles to solve simple problems involving right-angled triangles in two dimensions;
- use and interpret sine, cosine and tangent of obtuse angles, use the sine and cosine rules for the solution of triangles (angles in either degrees/minutes or degrees to 1 decimal place);
three dimensional problems - solve three-dimensional problems involving the angle between a line and a plane;

6.8.2. Area of a triangle - use the formula Area = \( \frac{1}{2} \text{absin C} \) for the area of a triangle;

6.9 VECTORS AND MATRICES

6.9.1. Vectors in two dimensions
translation and notation - represent a translation by a column vector and by a directed line segment and use the notation \( \overrightarrow{AB} \) or \( AB \) or \( AB \) or \( a \) or \( \overrightarrow{a} \) or \( \overrightarrow{ab} \); etc
- operations - add and subtract vectors and multiply by a scalar;
- position vectors, equal vectors, parallel vectors - identify and use the concepts of position vectors, equal vectors, parallel vectors,

6.9.2. Matrices
dimension/order - use and interpret a matrix as a store of information and show familiarity with the idea of dimension/order of a matrix;
- operations - add and subtract matrices (where appropriate) and multiply by a scalar;
- identity matrix - use the property of identity and zero matrix for 2 x 2 matrices;
- determinant - find the determinant of a 2 x 2 matrix and distinguish between singular and non-singular matrices and use the notation determinant \( A \) or \( \text{Det} \ A \) or \( |A| \); etc
- inverse matrix - find and use the inverse of a 2 x 2 non-singular matrix; (e.g. solving simultaneous linear equations) and use the notation \( A^{-1} \);

6.10 TRANSFORMATIONS

6.10.1. - carry out the following transformations in x-y plane:

6.10.2.
- translation - translate (T) simple plane figures;
- reflection - reflect (M) simple plane figures in the axes and in any line;
- rotation - rotate (R) about any point clockwise or anti-clockwise through 90° and 180°,
- enlargement - enlarge (S) about any point using a rational scale factor;
- stretch - stretch (S); both one way and twoway stretch using the axes as the invariant stretch lines and rational stretch factor,
shear - shear (H), using the axes as the invariant lines and rational shear factor.
- apply combinations of the above (e.g. if M(a)=b and R(b)=c then RM(a)=c);
- describe transformations fully;
6.10.2 Matrices as operators - identify interpret and/or use matrices which represent the above transformations,
- describe transformations using coordinates and matrices (singular matrices are excluded);

6.11 STATISTICS AND PROBABILITY
6.11.1. Statistics
collection and classification - collect, classify and tabulate statistical data;
data representation - read, interpret, draw and make simple inferences from barcharts, pie
charts, histograms and frequency tables/charts and frequency polygons (see also 6.3.1.);
measures of central tendency - calculate the mean, mode, median from given data
- use an assumed mean where appropriate;
- read and interpret data presented in classes and determine the modal class;
cumulative frequency - draw and use a cumulative frequency curve/ogive;

6.11.2. Probability
terms - use the terms: random, certain, impossible event, trial, sample space, equally likely,
mutually exclusive, independent events;
experimental probability, theoretical probability - distinguish between experimental and
theoretical probability;
probability of - single events - solve simple problems involving the probability of a
single event;
- combined events - calculate the probability of and solve simple problems involving
combined events e.g. mutually exclusive and independent events (use of tree diagrams and
outcometables is recommended).

7.0 SCHEME OF ASSESSMENT
WEIGHTING: Paper 1 - 50%, Paper 2 - 50%
TYPE OF PAPER: Paper 1 - Approximately 30 short answer questions. Paper 2 - Structured
Questions.
Section A (6 compulsory questions). Section B (3 questions out of 6)
TIME ALLOWED: Paper 1 - 2½ hours, Paper 2 - 2½ hours
Appendix B: ‘O’ Level Mathematics Student’s Questionnaire

School Code: ..............

Zimbabwe Open University: DPhil Mathematics Education

‘O’ Level Mathematics Student’s Questionnaire

Preamble

The purpose of this questionnaire is to find out from you, the ‘O’ level student, your perceptions and opinions about the mathematics curriculum and your career aspirations. Hence feel free to pin point your challenges, problems, worries or limitations, and your suggestions and recommendations of what could be done to improve teaching and learning of mathematics. The information you provide will be treated with the confidentiality and anonymity it deserves. No names of schools and persons are to be revealed. Ask if you do not understand any terms used in this questionnaire. Thank you.

Section A: Biographical Data

1. State your gender status (tick in the box)
   Male | Female

2. State your age in years ..................................................................................................
3. State your father’s occupation ......................................................................................
4. State your mother’s occupation ......................................................................................

Section B: Your perceptions and opinions about the Mathematics Curriculum

(SA = Strongly Agree, A= Agree, U=Undecided, D=Disagree, SD =Strongly Disagree: Please circle your response)

5. The Syllabus
   Is too long   SA A U D SD
   Contains too difficult topics   SA A U D SD
   Has some irrelevant topics for use in life   SA A U D SD
   Should be changed   SA A U D SD
   Write any other comments about the syllabus ...............................................................
6. **Teaching methods and Learning styles**

I am afraid of my math teacher  
SA A U D SD

My teacher knows a lot of maths  
SA A U D SD

I enjoy my math teacher’s lessons  
SA A U D SD

Mathematics is hard to understand  
SA A U D SD

Math is all about formulae and rules  
SA A U D SD

Math learning improves my problem-solving skills  
SA A U D SD

Math books do not have clear worked examples  
SA A U D SD

Write any other comments about teaching methods and/or learning styles .................

7. **Assessment Techniques**

I am afraid of the math examination  
SA A U D SD

I enjoy doing Maths homework  
SA A U D SD

I do not do my daily math exercises in time  
SA A U D SD

I feel unhappy when it’s time for a math test  
SA A U D SD

Many students always perform poorly in math  
SA A U D SD

Write any other comments about assessment techniques ........................................

Section C: Math Anxiety and Career aspirations

8. **Math Anxiety**

I feel bored when doing mathematics  
SA A U D SD

I am comfortable when I ask questions in the math class  
SA A U D SD

When the math teacher enters the classroom, I begin to worry  
SA A U D SD
I enjoy solving math problems most of the time
I am afraid of failing the math examination
It makes me nervous to think about doing a math problem
Mathematics is fun
I panic when I am writing a maths test
The harder I work at a math problem, the more confused I get
Write what you think, feel, worry, believe or like about mathematics

9. Career Aspirations
What job would you like to do after leaving school?
What are some daily activities of a person with this career?
I would not want to proceed studying math at ‘A’ level
Passing O level math is necessary for me to get that job
I will not use the math I am doing now in my desired job
Much preparation is necessary for working in my desired career
Write anything you know, think, or feel about your career aspirations

THANK YOU ONCE AGAIN FOR YOUR TIME AND EFFORT
Appendix C: ‘O’ Level Mathematics Teacher’s Questionnaire

Zimbabwe Open University
‘O’ Level Mathematics Teacher’s Questionnaire

Preamble: There is a widespread concern over the high failure and drop-out rates in ‘O’ level mathematics in most Zimbabwean schools. This survey attempts to find out the strengths and weaknesses of the ‘O’ level mathematics curriculum, its relevance and usefulness in the field of work. You are kindly requested to respond to this questionnaire but be very free to express your feelings and opinions. Your responses will be treated with the confidentiality and anonymity they deserve. No names of schools or persons are to be revealed. Thank you.

Section A: Biographical Data

1. What is your gender status? [Please tick in the appropriate box]
   - Male
   - Female

2. State your age group in years
   - Below 20
   - 20-30
   - 31-40
   - 41-50
   - 51-60
   - Above 60

3. State your highest qualifications
   - ‘O’ level only
   - ‘A’ level
   - Diploma/Certificate
   - Bachelors’ Degree
   - Masters’ degree
   - Any other (Specify)

4. What is your marital status?
   - Single
   - Married
   - Widowed
   - Divorced
   - Separated

Section B: Your Views About The ‘O’ level Mathematics Curriculum

(SA = Strongly Agree, A= Agree, U=Undecided, D=Disagree, SD =Strongly Disagree: Please circle your response)

5. The syllabus
   - The ‘O’ level maths syllabus is too long
   - Most of the topics in the syllabus are not useful in pupils’ lives
   - The syllabus is gender sensitive

195
The syllabus is coherent
The ‘O’ level topics are difficult for pupils
The syllabus should be changed
There should be a new policy for maths education
The syllabus aims are ambitious but not achievable

Any other comments about the syllabus .................................................................

6. Your Instructional Methods

I enjoy teaching maths
My pupils find it difficult understanding most concepts
I have difficulties teaching some maths topics
Maths has too many rules which are difficult to follow
Maths is an easy subject at ‘O’ level
Acquired skills are rarely applicable in the field of work
My pupils enjoy learning maths

Any other comments about your instructional methods ............................................................

7. The Assessment Methods

The ‘O’ level maths examination is too long
Most of my pupils will fail the maths examination
Exam tests pupils on what they will experience after ‘O’ level
The exam promotes memorisation of facts
Pupils are not assessed on practical skills

Any other comments about the ‘O’ level assessment methods ............................................................

8. Factors Affecting Achievement
State any factors you strongly consider to affect achievement in ‘O’ level mathematics.
...........................................................................................................................
...........................................................................................................................
...........................................................................................................................

Thank you so much for your time and effort

Appendix D: Mathematics Education Inspector, SCEI and DEO’s Questionnaire

Province/District Code ...............  
Zimbabwe Open University: DPhil Mathematics Education  
MEI, SCEI and DEO’s Questionnaire

Preamble: There is a widespread concern over the high failure and drop-out rates in ‘O’ level mathematics in most Zimbabwean schools. The problem is compounded by the fact that many employers and tertiary institutions require 5 ‘O’ level passes inclusive of mathematics for a school leaver to get employment or to go for further studies. Because of lack of a math pass, most school leavers’ career dreams are lost at this stage. This survey attempts to find out the strengths and weaknesses of the ‘O’ level mathematics curriculum, its relevance and usefulness in the field of work. You are kindly requested to respond to this questionnaire but be very free to express your feelings and opinions. Your responses will be treated with the confidentiality and anonymity they deserve. No names of schools or persons are to be revealed. Thank you.

Section A: Biographical Data

1. What is your gender status? [Please tick in the appropriate box]

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
</table>

2. State your age group in years

<table>
<thead>
<tr>
<th>Below 20</th>
<th>20-30</th>
<th>31-40</th>
<th>41-50</th>
<th>51-60</th>
<th>Above 60</th>
</tr>
</thead>
</table>

3. State your highest qualifications

<table>
<thead>
<tr>
<th>‘O’ level only</th>
<th>‘A’ level</th>
<th>Diploma/Certificate</th>
<th>Bachelors’ Degree</th>
<th>Masters’ degree</th>
<th>Any other (Specify)</th>
</tr>
</thead>
</table>

4. What is your marital status?

<table>
<thead>
<tr>
<th>Single</th>
<th>Married</th>
<th>Widowed</th>
<th>Divorced</th>
<th>Separated</th>
</tr>
</thead>
</table>

Section B: Your Views About The ‘O’ level Mathematics Curriculum

(SA = Strongly Agree, A= Agree, U=Undecided, D=Disagree, SD =Strongly Disagree: Please circle your response)
5. The syllabus

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ‘O’ level maths syllabus is too long</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most of the topics in the syllabus are not useful in pupils’ lives</td>
<td></td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>The syllabus is gender sensitive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The syllabus is coherent</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The ‘O’ level topics are difficult for pupils</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>The syllabus should be changed</td>
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<tr>
<td>There should be a new policy for maths education</td>
<td></td>
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<tr>
<td>The syllabus aims are too ambitious</td>
<td></td>
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<td></td>
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<tr>
<td>The syllabus objectives are achievable</td>
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<td></td>
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<tr>
<td>The learning activities are clearly laid out</td>
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<tr>
<td>The teaching methods are explicit</td>
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</tbody>
</table>

Any other comments about the syllabus ..............................................................

6. Your Perceptions About Teachers’ Instructional Methods

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most teachers do not enjoy teaching maths</td>
<td></td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>Most pupils find it difficult understanding math concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most teachers have difficulties teaching some maths topics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maths has too many rules which are difficult to follow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maths is an easy subject at ‘O’ level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acquired skills are rarely applicable in the field of work</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most pupils get intimidated by maths teachers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teachers do not have enough instructional resources</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Any other comments about teachers’ instructional methods ........................................

7. Your Views About The Assessment Methods

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>U</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ‘O’ level maths examination is too long</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Most of the pupils will fail the maths examination  SA  A  U  D  SD
Exam tests pupils on what they will experience after ‘O’ level  SA  A  U  D  SD
The exam promotes memorisation of facts  SA  A  U  D  SD
Pupils are not assessed on practical skills  SA  A  U  D  SD
Final grade to include both formative and summative assessments  SA  A  U  D  SD
Any other comments about the ‘O’ level assessment methods ..................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

8. Factors Affecting Achievement

State any factors you strongly consider to affect achievement in ‘O’ level mathematics.
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

Thank you so much for your time and effort
Appendix E: ‘O’ Level Focus-Group Discussion Guide

School Code ..................

Zimbabwe Open University: DPhil Mathematics Education

Focus Group Discussion With ‘O’ Level Mathematics Students

Preamble: Formal greetings, self-introductions and giving purpose of the discussions are to be done in English and Shona or local language.

Introduction: Good morning/afternoon/evening students. My name is Mr S. Chirume. I am carrying out a study with ZOU on the topic: “The Zimbabwe ‘O’ level Mathematics Curriculum and Students’ Career Aspirations in Shurugwi and Gweru Districts, Midlands Province: A Causal Comparative Analysis.” Thank you in advance for allowing me to discuss this topic with you. Please feel free to tell me your opinions, views and suggestions. I will not disclose confidential information to anyone and I will not divulge your names to anyone. The information taped or recorded here will be used for research purposes only and will be destroyed once the research is over. Thank you.

N.B The researcher ticks or writes in the blank spaces. The video/audio recordings will be taken

1. The researcher takes note of the number of discussants He/she records number of males and females.
........................................................................................................................................................................

2. Do you like the way your teachers teach you mathematics? Explain
........................................................................................................................................................................

3. Are you interested in learning mathematics? Explain
........................................................................................................................................................................

4. What do you think are the reasons why many pupils fail maths at ‘O’ level?
........................................................................................................................................................................

5. What maths learning challenges do you face?
6. How can the challenges be overcome?

7. What improvements should be made in the mathematics curriculum?

8. Do you think mathematics is important for your daily lives?

9. How do you feel about employers’ job recruitment requirement that a school leaver must possess five ‘O’ level passes including Maths?

10. What should be the Government’s policy about the teaching and learning of mathematics?

**Thank you so much for your time and effort**
Appendix F: Parents’ Interview Guide

Parent’s Code .................

Zimbabwe Open University: DPhil Mathematics Education
Interview with Parents

Preamble: Formal greetings, self-introductions and giving purpose of the interview are to be done in Shona or local language.

Introduction: Good morning/afternoon/evening Sir/Madam. My name is Silvanos Chirume. I am carrying out a study with ZOU on the topic: “The Zimbabwe ‘O’ level Mathematics Curriculum and Students’ Career Aspirations in Shurugwi and Gweru Districts, Midlands Province: A Causal Comparative Analysis.” Thank you in advance for allowing me to interview you. Please feel free to tell me your opinions, views and suggestions. I will not disclose confidential information to anyone and I will not divulge your name to anyone. The information taped or recorded here will be used for research purposes only and will be destroyed once the research is over. Thank you.

N.B The researcher ticks or writes in the blank spaces. The video/audio recordings will be taken

1. Gender (researcher ticks)

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
</table>

2. What do you think are the reasons why many pupils fail maths at ‘O’ level?
..........................................................................................................................................................................................

3. Do you think mathematics is important for pupils’ daily lives? ........................
..........................................................................................................................................................................................
For companies? .................................................................................................................................................................
For the country? .................................................................................................................................................................

4. Do you think employers’ job requirements for 5 ‘O’ level passes including English and Maths are justified? Explain .................................................................

5. What should be the Government’s policy about the teaching and learning of mathematics? ..................................................................................................................................................
6. How can you, as a parent/guardian assist your children to do well in mathematics?

Thank you so much for your time and effort

Appendix G: Employers’ Interview Guide

Employer’s Code ...............  

Zimbabwe Open University: DPhil Mathematics Education

Interview with Employers

Introduction: Good morning/afternoon/evening Sir/Madam. My name is Silvanos Chirume. I am carrying out a study with ZOU on the topic: “The Zimbabwe ‘O’ level Mathematics Curriculum and Students’ Career Aspirations in Shurugwi and Gweru Districts, Midlands Province: A Causal Comparative Analysis.” Thank you in advance for allowing me to interview you. Please feel free to tell me your opinions, views and suggestions. I will not disclose confidential information to anyone and I will not divulge your name to anyone. The information taped or recorded here will be used for research purposes only and will be destroyed once the research is over. Thank you.

N.B: The researcher ticks or writes in the blank spaces. The video/audio recordings will be taken

1. Gender

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
</table>

2. How long have you been working for this company? ........................................

3. How many employees do you have? .................................................................

4. How often do you recruit the employees?

<table>
<thead>
<tr>
<th>Weekly</th>
<th>Monthly</th>
<th>Yearly</th>
<th>As need arises</th>
<th>Any Other (state)</th>
</tr>
</thead>
</table>

5. What qualifications of the employees do you consider when recruiting them?

............................................................................................................................................

203
6. How many employees with 5 or more passes in ‘O’ level do you have?.......... How many are with maths? .......................... without maths? ........................................

7. Do you think that the maths pass or qualification is important? Yes/No. Please explain your answer ........................................................................................................

8. Do your employees use the maths knowledge, concepts or skills when doing their job? Yes/No. Please explain ........................................................................................................

9. Do you think employees with the maths pass or qualification produce more goods/services than those employees without maths? ................................................

10. What do you think are the reasons why pupils fail maths at ‘O’ level? ..................

11. How can companies or industries help schools to improve pupils’ performance in maths? ......................................................................................................................

12. Can you justify most employers’ requirement for five ‘O’ level passes that must include maths? ........................................................................................................

Thank you so much for your time and effort
Appendix H: Note on Appendices I and J

Letters for Permission to Visit Schools and Conduct Research

The original research topic was: “An Evaluation Of The Zimbabwe ‘O’ Level Mathematics Curriculum: How Does It Relate To The students’ Career Aspirations?” but was later changed to “The Zimbabwe ‘O’ level Mathematics Curriculum and Students’ Career Aspirations in Shurugwi and Gweru Districts, Midlands Province: A Causal Comparative Analysis.” The items in the questionnaires and interview schedules remained the same and were not in any way affected by these changes.
Appendix I: Letter to the PED Applying to Conduct Research in the Schools
Appendix J: Letter from the PED Granting Permission to Conduct Research
Appendix K: Letter Requesting Permission to Visit Employers and Conduct Research
Appendix L: Codes used for students’ dream jobs and desired careers (list not assumed to be exhaustive)

0. Passed away/not entered
1. Not employed/not working
2. Self employed/Vendor
3. Rural farmer/Security guard/Factory worker
4. Office secretary/Driver/Typist
5. Security officer/Police officer/Soldier/Electrician/Plumber
6. Nurse/Senior clerk/Writer/Agriculture (Arex) officer
7. Teacher/Pastor/Bank supervisor/ICT designer/Salesman
8. Manager/Senior accountant/Economist/Bishop
9. Lecturer/Engineer/Director/Architecture
10. Pilot/Astronaut
11. Lawyer
12. Doctor/Gynaecologist/Dermatologist
13. Scientist/Physicist
Appendix M: The Mathematics Achievement Test Paper

Zimsec O level Maths Paper 1 2012.pdf